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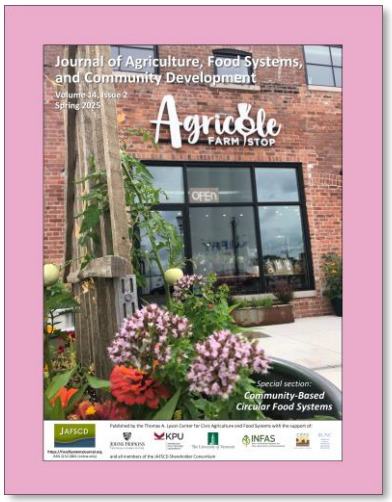

On our cover: Agricole Farm Stop is an everyday farmers market in historic downtown Chelsea, Michigan, USA. The store opened in July 2019 with a simple mission: grow the local food economy and cultivate community connection. Agricole is passionate about supporting nearby farmers, increasing local food access, and connecting its community with fresh, sustainably grown food. Nearly 200 farmers sell their goods on consignment (with a 75/25 split between the farmer and Agricole). Since 2019, Agricole has returned US$5.8 million to local farmers and food businesses.

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This special issue features articles in response to the call for papers on **community-based circular food systems**, sponsored by the Thomas A. Lyson Center for Civic Agriculture and Food Systems, publisher of JAFSCD.

Community-Based Circular Food Systems

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Community-Based Circular Food Systems

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SPECIAL ISSUE EDITORIAL

More than closing loops: Community-based circular food systems as pathways for transformation

SPECIAL ISSUE
Community-Based Circular Food Systems

Sponsored by the Thomas A. Lyson Center for Civic Agriculture and Food Systems

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Introduction

As we move deeper into the third decade of the 21st century, global food systems are being profoundly shaped by external pressures of what scholars have termed a VUCA world, marked by **V**olatility, **U**ncertainty, **C**omplexity, and **A**mbiguity (Bennett & Lemoine, 2014). VUCA-related issues such as climate-driven

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disasters, military conflicts, pandemics, land grabbing, environmental degradation, and economic inequality are increasingly creating local, regional, and global sustainability food concerns (Persis et al., 2021; Sharif & Irani, 2017). These conditions have only intensified the geo-political disturbances across the globe since early 2025, reshaping both the challenges and the possibilities for food system transformation.

Amid growing global turbulence, food systems are recognized increasingly not only as sites of vulnerability but also as critical levers for resilience and social-ecological regeneration. As Cooper (2023) and others have argued, agriculture and food are now central to both the causes and potential solutions to global climate and environmental change. Any meaningful progress toward the UN Sustainable Development Goals will require a transformative change across the food system, from production to consumption and waste, while promoting human and planetary well-being (van Zanten et al., 2023). In this context, the push for circularity has emerged as a promising pathway. Yet predominant visions of circular economies, often focused on closed-loop industrial efficiencies, fall short on addressing deeper questions of equity, culture, power, and community agency.

This JAFSCD special issue centers on an alternative vision: community-based circular food systems (C-B CFSs), which can be defined as local and regional food systems that reduce waste and regenerate ecosystems through practices grounded in participation, equity, and the local context. The concept of C-B CFS also challenges the assumption that circularity is primarily technical or economic. Instead, it asks how we might redefine value, reclaim waste, regain ownership, and rebuild relationships in ways that support both human and planetary health.

Why Community-Based Circular Food Systems?

C-B CFSs represent a growing movement to localize and humanize the principles of circularity in ways that are attentive to cultural context, lived experiences, and shared responsibility. Traditionally, circular economy models have been dominated by technical narratives centered on turning one firm's waste into another's resource, enabling closed-loop material flows. While important, this focus has left behind the socio-cultural and material arrangements of everyday resource demands (Greene et al., 2024), often obscuring the systems of provision and uneven power relations underlying production and consumption (Davies et al., 2024; Greene et al., 2024). It can reinforce unsustainable practices, even if unintentionally, by upholding high rates of production, centralized control, and extractive market logic.

In contrast, C-B CFS exemplifies the need to first prioritize waste prevention and reduction, thus fostering local resilience and community ownership while embedding circularity within social and cultural contexts. These systems emphasize rethinking material flows altogether, not merely optimizing them, and challenge the idea that scale and speed are always desirable. Their emphasis extends beyond material flows to encompass relational dynamics, participatory governance, and holistic well-being. Uncertain times require robust and adaptable systems, and C-B CFSs are uniquely positioned to build resilience. They emphasize local production, direct farmer-consumer relationships, and diversified revenue streams, among other offerings, providing tangible benefits for reducing waste, strengthening local economies, and promoting indigeneity (Antonelli, 2023). Ultimately, C-B CFS operationalize circularity through social ties as much as through technical systems.

It is critical to note that C-B CFS initiatives are often resource-constrained and highly localized, which can make them vulnerable to systemic shocks and very much reliant on community buy-in for long-term viability. This can result in organizational challenges to scale impact, secure long-term financing, and navigate regulatory constraints. Thus, the influence of structural constraints and challenging political contexts are not to be underestimated in efforts to create a C-B CFS (Corvellec et al., 2022). At the same time, their rootedness in place enables flexibility and adaptive capacity in ways that large systems may lack. In this editorial, examples of community composting programs in Florida (Campbell et al., 2024), farm stops across the U.S.

(Barr, 2025), and living labs for circular technologies in several African cities (Obeng et al., 2024) have all demonstrated that localized food systems can sustain food access and build trust by reducing waste—even in turbulent times—when supported by education and design processes that reflect community needs.

These examples reinforce a growing consensus that the transition to a circular food system cannot succeed without addressing its social dimensions. As Dias et al. (2025) note, circular interventions risk marginalization if they neglect the lived experiences and priorities of those working across the food chain. Engaging diverse stakeholders, from growers and composters to consumers and municipal actors, is not a secondary concern; it is essential to ensuring equity, effectiveness, and legitimacy in circular transitions.

Why This Special Issue?

Recognizing the urgent need to surface, connect, and evaluate diverse C-B CFS practices, JAFSCD issued a call for papers to gather practitioner insights, scholarly research, and reflective commentaries from around the globe. We sought work that would move beyond enterprise-scale case studies and highlight circularity as a collective effort grounded in local ecosystems and shaped by community relationships and values.

This special issue offers contributions from a broad range of stakeholders: farmers, researchers, nonprofit leaders, municipal actors, and policy thinkers. It includes case studies from across North America, Europe, and Africa, and represents a wide variety of approaches, from compost cooperatives to consignment-based farm retail, and feminist food-sovereignty frameworks. What connects them is a shared commitment to rethinking food waste, building on community knowledge, and adapting infrastructure to support more inclusive forms of circularity.

The special issue also highlights a critical need for a balanced approach between bottom-up innovation and the realities of systemic constraints. The "success" of C-B CFS initiatives is likely to depend on collaborative efforts among diverse stakeholders, from local governments to nonprofits, businesses, universities, and community members, which is becoming increasingly challenging in this intensified VUCA time. Therefore, our goal with this JAFSCD special issue is to share practical frameworks, reflect on emergent insights, and identify best practices that others may adapt and build upon.

Summary of Themes Addressed in the Special Issue

This special issue explores the evolving practice and politics of C-B CFSs across a wide range of geographies, actors, and scales. While the approaches and contexts differ, the articles and commentaries collectively reveal that circularity is most effective when social dimensions are placed at its core. Across five thematic questions, the contributions interrogate how relationships, material flows, motivations, and governance structures shape the possibility and limits of circular transformation.

How can social engagement shape the success of circular food systems?

Several papers emphasize the importance of participatory design, fostering trust and shared governance. Campbell et al. (2025) examine household food waste behaviors in a Florida community composting program, revealing how citizen science and collective learning create the confidence and capability to reduce waste in private, often invisible, settings. At the other end of the value chain, Hanson et al. (2025) analyze community farming initiatives in Northern Ireland, defining them as "collaborative transformations" at the intersection of land, community, and enterprise. Using a social return on investment (SROI) approach, they find that 90% of the value created was social in nature, highlighting how the C-B CFS create shared spaces for healing, belonging, and purpose. This social focus is echoed in Bridge et al. (2025)'s work with UK food hubs, where the co-design of an impact evaluation tool strengthened the alignment between goals and actions. While these hubs face practical constraints such as precarious funding, volunteer turnover, and evaluation fatigue, the process of collaboratively measuring impact helped enhance organizational identity and

sector cohesion. Goris et al. (2025) further deepen this conversation by drawing on feminist relational autonomy theory to explore Dutch values-based territorial food networks. Their case studies show how mutual care, redistribution, and solidarity practices reconfigure interdependencies between humans and non-humans, while also exposing how industrial rationales persist even in alternative systems. Together, these articles reveal that social embeddedness is not an add-on to circularity, but rather its foundation.

What does it mean to redefine waste in circular food economies?

A second group of articles explores what it means to redefine waste in circular food systems, pushing beyond narrow techno-efficiency frameworks and offering alternatives rooted in equity and innovation. DuBois et al. (2025) offer a provocative intervention into this conversation by documenting a workplace urine nutrient reclamation project in the U.S., one of the first of its kind. Their work challenges deep-seated cultural stigmas and regulatory inertia around human waste, while also underscoring the need for clearer policies and public education. Baisey et al. (2025) take on organic waste mandates in California, finding that while legal frameworks are essential, they must be supported by on-the-ground coordination, trust-building, and shared incentives. Olauson Barlas et al. (2025)'s scoping review of food loss and waste interventions at the retail level identifies key levers: digital platforms, volunteer networks, and food rescue partnerships, while also emphasizing the need for policy support and long-term infrastructure investment. Collectively, these papers argue for a shift from considering waste as a logistical problem to waste as a political and deeply cultural issue.

What motivates practitioners to participate in circular economies? And what holds them back?

The third theme turns to the motivations, opportunities, and constraints facing circular food practitioners, offering insight into what drives engagement and where transformation can stall. Burkholder et al. (2025) apply the motivation-opportunity-ability (MOA) framework to the emerging circular food economy in Metro Vancouver, Canada. They find that practitioners, while strongly motivated by environmental concerns, are equally driven by the desire to address food insecurity and create new economic opportunities. However, tensions between nonprofit and for-profit logics, as well as challenges related to funding and regulation, often complicate collaboration. What emerges is the need for a unified yet flexible vision; accommodating diverse strategies can foster collective momentum toward systemic change. Bridge et al. (2024), revisited here, demonstrate how evaluation tools can serve as both a mirror and a motivator, helping practitioners articulate their contributions and advocate for broader support. However, the message from the special issue articles is clear: motivation alone is insufficient without the enabling conditions.

How are new business models and infrastructure supporting equitable circularity?

A fourth cluster of contributions highlights business models and infrastructure that enable circular transitions. Barr (2025) introduces the concept of "farm stops," a consignment-based model of food retail that empowers producers with price-setting autonomy and fosters deep relational infrastructure. These spaces, rich in community interaction and educational initiatives, demonstrated remarkable adaptability during the COVID-19 pandemic by offering lessons in resilience rooted in connectivity rather than scale. Similarly, Elton et al. (2025) examine the Ontario Food Terminal (OFT), a long-standing piece of public infrastructure that supports midscale farms, often overlooked in consolidated food systems. They argue that the OFT's success is a compelling case for public investment in regional food infrastructure. Both papers underscore the importance of physical and social infrastructures evolving together to support equitable circular food economies.

How can global-local learning accelerate circular innovation?

Finally, the special issue turns outward in scale and scope, asking how global-local learning and rapid assessments can accelerate circular innovation. Obeng et al. (2025) report on co-creative rapid assessments con-

ducted in eight African cities as part of the INCiTiS-FOOD project. Using a mix of expert elicitation, visualization tools, and participatory focus groups, the assessments identified both barriers and entry points for circular technologies like aquaponics and insect farming. Central to the process was a "living lab" approach that foregrounds community expertise—particularly that of women and youth—and tailors interventions to local ecological and cultural contexts. The article demonstrates how especially in resource-constrained environments, meaningful engagement and targeted innovation can spark systemic shifts. It also reinforces a key insight from across the issue: to be effective, circularity must take root in local contexts, remain socially accountable, and be backed by structural support. Agility, inclusivity, and local knowledge are not barriers to circular innovation; they are its accelerators.

This issue also includes two commentaries that extend the conversation geographically and institutionally. Amanullah and Khan (2025) explore how C-B CFSs could help address food insecurity in Pakistan by strengthening local production, farmer-consumer relationships, and climate-resilient agriculture. Meanwhile, Clements (2025) reflects on efforts to scale regional food systems in Eastern Connecticut through a U.S. Department of Agriculture (USDA) Regional Food Systems Partnership grant, drawing lessons about collaboration, data equity, and the risks of top-down approaches.

Conclusion

The articles and commentaries in this special issue reflect a collective shared insight: circularity is not only a technical fix, but a practice deeply embedded in social relationships, political processes, and cultural norms. This insight is reflected in the actions of C-B CFS initiatives, which test and demonstrate alternative approaches in practice by reclaiming nutrients from overlooked waste streams, designing inclusive metrics for food hub impact, and resisting consolidation through public infrastructure and cooperative markets. The special issue also reveals important tensions and limitations facing global C-B CFS efforts, marked by patchwork funding, policy inconsistency, structural inequalities, and limited recognition in planning frameworks. To support a more enabling ecosystem for C-B CFS, the special issue identifies a number of important next steps for their design, implementation, and evaluation:

- **Public investment** in place-based infrastructure (Elton et al., 2025);
- **Adaptive governance models** that support community co-creation (Obeng et al., 2025);
- **Better metrics and narratives** to evaluate success beyond growth and profit (Bridge et al., 2025); and
- Above all, a recognition that **circularity without justice is incomplete**, since circular economy initiatives can deepen inequalities if not approached carefully (Barrie et al., 2022).

C-B CFSs should not be romanticized, but neither should they be marginalized. While they may not scale in traditional ways, these efforts offer practical yet visionary alternatives to extractive and centralized food systems. By centering community agency and embedding principles of justice, C-B CFSs can provide localized avenues for challenging the structural inequalities that sustain linear models of production and consumption (Dias et al., 2025). Importantly, they suggest that resilience is cultivated not through control or consolidation, but through practices of connection and care (Morrow & Davies, 2022). In an increasingly VUCA world, such alternatives to business-as-usual approaches may contribute meaningfully to the development of food systems that can respond and adapt to change.

continued

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Household food waste behaviors of participants in a municipal community compost program

SPECIAL ISSUE
Community-Based Circular Food Systems

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Abstract

Food waste is a critical problem in the U.S. and globally. Most household food waste is landfilled, with just a small proportion composted. Household food waste accounts for a substantial amount of the food waste problem, but because it occurs in the privacy of people's homes, we have a limited understanding of it, hindering our ability to create policies or programs to address the issue. Community composting programs have the potential to reduce the amount of landfilled food waste and convert it into a valuable resource. One strategy to address this gap is citizen science, whereby the public is trained to collect data and participate in the research cycle. This technique is particularly useful for answering research questions in real-world conditions to which researchers typically do not have access, such as individuals' daily lives and activities in their homes. The purpose of this study was to gain a baseline understanding of the amount of food waste individual households contribute to a community compost program, the primary reasons people generate food waste, the types of pack-

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aging households typically discard, and individuals' knowledge, attitudes, and beliefs about food waste and the impact that a community-based compost program has on their lives. Participants in a community-based compost program in Florida have positive attitudes and beliefs about reducing food waste, but they have a less positive perception of the value judgments of influential people in their social circles (i.e., social norms) regarding food waste. Participants have limited confidence that they can reduce their food waste. Community-based compost program participants indicate that the program has increased their awareness of food waste, reduced their waste, and increased their appreciation of community-based circular food systems (CB-CFS), i.e., systems that support community well-being while minimizing environmental harm and resource depletion. This study highlights the value of a community-based compost program for diverting food waste from individual households, increasing knowledge, and changing resident attitudes and behaviors related to food waste. Our findings suggest that key behavioral variables, such as self-confidence, may support individual ability to reduce food waste, and that participation in an community composting program may bolster self-confidence and increase the likelihood that individuals reduce household food waste. We recommend that stakeholders interested in developing a community composting program conduct feasibility assessments and provide education to program participants.

Keywords
citizen science, food waste, compost, community food systems, circular food systems

Introduction and Literature Review

With roughly one-third of the food produced for human consumption wasted or lost globally, an estimated 1.3 billion tons annually (Vilariño et al., 2017), food waste is increasingly recognized as a critical global problem. This recognition led to the United Nations Sustainable Development Goal (SDG) 12: Responsible Consumption and Production as part of 17 global SDGs established in 2015 to meet critical environmental, social, and economic objectives by the year 2030 (United Nations, 2015). SDG 12.3, a sub-objective for SDG 12, specifically targets reducing food waste in retail and consumer operations by half by 2030 (United Nations, 2015). In the U.S., food is the least recovered municipal waste material, for which households are responsible for roughly 40% (Pai et al., 2019). Household food waste studies have found that households waste roughly 32% of the food purchased (Yu & Jaenicke, 2020). The majority of household food waste (66%) is landfilled, and only

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4% is composted (U.S. Environmental Protection Agency, 2023). The EPA estimates that each household produces 337.9 pounds of food waste per year, roughly 6.5 pounds per week (EPA, 2023). While there are various estimates of the amount of food wasted by individual households, many of these estimates come from extrapolations from aggregate data, due to the complexity of collecting data at the household scale (von Massow et al., 2019). Recent proposals to reduce household food waste have therefore included calls for the more robust and consistent "internal monitoring" of household/consumer-level food waste *amounts* (i.e., the quantified assessment of food waste by household), as well as of the *drivers* or *constraints* associated with household members' efforts to reduce their waste (Pateman et al., 2020). These calls require that members of the public are engaged as prospective agents of change, capable of helping researchers monitoring food waste and of better understanding factors that contribute to it.

Drivers of Household Food and Packaging Waste

With the identified need for research on household-level food waste behaviors, existing literature has highlighted some significant potential factors. While Qi and Roe's (2016) analysis of food waste awareness and attitudes among U.S. consumers revealed a moderate degree of guilt associated with food waste—and an associated feeling reported by respondents that they could do more to reduce waste—consumers also feel there are direct practical benefits from discarding food in certain situations. For example, approximately 70% of respondents agreed that throwing away food that is past "sell by" or "use by" dates on product packaging can reduce the risk of foodborne illness for themselves or family members. Additionally, 60% agreed that discarding uneaten food is necessary to ensure meals taste fresh (Qi & Roe, 2016). While there may be incongruity between what current food labels mean in terms of food safety and what consumers *perceive* they mean, these findings nevertheless demonstrate that concern about foodborne illness and retaining food freshness is a potential driver of U.S. households' food waste behavior. (Qi & Roe, 2016). Households with children are more likely to waste food, in part due to children generating food waste (e.g., by burning food in preparation), taste preferences (i.e., "picky eaters"), and parental difficulties with estimating portion sizes (Kansal et al., 2022).

Parizeau et al.'s (2015) Canadian household survey similarly found that consumers felt guilty not only about wasting food, but also about using and discarding recyclable and non-recyclable food packaging. Respondents asserted that individuals (as opposed to food manufacturers or government structures) were primarily responsible for reducing both types of waste, suggesting a degree of self-efficacy and perceived control in carrying out waste reduction behaviors (Parizeau et al., 2015). Respondents identified key drivers of both food and food packaging waste, including limited awareness about the social, economic, and environmental impacts of waste, limited knowledge of ways to implement strategies to reduce waste, and time and lifestyle conflicts—particularly for individuals with children in the household (Parizeau et al., 2015). These dynamics point to the need for further understanding of the conditions that facilitate or inhibit food waste behaviors, as well as of how individuals conceptualize their agency in making meaningful changes at home.

Assessing Household Food Waste Through Citizen Science

While household food waste is a large problem in the U.S., it is a difficult phenomenon to monitor directly because it occurs in the privacy of homes. Citizen science, a participatory research method that enlists community members as scientists to collect data at a scale that would not be possible for researchers on their own (Ebitu et al., 2021), has the potential to overcome this barrier. Citizen science is especially useful for collecting data in real-world conditions to which researchers typically do not have access (Pollard et al., 2017). Household food waste, a critical issue for which there is little directly measured data, is a good example of an issue that may be more effectively studied with the help of citizen scientists (Breitenmoser et al., 2024; Pateman et al., 2020). Citizen science methodology can be beneficial not just for collecting data, but also for understanding participants' underlying perspectives and beliefs that are respon-

sible for their behavior (Pateman et al., 2020).

While citizen science is a valuable methodology for gaining a deeper understanding of household food waste, it has been noted that the "yuck" factor associated with sorting through messy and rotting foods creates a significant barrier to the direct measurement of food waste (Roe, 2021, p. 22). Additionally, as with the application of citizen science in other areas, the implementation of citizen science to assess household food waste can be logistically demanding, requiring significant training and coordination with participants that places high demands on research team members, expense (financial reimbursements of participants' time is a common feature), and potential data fidelity issues (Pateman et al., 2020). The presence of these and other challenges (e.g., funding sources may not routinely award citizen science-based food waste proposals due to limited empirical evidence of their value) may explain the limited number of citizen science-based studies of household food waste. However, the current lack of citizen science approaches in this domain presents an opportunity for researchers interested in food waste and circular food systems to utilize citizen science methods (Pateman et al., 2020).

Community Composting Programs: Opportunities and Challenges

Community composting programs may represent an avenue to engage prospective citizen scientists to monitor household food waste or integrate community perspectives on the subject more broadly (Benyam et al., 2018; Christie & Waller, 2019; Pierini et al., 2021). The programs require a local network of private and public non-profit sector actors to provide and operate "distinct collection and processing equipment, such as a set of trucks dedicated to food waste collection, and transfer stations that are able to hold sufficient food waste before being hauled to a treatment facility" to successfully divert residential food waste (Pai et al., 2019, p. 2). This model differs from traditional centralized collection and diversion services that operate at a particular economy of scale at municipal, county, and regional levels. More than 350 U.S. communities have adopted community composting programs (also referred to as residential food scrap collection programs), nearly all in California and Washington (Yepsen, 2015). Curbside collection of separated food scraps (with compost-appropriate food waste picked up by service providers in buckets in front of homes) is the most common format for these programs, in communities such as Palo Alto, California; Boulder, Colorado; and Oak Park, Illinois (Pai et al., 2019). Community composting programs have been found to have ecological, economic, and social benefits as compared with both backyard composting and centralized composting programs, including the localized reuse of "finished" organic matter (i.e., compost), the source-separation of food scraps (which has been shown to reduce waste), and the potential to stimulate small-scale enterprises (Pai et al., 2019).

Key barriers to implementing community composting programs include logistical constraints on finding suitable stakeholders, sites, and participants (i.e., inappropriate or insufficient "social infrastructure"), and data constraints about food waste "flow" disaggregated to a neighborhood or household level (Pai et al., 2019). Inadequate knowledge of the volume of waste generated by specific neighborhoods and/or households limits a community's capacity to strategically plan for and develop a community composting program (Katpatal & Rama Rao, 2010). Another crucial challenge is the limited research on current program participant knowledge, attitudes, and beliefs toward such programs, as well as their ability to reduce their food waste through participation (Wu et al., 2019). However, some studies have explored attitudes toward and willingness to participate in community or residential curbside composting programs (Antone & Hellwinckel, 2021; Niles, 2020).

Antone and Hellwinckel's (2021) survey of neighborhood residents in Knoxville, Tennessee invited to pick up free compost during a localized shortage due to the pandemic demonstrated that the majority of respondents were very supportive of a community composting program that serviced their neighborhood, and 94% were willing to save and sort home food scraps to be picked up for composting. Most respondents were also willing to volunteer at a community composting operation, and a slim majority indicated they would be willing to pay, within a certain range, for a five-gallon

bucket of finished compost produced by the operation (Antone & Hellwinckel, 2021). A survey of rural residents in Vermont found a moderately low willingness to participate in curbside compost collection and an even lower willingness to pay for such a service, as both backyard composting and/or feeding food scraps to pets or livestock were engrained food waste management practices in the area (Niles, 2020).

While community composting feasibility studies have been conducted to assess salient challenges and highlight model programs (Pai et al., 2019; Platt et al., 2014), research on knowledge, attitudes, and beliefs of existing community composting program resident participants is sparse in the academic literature, demonstrating a gap and opportunity (Wu et al., 2019). Prior research on citizens' perspectives on community composting initiatives has been done outside the U.S., in Australia, Argentina, and Italy, for example (Benyam et al., 2018; Bruni et al., 2020; Christie & Waller, 2019; Pierini et al., 2021). These studies assessed citizens' socioeconomic status, their understanding of and attitudes toward how household food waste was generated, and the attitudinal impacts of participating in a community composting initiative (Bruni et al., 2020; Christie & Waller, 2019; Pierini et al., 2021).

While valuable insights have been generated, certain elements of current or prospective participant views remain underexamined. Bruni et al. (2020) acknowledged participant willingness to join community composting programs and identified cost of joining as a key determinant of actual sustained participation, but did not explore participant knowledge, attitudes, or beliefs beyond that. An assessment of apartment resident participation in a communal on-site composting initiative demonstrated increased awareness of food waste and impacts on other psychosocial metrics such as increased motivation to engage in green, nature-based, and community-oriented thinking and action, though the authors cautioned that the case study results were limited and more research was warranted (Christie & Waller, 2019). Pierini et al. (2021) evaluated citizens' existing knowledge and willingness to engage in specific pro-environmental food waste management behaviors, such as sorting food scraps prior to disposal, but did not directly assess broader attitudes or beliefs.

Because of the specific foci and geographic settings of these studies, we contend that our study represents a novel area of research. Our emphasis on utilizing a citizen science approach to elicit knowledge, attitude, and belief—as well as collecting empirical household food waste data—from participants in an innovative Southeastern curbside community compost initiative is one modest step toward better understanding the potential function and impact of comparable programs in the U.S.

Study Context

While food waste experts agree that reducing the overall quantity of food waste is paramount, composting food that would otherwise be sent to a landfill is an important opportunity to model the concept of circular food systems or circular food economies, in which resources generated or used during production, distribution, consumption, and disposal are repurposed for productive use, and are therefore not lost or wasted (EPA, 2023). Various models of composting municipal food waste—often involving collaboration between local governments, private waste operators, nongovernmental organizations, and community members—have been shown to align with circular economy principles that advocate for the regeneration of communities by recycling, reusing, refurbishing, and remanufacturing material resources and incorporating sustainability issues into local policy initiatives (Mihai et al., 2022). To effectively develop and scale up community composting programs, we need a better understanding of the amount of compostable food waste produced by households—distinct from other sources such as restaurants or retailers—and the attitudes, beliefs, and perceptions of participants in U.S. residential food waste composting programs. Therefore, the purpose of this study was to assess the volume of household food waste generated by the City of Gainesville, Florida's community composting program participants, and the primary reasons for that waste. We additionally strived to better understand participant knowledge, attitudes, and beliefs about food waste, their discard behaviors involving food-related packaging, and their perceptions of the overall impact of the community composting program.

The City of Gainesville has set a goal to be 90% zero waste by 2030, and 100% zero waste by 2040 (Hanna, 2023). To help achieve these goals, ordinances to reduce consumption, increase recycling, and improve food diversion opportunities have been enacted. In 2021, the City of Gainesville initiated a pilot program for residential curbside collection of separated food scraps, partially funded by a U.S. Department of Agriculture (USDA) Community Compost and Food Waste Reduction grant, with the city contributing funds as well (Vargas, 2020). The purpose of the pilot program is to determine the feasibility of community composting collection programs and to gauge interest in participating in alternative waste recovery programs. The program will provide valuable data to help the city determine what zero waste initiatives to pursue in the future. The program started with 200 participants who deposit their compostable food waste into buckets picked up weekly by a local composting company, Beaten Path. Program participants place a five-gallon bucket containing their compostable food waste outside their homes each Tuesday. Beaten Path picks up their full buckets and drops off clean five-gallon buckets. These participants each contribute about seven pounds of food waste each week (City of Gainesville, 2023). The composting company also composts food waste from restaurants and residents outside the pilot program areas, who pay for the service. Beaten Path sells the compost to gardeners and farmers who use it as a soil amendment. Between 2021 and 2023, the pilot program diverted over 58.50 tons of food waste from landfills, and reduced greenhouse gas emissions by 36.69 $MTCO_2E$ (metric tons of carbon dioxide equivalent) (City of Gainesville, 2023). In 2024, the program expanded to enroll another 200–230 more participants in an expanded range of neighborhoods (Gainesville Zero Waste News, 2023).

Methods

Recruitment

Two phases of data were collected. In October of 2021 and March 2024, surveys were distributed to all participants of the curbside compost pilot program (200 and 430, respectively). In March 2024, the research team recruited citizen scientists from the participants in the curbside compost program. A total of 107 Gainesville residents signed up to participate in the citizen science study and received project materials.

Citizen Science Data Collection

Enrolled participants received a 2-gallon compost bin, a digital scale, and an instructional guide, which included a visual guide of different types of food packaging to help them report on the types of packaging they discarded. We sought to mitigate the above-mentioned "yuck factor" (Roe, 2021, p. 5) by having participants record the total weight of daily food waste, rather than separating and weighing each type of food wasted. They received a daily log sheet to record the total weight of the discarded food, types of discarded packaging, and the reasons they discarded food on that day. At the end of each day the citizen scientists weighed their total food waste in pounds. They were given a list of reasons that food may have been discarded and were asked to note each day if food had been discarded for any of those reasons, with an "other" category to write in any other reason food had been discarded. Similarly, participants were given a list of types of packaging and were asked to record if they had discarded any that day. Citizen scientists recorded only waste produced within the household. Because the purpose of the study was to assess food waste in relation to a residential curbside compost program, we focused on waste produced in homes, which would be part of the residential food waste stream, rather than waste that would be in the business or restaurant waste streams.

The research team provided the citizen scientists with a pre-recorded video to explain how to record data, and the research team also hosted a live training and question and answer session the evening before data collection began. For a two-week period in April 2024, the citizen scientists recorded their food waste data. At the end of the data collection period, the citizen scientists received a prerecorded video instructing them how they would transfer the data from their log sheets into the online survey. The research team then hosted a live training and question and answer ses-

sion the evening of the last day of data collection, the day before they were asked to provide the data back to the research team. At the end of the two weeks, they received a survey via an online survey platform (Qualtrics). Upon completing the data collection and survey, participants were provided US$150.00 in compensation for their time and effort via electronic Amazon gift cards (eCards).

Citizen Science Instrumentation

The research team developed a survey to collect information about participant demographics, food waste data, and their knowledge, attitudes, and beliefs about household food waste. The questions about knowledge, attitudes, and beliefs were based on Ajzen's (1985) Theory of Planned Behavior (TPB). TPB asserts that an individual's behavior is preceded by an intention to act, that the intention to act is influenced by the person's attitudes toward the behavior (i.e., whether the person sees the behavior as positive or negative), subjective norms (i.e., the person's perceptions of social pressures or expectations about the behavior), and the person's perceived control over the behavior (i.e., their belief in their ability to perform the behavior successfully) (Ajzen, 1985). We also asked about their experiences in the curbside compost program, including what year they joined and whether they had received compost from Beaten Path. The survey also included Likert-type agreement questions (1=*Strongly Disagree* to 5=*Strongly Agree*) about perceptions of the impact of participating in the program: e.g., "I have increased awareness of food waste"; "I have reduced my household food waste"; and "I have increased appreciation for circular food systems (or 'closing the loop')." The survey questions matched the data collection logbook in which participants entered their citizen science data for each day—the total weight of food discarded, the reasons they discarded food, and the types of packaging they discarded.

An expert panel of food waste researchers and practitioners reviewed an initial draft of the survey for face and content validity, that is, its perceived relevance to and representativeness of the subject matter and appropriateness and usefulness for target respondents (Creswell & Plano Clark, 2017). The survey was revised based on this review, yielding the final instrument that was given to participants. This research was approved by the University of Florida Institutional Review Board (IRB # ET00019640).

Data Analysis

We generated descriptive statistics for the data using the statistical software package SPSS. To produce the final frequency, mean, and standard deviation rates for the "daily weight of food composted," "reasons for food discard," and "types of packaging discarded" variables, we computed respective variables over the 14-day waste logging period.

Results

The 2021 survey received 120 responses (60% response rate), and the 2024 survey received 84 responses (20% response rate). In total, 84 respondents completed the citizen science study (79% study completion rate), generating data on the demographic and household characteristics of participants in the City of Gainesville's curbside compost pilot program.

Citizen Scientists

Table 1 displays the demographics of the citizen scientist respondents. Most of our sample had a graduate or professional degree (61.9%) and were employed full-time (58.3%), reflecting county-level U.S. Census data in terms of employment (Alachua has a 59.9% employment rate), but disproportionately representing advanced-degree earners, as only 28.9% in the county have graduate or professional degrees according to 2023 American Community Survey estimates (U.S. Census Bureau, 2023a; U.S. Census Bureau, 2023b). Most participants were between 40–59 (41.7%), and the vast majority identified as White (97.6%) and not Hispanic or Latino (89.3). Most households consisted of two adults (79.8%), with a near-even split between those with and without children living at home (51.2% and 48.2% respectively). For income, 34.6% of households reported an annual income exceeding $150,000 (all amounts in US$), with the next highest proportion of respondents (21%) reporting they earned $70,000–$109,000 and $110,000–$149,000 per year, respectively. Median household income in

Table 1. Demographics and Household Characteristics of Citizen Scientists

Variable	f	%
Age Range		
18–39	23	27.4
40–59	35	41.7
60–79	22	26.1
>80	4	4.8
Race		
White	82	97.6
Black or African American	2	2.4
American Indian or Alaska Native	1	1.2
Asian	5	6
Ethnicity		
Not Hispanic or Latino	75	89.3
Hispanic or Latino	8	9.5
Missing	1	1.2
Education Level		
High school graduate or GED certificate	3	3.6
Some college, technical or vocational training	5	6
Associate degree	4	4.8
Bachelor degree	20	23.8
Graduate or professional degree	52	61.9
Current Employment Status		
Employed (full- or part-time)	63	75
Unemployed	3	3.6
Retired	16	19
Student	1	1.2
Approximate Annual Household Income (US$)		
<$15,000–$29,000	3	3.7
$30,000–$69,999	16	19.8
$70,000–$109,999	17	21
$110,000–$149,999	17	21
>$150,000	28	34.6
Received Food Assistance in Last 12 Months		
No	82	97.6
Yes	2	2.4
Number of Adults Living in the Household		
1	8	9.5
2	67	79.8
3 or more	9	10.7
Children Living in the Household		
No	41	48.8
Yes	43	51.2
Number of Children Living in the Household		
1	16	19
2	22	26.2
3	3	3.6
4	1	1.2
Approximate Weekly Spending on Food in a Normal Week (US$)		
<$50–$100	10	11.9
$101–$200	35	41.7
$201–$300	30	35.7
>$300	9	10.7
Year Joined City Curbside Compost Program		
2021	35	41.7
2022	12	14.3
2023	30	35.7
2024	7	8.3
Received Beaten Path Compost		
No	70	83.3
Yes	13	15.5
Missing	1	1.2

Alachua County, $57,566, is lower than the income reported by study participants (U.S. Census Bureau, 2022). Most respondents (97.6%) reported they had not received food assistance (e.g., SNAP) in the past year. In Alachua County, Florida, 8.8% of the population is SNAP-eligible (Florida Department of Health, 2022). There was moderate variability in weekly spending on food, with the bulk of respondents indicating they spent $101–$200 (41.7%) on food in a normal week. The largest percentage of the respondent cohort joined the city's program in 2021 (41.7%), when it started, with the next highest number (35.7%) joining in 2023. Finally, most respondents had not received Beaten Path's finished compost product generated from their food waste (83.3%).

Table 2 presents respondents' attitudes and beliefs about food waste reduction, as well as their perceptions of normative influences and their perceived self-efficacy/control in reducing their household waste. Attitudes about food waste reduction as a practice were extremely positive, with the highest mean scores for the practice being "overall good" (M = 4.99), "beneficial" (M = 4.96), and "good for communities" (M = 4.94). The overall attitude scale mean score of 4.88 reiterates the overall positive food waste attitudes, respondents believing that food waste reduction has positive social and environmental impacts. Respondents believe that reducing food waste will "reduce landfill use" (M = 4.75)

Table 2. Participant Food Waste Reduction Attitudes, Beliefs, Norms, and Perceived Control (*N* = 84)

Variable	*M*	SD
Reducing Food Waste Attitudes		
Overall bad – Overall good	4.99	.11
Harmful – Beneficial	4.96	.19
Bad for communities – Good for communities	4.94	.28
Unimportant – Important	4.91	.28
Useless – Useful	4.90	.34
Not a priority – A high priority	4.55	.59
Attitude scale	4.88	.20
Reducing Household Food Waste Beliefs		
Reduce landfill use	4.75	.83
Make a meaningful difference environmentally	4.52	.81
Decrease greenhouse gas emissions	4.44	.97
Conserve energy	4.35	.77
Conserve water	4.26	.88
Help mitigate climate change	4.19	.94
Reduce food insecurity	3.70	1.03
Beliefs scale	4.32	.70
Household Food Waste Norms		
Most people important to me support my efforts to reduce the amount of food I discard	4.31	.91
The media I consume frequently highlights the importance of reducing FW	3.40	1.31
Most people important to me believe I should reduce the amount of food I discard	3.08	1.25
Norms scale	3.60	.83
Household Food Waste Perceived Control		
Whether I reduce my FW is completely up to me	4.11	1.09
I am capable of discarding less food than I currently do	3.89	1.10
Perceived control scale	4.00	.88

and make a "meaningful difference environmentally" (*M* = 4.52). The generated beliefs scale affirms these moderately strong views. Social norm scores suggest a moderately supportive social environment, with the highest score for "most people important to me support my efforts to reduce the amount of food I discard" (*M* = 4.31). The norms scale score of 3.6 highlights potential uncertainty from respondents about how supportive normative influences were for reducing food waste. Perceived control (i.e., personal efficacy) scores in carrying out food waste reduction were also moderately high, with a scale mean score of 4.0.

The citizen scientists reported the total daily weight of food discarded over the two-week logging period, and the frequency of participants discarding food for specific reasons and discarding food packaging types. Table 3 presents the average daily weight of food composted over two weeks, which participants weighed in a provided two-gallon compost at the end of each day. For both weeks, Sunday (2.5 lbs. and 2.6 lbs., respectively) generated the highest average weight. Weekend averages were overall higher than weekdays, indicating more waste producing activity on those days. Overall, the total weight of composted food remained consistent across both weeks (14.17 lbs. for Week 1, 14.34 lbs. for Week 2).

Table 4 displays the percentage of citizen scientists who discarded food for specific reasons at any point over the two-week data collection period, as well as the average number of days (of 14) that food was discarded for each reason by each citizen scientist over the collection period. For each day, citizen scientists were prompted to indicate whether they had discarded food for any of these reasons with a "check all that apply" question format. All of them discarded "inedible parts," the

average number of days being almost 12 of 14 (M = 11.94 days). Less frequently cited discard reasons included when food was "old" (i.e., past recommended storage time in fridge or pantry; 88.1% of participants; M = 3.4 days), there was "too little food to save" (72.6% of participants; M = 2.87 days), and food had "blemishes/ damage" (70.2% of participants; M = 2.5 days). Responding to the "other" discard category (41.7% of participants; M = 1.45 days), participants were able to write a specific reason for discarding food not described by the preceding options. For example, several respondents indicated that the process of feeding their babies or toddlers generated waste. Finally, discarding food due to public health advisories or food contamination rumors were the least cited reasons by participants.

Table 3. Average Weight of Food Composted, in Pounds (N = 84)

	Week 1		Week 2	
Day	***M***	**SD**	***M***	**SD**
Monday	2.35	2.11	2.25	1.29
Tuesday	2.15	1.57	1.94	1.01
Wednesday	1.27	1.29	1.97	1.21
Thursday	1.97	1.22	2.08	1.47
Friday	1.92	1.47	1.88	1.29
Saturday	2.19	1.73	2.38	1.88
Sunday	2.50	2.20	2.60	2.07
Weekday Average	2.08	1.18	2.03	0.96
Weekend Day Average	2.36	1.78	2.51	1.76
Total for Week	**14.17**	**8.40**	**14.34**	**7.26**

Note: (1 lb. = 0.45 kg)

Table 4. Food Discarded by Reason (N = 84)

Discard Reason	*f*	%	*M*	SD
Inedible parts	84	100.0%	11.94	2.65
Old	74	88.1%	3.4	2.67
Too little to save	61	72.6%	2.87	3.08
Blemishes/damage	59	70.2%	2.5	2.91
Smelled and/or tasted "off"	46	54.8%	1.32	1.99
Past packaging dates	36	42.9%	0.92	1.47
Other	35	41.7%	1.45	2.94
Stored improperly	25	29.8%	0.56	1.17
Ate out or planned to eat out	24	28.6%	0.69	1.8
Too much and too little space to save	18	21.4%	0.43	1.19
Cooked improperly	17	20.2%	0.27	0.65
Part of rumored contamination outbreak	1	1.2%	0.01	0.1
Subject to recall or public health warning	0	0.0%	0	0

Table 5 presents the percentage of respondents who reported discarding specific food packaging types at least once over the collection period. The most frequently discarded types of packaging were plastic containers (100%), plastic film/wraps (97.6%) and bags (95.2%), and paper and cardboard boxes (97.6%).

Participant Feedback on City Curbside Compost Program

The curbside compost program started in 2021, and 42% of study participants enrolled in the program that year, with 14% joining in 2022, 36% joining in 2023, and 8% joining in 2024. Table 6 summarizes their involvement with the pilot program and their perceptions of its impacts. In terms of perceived impacts, respondents reported high rates of agreement ("somewhat agree" and "strongly agree") that their participation in the compost program increased their awareness of food waste (85.8%), reduced their household food waste (71.5%), and increased their appreciation for circular food systems and/or the idea of "closing the loop" (79.8%).

Reflecting the strong "increased awareness" agreement scores in Table 6, responses to the open-ended questions highlighted that increased awareness of food waste translated into reduced food waste. As one respondent noted:

> My family as a whole is more mindful about the food we eat, how much, and in particular our portion sizes starting out so that we reduce the amount we used to throw away.

Another respondent strongly affirmed this sentiment, demonstrating that increased awareness may in fact lead to sustained behavior change for this household:

> We've significantly reduced the amount of garbage we produce, as a large portion of our household waste now goes into the compost bin. This program has heightened our awareness of the amount of food waste we generate daily. We are also considering installing our own compost bin in the backyard to further contribute to environmental sustainability.

Table 5. Packaging Types Discarded (*N* = 84)

Packaging Type	*f*	%	*M*	SD
Plastic containers	84	100.0%	6.69	3.25
Plastic film and wraps	82	97.6%	6.92	3.88
Paper and cardboard boxes	82	97.6%	6.57	3.2
Plastic bags	80	95.2%	6.69	4.04
Plastic bottles	77	91.7%	4.36	3.32
Aluminum cans	71	84.5%	5.08	4.28
Paper bags	70	83.3%	2.2	1.86
Metal aluminum foil and trays	69	82.1%	2.54	2.14
Tin cans	65	77.4%	2.58	3.29
Paper and cardboard composite material	65	77.4%	2.57	2.63
Paper and cardboard wraps	63	75.0%	2.73	3.05
Glass bottles	57	67.9%	1.94	2.1
Glass jars	55	65.5%	1.39	1.5
Plastic foam	54	64.3%	1.52	1.77
Plastic trays	52	61.9%	1.64	2.42
To-go containers	49	58.3%	1.37	1.71
Disposable cups	40	47.6%	1.55	2.5
Disposable plates and bowls	30	35.7%	0.82	1.55
Straws	22	26.2%	0.63	1.39
Utensils	22	26.2%	0.5	1.13

Certain respondents indicated that they were grateful that the pilot composting program provided them with increased capacity and ability to compost, which they struggled to do consistently and/or successfully despite their interest. As one participant noted:

> I have been composting for a while. But my small compost bin was not able to keep up with the amount of food we were putting in it, so I had to throw out the rest. The city compost allows me compost what I can and then send the rest to the city to be composted, rather than the garbage. Also, during colder months I almost exclusively use the city's compost because mine does not break down as fast when not exposed to heat.

Another respondent agreed that their personal composting efforts were complicated by technical issues and lack of confidence, making the Gainesville composting service a much-appreciated asset:

> I am so grateful to have this program as a resource. I was struggling to properly maintain the correct ratio of green to brown compost while doing it on my own, and I was worried about handling it improperly and accidentally creating a biohazard. Through the program, I'm able to be more cognizant of my food waste and achieve my sustainability goals without it being all on me.

Table 6. Gainesville Curbside Compost Pilot Program Participation Impacts

Variable	Strongly disagree (%)	Somewhat disagree (%)	Neither agree nor disagree (%)	Somewhat agree (%)	Strongly agree (%)
Increased awareness of food waste	8.3	—	6	17.9	67.9
Reduced household food waste	6	7.1	15.5	42.9	28.6
Increased appreciation for circular food systems	4.8	2.4	13.1	16.7	63.1

Participants affirmed that "composted waste has ecological value," indicating the practical value that generating compost had for the health of their home gardens and the capacity to attract beneficial pollinators to their yards. One participant noted, "the free compost went into our yard/plants. [The] full circle feels good." Another participant stated, "I started my own backyard compost and started a home vegetable garden and butterfly garden."

Finally, respondents noted that their participation in the community compost program helped to mitigate a frequently mentioned concern about home composting systems attracting rodents. One respondent expressed their appreciation that the program addressed this issue:

> We had problems with rodents getting into our compost bin so the curbside program has allowed us to compost without also having to deal with rats. We're very grateful to have the option.

Another participant echoed this perspective, sharing their own experience with increased rodent and other pest challenges:

> Our vegetable and fruit compost started attracting rodents. We also happen to live near one of the local Publix grocery stores. When we realized it was attracting pests, we stopped composting in our back yard. That was about the same time the curbside pickup started. It solved the issue of pests coming into our yard.

Overall, these quotations reflect appreciation for the practical value that the pilot community composting program provided.

In terms of program logistics, in 2021 and 2024 the curbside compost pilot program participants were asked how frequently they set out their compost buckets for collection. In 2021, 79% of participants set them out every week, while 18% did so most weeks. Very few respondents indicated that they rarely or never set out their buckets. In 2024, the number of participants who put out buckets for collection every week dropped to 61%, although the rate of participants bringing out buckets most weeks increased to 35%. Participants were asked about the frequency of compost buckets not being collected by the contracted compost company after participants had set them out on the curb. Most (84.5%) of participants reported never having their bucket missed. 11.9% experienced a missed pick-up once, 2.4% reported a missed pick-up two or three times, and 7.1% reported there were missed pick-ups multiple times.

Participants were asked how easy or difficult it was to separate food waste from garbage. Most respondents (81%) found it very easy to separate food waste from garbage, and 16.5% found it easy. Only 2.5% of respondents reported it was neither easy nor difficult, and no respondents found it either difficult or very difficult to separate the waste types. While they indicated that it was not difficult, they did have express uncertainty in the open-ended responses about "items that are not okay to put in [the] bucket," and "what paper waste can go into the bucket."

In 2021 and 2024, participants were asked about whether they experienced issues with insects and compost. In 2021, about half of respondents (50%) reported no issues with insects in their collection containers, 28% experienced problems a little, and 16.5% had a moderate amount of issues with insects. In 2024, responses to the same question showed those experiencing no issues increased to 80%, while those experiencing problems a little decreased to 17%. In the open-ended responses, participants described their issues with pests and made suggestions about bucket cleaning to reduce bugs. One respondent advised, "the small collection bucket [should] be emptied at least once a day … this reduced fly infestation." A second respondent provided a more expansive recommendation:

> We had a lot of insects with the small pail in the kitchen. We eventually moved toward just using the bucket and that has prevented insects. I think many may be discouraged if they're using the small pail in combination and not immediately throwing it in the yellow bucket. Perhaps the [program] literature can encourage folks not to leave the small pail out for too long or provide a pail that seals better to prevent insect intrusion.

Participants were asked about when their food waste collection day occurred, in relation to their standard garbage collection day. Approximately half (49%) confirmed that their food waste collection day was the same as their garbage collection day, approximately half (48%) reported that their food waste collection was the day before garbage collection, and only 3% reported food waste collection was the day after garbage collection. Participants were asked what day of the week that they would prefer to have their food waste collected. A significant majority (81%) preferred collection to take place the same day as their garbage collection day; 15% favored food waste collection the day before garbage collection, 3% preferred collection on a Monday or Friday, and only one respondent indicated they preferred food waste collection the day after garbage collection. In the open responses, they expressed their interest in changing and/or adding a compost collection day. As one respondent noted, "our yellow bucket day is two days before garbage day. It would be easier to remember if it were the same day." Another respondent indicated they would prefer an additional pickup day during the week:

> Container collection twice a week. It would help avoid bugs, make [the] container lighter (sometimes mine gets too heavy to carry to the curb), and it would eliminate [the] temptation to discard good scraps in [the] regular trash if I ever forgot to discard something that was sitting in the back of the fridge.

The City of Gainesville hosted an educational event for program participants, where participants learned about how waste is composted and were able to take a bucket of compost home with them. The majority (60%) acknowledged receiving an email about the event but did not attend, and 21% reported being completely unaware of the event. Only 12% indicated they attended the event. Based on the open-ended responses, this event would have answered many questions that participants had about the program. For example, the survey responses included various topics about the program, such as "what the compost is used for after it's collected," and "how the waste is composted." In the open-ended responses, participants expressed an interest in receiving compost from the program; a representative pertinent question was "how [do I] obtain compost for [my] garden, if this will eventually be an option with the program?" A respondent echoed this with an inquiry as to whether "there's a way to purchase the compost that's made."

Discussion

This study contributes new understanding of attitudes, beliefs, social norms, and self-efficacy that community compost program participants have about household food waste and the impact that the community compost program has in their lives. In our study, individuals had positive attitudes toward reducing food waste and believe that reducing food waste will have a positive impact on their communities. However, the lower scores for the responses in the social norms and their perceived agency over reducing food waste highlight the importance of the broader context in which household food waste occurs and individuals' perceived ability to reduce their food waste. Notably, our respondents indicated that they do not think that the media emphasize the importance of reducing household food waste, and they had lower scores for their perceptions of their capability to reduce their household food waste.

These findings have theoretical implications for the adoption of food waste reduction behaviors. As Ajzen's (1985) TPB posits, attitudes, subjective norms, and perceived behavioral control are directly associated with behavioral intention, which has been demonstrated to be the strongest predictor of the actual adoption or maintenance of a target behavior (Ajzen, 1991; Fishbein & Ajzen, 1975). Because TPB has been effectively integrated in previous consumer food waste studies to frame decision making around household food waste reduction (Graham-Rowe et al., 2015; La Barbera et al., 2022), we contend that our TPB-informed results also have implications for household food waste reduction efforts among comparable communities. The low self-efficacy and perceived control scores provide a key example of how efforts to reduce food waste reduction efforts can be hampered and where

policy and programmatic initiatives should focus their efforts.

The open-ended responses provide additional detail on participant positive attitudes and beliefs about how reducing food waste impacts the community. Many of them had struggled with their own efforts to compost, so this program was a valued way for them to keep their food waste out of the landfill and recycled into their community, making this program likely to support feelings of self-efficacy and more positive social norms related to reducing food waste. Responses to open-ended questions regarding their experience with the pilot compost program demonstrated an appreciation of the program's role in repurposing their household's waste into a circular system, rather than into a conventional waste stream. Several respondents indicated that while they had previously attempted to compost, they had struggled to do so effectively.

An important finding of this study was that the citizen scientist households reported more than double the amount of food that discarded per week (with a mean of over 14 pounds for each week) as compared with the EPA estimate of 6.5 pounds per week. This study provides data on the reasons why people waste food, and on the quantity of waste that individuals in a community compost program can divert from landfills. We found that the overwhelming reason that people discarded food was that they were discarding parts of food that they perceived to be inedible. With the goal of reducing food waste, there is an opportunity for future research and education involving awareness/knowledge of food parts that are edible but commonly discarded, such as broccoli stalks, and of ways to reuse food scraps via stocks, pickling, freezing, and recipes designed to use food scraps. As 42% of respondents reported discarding compostable food for "other" reasons, further exploration of these additional reasons may be warranted. Several respondents reported discards that were due to babies or very young children not finishing their food or throwing it on the floor. This dynamic may not be surprising since most respondents (51.2%) reported having children living with them at home. The recurrence of this cited reason may reflect patterns from prior and ongoing research concerning the significant influence children have on household food waste production, despite the best intentions of adult household members (Kansal et al., 2022; von Massow et al., 2019). Other reasons for discarding food included impending travel, returning from travel, and spoilage from a malfunctioning fridge. With respect to household members' agency and personal control in adopting waste-reducing behaviors, these discard reasons appear less subject to fickleness about food quality, taste, and preference; they may be less actionable than other discard reasons as behavioral decisions to reduce food waste. For researchers interested in further examining this topic. and for policymakers and stakeholders interested as well in reducing household waste in their communities, the practical implication of this study may be to increase focusing on sources of food waste that are under the control of individuals.

Finally, this study provides an initial overview of the types of food-related packaging that are thrown away, understanding that can be used to develop strategies to reduce the waste by encouraging the use of compostable food packaging in communities. The finding that four of the five most discarded items were made with plastic highlights opportunities for cities to adopt policies to require or incentivize the use of compostable packaging products.

Limitations

This project sought to understand citizen scientists' attitudes, perceptions, and beliefs about food waste, as well as the types and quantities of their household food waste and its causes. A serious concern with citizen science data is its quality: if it is of low or inconsistent quality, it can be of limited use (Kosmala et al., 2016). To mitigate this potential issue, we enlisted citizen scientists who were relatively knowledgeable about composting practices, who would have a better chance of understanding what was being asked of them and would have a greater likelihood of completing data collection as directed for the duration of the study, due to already separating their compostable food waste. However, enlisting a group that would yield higher

quality data and with more fidelity meant that our population is not representative of the public, and, hence, these results are not strongly generalizable. As was the case for our study population, it is common for citizen scientists not to be representative, as there is a narrow range of individuals who self-select into participating in citizen science projects who tend to be more educated and affluent, with high levels of interest in science and positive attitudes about the environment prior to enrolling (Chase & Levine, 2018; Domhnaill et al., 2020; Pateman et al., 2021).

Recommendations for Practice

Policymakers, educators, and community stakeholders interested in developing community household composting programs should consider a suite of practical and logistical challenges, many of which were identified by our pilot cohort. First, there must be personnel who can pick up food waste and drop off empty buckets. Program operators may be municipal staff or a contracted third party, as is the case in our study. Sites for waste transfer and processing as well as trucks and waste collection bins are required to facilitate the smooth operation of the composting program. To develop a program, a municipality should assess community needs, scout potential target neighborhoods, identify potential partners, and negotiate a contract or memorandum of understanding with a partner providing the waste pick-up and drop-off service. As the City of Gainesville has done, interested municipalities or organizations should consider implementing a pilot program initially limited to select neighborhoods and households**.** If the pilot program demonstrates promise, program staff can expand the program to additional homes in other neighborhoods.

Educational outreach is also critical. Both in the needs assessment phase of program development, and after a pilot program is launched, stakeholders should conduct regular community workshops and information sessions to educate participants about the benefits of composting, the importance of reducing household food waste, and ways to appropriately discard food waste. As we found from our cohort of participants, logistical constraints can erode participant confidence and willingness to continue to participate in the program. Our data demonstrated that odor, pests, theft, and lack of knowledge could be deterrents for participants. Receiving feedback from participants can help to identify areas for improvement and adjustments to the program, and can also capture information on how to positively motivate participants. Fostering a collaborative environment where participants can share such positive experiences and perspectives with program staff and one another may stimulate program growth.

Conclusion

Community-based compost programs divert food waste from landfills and use it to create compost that can be used by program participants, school and community gardens, municipal landscaping, and commercial farming. Participants in the community compost program in our study had little difficulty participating in the program and identified numerous benefits beyond simply diverting their food waste from landfills. Our finding that households produced more weekly food waste than the EPA official estimates may necessitate additional household-level studies to gain more accurate estimates of the levels of household food waste that could be diverted from landfills and become a part of a circular community food system. While more research is warranted, our study demonstrates that community compost programs are a promising strategy to improve household-level awareness, knowledge, and confidence in reducing food waste, and to bolster a circular food system in a target area. At a broader, global scale, the United Nations Sustainable Development Goal 12.3 target to halve global food waste at the retail and consumer levels necessitates that a wide array of innovative, community-driven models should be proposed, piloted, and studied for their capacity to scale up for regional, national, and potentially global application and impact. While our study highlighted a specific community composting program in a specific target area, our review of literature identified several comparable programs, with understandable variation in size, scope, and structure, across North America and several countries (Benyam et al., 2018; Breitenmoser et al., 2024; Bruni et al., 2020; Christie & Waller, 2019).

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Community farming in Northern Ireland: Definitions and impacts

SPECIAL ISSUE
Community-Based Circular Food Systems

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Abstract

This paper explores the extent to which community farming can be a component of a community-based circular food system. Community farming is part of a broader pattern of civic agriculture, whereby more localized food production and consumption are linked to a wider, and sometimes global, set of economic, social and environmental factors. However, although aspects of community farming, notably community supported agriculture (CSA) and care (or social) farming have been well defined and studied, community farming as a broader process of civic agriculture has not. Furthermore, there is a limited number of published studies on the social, economic, and environmental impacts of the varied components of community farming. In this study, a focus group was used to generate the following definition of community

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farming: a process of collaborative transformation at the intersection of land, community, and enterprise; and a definition of a community farm: a place of collaborative transformation at the intersection of land, community and enterprise. This study also presents data from nine diverse community farming projects in Northern Ireland that are part of the Cultivating Community Farming (CCF) project. Over a two-year period, social return on investment (SROI) methodology was used to quantify their cumulative impacts, employing 12 metrics: 11 monetized and one nonmonetized. The overall SROI ratio for the nine projects was 3.52:1, with 90% of this value being social, followed by 8% environmental and 2% economic. This study provides valuable insights into some of the value generated by community farming, notably social, as well as an operational definition that can catalyse further research, practice, and advocacy among stakeholders. It also articulates community farming as a continuum or umbrella term which can incorporate more multifunctional approaches such as care and social farming, and more food production-oriented practices such as CSA.

Keywords
Ireland, community supported agriculture, care farming, social farming, civic agriculture, social agriculture, social return on investment, community-based food systems

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Author Contributions
Study design: CC, TO, and JHH; Data collection and analysis: CC; Article writing: JHH; Article editing: JHH, CC, TO, and MNW.

Author Disclosures
Dr. Jonathan (Jonny) Hanson was a consultant on the Cultivating Community Farming (CCF) project and is now at the ARK social policy hub at Queen's University Belfast. Ciaran Collins was the CCF impact measurement consultant and is the director of CiCo Consulting, while Tiziana O'Hara was the CCF project lead and is a director of Co-operative Alternatives. Dr. Matthew (Matt) Williams is the education and conservation manager at Jubilee Community Benefit Society.

Introduction

Community farming can be conceptualized as a diverse spectrum of approaches that connect communities with farming and farming with communities. It is part of a broader pattern of civic agriculture, whereby more localized food production and consumption are linked to a broader set of economic, social, and environmental factors composing a sustainability agenda, often at a global level (Kaika & Racelis 2021; Lyson, 2004). Multifunctional elements, especially involving wellbeing and education, may also be integrated with the food production components (Henderson & Van En, 2007). These elements can include formal care/social farming programs focused, for instance, on therapeutic interventions (Jarábková et al., 2022; Parsons et al., 2010). However, this breadth and diversity of community farming belies a lack to date of articulated scholarly definition. In a Google Scholar search for the term "community farming," for example, none of the top four journal articles that mention the term in their title defines it (Davenport & Mishtal, 2019; Heise et al., 2017; Liu et al., 2017; Ravenscroft et al., 2013). Furthermore, there is a lack of clarity about how community farming relates to other, similar approaches, particularly care/social farming and community supported agriculture (CSA).

With its longstanding Japanese origins, and reflecting the reality of communal approaches to at least some agricultural tasks through most of human history (Takahashi et al., 2022), CSA remains the most commonly practiced, studied, and defined form of community farming. Robyn Van En, an early American pioneer of CSA, defined it as "food producers + food consumers + annual commitment to one another = CSA + untold possibilities" (Henderson & Van En, 2007, p. 3). A later definition, in a report on English CSAs, suggested: "any food, fuel or fibre producing initiative where the community shares the risks and rewards of production, whether through ownership, investment, sharing the costs of production, or provision of labour" (Saltmarsh et al., 2011, p. 4). More recently, the Community Supported Agriculture Network UK (n.d.) has defined CSA as a "partnership between farmers and consumers in which the responsibilities, risks

and rewards of farming are shared" (p. 1).

The CSA Network UK also categorizes CSAs as farmer-led, community-led, producer-community partnerships, and community-owned farms. The fourth category, however, may not necessarily involve CSA models; for example, at Fordhall Farm, England's first community-owned farm, the food is sold through a farm shop, farm café, and pop-up food trailers rather than through a CSA model (Hollins, 2012). Nor do these definitions of CSA cover the wide range of social, cultural, community, and environmental services provided by many CSA schemes in addition to their food shares. For these reasons, CSAs can be important in creating social value (Haney et al., 2015). As well as through improving wellbeing (Rossi & Woods, 2021), this can include the development of both bonding social capital, where connections are created within a community of CSA members, and bridging social capital, where these interactions are extended to nontraditional CSA members or communities (Furness et al., 2022). Nevertheless, despite this social value creation, many CSAs struggle to achieve financial security and resilience (White, 2015). In the U.S., cost-offset CSAs (CO-CSA) augment financial subscriptions with grant-based income in order to benefit disadvantaged communities, such as through public health improvements (Sitaker et al., 2021). While the primary focus of CSAs may be food production, it is also clear that they can be multifunctional entities in their own right, creating multiple and complementary forms of value.

This multidimensional ethos is at the core of care/social farming practices, which have also been studied extensively. (In this study, care and social farming are used interchangeably.) For instance, Jarábková et al. (2022) cite no less than eight definitions of social farming in their systematic literature review. The sector also uses differing terminology, depending on situation. In the UK, for example, the term care farming is more widely used; it has been defined as the "therapeutic use of farming practices" (Parsons et al., 2010, p. 237). Jarábková et al. (2022) identify three broad strands of care/social farming, focused on wellbeing, social inclusion, and education; a categorization found, for instance, among social farming in the Netherlands (Hassink et al., 2020). While only 8.2% and 6.7% of the 134 studies reviewed by Jarábková et al. considered environmental and economic topics, respectively, food production featured in four of the eight definitions.

As with the educational and wellbeing elements of CSA, the food production aspects of care/social farming have received less attention (e.g., Nazzaro et al., 2021; Nicolosi et al., 2021), although Tulla and Vera (2019) argue that it could be used as a tool to help achieve food sovereignty in Europe. While the primary focus of care/social farming may be its wellbeing, educational, and social inclusion components, food production clearly can be an important part of its mission. As with CSAs, care/social farms are able to create social, economic and environmental benefits in tandem (Hassink et al., 2020).

Irrespective of competing or absent definitions, incorporating elements of CSA and care/social farming, and with our working definition of community farming as a "diverse spectrum or continuum of approaches that connect communities with farming and farming with communities," it is clear that community farming is diverse and multifaceted. The availability, affordability, quality, and sustainability of food are key tenets of the practice (Samoggia et al., 2019). It often involves economic or financial considerations on the part of the farmer, whether the farms are family-owned businesses (Piccoli et al., 2021; Pole & Gray, 2013; Samoggia et al., 2019) or social enterprises (Hudcová, 2022). Issues of connection and identity, especially between consumers and citizens on the one hand and their environment on the other, are often significant (Liu et al., 2017; Ravenscroft et al., 2012; Ravenscroft et al., 2013). These issues may often connect with wider, more global concerns about equity and justice (Bonfert, 2022; Ostrom, 2007; Ravenscroft et al., 2012; Wittman et al., 2017). Significantly, community farming often aims to address and incorporate a range of environmental, social, cultural and community concerns (Bougherara et al., 2009; Piccoli et al., 2021), such as the inclusion of marginal groups such as refugees (Andreatta, 2006).

Community farming in Northern Ireland (NI) exhibits many of these same trends but is less

developed or studied compared to other regions of the UK, Ireland, and Europe. The CSA Network UK map shows four CSA members in NI, compared with over 150 members for the whole of the UK (Community Supported Agriculture Network UK, 2024), though the numbers are similar on a per-capita basis. However, this small number represents an increase from one CSA—Jubilee Community Benefit Society (JCBS) (2024)—in 2018, with a small number of others that are in development or unregistered. By comparison, care/social farming projects that incorporate wellbeing, education, and/or social inclusion elements are better established, led by Rural Support with family farms and Social Farms & Gardens (formerly the Federation of City Farms and Community Gardens) with community and urban gardens. The former's website shows 16 operational social farms in NI (Rural Support, 2024), while the NI map of the latter has more than 100 initiatives (Social Farms & Gardens, 2024), with some overlap between these and both the CSA Network UK and Rural Support projects. However, while social farming in NI has had clear buy-in and funding from both the Department of Agriculture, Environment and Rural Affairs (DAERA) and the Department of Health, and community gardening has received support from local governments (Social Farms and Gardens, 2023), community farming, including CSA, has had little to no official support to date from relevant government departments (Hanson & Walsh, 2024). Partly to address this gap, the Cultivating Community Farming (CCF) project was developed from 2022 to 2024, funded by the Co-op Foundation, and delivered by Co-operative Alternatives and JCBS (Cultivating Community Farming, 2024). It worked with nine early-stage community farming projects across NI to accelerate their growth through networking, mentoring, skills development and capacity building. Accelerator and incubator projects like this have increased the success rates of other participating enterprises (Smith et al., 2019). Overall, community farming in NI has the potential to contribute to a more multidimensional, circular, and sustainable agri-food sector (Albanito et al., 2022; Nature Friendly Farming Network, 2023), but this potential is poorly understood.

Our review of the relevant literature has identified gaps in what constitutes community farming, including its relation to both CSA and care/social farming, as well as its social, environmental, and economic impacts. Within the wider framing of how community farming might be a component of a community-based circular food system, the following research questions were devised:

1. What are the definitions of community farming and community farm?

2. What are the social, environmental, and economic impacts of community farming in Northern Ireland?

Methods

Measuring Impact in Community Farming

Agriculture of all types has seen a recent significant increase in assessment of its impact and sustainability, driven by increasing environmental and social concerns (Latruffe et al., 2016). Overall, numerous benefits from assessing impacts have been cited, including improved innovation (Ryan et al., 2016), improved organizational practice (NPC, 2022a) and increased ability to attract funding (NPC, 2022b). A notable tension for many of the indices and measurements developed exists between, on the one hand, the need to have generalized indicators that can be used in and compared between multiple regions and types of farming , and on the other hand, the challenges of like-for-like comparisons across the diversity of these farming regions, practices, and systems (Gomez et al., 1997; Reig-Martinez et al., 2011; Zahm et al., 2008). Similarly, as with all research approaches, broad quantitative methods can lack depth while narrow qualitative approaches can lack breadth. This study therefore employed a mixed-methods approach to capture the breadth and depth of community farming data.

Reports on CSA impacts in England (Saltmarsh et al., 2011) and Wales (Little & Giles, 2020) have used varying methodologies to assess different dimensions of CSA practice, especially surveys and questionnaires. Saltmarsh et al.'s (2011) study used the asset-based sustainable livelihoods ap-

proach, while the Welsh report did not specify a framework. However, while the sustainable livelihoods approach is useful for providing an information baseline for access to assets, it is less useful for measuring changes and/or impacts to and/or from these resources. In addition, the lack of a standardized approach for both studies makes like-for-like comparisons with other impact assessments challenging. However, the Saltmarsh et al. use of case studies provided in-depth qualitative information to complement the quantitative data. A project to provide a social impact toolkit for community food enterprises, by Coventry University and the Real Farming Trust, detailed an array of methodologies (Coventry University, 2018). Quantitative data on the social, environmental, and economic impacts of community farming can be used to assess their potential contribution to more circular food systems, as has been done in Europe (van Zanten et al., 2023).

Another quantitative option for community farming impact assessment is Social Return on Investment (SROI), a participatory and robust approach which, in monetising impact, can be of particular interest to policymakers. However, its complexity requires expert input and can be resource-intensive (Communities Living Sustainably, 2015; Morris, 2019). Nevertheless, compared to the sustainable livelihoods approach, for instance, it allows changes in impact to be measured across social, economic, and environmental outcomes, as well as allowing like-for-like comparisons with other projects, whether focused on community farming or not. Furthermore, it involves project participants in defining the outcomes they wish to measure and the indicators they wish to use in the process, increasing buy-in, involvement, and relevance to participants (Greenspace Scotland, 2011).

A review of SROI assessments from 20 Scottish greenspace projects found ratios of between 2:1 and 20:1, with approximately two-thirds at up to 9:1 (Greenspace Scotland, 2013). Similarly, a SROI analysis of three English community food projects had a combined result of 6.97:1 (Courtney, 2014). More recently, Vasiliu et al. (2024) found an SROI ratio of 2:1 in the determined value of an urban greenspace in Northern Italy. In summary, SROI results can vary widely.

Finally, focus groups have been used successfully in analysing food projects (McGlone et al., 1999). They provide a quick and accessible method to gather qualitative information, with the participation in the process increasing the depth and range of perspectives shared (Newing et al., 2011).

Overall, these impact measurement approaches to assessing community farming projects demonstrate the inherent limitations of quantitative data in capturing the depth of human interactions with farming systems, as well as the difficulty of comparing multiple qualitative data sets. Consequently, mixed-methods approaches, such as that of Saltmarsh et al. (2011), can provide both quantitative breadth and qualitative depth in attempting to measure the social, economic, and environmental benefits of the projects.

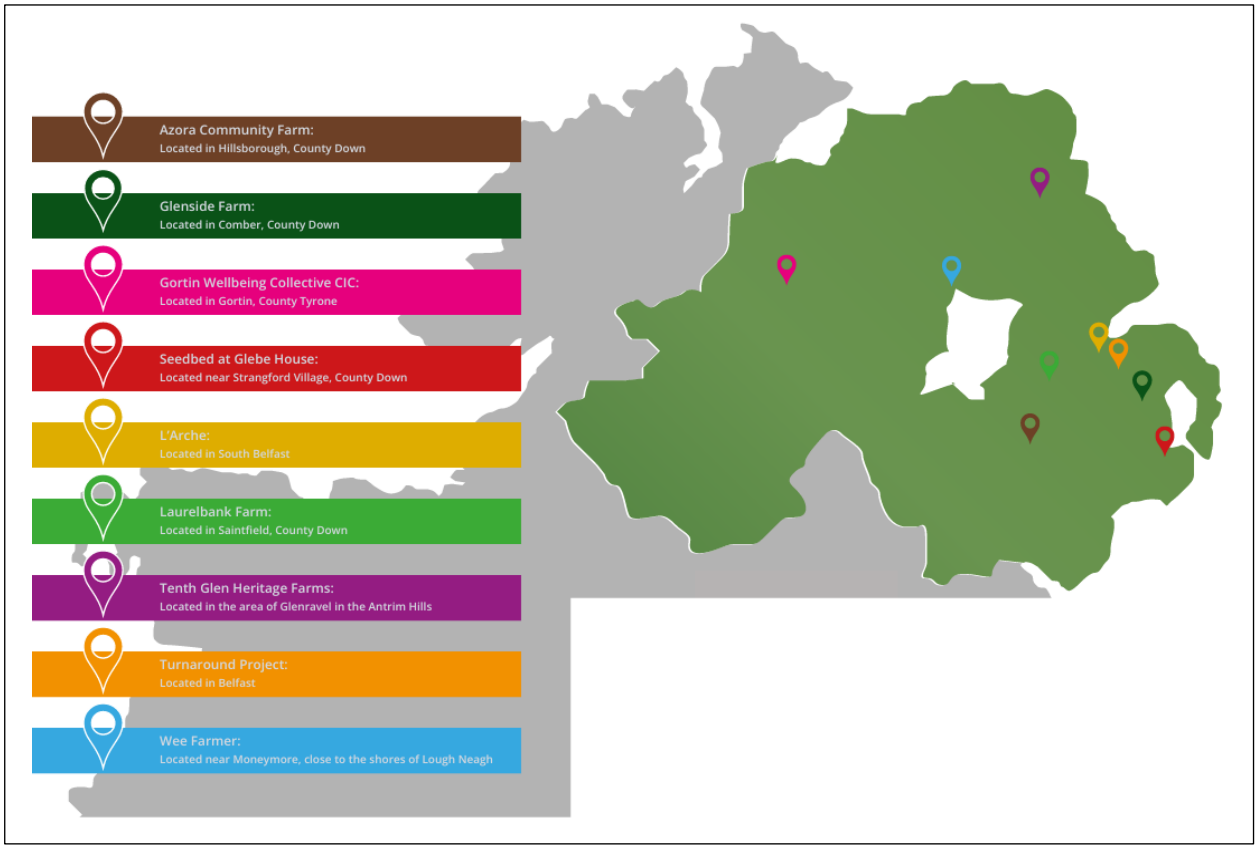
Sample

The nine community farming initiatives that participated in the CCF project were spread across three of Northern Ireland's six counties (Figure 1). One was in Co. Tyrone, four were in Co. Antrim and four were based in Co. Down. Their legal structures varied from limited company and community interest company to community benefit society and unincorporated constituted group. Six of the groups owned land, two rented land and one did not have access to any land. Overall, the nine community farming projects made 37 acres of land available for community initiatives, with 7.4 acres given to food production and 17.2 acres to conservation. During the two years of the CCF project, 1,587 individuals engaged with the projects, contributing 15,000 volunteer hours. Three of the groups sold goods through farm-gate sales, while one had a CSA operation and another an agritourism operation. Further information on each of the nine projects, including case studies for each, can be found in the CCF final report (Cultivating Community Farming, 2024).

Ethics and Consent

Ethics are an integral part of conducting research, regardless of the institutional setting (Newing et al., 2011). Central to ethics is the principal of informed consent. Accordingly, informed consent was ob-

Figure 1. Map of Cultivating Community Farming Projects



tained by all project impact assessment and stakeholder focus group participants. Overall ethical approval and review was provided by the CCF project leads and their respective boards in collaboration with the project impact assessment consultant.

Definitions Focus Group

Following the research guidelines of Newing et al. (2011), a focus group with representatives from the nine participating groups, as well as three of the authors, was conducted in September 2023. Keywords, phrases, terms, and references that participants felt defined community farming were collated. Following the approach of Parsons et al. (2010) to defining care farming in the UK, the authors refined and edited the material further to ensure brevity and clarity, and to create collaborative definitions of community farming and of a community farm.

Social Return on Investment Analysis

Initially developed to evaluate the social value of grant requests in the U.S., SROI has become a common methodology globally, including, for example, in collaborations between nonprofit and public-sector organizations in the UK (Corvo et al., 2022). Its ability to price previously undervalued social and environmental goods in a single econometric has been recognized (Maldonado & Corbey, 2016). However, it has been criticized as an example of the "market society," the financialization of day-to-day life (Roy & Teasdale, 2022). Arvidson et al. (2013) noted a tension in the approach between its participatory nature and its utility in competing for limited grants between third-sector organizations. Nevertheless, despite these concerns, its role has been cited as an important tool for management, accountability, participation, and knowledge generation.

The SROI methodology followed the six stages of the National Social Value Standard: scope

and identify stakeholders; map outcomes, evidence and value outcomes; establish impact; calculate SROI; report and utilize data (National Social Value Standard, 2022). The objective of stages 1–2 is the Theory of Change definition, while the focus for stages 3–5 is the monetization of outcomes. This mixed-method approach allowed both quantitative and qualitative data to be obtained.

For stages 1–2, a semi-structured interview and a detailed web-based survey were undertaken with each participating CCF project from April to August 2023. The interviews and surveys were all completed with the leaders of each project, as they had the best overview of the project's history and development. A focus group with the nine participating groups, and three of the authors, to refine the Theory of Change (ToC) and outcomes frameworks, as well as the social, environmental, and economic outcomes of the CCF interventions reported by each group, was held in September 2023. Based on these approaches, and across social, environmental and economic categories, 12 outcomes were selected (Table 1).

For stages 3–5 of the SROI methodology, metrics were selected for the12 outcomes, of which 11 were monetized and one was nonmonetized. They drew on a number of sources of validated quantification (Banks & Dias, 2023; HM Treasury, 2022; National Social Value Standard, 2022). A nonmonetized measure of volunteering—hours—was also included to provide a contrasting lens through which to view the impact of volunteerism. First, the metrics were assigned indicators, an effect length, and, for the 11 monetized measures, a financial proxy. Next, to establish the impact of the 11 monetized metrics, discounting with four context-related factors was applied: drop-off, displacement, attribution, and deadweight. In the final stage of the outcome monetization phase, and following the National Social Value Standard (2022), Loop Software was used to compute the SROI figures, across each of the three categories and overall (Loop, 2024). This also involved including the nonmonetized volunteering measure in the calculation. Additional technical information on the SROI approach undertaken is in the Supplementary Information. Stage 6 involved the production of the project report (Cultivating Community Farming, 2024), and its sharing via events, social media and networks.

Despite adherence to the methodology, and efforts throughout the study to increase data reliability, the analysis has two related limitations that may impact the robustness and usefulness of findings. First, standardization: given the nature of the study, there were limited baselines available for some of the participating groups prior to the start of CCF intervention, with no standardized impact measurement tool in use from the outset of the CCF project. Subsequently, some of this initial data could only be estimated retrospectively. Second, subjectivity: the study relied on the data and outcomes reported by each participating group, their beneficiaries, and the stakeholders that they engaged with. While training on data collection and impact measurement were provided as part of the CCF project, these self-reported results were not independently verified.

Results and Discussion

Definitions

Based on the focus group data, community farming was defined as a process of collaborative transformation at the intersection of land, community and enterprise. Similarly, a community farm was defined as a place of collaborative transformation at the intersection of land, community and enterprise.

The definitions of community farming and community farm articulated by the CCF project participants and coordinators focus on three distinct asset classes that are correlated with community farming: land, or natural capital; enterprise, or physical and financial capital; and community, or human and social capital (Figure 2). In this regard, community farming has parallels with the widely utilized Sustainable Livelihoods framework, which has been used to assess the impact of CSAs in England (Saltmarsh et al., 2011). This definition also differs from the various definitions of CSA (CSA UK Network 2024; Henderson & Van En, 2007; Saltmarsh et al., 2011), which focus more explicitly on the production and consumption of food and on the allocation of risk, reward, and responsibility in this process.

Table 1. Social Return on Investment Analysis Metrics, Categories, and Outcomes

Metric	Subcategory 1	Subcategory 2	Subcategory 3	Description
1. Community, charity, and other stakeholders	Community health	Community mental health	Lower impact intervention	Interventions delivered to the community that improve their mental health.
2. Supply chain	SME, start-up, VCSE, or mutuals support (monetized)	Full intervention	N/A	The number of stakeholders who attended a relevant event, i.e., for events relating to: small and medium-sized enterprises (SMEs); start-ups; voluntary, community and social enterprise organizations (VCSEs); and mutuals benefiting from development support, seminars; and market/supplier engagement events between reporting periods.
3. Community, charity, and other stakeholders	Site visit (monetized)	Hourly	N/A	A scheduled visit to a work site by school children or anyone who benefits from it in terms of education or employability.
4. Environmental	Biodiversity (monetized)	N/A	N/A	Number of net biodiversity units created, representing habitat creation or protection. Natural England's Biodiversity Metric 3.0 spreadsheet can be used to calculate the number of units.
5. Environmental	Material use (monetized)	Organic	Compost derived from food and garden waste	Net reduction (+) in material use or net increase (-), against the relevant baseline.
6. Community, charity, and other stakeholders	Loneliness (monetized)	N/A	N/A	Reduction in loneliness per person as a result of a specific intervention, which could be in a community or within a workforce. This is assuming a point shift in a 5-point scale of loneliness.
7. Community, charity, and other stakeholders	Community learning interventions (monetized)	Hourly	N/A	Community training opportunities created, other than apprenticeship. Where there is a qualification involved, the qualification metrics should be used.
8. Community, charity, and other stakeholders	Green space (monetized)	Use of countryside green space	N/A	Number of individuals living in or within close proximity to desirable natural areas and environmental resources, such as private gardens and designated areas, which have been protected or created by the intervention.
9. Community, charity, and other stakeholders	Green space (monetized)	Use of urban green space	N/A	Number of individuals living in or within close proximity to desirable natural areas and environmental resources, such as private gardens and designated areas, which have been protected or created by the intervention.
10. Community, charity, and other stakeholders	Volunteering (nonmone-tized)	No. of person-hours spent protecting and improving the environment	N/A	Number of person-hours spent protecting and improving the environment.
11. Community, charity, and other stakeholders	Volunteering (monetized)	Annually—several times a year	N/A	Time spent, unpaid, doing something that aims to benefit the environment or someone (individuals or groups) other than, or in addition to, close relatives.
12. Community, charity, and other stakeholders	Co-design/ co-creation with stake-holders (monetized)	N/A	N/A	Co-design/co-creation implies a high degree of citizen control (i.e., independent community-based initiatives that help others to develop and carry out their own plans. Examples include co-design and co-production). The default assumption is a duration of one year or regular (1–2 monthly) meetings.

Based on HM Treasury, 2022 & National Social Value Standard, 2022.

Through the procedural element of this definition—"collaborative transformation"—the definition is more akin to the eight definitions of social farming reviewed by Jarábková et al. (2022).

Figure 2. Elements of Community Farming

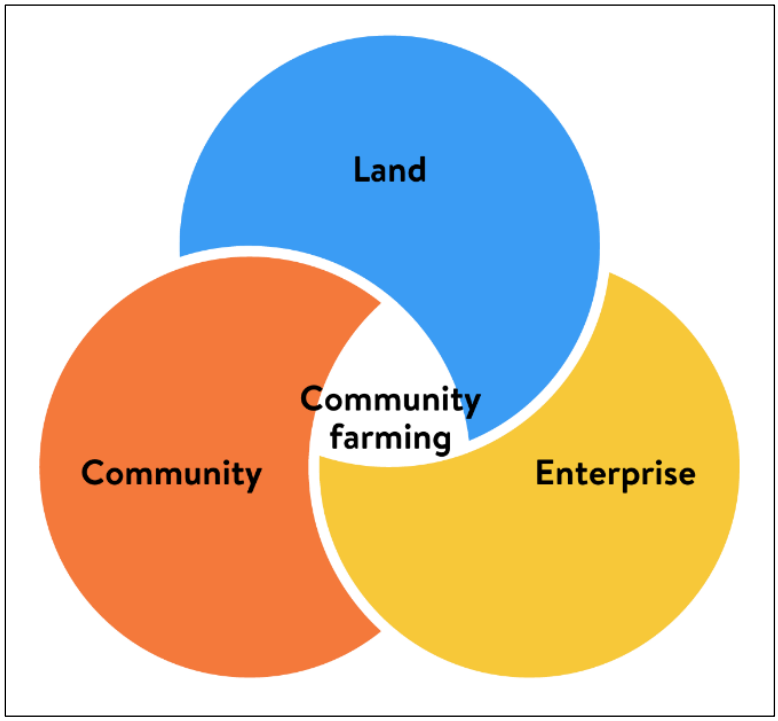
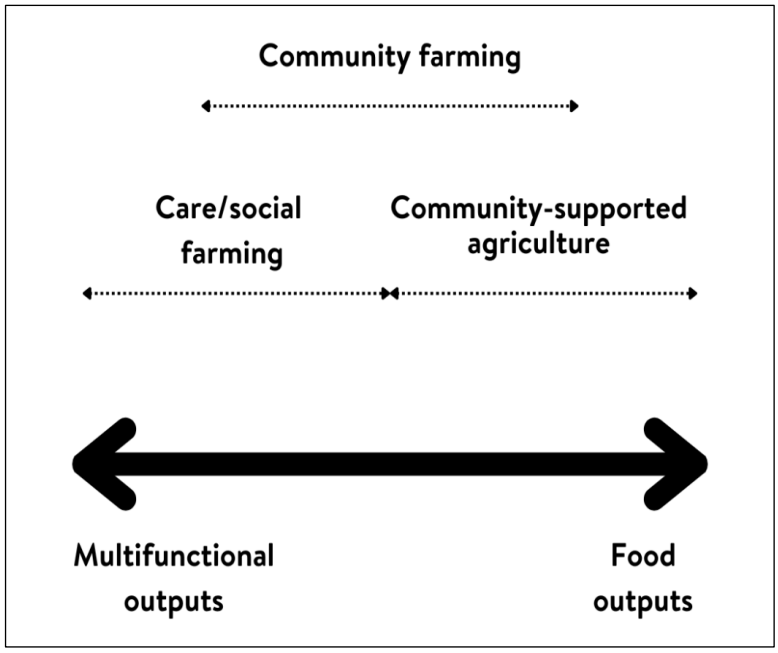


Figure 3. Continuum of Community Farming



It also has parallels with Parsons et al.'s (2010) definition of care farming as "the therapeutic use of farming practices," although only a few of the nine study projects offered formal care farming programs for disadvantaged groups. This study's definitions of community farming and community farm therefore suggest that they may be continuum or umbrella terms, which can incorporate both more multifunctional approaches like care/social farming, and more food production-oriented schemes such as CSA (Figure 3).

Social Return on Investment

Table 2 details the SROI results by metric and category. The SROI analysis demonstrated that for every £1 invested in community farming through the CCF project, £3.52 of value was generated, equating to an SROI ratio of 3.52:1. In comparison to other SROI results, this was lower than for a community food project in England (Courtney, 2014), within the range of values for 20 greenspace projects in Scotland (Greenspace Scotland, 2013), and higher than an urban greenspace project in Italy (Vasiliu et al., 2024).

Overall, the £100,000 CCF investment created £351,630 of project value, including £316,242 of social value, £28,007 of environmental value, and £7,381 of economic value (Figures 4 and 5). The vast majority of the total social value of £316,242 was attributed to the social impact generated by the CCF intervention. This encompassed the positive changes in improved community mental health (£18,160); reduced loneliness (£60,464); use of countryside (£117,852) and urban (£50,184) green spaces; (monetized) volunteering (£22,578); and project co-design with stakeholders (£45,515) (Table 2). It

Table 2. Social Return on Investment Analysis Metrics, Categories and Results

Metric	Subcategory 1	Subcategory 2	Subcategory 3	Achieved	Achieved social (£)	Achieved environmental (£)	Achieved economic (£)	Achieved value (£)
1. Community, charity, and other stakeholders	Community health	Community mental health	Lower impact intervention	15	18,160	0	2,412	20,572
2. Supply chain	SME, start-up, VCSE, and mutuals support (monetized)	Full intervention	N/A	18	247	0	2,822	3,069
3. Community, charity, and other stakeholders	Site visit	Hourly	N/A	30	406	0	0	406
4. Environmental	Biodiversity	N/A	N/A	2	0	27,124	0	27,124
5. Environmental	Material use	Organic	Compost derived from food and garden waste	50	0	883	0	883
6. Community, charity, and other stakeholders	Loneliness	N/A	N/A	18	60,464	0	2,147	62,612
7. Community, charity, and other stakeholders	Community learning interventions (monetized)	Hourly	N/A	50	836	0	0	836
8. Community, charity, and other stakeholders	Green space (monetized)	Use of countryside green space	N/A	7	117,852	0	0	117,852
9. Community, charity, and other stakeholders	Green space (monetized)	Use of urban green space	N/A	2	50,184	0	0	50,184
10. Community, charity, and other stakeholders	Volunteering (nonmonetized)	No. of person-hours spent protecting and improving the environment	N/A	15,000	0	0	0	0
11. Community, charity, and other stakeholders	Volunteering (monetized)	Annually—several times a year	N/A	18	22,578	0	0	22,578
12. Community, charity, and other stakeholders	Co-design/co-creation with stakeholders	N/A	N/A	10	45,515	0	0	45,515

SMEs = small and medium-sized enterprises; VCSEs = voluntary, community, and social enterprise organizations

also captured the benefit of the significant amount of (nonmonetized) volunteering involved: 15,000 hours (Table 2), addressing volunteer hours as an engagement metric. Similarly, the monetized version of volunteering assigns economic value to those hours and other general volunteering, thereby offering different lenses through which to view the impact of volunteerism. The significant percentage of the total social value devoted to social impact underscored the effect the CCF intervention had on individuals and communities involved with the nine community farming projects across NI. It also demonstrates the significant social benefits that accrue from accessing green spaces, a trend noted in the literature on both CSA (Saltmarsh et al., 2011) and care/social farming (Jarábková et al., 2022).

This finding echoes studies in the literature that point to the importance of connection between community farming participants and a specific piece of land or their local environment in general (Hassink et al., 2020; Liu et al., 2017; Ravenscroft et al., 2012; Ravenscroft et al., 2013). It also highlights its potential wellbeing benefits for a wide range of groups (Andreatta, 2006; Parsons et al., 2010; Rossi & Woods, 2021; Sitaker et al., 2021). Furthermore, there is overlap with the development of bonding social capital, where relationships are developed within a community of CSA members, and bridging social capital, where connections develop between members of a community farm and of other communities, as noted in some British CSAs (Furness et al., 2022). However, in our study it was not possible to ascertain the direction of causality, i.e., whether community farming causes or is caused by high levels of social capital. Finally, the significant bias in this study toward social value creation corresponds with the definition's placement of community farming on a civic agriculture continuum that can incorporate both food-focused and more multifunctional community farming approaches.

By contrast, environmental impact accounted for a much smaller portion of the total social value (Figures 4 and 5). Almost all of this value, £27,123, was due to biodiversity gains through the setting aside of land for conservation, while £883 was from on-site compost production (Table 2). The £28,007 assigned to environmental impact there

Figure 4. Social Return on Investment Impact by Category

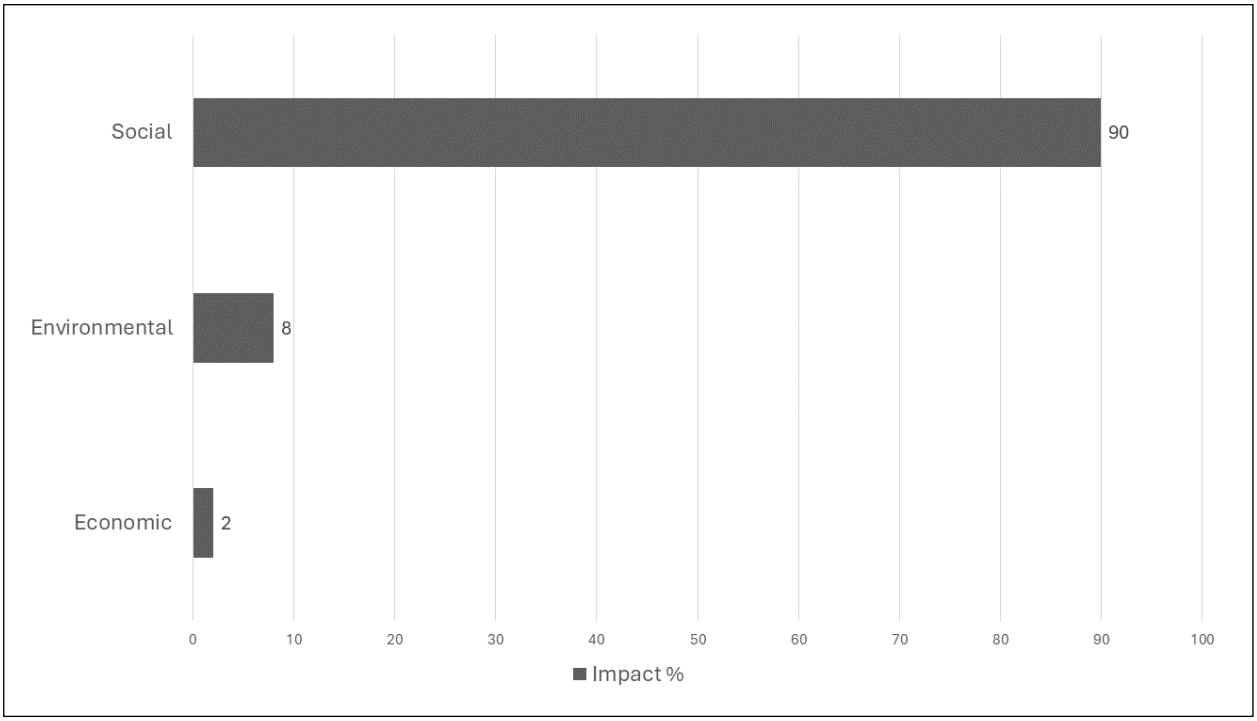
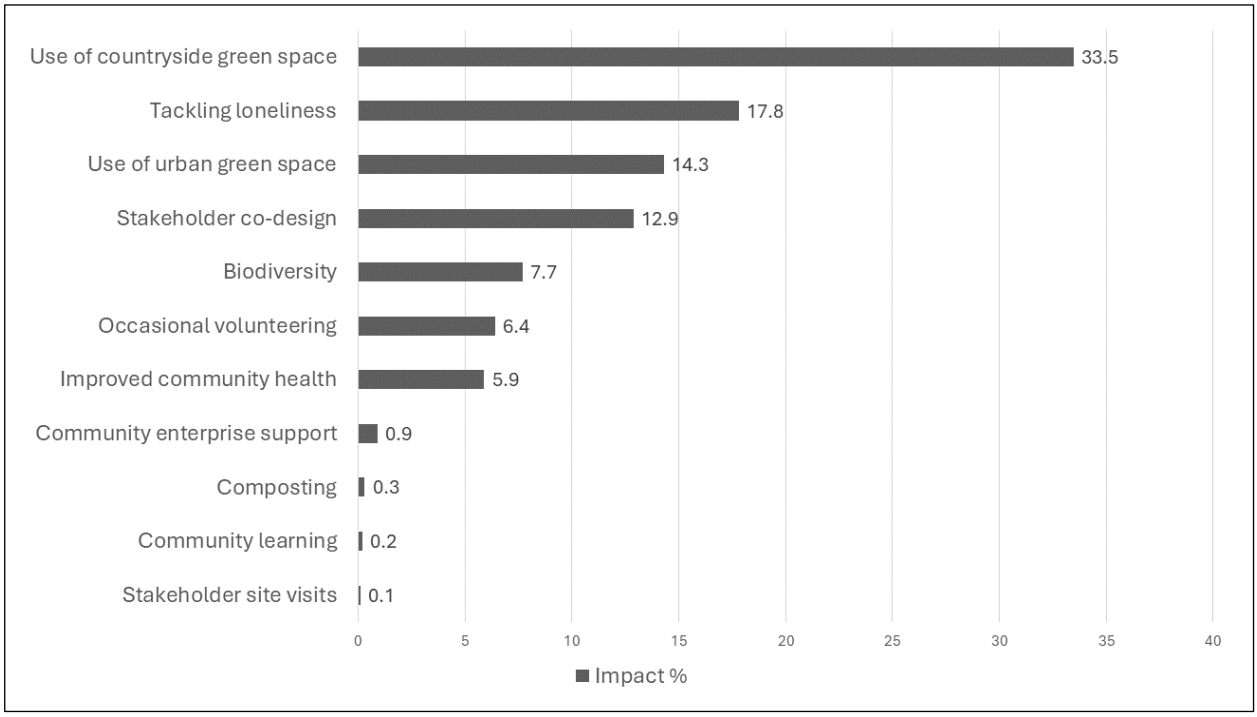


Figure 5. Social Return on Investment Impact by Indicator



fore represents a tangible commitment to ecologically responsible farming, but was lower than expected given the frequency of environmental considerations among the project participants and its equal weighting in the definition. In addition, the setting aside of land for community farming purposes prevented its use for other, more environmentally damaging activity. However, the primary limit on environmental value in this study is likely to be the relatively short-term impact measurement cycle of two years, with environmental benefits in agro-ecosystems typically accruing over longer time periods (Albanito et al., 2022).

Overall, while environmental sustainability can be a key component of community farming (Henderson & Van En, 2007; Saltmarsh et al., 2011; Samoggia et al., 2019), and the environment—or land—was one of the three pillars of this study's definition, this finding is a further indication that what defines community farming most may be its social elements. This study also raises questions about the extent to which community farming can contribute to a more circular and sustainable agri-food system, whether in Northern Ireland (NFFN, 2023) or at the European level (van Zanten et al., 2023), although longer time periods are required to accurately capture the full environmental benefits from the study's nine projects.

The economic impact made up a very small fraction of the total social value of the CCF intervention (Figures 4 and 5). As well as economic contributions toward improved community well-being (£2,412) and decreased loneliness (£2,147), a significant element was the enterprise skills and capacity developed through support delivered to project participants (£2,822) (Table 2). The £7,381 allocated to economic impact emphasizes the initiative's very limited role in bolstering the economic fabric of local communities, although enterprise is one of the three pillars of this study's definition. However, as with the environmental value, economic impact reflects the early developmental stage of many of the projects in the CCF initiative. Typical economic challenges faced by the nine groups included low margins and difficult routes to market, for example. As with other similar incubator or accelerator projects, it can take a considerable amount of time for new enterprises to become established (Smith et al., 2019). Similarly, as White

(2015) has noted for CSAs, many struggle to achieve financial resilience and security.

This relatively low amount of economic value in this sample contrasts with the greater economic impacts of CSA operations in England (Saltmarsh et al., 2011) and Wales (Little & Giles, 2020), and the greater focus on food production in CSA projects generally (CSA UK Network, 2024; Henderson & Van En, 2007). Food production is also an under-researched aspect of care/social farming projects, with limited data available on its economic value in these systems (Jarábková et al., 2022; Nazzaro et al., 2021; Nicolosi et al., 2021; Tulla & Vera, 2019). The limited economic value generated in this study's nine projects over two years may also restrict the attractiveness of community farming as a form of diversification to traditional family-farming businesses, for whom financial and economic considerations are often central (Piccoli et al., 2021; Pole & Gray, 2013; Samoggia et al., 2019).

Conversely, however, community farming may prove more attractive precisely because of its creation of greater social and, to a lesser extent, environmental value to the majority of people who have no experience of the business side of farming. In this cross-section of projects, success did not depend primarily on economic value, despite the enterprising and income-generating activities of all nine CCF groups. This raises a question about the assumption that community farming needs to make a profit in order to carry the social and environmental benefits that it has. Our results suggest that group members may be willing to participate in this activity as long as it has a minimum level of economic sustainability.

However, the overall SROI value from this study, and the environmental and economic impact as well, is likely to be an understatement for two reasons (National Social Value Standard, 2022). First, several outcomes and stakeholders were excluded from the analysis because there were limits to the number of variables that could be considered and certain variables were identified as most suitable by the participating groups. Second, it is likely that financial proxies have underestimated the value of some outcomes, due to the subjective nature of monetization in SROI methodology. For example, not all impacts can be monetized robustly, and the quality of some of the data from some of the participating projects limited the scope of analysis. These factors in the understatement of SROI value due to these methodological reasons are in keeping with the broader critiques and limitations of the SROI methodology (Arvidson, et al., 2013; Corvo et al., 2022; Maldonado & Corbey, 2016; Roy & Teasdale, 2022).

Conclusions

This study's definitions of community farming and community farms illustrate the interconnection of land, community, and enterprise (Figure 2) and of the role of collaboration in utilizing them in tandem. This provides an articulation of the community farming process that has been lacking in previous discussions of the concept (Davenport & Mishtal, 2019; Heise et al., 2017; Liu et al., 2017; Ravenscroft et al., 2013). This definition also suggests that community farming can act as a continuum or umbrella term that incorporates both more multifunctional approaches like care/social farming, and more food production-oriented schemes such as CSA (Figure 3). In fact, as a spectrum of approaches that connect communities with farming and farming with communities, community farming provides a definition and terminology that can capture this breadth of diversity.

However, in this sample of nine early-stage Northern Irish community farming ventures, a considerable majority of the total SROI value was attributed to social value, with limited environmental and economic value. This social value was primarily based on the mental health, volunteering, green space access, and stakeholder co-design aspects of the projects. This affirms the importance of social impact and wellbeing benefits noted in both care/social farming and CSAs (Furness et al., 2022; Haney et al., 2015; Hassink et al., 2020; Jarábková et al., 2022; Rossi & Woods, 2021; Sitaker et al., 2021). Nevertheless, the early-stage nature of many of the projects, and the time-limited impact measurement period, likely affected valuation of the environmental and economic dimensions, as is common in similar incubator-type programs (Smith et al., 2019). Longitudinal assessments of

social, environmental, and economic value would provide a clearer indication of sustained value creation, which could lead to greater understanding of how food production in community farming ventures could contribute to a more community-based circular food system in Northern Ireland (NFFN, 2023) and elsewhere (van Zanten et al., 2023).

Future research could therefore focus on exploring the environmental and economic aspects of community farming in NI and beyond, while the definition could catalyse further debate, research, practice, and advocacy among stakeholders. Additional advocacy work is also required to provide policy support for the development and expansion of community farming in NI, due to its relative sparseness to date (Hanson & Walsh, 2024). The social capital causality—and its direction—remain an open question in this context, despite some work on social capital development in British CSAs (Furness et al., 2022). Applying the work of Mouw (2006) and Chen (2022) to explore social capital in community farming could help to explicate these relationships further.

Nevertheless, despite the caveats discussed above and a definition that incorporates the three pillars of sustainability, the value generated in the two-year period among the nine participating projects was primarily social. In this instance, there may be more "community" than "farming" in community farming. Yet this accumulation of collaborative and innovative social value may still help to accelerate the development of community-based circular food systems in Northern Ireland and beyond.

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Co-designing an impact evaluation tool for food hubs in the UK

SPECIAL ISSUE
Community-Based Circular Food Systems

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Abstract

In the UK, place-based food initiatives, herein "food hubs," offer a range of economic, social, and/or environmental benefits via the programs, activities and support they offer. Examples of food hubs include food banks, food pantries, social supermarkets, community farms and gardens, and community cafes. Identifying, monitoring, and communicating the benefits of and areas of improvement for food hubs are important in enabling these organizations to access funding, scale up and/or out, and support their ambitions to enhance community development and promote community-based circular food systems (C-B CFS). However, due to constraints in time, funding, and resources, evaluation of the work of food hubs across the UK is limited to date and does not capture the multidimensional benefits they provide or

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Declaration of Interest

The authors have no conflicts of interest to declare.

the impacts they have to achieve a C-B CFS. This paper presents the co-production and application of an impact evaluation tool aiming to support food hubs to capture evidence of the benefits they provide, and areas where additional benefits can be achieved across four domains: (a) sustainability and resilience; (b) health and wellbeing; (c) access and demand for healthy, local food; and (d) food security and economy. The tool, available freely online, was implemented at 10 diverse food hubs in Leeds, UK, to capture their activities and impact. Participating food hubs agreed that the tool offers a comprehensive yet practical method of evidencing the impact of their activities. The evidence captured using the tool could strengthen both individual PBFIs and the wider community food sector. By demonstrating their contributions to national and global priorities in health, food security, and sustainability, this evidence supports advocacy for greater policy recognition and funding. After assessing the implementation of the too across multiple PBFIs, we found how structured impact monitoring could enhance operational resilience, inform strategic planning, and reinforce the case for systemic support of C-B CFS.

Keywords
food hubs, food banks, food security, circular economy, community development, sustainability, community-based circular food systems, impact analysis, evaluation

Background and Literature Review

Household food insecurity occurs when a household cannot access or is concerned that they may not be able to access, "an adequate quality or sufficient quantity of food in socially acceptable ways" (Dowler et al., 2001, p. 12). Globally, food insecurity has increased over recent years, with estimates indicating that 1.3 billion people were food insecure in 2022, representing an increase of 10% from 2021 (Zereyesus & Cardell, 2022). The issue of food insecurity is reflected at the national level in the UK, with 18% of households experiencing food insecurity, representing over 9 million adults, in January 2023 (Food Foundation, 2023). These increases in food insecurity are the result of a complex combination of factors, including climate change, war, environmental degradation, pandemics, and inequality (Hadley et al., 2023; Zereyeus et al., 2023). Additionally, the cost-of-living crisis, which refers to the fall in disposable incomes seen since 2021 (Hourston, 2022), has further exacerbated food insecurity. According to the Office for National Statistics (ONS), in May 2023, 95% of adults in the UK reported an increase in their cost of living, with almost all adults (97%) reporting an increase in the cost of their food shopping, and almost half (46%) stating that they had actively reduced their spending on essentials such as food (ONS, 2023). Those that have been most affected by the cost-of-living crisis, and food insecurity, include vulnerable groups such as children, the elderly, those that are ethnically minoritized (Gov.UK, 2024), and people with disabilities (Ahsanuzzaman & Islam, 2020; Ajaero, 2017; Rodriguez-Llanes et al., 2016).

The current food system is not only failing to meet the needs of people, but it is also a significant contributor to climate change (Food and Agriculture Organization of the United Nations [FAO], 2023; Wood et al., 2023). Recent data indicate that the emissions produced by the food system, including how food is grown, sold, transported, and eaten, contributes to over 34% of total greenhouse gas (GHG) emissions annually (Crippa et al., 2021).

In response to increasing levels of food insecurity and the impact of the current food system on climate change, there have been calls for system-wide transformation to achieve a more resilient and sustainable food system. As summarized by Worstell and Green (2017), resilient food systems are connected but with independent entities, locally self-organized, and have robust physical infrastructure. Resilient food systems also exhibit responsive redundancy. This means that functions, roles, or resources within the system can be dynamically allocated or adjusted to changing needs. According to Worstell and Green (2017), resilient food systems also encourage innovation and learning, are ecologically self-regulated by working with nature and embracing changes to enable transformation. Community-based circular food systems (C-B CFS) can help to realize the ambition to achieve more resilient food systems. C-B CFS aim to bring local people together and encourage self-reliance to sup-

port health and resilience outcomes within the community (Worstell, 2020). C-B CFS focus on the whole food system, by working at the local level. They aim to minimize waste from food production and consumption, protect shared natural resources, and seek to promote community health and well-being (Alattar, 2021; Bonilla Cedrez et al., 2023).

Food hubs have surfaced to support households to access adequate food, support health and wellbeing, and promote the transition to more sustainable C-B CFS. Food hubs can be broadly categorized into two approaches: values-based agri-food supply chain management and sustainable food community development (Berti & Mulligan, 2016). The values-based supply chain model, often for-profit, aligns with the U.S. Department of Agriculture's (USDA) definition of a food hub as "a business or organization that actively manages the aggregation, distribution, and marketing of source-identified food products primarily from local and regional producers to strengthen their ability to satisfy wholesale, retail, and institutional demand" (Barham et al., 2012, p. 4). In contrast, the sustainable community development model, typically non-profit, is defined as "networks and intersections of grassroots, community-based organizations that work together to build increasingly socially just, economically robust, and ecologically sound food systems that connect farmers with consumers as directly as possible" (Blay-Palmer et al., 2013, p. 524). Here, we define them as centralized facilities that coordinate the marketing, aggregation, and distribution of locally produced or grown food, typically with an ethical or moral motivation (Bloom & Hinrichs, 2011 ;). Food hubs in the UK are diverse in nature, objectives, populations served, primary motivations, sourcing methods, and distribution approaches (Berti & Mulligan, 2016; Blay-Palmer et al., 2016; Morley et al., 2008). Despite this variation, most prioritize social and ecological goals (Clark et al., 2019) and align with the sustainable community development approach, as defined by Blay-Palmer et al. (2013), forming networks of community-based actors and working together to build C-B CFS that are socially just, economically robust. and ecologically sound, connecting farmers and small producers with consumers as directly as possible. Many food hubs also strive to promote the development or strengthening of local food systems, for example by developing networks or working in partnership with other organizations (Sonnino & Coulson, 2021). Some food hubs provide food free of charge or at a reduced cost to members of the public; examples include food banks, of which there are over 2,500 in the UK (Francis-Devine, 2024). Food banks are typically run by charities and aim to act as a temporary supply of emergency food, while also making the most of food and reducing food waste (Francis-Devine et al., 2023). Other food hubs, such as community cafes and community farms, provide cooked meals or food parcels, offer cooking lessons, financial or social advice, food growing sessions, and or vegetable boxes, all of which help to support their local communities to access the food they need. Food hubs also offer volunteering, employment, and educational opportunities, helping to support community development and resilience (Francis-Devine, 2024).

Thanks to the range of services and programs offered by food hubs, their communities and the broader food system benefit in a range of ways (Papargyropoulou et al., 2024). These benefits include reducing food waste (The Global Food Banking Network, 2020), increasing access to fresh and healthy food (Hume et al., 2022), reducing food insecurity (Walters et al., 2021), promoting ecological and social sustainability (De Boni et al., 2022), and supporting local economies (Bonfert., 2022). By sourcing and distributing food regionally and redistributing food surplus, food hubs can also promote C-B CFS and reduce the carbon footprint and transportation costs associated with conventional food supply chains. By providing educational opportunities for communities and consumers to learn about food production and health, as well as offering food growing sessions, food hubs can help community members to gain greater autonomy over their food choices and have better access to culturally acceptable foods (Diekmann et al., 2020).

Considering this range of activities and benefits and using the eight qualities of resilient food systems as outlined by Worstell and Green (2017), it is possible to see how food hubs in the UK can support the transition to C-B CFS. Food hubs promote connectivity in a variety of ways, for example,

by offering community meals and group activities. Most food hubs are also locally self-organized—being run by local people with a focus on supporting local communities. Food hubs can also support local economies by building local capital, for example by employing community members or providing volunteering opportunities (Merritt et al., 2024). Food hubs are diverse in their offer and perspectives. For example, some develop local infrastructure such as community farms or community spaces. Food hubs are also open to change and adapt when needed, and are even open to periodic transformation, whereby they try offering new activities or developing new programs.

However, while food hubs offer a range of benefits and may support C-B CFS ambitions, many food hubs in the UK, operating according to the community development approach, struggle with financial sustainability and operational efficiency (Neumann & Sharpe, 2023). Such challenges relate to most food hubs being charitable entities that rely on grant funding and/or donations (Goodwin, 2023). Many also rely on volunteer workforces. The reliance on volunteers impacts food hub sustainability because volunteers have varying levels of commitment and availability and can have high turnover rates, which are costly in terms of training and recruitment, and the continuity of programs (Handy & Mook, 2011).

Capturing evidence of the range of benefits that food hubs offer is important, as this evidence can help these organizations share ideas and learnings with other food hubs, as well as demonstrate their value to funders, policymakers, and other stakeholders (Nelson & Landman, 2020). In turn, this evidence could help food hubs to win funding and support, which is currently an ongoing challenge for food hubs of all sizes (Neumann & Sharpe, 2023; Rysin & Dunning, 2016;). Moreover, the evidence captured could support food hubs to identify areas of weakness or opportunities for improvement. For example, the identification of more sustainable funding opportunities such as income generation via selling produce, or developing membership based social supermarkets, could help them to become more financially sustainable, and in turn continue supporting their communities and the wider food system.

However, for the evidence to be useful, it is important that food hubs capture a range of information thoroughly and regularly, considering both their strengths and weaknesses. This process should start before a program or service is offered by a food hub through the development and setting of clear objectives, outcomes, and goals, which can then be assessed, explored and captured. Then, as the food hub offers their services or programs, it is important to capture data so that objectives and goals can be monitored and assessed. Methods to capture data can include, but are not limited to, photos of the services offered, or the outputs produced, quantitative data about food parcels provided or amount of food waste saved, as well as interviews or quotes from service users or employees. It is important to include service users including young people, volunteers, and employees when collecting data, as they can provide information to determine how the activities delivered are experienced by those running the hub and by those receiving or attending the hub. The data can be captured during the program or service. This form of data collection is referred to as a "process evaluation" and can help to provide in-depth insights into mechanisms of action, contextual influences, and how the hub works in practice. Finally, additional data collection for the evaluation can be carried out at the end of the program or service, or after a predecided period, to consider the impact of the program or service. This evaluation process can help to determine whether the program has achieved its intended goals, the extent of the impact, and the overall effectiveness of the hub. By conducting these evaluations, food hubs can continuously improve and ensure that they are achieving their desired impact.

Food hubs are resource- and time-poor, which can limit their ability to collect evidence of their benefits regularly and thoroughly. This hampers their ability to capture the complex, multidimensional, context-specific benefits that many of these organizations strive to achieve so that they can meet current and future food and community development needs (Rysin & Dunning, 2016). To monitor and evaluate food hub activities in Ontario, Canada, , Nelson and Landman (2020) conducted a participatory research project to

develop an evaluation resource. The authors worked with a range of food hubs focused on improving the locality of food, sustainable agriculture, achieving profit, and promoting social justice and community and civic engagement, to develop the tool that they wanted to help evaluate social and/or ecological impacts of the hubs. While this tool is useful, following conversations with UK-based food hubs, it was highlighted that they found it important to develop a tool that considered the specific needs and challenges of UK-based food hubs. They offered ideas for metrics to use to monitor impact, and highlighted that they needed a tool that they could use "in the field." To develop a useful tool for UK-based food hubs, we conducted a collaborative project working with 30 food hubs across the city of Leeds, UK, who all contributed to the co-development, validation, and application of the tool. (See full details of participating food hubs in Appendix B.)

Materials and Methods

The aim of this study was to co-develop a tool that community development and sustainability-focused food hubs could use to capture, monitor, and communicate evidence of the range of benefits that they provide to the communities they serve and the broader food system, as well as identify areas of weakness in their work. The study focused on the city of Leeds, UK, as an example of a complex, socio-economically and culturally diverse urban food system of under one million population in the global north (Jensen & Orfila, 2021), with a diverse food hubs network (Food Aid Network [FAN], n.d.). These conditions allowed for access to potential participants, resources, and insights relevant across the UK, as well as enabled us to include food hubs providing a range of activities such as food growing, food redistribution, and financial support (see Appendix B, Table B1). This study was part of a larger research project, presented in detail in Papargyropoulou et al., (2024).

In the following sections we present the approach employed and the steps and methods involved in the development and application of the Food Hubs Impact Evaluation Tool. These include a literature review, a mapping exercise, a survey, 11 semi-structured interviews, four focus groups with 8 food hubs, and the application of the impact evaluation tool with 10 food hubs. Data was collected in five stages between February 2022 and June 2023.

The first stage involved a literature review to explore the range of benefits that food hubs provide to communities and wider food systems and how these benefits are currently monitored and/or evaluated. The next step was a mapping exercise to identify the range and number of food hubs present in Leeds. This was achieved by sourcing and collating information on food hubs listed in locally available records, such as on the Leeds Food Aid Network website (FAN, n.d.) and in the Leeds City council membership lists, and cross-checking with experts working in the food hub space in the city. In total, 58 food hubs were identified at the time of the study across the city of Leeds.

All food hubs in Leeds that were listed on the Food Aid Network and known to Leeds City Council were invited to take part in an online survey that was conducted in February and March 2022. The survey, which was shared via Twitter and email networks, sought to capture evidence of the services, motivations, impact, and aspirations for the future and support needed by the food hubs. (A survey template is provided in Appendix A.) In total, 37 participants started the survey, representing a mix of 27 food hubs across the city, offering a diverse array of services and support (Appendix B, Table B1).

Following the survey, food hubs that had given us permission to contact them for future involvement in the research were invited to take part in semi-structured interviews. The aim of these interviews was to co-develop a tool to evaluate the range of impacts of food hubs. Eleven interviews were conducted online via Microsoft Teams or Zoom platforms or face-to-face between March and April 2022 to gain more depth and context on the impact food hubs have on food security, sustainability, resilience, food justice, and healthy diets, and how this impact can be evaluated. (The semi-structured interviews template is provided in Appendix C.) The interviews lasted between 30 and 45 minutes and were audio recorded, transcribed, and thematically analyzed. The findings from the survey and the semi-structured interviews

were used to develop a draft impact evaluation tool that was suitable for food hubs in the UK context.

Four online focus groups were then conducted in May to June 2022 with food hub representatives. The aim of these focus groups was to test, validate, and refine the draft impact evaluation tool. Each focus group was 30 to 60 minutes long and comprised three to six participants and a facilitator. The focus groups involved first building a shared understanding of the challenge of conducting an evaluation with the food hubs. The participants were given prior access to the draft impact evaluation tool. During the focus groups, they provided feedback on the content, format, and user-friendliness, and made suggestions for improvement. The focus groups were audio recorded and transcribed to enable themes to be captured.

In the final phase of the project, the tool was put into practice in 10 diverse food hubs across Leeds (see Appendix B, Table B1). The aim of this phase of the work was to help the food hubs to identify the range of benefits that they provide and any areas of weakness or opportunities for change, and to explore the usefulness of the tool in practice and further refine it. First, we visited each of the food hubs, observed their work, and took notes about their services; the number of volunteers, staff, and members; food provision; and other services available. We used these data to support food hubs to complete the impact evaluation tool. To add to the tool, we conducted semi-structured interviews with a representative of the food hub. During these interviews, which were conducted online or in person, we captured any further insights about the impact of the food hub across the four categories and indicators identified in the tool, finalized the completion of the tool, and shared it with the food hubs for their records and to build on in the future.

The interactions and engagements throughout the implementation process enabled us to assess the feasibility of using the tool in a real-world setting. By co-developing the tool with food hubs, and involving food hubs directly in applying the tool, we were able to capture valuable insights into its strengths and areas for refinement. The collaborative nature of the process also ensured that challenges encountered during implementation were addressed promptly, enhancing the tool's adaptability. The final impact evaluation tool was made available as an accessible and interactive online resource in two formats: an editable Excel spreadsheet and an editable PDF document.[1]

Ethical Considerations and Co-development in the Methodological Approach

The study was conducted in accordance with the University of Leeds Research Ethics and Integrity Framework. In line with this framework, the identity of the research participants was kept anonymous and participant consent protocols were followed. All participants were given a project information sheet describing the project, explaining how data will be anonymized, stored, analyzed, and used, and asking them to provide consent before taking part in the survey, focus groups, and/or interviews. Participants were reminded that they were free to withdraw at any time during the study, up to the point of data analysis, and were free to ask any questions about the research.

The impact evaluation tool was co-produced with participating food hubs and in collaboration with FoodWise[2] and Leeds City Council's Public Health, Sustainability, and Financial Inclusion teams. FoodWise formed in 2017 as the city's food partnership to create a healthy, sustainable, and fair food system for everyone in Leeds. FoodWise consists of representatives from the third sector, academia, business, and the council. FoodWise and Leeds City Council co-developed the Leeds Food Strategy and will oversee its delivery.

Our approach to co-production of research was reflected in our commitment to diverse knowledge forms. We valued and incorporated the views of those who will use the tool and those who will be affected by it. We co-produced the impact evaluation tool with people working in and utilizing food hubs through engagement and participatory

[1] https://environment.leeds.ac.uk/see-research-innovation/dir-record/research-projects/1854/food-hubs-for-food-security-health-inclusive-growth-and-sustainability
[2] https://foodwiseleeds.org/

research. We were guided by the principles of the University of Leeds (UoL) Co-Production Network's Research Co-production Tool (Leeds Social Sciences Institute, 2022), and as such, considered the principles of equitability, inclusivity, mutual benefit, co-production, and a foundation of trust throughout the research. To align the research with the UoL Co-production Tool, we established equal partnerships, acknowledging shared values and actively addressed power imbalances, engaging stakeholders not merely as "participants" but as integral "collaborators" (i.e., equitability). From the project's inception, we collectively shaped the research agenda (i.e., co-production). We were inclusive in our approach throughout our process, whereby all stakeholders involved in the food hub, spanning third-sector, community development organizations, policymakers, and individuals with Lived Experience (LEX) (i.e., those with first-hand experience in living with or being affected by food insecurity, and using the services provided by food hubs) (O'Leary & Tsui, 2022), contributed their unique perspectives to the development of the tool and its application (i.e., inclusivity). The research process and outputs were mutually beneficial by ensuring that each stakeholder derived value, tailored to their needs and values, surpassing traditional research outputs (i.e., mutual benefit). Finally, all our interactions were underpinned by transparency, open-mindedness about roles and expectations, and trust through continuous dialogue (i.e., foundations of trust).

Results

The tool was co-developed with food hubs and other relevant food actors through an iterative process, as described in the methods section above. This results section presents the tool and key insights from the development and application process. The full tool is included in Appendix D.

The Food Hubs Impact Evaluation Tool

The impact evaluation tool begins with background information about its purpose and provides step-by-step instructions on how it can be used. It lists several possible activities food hubs can be involved in, such as supplying emergency food parcels, providing cooked meals, operating a food pantry or social supermarket, growing food, and offering community group activities such as gardening or exercise classes. The tool asks food hubs to evaluate the impact of these activities, while considering that activities can contribute to multiple impacts and can therefore be mentioned several times. For example, providing cooking classes could improve the health *and* food security of community members.

The tool is then organized into four sections, grouping the impacts food hubs have in terms of (a) sustainability and resilience; (b) health and well-being; (c) access and demand for healthy, local food; and (d) food security and economy. Each section is presented as a table comprising five columns (Figure 1). The first column lists possible "impacts," which refer to the outcomes that the food hub aims to achieve. The second column asks food hubs to record the "frequency," which relates to how regularly the impact is expected. The third column, "indicators," refers to the metrics used to measure the effect of the outcome, such as volume or number of people. The fourth column asks food hubs to provide "evidence," that is, the information collected to demonstrate the effect of the outcome. Finally, the "comments" column provides space for food hubs to reflect on and note suggestions on how they could progress their work or increase the impact they are achieving. An example is provided to show how the tool can be filled in, and prompts are provided throughout the tool guiding the food hubs through the evaluation process. The tool provides additional rows so that food hubs can add additional impacts and indicators that are relevant to their setting.

Next, we describe each section of the tool and present examples of the activities, and impacts of these activities, from the food hubs involved in developing and implementing the tool.

Sustainability and resilience

This section of the tool aims to capture the impact food hubs have in terms of sustainability and resilience (Figure 1). Relevant impacts include supporting local or national sustainability, resilience, and C-B CFS ambitions through repurposing surplus food and reducing GHG emissions while also promoting access to affordable food (The Global

Figure 1. The Sustainability and Resilience Section of the Impact Evaluation Tool

Sustainability and resilience

Impacts What outcomes do your activities/programmes achieve? Examples provided.	Frequency How often do you do this? E.g. never, sometimes, always, everyday, once a month	Indicators What metrics do you use/would like use, to measure the effect of your outcomes? Examples provided.	Evidence What information do you have to support the effect of your impact?	Comments What could you do to increase the impact of your food hub, or how to capture the effect of the impacts?
***Example**: Utilising food surplus to make meals (Activity) has the positive environmental impact of reducing food waste (Impact)*	*Everyday*	*Number of meals provided*	*We record how many meals we serve every day: on average 50 meals/day*	*We will capture information about the amount of surplus food we are using.*
Reduce food waste		Volume of surplus food used (kg); Number of food parcels given; Number of meals provided		
Reduce Greenhouse Gases (GHG) by using locally grown food		Percentage of locally sourced food, 'food miles' travelled (miles/km)		
Reduce Greenhouse Gases (GHG) by using seasonal produce		Percentage of fresh produce used that is 'in season' compared to that which is not		
Support biodiversity by growing fruit and vegetables		Volume of fruit and vegetables grown (% of produce grown in house versus purchased/kg of produce grown)		
Support biodiversity by planting trees and plants		Number of trees, plants planted		
Improve soil quality by composting/using compost		Volume of compost produced/used (kg)		

Food Banking Network, 2020), through growing or purchasing locally grown and seasonal produce to reduce distance food travels, and by supporting biodiversity and improving soil quality through compositing or regenerative farming. Food hubs can support local C-B CFS ambitions by carrying out such activities. For example, Neruka's Soul Food Kitchen, a small community organization that aims to attend to the needs of people struggling in many areas of their lives, utilizes food surplus from local supermarkets to produce meals for people affected by food insecurity. In doing so, Neruka's can help to prevent food waste, promoting circular economy principles, while also helping local people to access affordable food. The impact of utilizing surplus food can be monitored and evaluated by measuring the volume of surplus food saved, the number of food parcels donated, or meals served, and by capturing quotes and/or stories from people receiving food parcels or meals produced from surplus food.

Another way in which food hubs can promote sustainability is by sourcing food grown and/or produced locally. In doing so, they can reduce food miles and GHG emissions and keep profits locally, promoting a circular economy. This can be evaluated by assessing the percentage of products purchased and/or grown locally and by calculating the number of food miles travelled.

Food hubs that grow food, such as Kirkstall Valley Farm, a community supported agriculture (CSA) scheme in Leeds, can further promote circular economy ambitions. For example, Kirkstall Valley Farm uses regenerative farming techniques to

increase biodiversity in their local area, by planting trees in nongrowing areas and growing seasonal fruit and vegetables. Kirkstall Valley Farm also improves soil quality by using rotational crops and nondig methods, and by using compost. What is more, Kirkstall Valley Farm also offers volunteering opportunities that can promote skill development, enhance employment opportunities, and improve community development. Monitoring and evaluating the impact of food growing hubs could be done in several ways, for example by assessing soil health, capturing and recording evidence of foods grown, and capturing and sharing stories of volunteers and staff working on the farms.

Health and wellbeing

The health and wellbeing section of the tool aims to capture the range of impacts that food hubs have on health and wellbeing, as well as identify areas for further health and wellbeing benefits (Figure 2). Through the activities and support that they offer, which range from cooking classes to community cafes, community meals, and physical activity classes, food hubs can improve the physical health of community members. For example, Hamara Healthy Living Centre in Leeds offers a Revive Body and Mind Group for women, providing access to a gym to promote physical activity, alongside nutrition and wellbeing advice

Figure 2. Health and Wellbeing Section of the Impact Evaluation Tool

Health and wellbeing

Impacts What outcomes do your activities/programmes achieve? Examples provided.	**Frequency** How often do you do this? E.g. never, sometimes, always, everyday, once a month	**Indicators** What metrics do you use/would like use, to measure the effect of your outcomes? Examples provided.	**Evidence** What information do you have to support the effect of your impact?	**Comments** What could you do to increase the impact of your food hub, or how to capture the effect of the impacts?
Improve health e.g. physical activity or healthy eating support		Quotes/images to describe or evidence the impact of the food hub on health		
Improve emotional wellbeing e.g. mental health support		Quotes/images to describe or evidence the impact of the food hub on emotional wellbeing		
Improve quality of life e.g. volunteering opportunities		Quotes/images to describe or evidence the impact of the food hub on improving quality of life		
Improved educational/work attainment due to improved access to healthy food		Improved grades in school; Improved job opportunities; Quotes about concentration		
Promote opportunities to develop social connections and relationships e.g. lunch clubs		Examples/descriptions of programmes that promote social connections and relationships; Quotes/images to describe or evidence the impact of the food hub on providing opportunities to develop social connections, sense of belonging		
Provide opportunities to engage in community activities e.g. gardening groups		Examples/descriptions of programmes that provide opportunities to engage in community activities; Quotes/images to describe or evidence how the food hub engages in community activities		

to improve knowledge on nutrition.

Food hubs can also have a positive impact on the mental and emotional health of their communities, promoting resilience and community development. For example, New Wortley Community Centre in Leeds provides opportunities for members of the community to eat together at a community cafe, and also offers volunteering opportunities to improve self-esteem, offer mental health advice, and signposting.

Food hubs, such as Leeds North and West Foodbank, can also support community wellbeing by offering emergency food parcels, reducing the uncertainty of where the next meal will come from, and in turn helping to address one source of anxiety and psychological distress in food-insecure individuals (Myers, 2020). As well as monitoring community health in the long term in collaboration with local health-service providers, the range of health and wellbeing impacts offered by food hubs could be assessed by carrying out evaluations with those attending activities. To promote engagement, such evaluations could utilize novel methodologies such as photovoice (Wang & Burris, 1997), whereby attendees are asked to share images and photos of the creative sessions and then discuss the aspects of the session they enjoyed and areas that could be improved.

Access and demand for healthy, local food

Food hubs can empower and enable local people to access healthy, local food and contribute to increasing the demand for such produce (Figure 3). However, these efforts often require collaboration with other organizations and stakeholders to address challenges and ensure sustainable impact. The activities that food hubs can do to achieve these impacts include developing or strengthening rural-urban linkages for example by developing relationships with local farmers and by sourcing food items from local growers and grocers for community cafes, food pantries, food parcels and cooked meals, by providing or supporting local people or groups to access land or facilities to grow food (e.g., in CSA or allotments) and supporting the purchase of locally produced healthy food through subsidized food or home delivered fruit and vegetable boxes.

Some food hubs work hard to offer a diversity of culturally appropriate options. For example, Hamara Healthy Living Centre offers food parcels that cater to diverse dietary preferences such as Halal, vegetarian, African, Caribbean, Eastern European, and Asian which ensures that a diversity of people within their community can access culturally appropriate food.

Food hubs also work to empower their communities to access healthier and more locally produced food. For example, Meanwood Valley Urban Farm in Leeds offers educational opportunities for community groups and schools to highlight the benefits of local and seasonal food choices, they also sell affordable vegetable boxes for local people.

Finally, some food hubs aim to enable their members to cook and use fresh, local produce. For example, Health for All in Leeds achieves this by offering cooking classes, and sharing seasonal, healthy and culturally appropriate recipes.

To evaluate these activities, and evidence their impacts on local food systems and circular economy ambitions, highlight areas where further impacts can be made, food hubs can monitor the development of relationships and supply chains with local farmers and grocers, by measuring the space available for food growing, by calculating the number of vegetable boxes purchased, and by capturing feedback and stories from people that have attended workshops and programmes.

Food security and economy

The final section in the food hub evaluation tool aims to capture and evidence the food hubs' work in supporting people to access food and promote local economies and support them to identify where additional impacts can be achieved, or where changes need to be made to prevent negative impacts of their work (Figure 4). Supporting people affected by food insecurity was the primary motivation for most food hubs in the UK to launch. They aim to reduce food insecurity by providing emergency food provision, for example by offering food parcels through food banks, but also by supporting communities to access affordable healthy food through food pantry, social supermarket, and food growing models. Rainbow Junk-

tion in Leeds offers pay as you feel meals for local people to support access to affordable food, but also to reduce isolation and loneliness.

Some food hubs do additional impactful policy work via advocacy and campaigning. For example, Hamara Healthy Living Centre advocates to reduce health inequalities and poverty in Beeston and Holbeck, particularly among people from minoritised ethnic backgrounds.

Food hubs support individuals to improve their financial situation by providing advice to access financial support or assistance and by signposting to other relevant services dealing with wider social-economic aspects. Food hubs also help local communities to become stronger economically by operating social enterprise models that reinvest revenue into the local community, promoting circular economy principles, and by offering employment, training, and volunteering opportunities to community members. Their localized focus ensures that income generating activities benefit the local economy for example by sourcing food from local greengrocers, facilitating connections between local organisations such as farms and shops, providing market access to small scale farmers. To evaluate this range of impacts, food hubs

Figure 3. Access to, and Demand for, Healthy and Local Food Section of the Impact Evaluation Tool

Access and demand for healthy, local food

Impacts What outcomes do your activities/programmes achieve? Examples provided.	Frequency How often do you do this? E.g. never, sometimes, always, everyday, once a month	Indicators What metrics do you use/would like use, to measure the effect of your outcomes? Examples provided.	Evidence What information do you have to support the effect of your impact?	Comments What could you do to increase the impact of your food hub, or how to capture the effect of the impacts?
Provide access to land, facilities and infrastructure for food growing (e.g. allotments)		Area of land for growing food (ha/acres)		
Support the purchase of healthy food		Number of people who access food that contain fresh/healthy produce		
Offer a diverse range of healthy, local, culturally appropriate foods		Types of dietary & cultural preferences considered (e.g. halal, vegetarian, African, Afro Caribbean, Eastern European, Asian); Types of food offered (e.g. tinned meat, fresh fruit)		
Raise awareness for benefits of healthy local food		Number of people attending food programmes; Reach of healthy eating campaigns (e.g. social media metrics)		
Develop food skills and food literacy		Number of cooking/food growing classes and number of people attending		
Enable individuals/families to use food provided		Number of cooking utensils/appliances given; Number of recipes donated		
Provide space to store food safely		Space available to store food (meters squared) or number of fridges of x volume		

could measure the number of parcels provided or members of a food pantry or cafe. They can also capture stories from those volunteering at the hub, calculate the number of people employed at the food hub or supported to find work through programs offered by the hub, and could calculate the revenue generated by the hub, through programs such as community cafes or art exhibitions, and that which was reinvested in food hub programs or the local community.

Reflections on Using the Tool

After developing the tool, we conducted further research to assess the practicality of using the tool.

Figure 4. Food Security and Economy Section of the Impact Evaluation Tool

Food security and economy

Impacts What outcomes do your activities/programmes achieve? Examples provided.	Frequency How often do you do this? E.g. never, sometimes, always, everyday, once a month	Indicators What metrics do you use/would like use, to measure the effect of your outcomes? Examples provided.	Evidence What information do you have to support the effect of your impact?	Comments What could you do to increase the impact of your food hub, or how to capture the effect of the impacts?
Contribute to food security e.g. physical and economic access to sufficient, safe and nutritious food that meets dietary needs and food preferences for an active and healthy life		Number of food parcels provided per week; Number of members of a community food pantry/café or similar; Quotes from members about how the food hub helps them to access food		
Advocate for policies/programmes supportive of sustainable local foods		Examples of advocacy programes/campaigns to promote sustainable local food		
Facilitate connections between other businesses/ organisations		Description of/number of connections between organisations or businesses		
Provide market access to small/medium scale farmers/food businesses		Examples of partnerships with local businesses; Quotes or other evidence from local farmers/food businesses/food producers/ greengrocers about their improved access to market		
Assist with access to financial or other support for community members		Description of financial or other support available (e.g. advice or signposting about benefits, debt, housing, education, abuse, immigration etc); Quotes from members who accessed support		
Support community economic development		Number of volunteers/work experience associates; Hours of volunteering/work experience offered; Quotes from volunteers/work experience associates about the impact of the opportunity on their life		
Employ staff		Number of employed staff		
Generate revenue		Sum of revenue generated per year (£)		

To do this, we worked with a sample of ten diverse food hubs across Leeds, UK to put the tool into practice. By working through the tool, reflecting on the range of impacts that the food hubs activities have, areas where further impacts can be achieved, and how evidence for these impacts can be captured, participating food hubs reported that they gained a better understanding of the significance of systematic evidence capture and documentation. The process elucidated the importance of integrating both qualitative and quantitative data, underscoring the nuanced and multidimensional nature of their impacts.

Furthermore, the food hubs mentioned how working through the tool facilitated a heightened awareness of their contributions to key societal agendas and priorities such as health and well-being, and sustainability, both locally and nationally. By capturing information and evidence, the food hubs reflected on how they would feel better prepared to write funding bids and/or share evidence of impact with funders or local authorities. Through the evaluation process, food hubs gained clarity on the depth and breadth of their influence, contributing to a growing body of evidence that substantiates their role in advancing overarching societal goals. When this evidence is combined from multiple food hubs, this can become substantial and could support efforts to advocate for change at the community level. In essence, the tool implementation served as a learning experience for food hubs, fostering a more in-depth approach to impact assessment and a nuanced comprehension of their multifaceted contributions. The outcomes underscore the intrinsic value of integrating systematic evaluation tools within the operational framework of food hubs, enhancing their capacity to articulate and substantiate their role in addressing critical societal imperatives.

The participatory approach adopted in the development and subsequent implementation of the tool not only enhanced the tool's relevance but also strengthened the relationship between researchers and local actors, fostering a more holistic understanding of the food hub landscape. This phase of implementation lays the foundation for further refinement and wider adoption of the tool to support sustainable food systems and community health initiatives.

Limitations and Challenges

Despite the range of positive benefits that the tool could offer, implementing it in practice could be difficult for some food hubs for example due to time and resource constraints. However, when working with food hubs during the development of the tool, it was highlighted that the time needed for this could be reduced by capturing and recording data throughout the week, or over the course of a project, rather than taking notes and adding them to the tool at the end of the project. While the tool is designed to accommodate various levels of data availability, a lack of comprehensive data might hinder the accuracy and comprehensiveness of the assessment of food hub benefits, in turn limiting their ability to provide evidence for funding or policy support. To support food hubs in capturing data, food hubs can use a range of methods that can be integrated into existing programs, such as using photovoice methodologies in collaboration with attendees, capturing, and sharing stories from people using the hubs services, counting the number of food parcels donated, and weighing the volume of food waste composted.

Conclusion

By using a co-development approach, we developed an evaluation tool for food hubs, such as food banks, social supermarkets, and community farms, in the UK to use to capture the range of benefits that they provide in their communities and across the wider food system, as well as to identify areas of weakness or opportunity for further benefit, with a focus on achieving C-B CFS and community development. Through a collaborative and participatory approach, we developed a tool that addresses need for UK food hubs to regularly capture data and evidence to support their ongoing work, and to shift from emergency models to those that are more sustainable. The mixed methods approach employed to develop the tool, and that is suggested by the tool, can help food hubs to collect evidence across a range of key indicators, relevant to funding calls and policy. The tool provides a standardized framework and acts as a prompt for

food hubs to identify and gather information about key aspects of their work. The findings of the project demonstrate the tool's practical utility and effectiveness in capturing the multifaceted benefits of food hubs, including economic, social, and environmental dimensions. The work conducted to develop the tool, as well as the insights captured during the implementation of the tool, highlights that food hubs are playing an important role in creating more circular food systems, and in strengthening community cohesion and development.

By offering a holistic and evidence-based approach, the tool empowers food hub operators, policymakers, and other stakeholders to make informed decisions, strengthen operations, and drive positive changes across the food system, with a focus on developing community-based circular food systems. This project's significance lies in its contributions to food hubs as well as to the wider food system, as the tool helps food hubs to highlight their role in promoting circular economies, supporting sustainability ambitions, fostering local economies, supporting small-scale producers, and enhancing community health and engagement.

Despite the challenges and limitations faced during the co-design process, largely in relation to the limited time and resources that food hubs have, this project underscores the importance of continued collaboration and ongoing improvement to enhance the tool's effectiveness, and to capture evidence of the ways in which food hubs are supporting circular economy principles and promoting regional sustainability. We recommend that further research is conducted to explore the application of the tool to a broader range of food hubs to promote sustainable practices on a larger scale. By promoting a comprehensive and inclusive approach the identification of a range of benefits and supporting food hubs to identify areas of weakness and opportunities for change for further benefit, this research contributes to the creation of resilient and sustainable food systems that benefit communities, producers, and the environment alike. As food hubs play an increasingly critical role in shaping our food landscape and promoting circular economies, our tool offers a practical and impactful means to grow their positive impact and support them in their community development and advocacy efforts.

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Appendix A. Food Hubs Survey

Information and Informed Consent

Welcome to the Leeds Food Hub survey! In partnership, the University of Leeds, Leeds City Council and FoodWise Leeds are running a project to identify and evaluate the benefits that food hubs (including food banks, food pantries, food clubs and community kitchens) across the city offer. The outputs of the project will be available to food hubs to support future strategy and funding bids and to enable an assessment and monitoring of their benefits in the community. The work will also feed into the development of the Leeds Food Strategy (due Autumn 2022). You are invited to take part in the survey because you work, volunteer at, or manage a food hub in Leeds. If you choose to take part in the survey, you will be asked to answer some questions about your food hub. Your responses will be kept confidential. The survey should take you around 10 minutes to complete. Your participation in this project is voluntary. You have the right to withdraw at any point during the survey. If you have any questions about the project, please contact XXXX: XXXXX. By clicking the button below, you acknowledge: Your participation in the study is voluntary. You are aware that you may choose to withdraw at any time for any reason.

- ○ I consent, begin the study
- ○ I do not consent, I do not wish to participate

About your food hub

Q2 The following section asks you questions about the food hub that you work, manage or volunteer at.

Q3 What is the postcode of the food hub?

- Please type the full postcode of the food hub e.g., LS16 5LL

Q4 What is the name of the food hub?

Q5 What population does the food hub serve? Please select all that apply.

- Anyone
- People living in a specific ward/ area.
- Children and/or schools
- Refugees/ migrants
- Older people
- Referral only
- People experiencing homelessness.
- Other, please state.

Q6 Where do you source your food from? Please select all that apply.

- Fareshare/ Too Good to Go/ Rethink Food or similar
- Donations from retail/ supermarkets
- Donations from the community
- Direct from farm(s)
- Retail - purchased at a discount price
- Retail - purchased at normal retail price
- Other, please state

Focus of work

Display Question 7 This section asks about the focus of the food hub and if/how COVID-19 altered that focus.

Q8 What is the main focus of work for your food hub currently?

- Foodbank
- Food pantry
- Social supermarket
- Community cafe
- Community centre
- Community care hub
- Support/ advice
- Farm or food growing
- Fruit and/or vegetable boxes
- Food processing
- Other

Q9 Beyond the main focus of work, what other services does the food hub provide? Please select all that apply.

- Foodbank
- Food pantry
- Social supermarket/ cooperative
- Community cafe
- Community centre
- Community care hub
- Support/ advice
- Farm or food growing
- Fruit and/or vegetable boxes
- Food processing
- Other

Q10 Did the provision of the food hub change as a result of COVID-19?

- Yes
- No

Display Question 11 if Did the provision of the food hub change as a result of COVID-19? = Yes

Q10 How did your provision change as a result of COVID-19? Select all that apply.

- Moved to providing emergency food parcels
- Moved to become a community care hub/ foodbank
- Added a food pantry
- Offered support/ advice
- Stopped face to face activities
- Changed the sourcing of food
- Other, please state

Display Question 12 if Did the provision of the food hub change as a result of COVID-19? = Yes
Q12 What was the reason behind the change in provision? Select all that apply.

- Increased requests for emergency food provision from the community
- Increased requests for advice/ support from the community
- Reduced funding
- Available funding for emergency food provision
- Change of venue
- Other, please state

Benefits of the food hub
Q13 This section asks questions about the benefits of the food hub to the food system e.g., the communities you serve, businesses you collaborate with, farmers, other actors in the food system, the planet, the economy.

Q14 How does the food hub benefit economic development and viability in Leeds? Select all benefits that apply.

- Generate revenue
- Employ staff
- Provide access to market for local businesses
- Enable investment in local food businesses
- Facilitate connections between other businesses/ organisations
- Assist with access to financial support for community members
- Assist with access to services for community members
- Support community economic development
- Other, please state

Q15 How does the food hub benefit ecological sustainability in Leeds? Select all benefits that apply.

- Reduce food waste
- Reduce greenhouse gas emissions
- Plant trees
- Grow fruit and vegetables
- Increased use of renewable energy
- Support biodiversity
- Other, please state

Q16 How does the food hub benefit access to and demand for healthy, local food? Select all benefits that apply.

- Raise awareness of healthy, local food and its benefits
- Support the purchase of healthy, local food
- Provide a diverse range of healthy local foods
- Act to increase local food system resilience
- Develop food skills and food literacy
- Provide access for marginalised groups
- Provide safe food storage
- Other, please state

Q17 How does the food hub benefit personal community wellbeing in Leeds? Select all benefits that apply.

- Improve health
- Improve emotional wellbeing
- Provide opportunities to engage in community activities
- Promote opportunities to develop social connections and relationships
- Improve quality of life
- Advocate for policies/programmes supportive of sustainable local foods
- Other, please state

The beginning

This section includes questions about the launch of the food hub.

Q19 What was the main motivation for launching the food hub?

- To collect and distribute food aid
- To provide affordable food to the community
- To improve dietary health for the community
- To provide a way to market for local farms
- To promote local food
- To provide support/ advice for the community
- To increase environmental sustainability of food systems
- To reduce food waste
- Other, please state

Q20 What was the main provision when the food hub was launched?

- Foodbank
- Food pantry
- Social supermarket/ cooperative
- Community cafe
- Community centre
- Community care hub
- Support/ advice
- Farm or food growing
- Fruit and/or vegetable boxes
- Food processing
- Other

SWOT Analysis

The questions in this section ask about the strengths, weaknesses, opportunities, and threats for the food hub.

Q22 What are the strengths of the food hub? Select all that apply.

- Multiple sources of food
- Part of a network across Leeds/ the
- Sustainable source of funding
- Team of reliable staff and/or volunteers
- Embedded in the community
- Other, please state

Q23 What are the weaknesses of the food hub? Select all that apply.

- Food is from only one source
- Work independently - not connected to other organisations
- No sustainable source of funding
- Limited human resources
- Other, please state

Q24 What are the opportunities for the food hub? Select all that apply.

- Diversification into other provisions (e.g., cooking classes)
- Work with other organisations
- Other, please state

Q25 What are the threats for the food hub? Select all that apply.

- Loss of working/ storage space
- Shocks to the food supply chain
- Limited control over what food is provided
- Funding is stopped
- Other, please state

Future plans

This section includes questions about plans for the future of the food hub.

Q27 What plans do you have for the future of your food hub? (e.g., expand capacity, provide more services, commercialise, become financially independent, more away from emergency food provision to other food/community/business/skills training etc. services)

Q28 What support do you think the food hub will need in the future? Select all that apply and elaborate with text where possible.

- Funding (please explain what kind of funding would be needed e.g., for cooking equipment)
- Human resources (please explain what human resources would be needed)
- Finding a fixed work/ storage space (please explain what space you would need)
- Training (please explain what training would be needed e.g., staff training)
- Other, please state

Any other comments

Q29, Do you have any other comments about food hubs in Leeds?

Email

Q30 If you would you be happy to be contacted to take part in later aspects of this project (a short interview and/or site visit to identify and evaluate benefits of your food hub), please write your email below:

_____

Appendix B.

Table B1. Research Participants Participating in Stages of the Research

Food Hub/Food Actors	Description	Survey	Interview	Focus Group	Impact Evaluation Tool Application/ Case study development
1. Barca Leeds	Community-based charity that aims to care, listen, and respond to the needs of the people in the communities and work with them to deliver outstanding services that improve their wellbeing. Community care hub for Bramley and Stanningley areas in Leeds. https://www.barca-leeds.org/	x	x		
2. Bramley Care Bears	Community-based charity run by community volunteers aiming to develop community spirit, trust, and support across the area. https://www.facebook.com/groups/2515675211859569/	x			
3. Butcher Hill Food Pantry	Community Food Pantry set up by KVDT to provide people with an affordable, sustainable, and dignified option when accessing food support. https://www.kvdt.org.uk/wp-content/uploads/2021/10/FoodPantryLeaflet_FINAL.pdf	x		x	
4. Feed Leeds	A sustainable food growing network, encouraging, and connecting individuals, communities, and organizations in Leeds. https://feedleeds.org/	x	x		
5. Groundwork	A charity that supports local communities and businesses to build capacity and resilience, with a focus on developing greener and healthier places. https://www.groundwork.org.uk/			x	
6. Grace and Care	A multicultural group of people aiming to encourage and support community and social projects. Providing a community café and support service. https://www.facebook.com/GraceAndCareOfficial/	x	x		
7. Hamara Healthy living centre	Community-based charity focused on providing support for people from minoritised ethnic backgrounds. Community Care Hub for Middleton Park, Beeston and Holbeck, as for cultural food support in west, north and south Leeds. https://www.hamara.org.uk/	x	x	x	x
8. Health for All—Beeston Village Food Pantry	Health for All is a charity that offers services and support to help people across generations, cultures and ethnicities achieve healthier, happier lives. https://www.healthforall.org.uk/	x		x	x
9. Health for All—Middleton Family Food Pantry		x		x	x
10. Holbeck Foodbank	A food bank and distribution service providing crisis food parcels to individuals and families in Holbeck, Leeds. http://holbeckfoodbank.org.uk/	x			

continued

continued

Food Hub/Food Actors	Description	Survey	Interview	Focus Group	Impact Evaluation Tool Application/ Case study development
11. Incredible Edible Garforth	Urban gardening project that aims to bring people together through actions around local food, helping to change behavior towards the environment. https://www.incredibleedible.org.uk/find-a-group/incredible-edible-garforth/	x	x		
12. InterACT Pantry Meanwood	A membership food club with a store at Meanwood Community Centre, offering local people the support of a reliable and good quality food resource at minimal cost. https://interact.uk.net/ylpmeanwood/	x			
13. Kirkstall Valley Development Trust/Kirkstall Valley Farm	Community development social enterprise and community owned farm. Part of the Community Supported Agriculture network. Community Care Hub for Kirkstall, Leeds. https://kirkstallvalleyfarm.org.uk/	x	x		x
14. Leeds Allotment Federation	The voice for allotment and leisure gardeners in the greater Leeds area. Aims to promote and support allotment gardening. https://leedsallotmentsfederation.org/	x	x		
15. Leeds North & West Foodbank	Food bank that supports people in the area that need food. https://leedsnorthandwest.foodbank.org.uk/	x			x
16. Leeds South & East Foodbank	Food bank that supports people in the area that need food. https://leedssouthandeast.foodbank.org.uk/	x		x	
17. Love in a Box	A halal foodbank that provides food parcels to hungry people struggling to afford enough food and once a week delivers 60 home cooked hot meals and essential warm clothes and toiletries to the homeless in Leeds city centre. https://www.leedsgrandmosque.com/love-in-a-box/about-love-in-a-box	x			
18. Meanwood Valley Urban Farm	A city farm for the community. Offering volunteering opportunities, allotment spaces, educational workshops, and vegetable boxes. https://www.mvuf.org.uk/				x
19. Middleton Elderly Aid	A charitable organization and a Neighborhood Network scheme aiming to promote independence amongst the over 60's population in Middleton and surrounding areas through a range of activities and services. https://middletonelderlyaid.org.uk/	x			
20. Neruka's Soul Food Kitchen	A community organization that aims to attend to the needs of people struggling in many areas of their lives. https://nerukassoulfood.co.uk/	x			x
21. New Wortley Community Centre	A community-owned and community-led center aiming to improve the area of and lives of residents living in LS12. Community Care Hub for Armley, Leeds. https://www.newwortleycc.org.uk/	x	x		x
22. Oblong	Community development charity aiming to help people and community's flourish. Community Care Hub for Little London and Woodhouse areas in Leeds. https://www.woodhousecommunitycentre.com/oblong/	x	x		

continued

continued

Food Hub/Food Actors	Description	Survey	Interview	Focus Group	Impact Evaluation Tool Application/ Case study development
23. Otley Action for Older People	A charity that is supporting independent living in Otley, Arthington and Pool-in-Wharfedale. Community Care Hub for Otley and Yeadon areas. https://www.otleyactionforolderpeople.org.uk/	x			
24. Positive Action for Refugees and Asylum Seekers (PAFRAS)	A community center, food hub and support space for refugees and asylum seekers in Leeds. https://pafras.org.uk/	x			
25. Rainbow Junktion	As a community cafe on Mondays and Thursdays, a food share on Fridays and a support and advice centre. Supported Community Care Hubs working in Woodhouse and Headingly areas in Leeds. https://www.allhallowsleeds.org/rainbow-junktion	x	x	x	x
26. Salvation Army - Leeds Central	A community café serving weekly hot meals to those in need. https://www.salvationarmy.org.uk/leeds-central	x		x	
27. Soup and More Foodbank	A community café and foodbank. https://leedsfoodaidnetwork.co.uk/food-banks/	x			
28. We Are Seacroft	A community group aiming to create and sustain a safer and more connected environment in Seacroft. https://weareseacroft.org.uk/				x
29. Wetherby & District Foodbank	A community food bank also offering support and advice to those in need. https://wetherbyanddistrict.foodbank.org.uk/	x	x	x	
30. Zarach Food Club	A charity focused on providing beds and basics to children in poverty. Provided food and supplies during COVID-19 by converting their vans into basic pantries. https://zarach.org/	x			
	TOTAL	**27**	**11**	**8**	**10**

Appendix C. Interview Template

Background

1. What population do you serve? (e.g., anyone/ specific ward/ only by referral)
2. Where do you source your food from? (e.g., donations/ purchased from supermarket)
3. What is the main focus of your work currently? (e.g., food bank/ food pantry/ community larder)
4. Beyond your main focus of work, what other services do you provide? (e.g., support for community members/ volunteer opportunities/ food growing)
5. Did your provision change during COVID-19?
    a. If yes, how did your provision change?
    b. If yes, what was the reason behind the change? (e.g., change to funding/ venue/ requests for support)

Your organisation/ group

6. What is the main work/provision of your organisation/ group?
7. What was the motivation behind setting up your organisation/ group?
8. What role do you think your group/ organisation plays in the food system in Leeds/ beyond?

Food hub definition

9. What do you understand by the term food hub?
10. Do you think there is a better way of describing 'food hubs'?

Impacts of food hubs

11. What benefits do you think that your food hub provides? (e.g., to the communities you serve, farmers, the planet, the economy) in terms of:
    a. economic development and viability
    b. ecological sustainability
    c. access to and demand for healthy and local food
    d. personal and community wellbeing

SWOT analysis

12. What do you think are the strengths of your organisation/ group currently?
13. What do you think are the weaknesses?
14. What opportunities are there for the organisation?
15. What threats face the organisation?

Future plans

16. What plans do you have for the future?
17. Do you think the provision you offer should remain indefinitely? If yes, why? If not, why not?
18. What support do you think you will need?
19. Any other comments related to food hubs in Leeds that you'd like to make?
20. Would you be interested in us coming for a site visit to identify and evaluate the impacts of your food hub?

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Appendix D. The Impact Evaluation Tool for Food Hubs

Impact Evaluation Toolkit for Food Hubs

2023

Project partners:

UNIVERSITY OF LEEDS

foodwise leeds

Leeds CITY COUNCIL

Background to the toolkit

This toolkit was developed by the University of Leeds in collaboration with Foodwise and Leeds City Council to assist Food Hubs in evaluating their impact on the communities they serve and the wider food system. More information about the research behind this toolkit is available at the Global Food and Environment Institute.

This toolkit is in line with the Leeds Food Strategy.

The **toolkit is designed to be self-administered by Food Hubs** to support them in developing funding bids or to evidence their impact within the community.

A Food Hub is an umbrella term to describe entities that sit between people who produce food and people who use it, gathering food from growers and distributing it either to commercial customers or directly to consumers – often working with an explicit set of ethical priorities.

For support using this toolkit or to receive an Excel version of this toolkit, please contact Dr Effie Papargyropoulou E.Papargyropoulou@leeds.ac.uk.

Food Hubs benefit **communities** and the **food system** by:

Toolkit edited and designed in collaboration with Research Retold (2023)

1

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How to use this toolkit

Click to get to the relevant section you are interested in.

1 Identify an activity

Begin by identifying an activity or programme to evaluate.

Go through the toolkit for each activity that you do. You can fill the information on this pdf. It is fillable.

2 Complete the tables

With that activity or programme in mind, go through each table and complete the columns.

- Sustainability and resilience
- Health and wellbeing
- Access and demand for healthy, local food
- Food security and economy

Impacts	Identify the outcomes that your activities/programmes achieve
Frequency	State how often you carry out the activity or programme (e.g. everyday, once per month)
Indicators	Consider how you measure the impact (i.e. what metrics you could use)
Evidence	Capture any evidence that you already have to support the impacts you've stated

We've provided some examples of impacts and indicators. Not all of them may be relevant - skip those which do not resonate.

As you're working through the toolkit, one activity or programme could contribute to multiple impacts and can therefore be mentioned several times. e.g. cooking classes could bring benefits in terms of 'Access and demand for local healthy food', 'Community wellbeing', and 'Economic viability'.

3 Record additional evidence needed

List any additional evidence that you need to collect in the future in order to support each impact of the activity or programme. Start collecting that data.

Step 1. Select an activity or program

- [ ] Community café/in house meal provision
- [ ] Food bank (free to customer)
- [ ] Distribute food parcels
- [ ] Community pantry/social supermarket (small cost/membership)
- [ ] Utilise surplus food
- [ ] Composting
- [ ] Cooking classes
- [ ] Food growing
- [ ] Food/health literacy support
- [ ] Finance support/signposting
- [ ] Mental health support/signposting
- [ ] Community group (e.g. art, gardening, music)
- [ ] _____
- [ ] _____
- [ ] _____

You can add other activities to this list.

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Step 2. Complete the columns for each impact of the activity

Sustainability and resilience

Impacts What outcomes do your activities/programmes achieve? Examples provided.	Frequency How often do you do this? E.g. never, sometimes, always, everyday, once a month	Indicators What metrics do you use/would like use, to measure the effect of your outcomes? Examples provided.	Evidence What information do you have to support the effect of your impact?	Comments What could you do to increase the impact of your food hub, or how to capture the effect of the impacts?
***Example**: Utilising food surplus to make meals (Activity) has the positive environmental impact of reducing food waste (Impact)*	*Everyday*	*Number of meals provided*	*We record how many meals we serve every day: on average 50 meals/day*	*We will capture information about the amount of surplus food we are using.*
Reduce food waste		Volume of surplus food used (kg); Number of food parcels given; Number of meals provided		
Reduce Greenhouse Gases (GHG) by using locally grown food		Percentage of locally sourced food, 'food miles' travelled (miles/km)		
Reduce Greenhouse Gases (GHG) by using seasonal produce		Percentage of fresh produce used that is 'in season' compared to that which is not		
Support biodiversity by growing fruit and vegetables		Volume of fruit and vegetables grown (% of produce grown in house versus purchased/kg of produce grown)		
Support biodiversity by planting trees and plants		Number of trees, plants planted		
Improve soil quality by composting/using compost		Volume of compost produced/used (kg)		

Step 2. Complete the columns for each impact of the activity

Health and wellbeing

Impacts What outcomes do your activities/programmes achieve? Examples provided.	Frequency How often do you do this? E.g. never, sometimes, always, everyday, once a month	Indicators What metrics do you use/would like use, to measure the effect of your outcomes? Examples provided.	Evidence What information do you have to support the effect of your impact?	Comments What could you do to increase the impact of your food hub, or how to capture the effect of the impacts?
Improve health e.g. physical activity or healthy eating support		Quotes/images to describe or evidence the impact of the food hub on health		
Improve emotional wellbeing e.g. mental health support		Quotes/images to describe or evidence the impact of the food hub on emotional wellbeing		
Improve quality of life e.g. volunteering opportunities		Quotes/images to describe or evidence the impact of the food hub on improving quality of life		
Improved educational/work attainment due to improved access to healthy food		Improved grades in school; Improved job opportunities; Quotes about concentration		
Promote opportunities to develop social connections and relationships e.g. lunch clubs		Examples/descriptions of programmes that promote social connections and relationships; Quotes/images to describe or evidence the impact of the food hub on providing opportunities to develop social connections, sense of belonging		
Provide opportunities to engage in community activities e.g. gardening groups		Examples/descriptions of programmes that provide opportunities to engage in community activities; Quotes/images to describe or evidence how the food hub engages in community activities		

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Step 2. Complete the columns for each impact of the activity

Access and demand for healthy, local food

Impacts What outcomes do your activities/programmes achieve? Examples provided.	Frequency How often do you do this? E.g. never, sometimes, always, everyday, once a month	Indicators What metrics do you use/would like use, to measure the effect of your outcomes? Examples provided.	Evidence What information do you have to support the effect of your impact?	Comments What could you do to increase the impact of your food hub, or how to capture the effect of the impacts?
Provide access to land, facilities and infrastructure for food growing (e.g. allotments)		Area of land for growing food (ha/acres)		
Support the purchase of healthy food		Number of people who access food that contain fresh/healthy produce		
Offer a diverse range of healthy, local, culturally appropriate foods		Types of dietary & cultural preferences considered (e.g. halal, vegetarian, African, Afro Caribbean, Eastern European, Asian); Types of food offered (e.g. tinned meat, fresh fruit)		
Raise awareness for benefits of healthy local food		Number of people attending food programmes; Reach of healthy eating campaigns (e.g. social media metrics)		
Develop food skills and food literacy		Number of cooking/food growing classes and number of people attending		
Enable individuals/families to use food provided		Number of cooking utensils/appliances given; Number of recipes donated		
Provide space to store food safely		Space available to store food (meters squared) or number of fridges of x volume		

Step 2. Complete the columns for each impact of the activity

Food security and economy

Impacts What outcomes do your activities/programmes achieve? Examples provided.	Frequency How often do you do this? E.g. never, sometimes, always, everyday, once a month	Indicators What metrics do you use/would like use, to measure the effect of your outcomes? Examples provided.	Evidence What information do you have to support the effect of your impact?	Comments What could you do to increase the impact of your food hub, or how to capture the effect of the impacts?
Contribute to food security e.g. physical and economic access to sufficient, safe and nutritious food that meets dietary needs and food preferences for an active and healthy life		Number of food parcels provided per week; Number of members of a community food pantry/café or similar; Quotes from members about how the food hub helps them to access food		
Advocate for policies/programmes supportive of sustainable local foods		Examples of advocacy programes/campaigns to promote sustainable local food		
Facilitate connections between other businesses/ organisations		Description of/number of connections between organisations or businesses		
Provide market access to small/medium scale farmers/food businesses		Examples of partnerships with local businesses; Quotes or other evidence from local farmers/food businesses/food producers/ greengrocers about their improved access to market		
Assist with access to financial or other support for community members		Description of financial or other support available (e.g. advice or signposting about benefits, debt, housing, education, abuse, immigration etc); Quotes from members who accessed support		
Support community economic development		Number of volunteers/work experience associates; Hours of volunteering/work experience offered; Quotes from volunteers/work experience associates about the impact of the opportunity on their life		
Employ staff		Number of employed staff		
Generate revenue		Sum of revenue generated per year (£)		

Step 3. **Record additional evidence needed**

Appendix A

Use this page to collate evidence about the demographics of the recipients of your services (i.e. users of your services)

Activity	Number of households or individuals served per week/month	Number of households with children served per week/month	Number of individuals with disabilities served per week/month	Number of pensioners served per week/month	Other relevant demographic characteristics (e.g. gender, age, socio-economic status, education, occupation)

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Appendix E. Worked Examples of the Impact Evaluation Tool for Food Hubs

Step 2: Complete the columns for each impact of the activity or programme

Health and wellbeing

Impacts (What outcomes do your activities/ programmes achieve?) Examples provided.	**Frequency** (How often do you do this? E.g. never, once per month, once per week, everyday)	**Indicators** (What metrics do you use/ would like use, to measure the effect of your outcomes. Examples provided.)	**Evidence** (What information do you have to support the effect of your impact?)	**Comments** (What could you do to increase the impact of your food hub, or how to capture the effect of the impacts?)
Improve health through cooking classes offering healthy eating support	Regularly	Number of people attending sessions. Stories about how the services have helped to improve health.		Capture stories of the impact of cooking sessions on health and wellbeing
Improve emotional wellbeing through adult therapeutic gardening sessions	Once per week	Quotes/ images to describe or evidence the impact of the food hub on emotional wellbeing	Photos of gardening sessions; Quotes/ stories from people attending the gardening sessions	
Improve quality of life through the volunteering programme	Everyday	Number of volunteer opportunities available.	89 volunteers are involved across the range of activities offered at NGCFI	Capture stories/ quotes of the impact of taking part in the volunteer programme on self esteem, wellbeing
Improved educational/ work attainment due to improved access to healthy food	Regularly	Description of the support provided.	Stories from young people and adults about the impact of	
Promote opportunities to develop social connections and relationships through community meals and activities	Regularly	Examples/ descriptions of programmes that promote social connections and relaitonships	Stories/ quotes from people attending the meals/ events; Photos of the meals	
Provide opportunities to engage in community activities through community gardening groups and cooking clubs	Regularly	Examples/ descriptions of programmes that provide opportunities to engage in community activities	Stories/ quotes from people attending the gardening groups and gardening groups; Photos of the gardens	

Step 2: Complete the columns for each impact of the activity or programme

Sustainability and resillience

Impacts (What outcomes do your activities/ programmes achieve?) Examples provided.	**Frequency** (How often do you do this? E.g. never, once per month, once per week, everyday)	**Indicators** (What metrics do you use/ would like use, to measure the effect of your outcomes. Examples provided.)	**Evidence** (What information do you have to support the effect of your impact?)	**Comments** (What could you do to increase the impact of your food hub, or how to capture the effect of the impacts?)
Utilising food surplus to make meals for the community - reducing food waste	Regularly	Number of meals provided; Weight of surplus food used	Record how many meals are served/ number of people attending community meals	Capture information about the amount of surplus food we are using.
Reduce Green House Gases (GHG) by using locally grown food and offering vegetarian/ vegan meals whenever possible	Regularly	Number of vegetarian/ vegan meals offered		Explore the 'food miles' travelled (miles/ km); % of locally sourced food
Reduce Green House Gases (GHG) by using seasonal produce	Seasonally	Volume or % of seasonal fruit and vegetables used/ purchased	Photos of the produce used; Stories about food growing; Number of portions of fresh fruit/ vegetables served	Capture evidence of the weight/ volume of seasonal fruit and vegetables used
Support biodiversity by growing fruit and vegetables	Regularly	Volume of fruit and vegetables grown (% of produce grown in house versus purchased/ kg of produce grown); Number of gardening sessions per week	Photos of the gardening sessions; Descriptions of the range of fruit and vegetables grown; Weight of fruit and vegetables grown	
Support biodiversity by growing plants and trees	Occasionally	Number of trees/ plants planted	Photos of plants/ spaces planted	Capture stories from local people about the impact of having plants/ trees in their local area
Improve soil quality by composting/ using compost	Everyday	Volume of compost produced/ used (kg)	Photos of composting areas	

Step 2: Complete the columns for each impact of the activity or programme

Access and demand for healthy, local dood

Impacts (What outcomes do your activities/ programmes achieve?) Examples provided.	**Frequency** (How often do you do this? E.g. never, once per month, once per week, everyday)	**Indicators** (What metrics do you use/ would like use, to measure the effect of your outcomes. Examples provided.)	**Evidence** (What information do you have to support the effect of your impact?)	**Comments** (What could you do to increase the impact of your food hub, or how to capture the effect of the impacts?)
Provide access to land, facilities and infrastructure for food growing	Regularly	Number of growing spaces available	Number of growing spaces available	Square footage of growing space; Photos of the growing spaces
Support the purchase of healthy food through community cafes and surplus food sharing	Weekly	Number of meals prepared that contain fresh fruit and vegetables; Volume of fresh fruit and vegetables used to produce meals	Number of meals prepared with fresh fruit and vegetables; Number of portions of fruit and vegetables served	
Offer a diverse range of healthy local culturally appropriate foods	Regularly	Images of the culturally appropriate food available; Number of culturally appropriate meals served	Number of culturally appropriate meals served	Photos of culturally appropriate meals
Raise awareness for benefits of healthy local food through cooking sessions	Regularly	Number of people attending cooking programmes	Number of people attending cooking programmes	Stories about the impact of cooking sessions on use of healthy, local food
Develop food skills and food literacy through cooking classes and growing sessions	Regularly	Number of cooking/ food growing classes; Number of people attending	Number of cooking/ food growing classes; Number of people attending	Stories or images from people attending sessions to demonstrate the impact on food literacy
Provide space to store food safely	Everyday	Square footage of storage space	Square footage of storage space	Photos of the storage space

Step 2: Complete the columns for each impact of the activity or programme

Food security and economy

Impacts (What outcomes do your activities/ programmes achieve?) Examples provided.	**Frequency** (How often do you do this? E.g. never, once per month, once per week, everyday)	**Indicators** (What metrics do you use/ would like use, to measure the effect of your outcomes. Examples provided.)	**Evidence** (What information do you have to support the effect of your impact?)	**Comments** (What could you do to increase the impact of your food hub, or how to capture the effect of the impacts?)
Contribute to food security e.g. physical and economic access to sufficient, safe and nutritious food that meets dietary needs and food preferences for an active and healthy life	Everyday	Number of food parcels donated. Number of individuals reached. Quotes about how the food has supported people to access food.	Number of food parcels donated. Number of individuals reached.	Quotes about how the organisation has supported people to access food; Stories evidencing the impact of having access to affordable food
Advocate for policies/programmes supportive of sustainable local foods	Sometimes	Number of policies advocated for or impact of the advocacy	Record the number of policies advocated for; Record evidence of the outcome of the advocacy efforts	
Facilitate connections between other businesses/ organisations	Sometimes	Record of the number and diversity of partnerships; Description of how the partnership supports the organisation to achieve impact	Record of the number and diversity of partnerships	Description of how the partnership supports the organisation to achieve impact; Develop a map to show the range of connections that the organisation has
Assist with access to financial or other support for community members	Sometimes	Description of the financial programmes/ support available; Number of people receiving support; Stories demonstrating the impact of accessing such services	Record the number of people receiving financial or other support; Description of the financial support available	Capture stories that demonstrate the impact of receiving financial support and/or signposting
Employ staff	Everyday	Number of staff. Hours staff work (equivillent FTE)	Record the number of staff	Record the number of hours staff work, including overtime
Generate revenue	Sometimes	Sum of revenue generated per annum (£)	Record the sum of revenue generated from various activites	

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Relational autonomy highlights how interdependencies shift in the transformation of food provisioning

SPECIAL ISSUE
Community-Based Circular Food Systems

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Abstract

In the past decade, there has been a surge in the Netherlands in food initiatives that seek to transform the prevailing agro-industrial model of food provisioning. This has evolved into a wide range of values-based territorial food networks (VTFNs). This article aims to understand the evolving diversity in VTFNs by looking more deeply into how community, circular, and territorial-based food networks operate. In doing so, the article examines how citizens, rural workers, and farmers cooperate

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Author Notes

Margriet Goris started working with the framework relational autonomy in her PhD dissertation, "Emancipation of young agroecological peasants in Zona da Mata, Minas Gerais, Brazil: An identity in-the-making" (Goris, 2020). Daphne Schoop contributed to the research during her internship at Agrosystems Research. Preliminary findings have been presented by Margriet Goris at XXIXth European Society for Rural Sociology Congress, "Crises and the Futures of Rural Areas," July 3–7, 2023, in Rennes, France.

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to change and create connections between livestock, land, water, and other resources. Furthermore, it aims to assess to what extent the evolving food provisioning practices of these VTFNs are re-embedded in the territory, how their collective capacity to transform food provisioning practices has expanded, and the impact that the expanded capacity has on the degree of relational autonomy over their operations. Twelve participatory observations and 16 interviews with farmers and citizens engaged in three different VTFNs are analyzed by identifying themes that emerged from the data, and themes that originate from the concept relational autonomy. Relational autonomy is introduced by feminist scholars and entails that autonomy is not an individual matter but is created in relationships. The concept allows for a deeper understanding of how a transformation of relations can raise the autonomy of all living beings, both human and non-human. The analysis demonstrates how relational autonomy in the three VTFNs studied is emerging along the three interdependent and co-evolving dimensions identified by Catriona Mackenzie (2019): determination, governance, and authorization. All three VTFNs studied crafted their own pathway toward relational autonomy by creating opportunities and building capacities. A relational autonomy lens enables us to articulate the interconnectedness between human and non-human systems; for example, phasing out agrochemicals increases our reliance on natural processes. This necessitates farmers and rural workers' ability to mimic these processes and requires a rearranging of market relations to share risks more equitably with citizens.

Keywords
values-based territorial food networks, relational autonomy, agroecology

Introduction

Food provisioning can be viewed as a deliberate configuration of practices embedded in a complex web or network of relations that shape, or govern, these practices. The web of relations of a VTFN is actively reproduced in people's enactment of practices such as taking turns collecting food from farmers for the network. Practices, and consequently the relations they are embedded in, might also be altered intentionally, resulting in a reconfiguration of relations and re-embedding of practices. Re-embedding requires the capacity to alter the web of relations to create the space needed when exploring alternative practices (Horlings et al., 2020). This capacity of a group to intentionally alter relations and practices hinges on the ability to recognize the vulnerabilities and interdependencies of all living beings, which Moriggi et al. (2020) refer to as response-ability. Changes might be minor or marginal, but in the case of major or profound changes, there may be a transformation in the mode of food provisioning (Visseren-Hamakers et al., 2021). This complexity of food provisioning is a living system and profound changes result in systems transformation. The division of power within a supply chain becomes a topic when change is asked for or pursued. Examples of this include when farmers seek a larger or fairer share of rewarding in food chains; or when citizens, particularly those who are Black, Indigenous, and People of Color (BIPOC), re-envision their own role in the food system (Session on Participatory Food Systems Governance at the 2021 Global Food Governance Conference, et al., 2024); or when questions arise regarding strategies to increase sustainability and enhance the resilience of communities or agroecosystems. Achieving change depends on the capacity of a group to alter, or ultimately to transform, the complex web of relations in which food provisioning practices are embedded, and likewise, how these relations are governed. This paper adds to scholarly work on food networks by introducing the relational autonomy framework to identify mechanisms used to alter relations and interdependencies. The framework enables us to understand how interdependencies persist within food provisioning networks, even as independence is pursued from industrial food systems. The concept of relational autonomy was developed by feminist scholars as a critique of the masculine understanding of autonomy, which is often defined by traits such as independence and nondomination (Mackenzie, 2019; Mackenzie & Stoljar, 2000). Relational autonomy posits autonomy as the status and capacities necessary to direct one's life and activities, grounded in rights, oppor-

tunities for self-determination, reflexive competence, authentic value systems, and the authorization of the self or collective as legitimate actors (Mackenzie, 2019). Goris (2020) first used a relational conceptualization of autonomy to understand how youth in Brazil enact relational autonomy at their agroecological farms by working with biodiversity and in their social movements by experimenting with the redistribution of agricultural, domestic, and care work. This relational approach in agrarian and food system studies is crucial to understanding interdependencies and the associated power dynamics in emerging networks. In the following sections, we explore concepts related to emerging food networks.

The dominant structure of food networks in the Netherlands is short food supply chains (SFSCs) (korte keten). A common strategy for improving the market position of the farmer is to reduce the number of intermediaries to few or none to prevent a middleman, for instance a processor, from appropriating a disproportionate share of the margin (Van der Schans & van Wonderen, 2019). This approach to short food supply chain alteration focuses mainly on economic dimensions (Nemes et al., 2023) and not on the territorial, social-material base in which economic practices are re-embedded; no major changes are involved. This narrow approach is different from the original meaning of SFSCs as coined by Renting, Marsden and Bank (2003). They view SFSCs as the process of rural development by farmers and citizens with a shared interest in the quality of food, food traditions, and food provisioning practices. These scholars highlight the role of institutional support and the surrounding networks required to maintain SFSCs, but in the public and institutional uptake the concept has been interpreted by many merely as a new economic model.

The concept of alternative food networks (AFN), however, is closer to the original meaning of SFSCs. Although alternative food networks position themselves as the opposite of chemical, industrialized, and export-led agriculture, the positioning of alternative versus conventional food provisioning can be difficult to reconcile given the diversity and dynamics of food networks identified by Renting et al. (2003). Holloway et al. (2007) have problematized the dualistic reasoning, and call for a recognition of the evolving and nuanced understanding of what is alternative at any given time and place.

While both SFSCs and AFNs indicate aspects of rural development, neither aligns with the relational approach of this paper. The meaning of SFSC has eroded to a value chain approach governed by linear thinking, thereby excluding relevant relations with actors in the wide spectrum of food networks, both human and non-human. Moreover, the way the definition of AFNs is couched in the negative as non-involvement with industrial agriculture does not line up with shifting (both positive and negative) interdependences in food networks. On the other hand, the values-based territorial food networks (VTFNs) concept captures the material and immaterial aspects as well as the relationality of food provisioning networks by pointing at the embeddedness of practices at the territorial level. Territories are determined by the way people relate to the landscape, the resources, and each other, rather than being determined solely by administrative demarcations. Territories therefore change over time as interrelationship shifts occurs, not due to administrative adjustments. Furthermore, the territories are determined by shared values of the consumers, producers, and processors of food products that have organized themselves in a given area (Escobar, 2010, 2015; Van den Berg et al., 2019). VTFNs are defined as networks that unite actors to cooperate at the territorial level to organize food systems on the basis of shared values regarding "social justice and wellbeing, environmental integrity, participatory governance and economic fairnes" (Nemes et al., 2023, p. 3). This concept takes into account the fact that actors who are not part of the supply chain but are part of the food network may interact with the dominant agricultural discourse and practices by organizing themselves around shared values on social and environmental justice. Shared values vis-à-vis food provisioning practices are the starting point for relations in which "the freedom to act is cocreated by all involved" (Goris, 2020, p. 17). The territorial approach allows us to understand the multiple initiatives beyond food provisioning practices that may emerge from the development of food networks.

The concept of VTFNs resonates with the concept of community-based circular food systems, which may put more emphasis circularity and the prevention of greenwashing and social washing (Journal of Agriculture, Food Systems, and Community Development, 2024). The territorial articulation of VTFNs may promote future inclusion of nonchain actors and rights of all living beings in food networks.

While VTFNs can be important vehicles for major, transformative change in food systems (Chiffoleau, 2019; Renting et al., 2003), little is known about the specific ways in which these food networks foster change. Therefore, this article uses the relational autonomy concept to explore how opportunities and capacities to perform (transformative) change are developed or impaired within VTFNs. Relational autonomy highlights interdependencies among all living beings that determine capacities for acting, including relations of care and cooperation. To this end, the next section discusses the understandings of autonomy in critical agrarian studies and introduces the feminist concept of relational autonomy to understand and effectuate change.

Peasant Autonomy, Relative Autonomy

The importance of relations for the performance of autonomy is articulated in critical agrarian studies on peasant autonomy and relative autonomy. Peasant autonomy is based on Marxist traditions that discuss the relation between labor, capital, and the state. It refers to the struggles of peasants to become as independent as possible of the state, specifically of agribusiness capital for inputs. Peasant autonomy is achieved by the peasant mode of production that entails farming without external inputs and working with local peasant knowledge on mimicking ecological processes for food provisioning practices. Resources such as knowledge, labor, and food provisioning are largely in peasant hands. By using nested markets and their own autonomy, peasants can limit the interference of the dominant industrial food system (Van der Ploeg, 2008; Van der Ploeg & Schneider, 2022). According to Van der Ploeg and Schneider (2022), autonomy is achieved by organizing resources to refrain from capital and to allow for agency at the level of the farm, between farms, at the territorial level, and at food markets.

Peasant autonomy is understood as relative autonomy by scholars, as there is always some interference with inputs, credit, and food markets (Rosset & Martínex-Torres, 2012), as well as with the state. Peasant autonomy and indigenous autonomy merge through shared histories and peoples (Rosset & Barbosa, 2021), and this takes place largely through the dispute with the power held by both capital and state, as well as through their collective right to belong to a given territory, to give place to their livelihoods.

A point of critique to the concept of peasant autonomy by Jansen et al. (2022) is that peasant autonomy tends to be presented as normative, because the desire to become autonomous from the "hostile" regime prescribes a particular way of relating to capital and state. Pointing only at struggles for independence to become relatively autonomous frames dependencies as negative, while in fact, people's interdependencies are a necessity: humans have always lived in groups, depending on each other and other living beings for their subsistence.

Coming back to the main theme of this article, the question remains, how do interdependencies shift over time? In a peasant mode of production, peasants become more interdependent on, for instance, working with natural processes and interfarm cooperation over time (Lucas et al., 2019). In terms of cooperating within the family, with other farmers, and with nature, this can be mutually reinforcing but may also impair the autonomy of some. The concept of peasant autonomy does not make explicit this shift of interdependencies, which can end up obscuring, for example, the empowerment that may stem from the territorial, experiential, farmer, and scientific knowledge produced in the ways they work with natural processes. Moreover, cooperation among farmers requires capacities, and it may not be free from oppression from patriarchism. Examining this issue of "one's own relative power within society" (Maughan et al., 2020, p. 296), these three scholars point at the need to reflect upon one's own practices that may impair other people's autonomy, such as structurally disadvantaged people such as women, BIPOC indi-

viduals, and people beyond national borders.

Other critics question "peasants" as an analytical category. Jansen et al. (2022) note that processes of decommodification are not exclusive to peasants but also happen, for instance, in vertical integration. However, this critique ignores the fact that the peasant mode of production refers to a holistic approach to farming with multiple, integrated characteristics that are not limited to their relationship with the market. An important characteristic of the peasant mode of production is the cultural knowledge base that is transferred over generations. After many years of work among social movements representing peasants worldwide, in December 2018, the UN General Assembly adopted the Declaration on the Rights of Peasants and Other People Working in Rural Areas (Claeys & Edelman, 2019). This document acknowledges that a significant number of people working in rural areas across the globe can be identified as peasants, or small-scale agricultural producers connected to a place and their family household for their livelihood (Cotula, 2022). This defined identity of "peasants," as recognized by global organizations, makes it an identifiable analytical category when scholars choose to use that categorization. However, some may still question if "peasants" is an appropriate analytical category for use in the context of the Netherlands. Historically, small traditional family farmers in the Netherlands have been classified as peasants, but nowadays, new entrants to farming who practice agroecology come closest to this definition, in contrast to the larger group of entrepreneurial farmers in the Netherlands as a whole.

In terms of methodological issues, Jansen et al. (2022) point at inconsistencies in the work of scholars in understanding peasant autonomy as relative. To illustrate, they refer to Van der Ploeg aligning peasant autonomy with the idea of "room for manoeuvre" (2018, p. 39), which is not limited to peasants. Van der Ploeg focuses on a specific kind of "room for manoeuvre": one that is transformative in nature and focuses on peasant autonomy. "Room for manoeuvre" is in his work about becoming relatively autonomous from the dominant industrial food system through a peasant mode of farming in which labour, knowledge, and food provisioning are largely in peasant hands (Garcia Júnior, 1989; Woortmann & Woortmann, 1997).

Relational Autonomy

Actors engaged in VTFNs have established or strengthened relations to practice and discuss their shared values, based on which values they seek to reinforce in the food system. In forming these relations, actors often cocreate the freedom to act differently in terms of food provisioning and the arrangement of the food system at a territorial level (Butler, 2015; Rancière, 2009). The concept of relational autonomy includes this relational dimension of emancipation (Goris, 2020).

Autonomy is often conceptualized from an individualistic point of view (Dove et al., 2017) and commonly understood as the self-governing of independent and self-determining subjects. This notion of autonomy is criticized by feminist scholars for not considering the ever-present interdependency among humans, neglecting relationships of care and cooperation that provide the conditions and capacities to act but that may also impair the autonomy of some (Dove et al., 2017; Lee, 2023; Mackenzie, 2008, 2019).

Agroecological peasants who work with nature, and scholars articulating the practices of agroecological farmers, have also challenged the human-centered notion of autonomy and have pointed out that these farmers cocreate autonomy with all living beings. One major example is how they approach soil life, reducing their dependency on agrochemicals and other inputs from the industrialized agricultural sector (Goris, 2020; van der Ploeg, 2008; Williams, 2008). While this is to the benefit of the soil and plants themselves, this also reduces farmers' dependency on agrochemicals while creating dependencies, such as on the health of the soil.

Diverse scholars note that social movements are an articulation of relational autonomy, as seen through the knowledge production and exchange facilitated by these movement organizations and through the inclusivity measures enacted by and for BIPOC people, women, and youth on farms (Goris, 2020; Paulilo, 2004; Williams, 2008). Social organization based on shared values provides the

social and material base for relational autonomy. The concept of relational autonomy involves negotiating values, norms, positions, knowledge, skills, and material resources in all living being relations within the VTFNs.

Scholarly works on relational autonomy point at the interdependency among all living beings and of humans as socially embedded persons who are shaped by social relationships and their contexts. In general the scientific debate on relational autonomy is about the conditions under which a person's autonomy can flourish while in relations of dependency. To clarify, the scientific debate is not about the conditions under which relational autonomy among multiple persons or everyone in a network can flourish simultaneously. To date, the debates revolve around the conditions for people to develop authentic preferences, such as the ability to make choices that reflect their own motivational structure. As far as the authors of this paper know, the concept of relational autonomy is mostly used at the personal level and as mentioned earlier on only studied by a few at a network level, such as in the contexts of social movements. Using other concepts, Le Velly et al. (2022), Bendfeldt, McGonagle, and Niewolny (2021), and Dunning (2016) have shown how farmers enhance the autonomy of all through cooperation. With the concept of "supply chain management and collaboration," Dunning (2016) shows how farms and a chain grocery store established mutually beneficial relationships. This paper explores whether relational autonomy is mutually created in VTFNs and questions how to achieve an optimum of strengthening autonomy of all living beings engaged in a VTFN without limiting the autonomy of some.

The framework of relational autonomy presented by Mackenzie (2019) is adapted here to understand relational autonomy at a network level. The framework departs from status as conditional for the autonomy of persons; that is. "persons are entitled to exercise self-determining authority over their lives" (Mackenzie, 2019, p. 147). Furthermore, she points out specific competences that are required for autonomy, namely, "the capacity to be self-defining and self-governing" (p. 147). As a result, the relational autonomy framework used here includes three dimensions of autonomy in values-based territorial food networks: determination, authorization, and governance. Figure 1 visualizes these dimensions. This aligns with the work of Lucas, Gasselin, and van der Ploeg (2019), who also point at status, "a certain standing within the co-op," and the capacity of "social skills" (pp. 159–160) needed to engage neighboring farmers in new ways of interfarm cooperation.

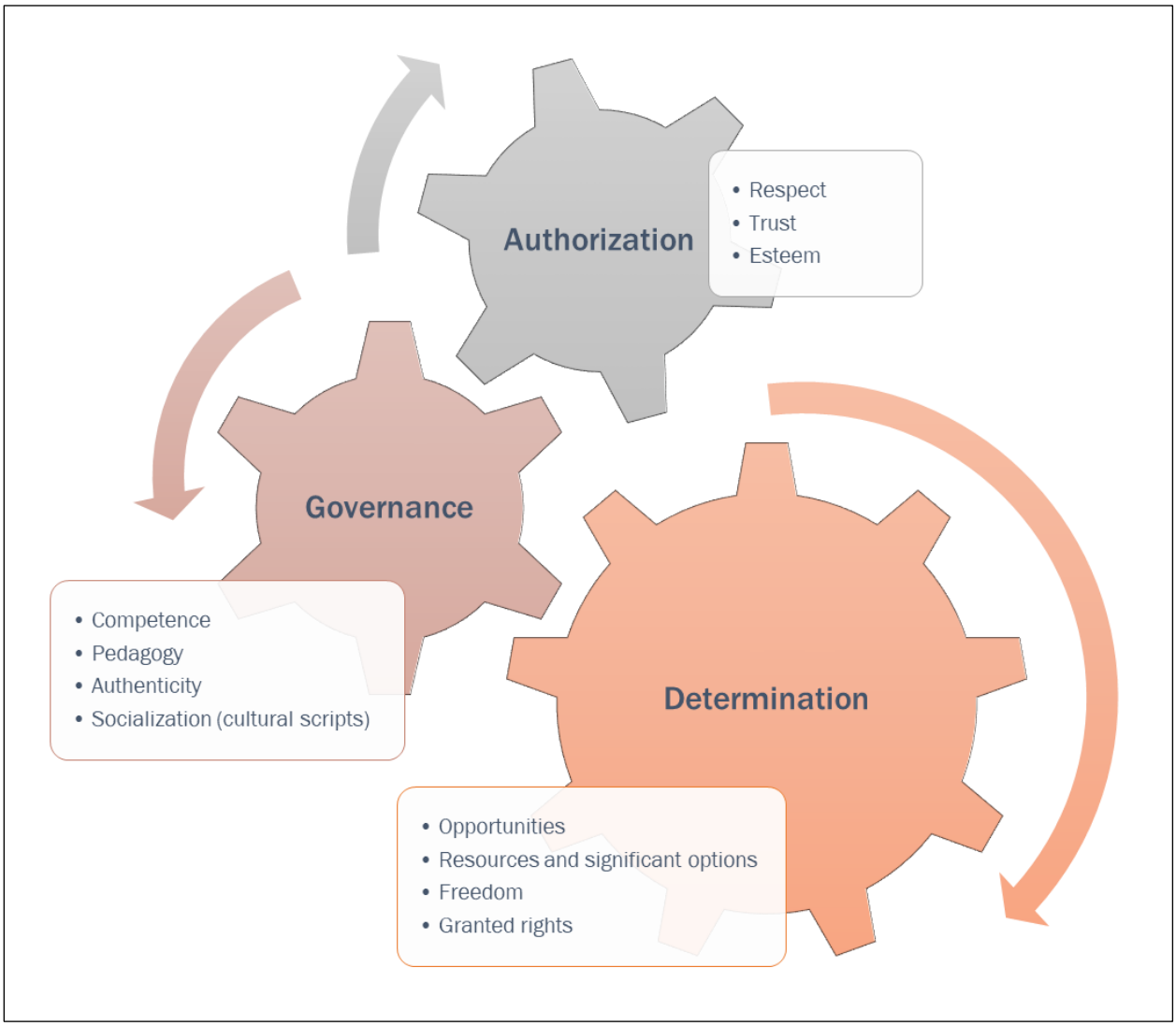
The first dimension, network determination, brings the analysis to "external, structural conditions for autonomy" (Mackenzie, 2019, p. 148). This highlights the relational character of this dimension, as determination is shaped by the opportunities and freedoms as manifested in the socio-material context of the people involved in a food network. Opportunities are created or limited by material and immaterial resources that are available and accessible to the decisionmakers, as these inform the significant options that the decisionmakers can choose from. Gibson-Graham et al. (2016) propose to examine the access, use, benefit, care, responsibility, and ownership of material and nonmaterial resources, including biophysical resources, knowledge, cultural resources, and social resources. Promoting determination entails changing the rules for allocating these resources (*Tijdschrift voor agrarische recht*, 2023), and then indeed allocating them differently (Dekking et al., 2020; Lucas et al., 2019). This also requires immaterial resources to imagine other ways of doing and being (Stock et al., 2015). When speaking of freedom, Mackenzie (2019) emphasizes defining this subcategory in positive terms, and thus refers to freedom as "granted rights by the social environment, in contrast to the negative definition of freedom as non-domination" (p. 148).

The second dimension, network authorization, refers to internal dynamics of evaluation, by which persons regard themselves as "authorized to determine the direction of one's life" (Mackenzie, 2019, p. 149). In other words, it refers to the dynamics that shape the extent to which actors consider themselves as legitimate and capable decisionmakers. It also refers to the capacity to account for one's actions (Mackenzie, 2019, p. 149). This latter subcategory relates to the concept of answerability. The relational character of this dimension is twofold. First, it brings the analysis to the external

social context of recognition that influences a person's sense of self. Second, it brings the analysis to the social construction of settings for answerability. Answerability is understood as the capacity to respond to actions by providing arguments to justify the decision or action (Lee, 2022; Smith, 2015). This answerability intertwines with granted rights, as the process of answerability depends on the creation of opportunities, time, and spaces to allow its occurrence. This implies that answerability is also relationally constituted. Phillips et al. (2015) indicate that decolonizing approaches to cope with oppression can be ways to foster authorization. A decolonizing approach focuses on the critical consciousness of the dominant system and highlighting identities that support collective action based on social and environmental justice. Lodik (2021) refers to "calling out" problematic behavior in public or "calling in" private occasions, as well as intersectionality, cultural appreciation, and exchange as ways to endorse authorization.

The third dimension, network governance, refers to the capacity to "make and enact choices that express or cohere with members identities, commitments, and values" (Mackenzie, 2019, p. 149). Network governance requires authenticity and competence. Authenticity refers to the ownership of the motivational structure by people, and

Figure 1. Relational Autonomy Framework Based on Mackenzie (2019)



the extent to which this reflects members' identities, goals, and values. Competence refers to the skills needed to put the personal value systems into action (Mackenzie, 2019). This competence includes various skills, ranging from emotional regulation, imagination of alternatives, and critical reflection on cultural norms and values. The relational character of this dimension brings the analysis toward the process of socialization, fostering critical examination of external cultural scripts with norms and values, and the way these influence people's value systems and capacity for authenticity. Additionally, it looks at how competences are fostered or diminished through people's pedagogical contexts. Novoa et al. (2012), Cooreman et al. (2021), and Goris (2020) indicate ways to endorse network governance through "counter-scripting," the process of rewriting history, meanings, and norms, or "alternation," the process of changing of roles of who educates or who carries out certain tasks. Klerkx and Begemann (2020) and Feola (2019) note that doing things differently also involves stopping doing certain things (exnovating) and indicate that network governance can be endorsed by building capacity on exnovating and dealing with financial loss due to exnovation. Scholars of agroecology point at governance by working with natural processes (Goris, 2020; de Schutter & UN Human Rights Council, 2010). Furthermore, Escobar (2010) and Aubrée and Maréchal (2008) state that network governance can be fostered by a territorial approach.

Mackenzie's relational autonomy framework (2019) adds "authorization" to the social justice framework as discussed by Maughan et al. (2020), which centers on distributive justice (opportunities) and procedural justice (governance), or, in other words, "not just on what is distributed but for whom and by whom the benefits and burdens of the food system are mobilized" (p. 284). With "authorization" Mackenzie also draws attention to trust, respect, and esteem of those engaged to act and "to make oneself vulnerable to the actions of another" (Dunning, 2016, p. 24) and to be accountable for actions.

This paper aims to understand shifts in interdependencies in VTFNs with Mackenzie's relational autonomy framework (2019). The framework allows us to understand how material and immaterial flows are or are not rearranged in relationships in these food networks, and how relational autonomy is enacted or impaired. In addition to existing studies on relational autonomy, this study aims to explore how relational autonomy is enacted by a group of farmers, citizens, and nonhuman simultaneously, and in what situations relational autonomy is nurtured for some and impaired for the others. Mackenzie (2021) suggests that social equality is a condition for relational autonomy. The paper contributes to the debate with empirical work about how social interventions minimize inequality in agriculture and how food systems like VTFNs change relational autonomy within the network.

Methodology

We used episodic narrative interview as our research method, which entails writing down the narratives of participants in a shared, bounded situation or episode (Mueller, 2019). Bendfeldt et al. (2021) argue that narratives allow for a rich and situated understanding of personal values, hopes, strategies, and experiences of farmers. Through 12 participatory observation and 16 episodic narrative interviews with farmers and citizens engaged in three VTFNs, it becomes evident how relational autonomy shifts or is enacted, nurtured, or impaired for some. The narratives depict three pathways mapped out over the three territories performing differentiated relational autonomy for agroecological transformations. The episodic narrative method allows us to capture how the evolution of a food network is experienced and described by its participants. This approach makes also data validation, in the form of narratives, appealing and accessible to participants. The three distinct food networks studied, Flevofood, De Meent, and Voedselkollektief Utrecht (VOKO), were selected due to their diverse founding memberships, which are representative of the range of food network initiators in the Netherlands. Flevofood is a food network of conventional and organic farmers, De Meent is a network initiated by a religious community and includes marginalized persons, and VOKO is a citizen-initiated urban food network. The three networks will be briefly introduced, fol-

lowed by passages of these narratives in which the members introduce the VTFNs themselves. The narratives written by the authors of this paper were validated by the members of the respective food networks and adapted as indicated by the members. The passage from a narrative on Flevofood is written by a member of that food network.

De Meent

Community farm De Meent on 31 hectares (77 acres) of land in Amstelland was established in 2020 and is a territorial food network based on social and ecological values. The community enables people placed in harsh living conditions by the state to grow their own food and to provide food for shelters and projects such as a social grocer in Amsterdam. The community consist of five part-time employees, about 25 volunteers, chickens, horticulture, and workspaces for diverse crafts and popular education.

De Meent narrative: "As far as you can see, there are meadows, meadow birds, ditches, and further on, the church tower of a small village Nes aan de Amstel. The sun is shining but it feels chilly because of the fresh spring wind. I just arrived at the community farm De Meent in the polders nearby Amsterdam. Other people arrive simultaneously. Some people arrive by car. They have been picked up by car at shelters in Amsterdam; others arrive by bike or on foot from the nearby Dorothy community, part of De Meent. When Blessing is asked to describe herself, she describes herself as someone who is not yet official here, a person without a permanent residence permit and who doesn't have a farm, a so-called landless farmer. She comes to the farm to learn. Sarah, sitting on the other side of here, states that she comes to the farm to volunteer, to talk with people and to grow food that goes to the Wereldhuis [community center] for daily free meals for refugees. Evelien, a paid employee at the farm, explains that one-third of the food produced goes to the Wereldhuis and other shelters, one-third is consumed at the farm or taken home by the workers and volunteers at the farm, and one-third is sold commercially. The people at the farm have become eaters and growers."

The first author composed, validated and adapted the narratives from multiple participants to create this narrative.

Voedselkollektief Utrecht (VOKO)

VOKO was established in 2014 and is a VTFN in Utrecht. It unites 12 farmers and about 90 citizens. It is not defined in terms of territory by its members, but the radius of 35 kilometers (22 miles) around Utrecht city falls within the Utrecht Ridge. Their three core values are **quality, transparency,** and **connection**. With **quality**, they are referring to healthy, fresh, and environmentally friendly food; with **transparency**, they are pointing at the origin, process, and costs of food; and with **connection**, they mean the bond of trust between local farmers and members, as well as between members themselves. Furthermore, the food collective works with participatory governance.

VOKO narrative: "Equipped with crates and a cool box, we walk to her gray Opel Astra, jumping down the high step again. While I put the crates in the back, Charlotte rearranges the car. Putting the parcel shelf somewhere else, she mumbles, 'I should have just taken that out too…' I walk to the passenger side and take a seat. Charlotte sets the navigation and drives away from the street, again without hesitation. We turn left, turn right, then I don't notice anymore. Charlotte talks about VOKO as we make our way through Utrecht. 'Nice that you also joined VOKO. Our goal is to be able to eat sustainable food. And we also want to get that directly from the suppliers. With VOKO we also often try to visit suppliers with the members.'"

The second author composed, validated and adapted the narratives from multiple participants to create this narrative.

Flevofood

Flevofood was established in 2017 and is a VTFN located on new land where administrative demarcations of the province and geographical and sociomaterial space align. Members encompass the entire food system, from farmers to processors to chefs. About 80 farmers are connected to Flevofood. The emphasis is on the values of economic fairness, social justice, and participatory governance. On ecological integrity, organic and conven-

tional farmers partly connect with each other to reduce food waste, increase circularity, and keep food miles as low as possible. The latter makes this an interesting case study to explore whether the VTFN provides and enforces relations that allow conventional farmers to take up more aspects related to ecological integrity.

Flevofood narrative: "We were guests at the organic arable farm of Wouter Klaasse Bos from Dronten on a beautiful soy plot. Together with Jan Groen from Green Organics, Bos gave an inspiring presentation on fresh soy cultivation. It is a new crop in Flevoland, with a high nutritional value from the high vegetable protein content and unsaturated fatty acids. Soy is also an important food element in vegan products. As a legume, it fits well in sustainable cultivation. By breeding a variety in our climate, soy can become a competitor of both organic and conventional grain cultivation. Five growers are united in sales."

This narrative was written by a Flevofood member.

Results

The next section describes the results found on the three dimensions of relational autonomy: determination, authorization and governance.

Determination

In the first result section on the dimension determination the opportunities offered by VTFNs are shown and after that the granted rights are described.

Opportunities

VTFNs offer the opportunity to sell nonstandard products that may not be accommodated by traditional long supply chains due to their strict standards and volume requirements. This variance in supply and adaptability is beneficial for farmers with diverse systems or products, as it allows them to offer seasonal produce as well as vegetables, meats, and dairy products that may vary in size, weight, or flavor. In interviews, farmers have revealed a lack of consistency in their variety of options. For example, in the VOKO food network, there is no agreement on minimum purchasing or any other mechanism to guarantee that participating farmers earn a sustainable income. Similarly, many farmers involved in Flevofood primarily produce cash crops, the majority of which are exported. Even with efforts to diversify, the quantities are often too large to be consumed in the nearby metropolitan area. Flevofood farmers aim to sell their products at major events such as the international flower and garden show Floriade or to government institutions committed to sustainable catering through a Green Deal.

> I just think the system needs to be different. We won't be able to do that with the supermarkets, but if we can arrange that with caterers in larger volumes—I'm not talking about one caterer who wants one crate of carrots; but if there are 30 caterers who all order 30 crates of carrots, then things are going well—but then they shouldn't say, "I want two cucumbers today." (Farmer, Flevofood)

According to the interviewed farmers, government procurement works in only a few cases. It is difficult to get started due to the conditions that government institutions set in tenders (contracts), due to long-term relationships with major caterers, and due to Flevofood's limited negotiating capacity. Participating farmers in VOKO and in Flevofood rely on other markets for most of their produce and indicate that being involved in more than one VTFN is beneficial to them. In addition to using different sales channels, the rules of sale are changed, resulting in less money going to intermediaries: "That will also be 10%, not very much" (Farmer, Flevofood).

For citizens, the networks provide a "significant option" in their food environment by making available foods from the local surroundings. De Meent aligns environmental and social values by producing sustainable food for people with a low or no income and simultaneously moves beyond the charity scheme by providing the significant option of access to land to people like Blessing and Sarah, both of whom talked about the set-up of De Meent that allows them to produce food themselves. Connecting and strengthening relations creates significant options for circularity. To integrate residual flows, De Meent is not certified organic:

> Pure poultry [and swine] farming is a recent invention. In the past it was always mixed. The role of pigs was always to process leftovers, that's how the animal has been bred. Most poultry farmers are nowadays a black box of input and output. Converting high-quality proteins into animal proteins is inefficient. You really shouldn't do that! Give pigs and chickens food losses and waste, and if you no longer have access to that, stop keeping pigs and chickens. We do not have food losses and waste ourselves. These flows come from the baking industry, and are not organic. You should also not give high-quality grains to pigs and chickens. Purely organic food losses and waste flows are almost nonexistent. We are well above the animal welfare bio norm. We are raising roosters, and roosters are normally gassed (because they do not produce eggs), even in organic farming. (Farmer, De Meent)

The principles of circularity and of providing living beings with more dignity unite in the way De Meent farmers raise roosters, namely, in that they do not see roosters as waste, but allow them to live. This "counterscripting" leads to a mutual enhancement of relational autonomy between farmer and rooster: after the roosters mature, their meat provides an extra income stream, and in turn, the roosters live a life of dignity rather than being immediately killed.

The VTFNs also provide options for arranging resources differently. A group of people in the VOKO network pooled together resources to purchase a van for the transportation of the orders, thereby making more feasible the larger orders which came with the growth of the network.

In a few interviews, farmers mention missed options to ensure relational autonomy at a collective level. A fruit grower points out the fact that farmers take the risk if they want to phase out the use of pesticides:

> And if you are in the Flevofood network, there is no other fruit grower in there. I can't really match with fellow fruit growers there—there are only arable farmers there. And if the cultivation fails—last year my harvest failed. Just try to earn that back. Cancer and mildew. Well, then you've lost €50,000. (Fruit grower, Flevofood)

The fruit grower points at a weak spot of many VTFNs, and also of living labs and field labs, where farmers are not asked to participate in a food network, living or field lab on the basis of a shared buyer or retailer. The networks do not provide a discursive space to discuss how to include regenerative measurements in their contracts with the buyer, and subsequently, to ensure a critical mass among farmers of one specific buyer to obtain a contract that includes risk-sharing or an additional price for regenerative measurements. The farmer also notes that a very diverse food network in terms of actors from diverse agricultural sectors, buyers, processing does not provide sufficient peers for in-depth knowledge production and exchange. Another farmer regrets that before ensuring significant options to everyone within the network, options are provided to nonpaying farmers outside Flevofood.

Granted rights

When entering into the network, producers and citizens collectively subject themselves to an obligation relating to the uptake of responsibilities. In this mutual agreement, the assignment of tasks can be rotated or based on preferences. Members are interdependent on the governance of the VTFNs:

> VOKO is a kind of "do-it-yourself" in that regard; I like that charm. There was another member who offered to take over scheduling from the former coordinator. He had written his own program for it. So, you see, everyone can do it in their own way. And, it was a requirement for me, because I hate scheduling." (Member, VOKO)

Farmers are granted the right to choose what product to offer to the networks; there are no preestablished supply agreements. This allows a flexibility that can attune to seasonality, variation in products, and the farmer's capacity. Farmers in the networks view this as positive, as it aligns with a diversified farming system:

> I am very happy ... that VOKO orders from us. … It's really ideal, because we can just indicate what we have, when we have it, and that will be ordered. This kind of thing is really ideal for complex farmers like us, who produce a lot of different things." (Food forest farmer connected to VOKO)

Authorization

In the result section on the dimension authorization the aspects esteem, respect and trust are discussed.

Esteem, respect, trust

The authorization by producers in the network is expressed in the process of price-setting and boundary-setting with regards to the manner of interacting between the members of the network. The farmers who participated in this study either determined the price based on comparison to external price-setting, done by conventional outlets (e.g., supermarkets or processors), or they relied on their own assessment of what the price should be. Regarding the latter, however, there was no clear script according to which this assessment needs to be done. As one farmer explained:

> I ask two euros for this box [of peppers]. I have no idea whether that is a good price. I base the price usually on feeling, I just make up something. I then think about what I would pay for it. (Food forest farmer connected to VOKO)

Determining this price is a skill subjected to levels of esteem and respect on the part of the producers. Thus, price-setting also is an expression of authorization, for it relies on how farmers value themselves, their labor, and their farming system. Socialization plays a role in this, insofar as prices may reflect internalized societal values of farmers.

> We simply ask a farmer how much you want for it, we do not go further in discussion. Ultimately, you have to pay for your entire chain, logistics and so on. Therefore we put about five to ten percent on top of the price. Network board member, Flevofood)

A second manifestation of authorization is observed in the practice of boundary-setting. The capacity for boundary setting is important for farmers to protect themselves from self-exploitation. For example, due to the small volume sold to the network and the variance between orders, farmers sometimes come close to laboring for little compensation. The network also creates and facilitates moments of answerability, enhancing the authorization by members of the network. The connection between farmers and citizens provides the farmer with opportunities for accountability. This happens mainly during excursions that facilitate storytelling regarding the farmer's product and mode of production. During these visits, the farmer can give an in-depth account of personal motivations and decisions. In the excursions, farmers can demonstrate their farm system and answer questions that the citizens might have. This allows them to account for their system and the reason behind decisions. As such, they get the opportunity to present themselves as legitimate decisionmakers. Furthermore, the interactions bring recognition, adding to the authorization by farmers.

Finally, the uptake of responsibilities in the networks enables citizens to learn organizational skills and food literacy. They develop their food literacy through sharing knowledge, thus learning about new foods and new ways of preparing food. Moreover, citizens end up feeling empowered when taking on responsibility. This is illustrated by the account of a member of the VOKO network: "I came from the neurosurgery department, so the coordination [of the partition team] was really peanuts! I was always told 'you can't do that,' but look at me now!" (Member, VOKO).

Similarly, another member of the VOKO network feels empowered to take action to address climate change: "It feels good to do this. That's the beauty of this initiative. After all, it's a way to contribute a little bit; a tiny little contribution, but still a contribution" (Member, VOKO).

Thus, citizens increase their self-esteem through taking on responsibilities, and they can feel empowered by being able to contribute to addressing issues in the food system. As such, the authorization by citizens in the network is

enhanced. Another member of the VOKO network called out responsibilities:

> I said in the meeting, "Guys, that voluntariness, we need to get rid of some of that." Because people are afraid to start doing the coordination functions. And once you are [doing coordination], you might be doing it for a few years. Then all of a sudden, [people say] I quit, and nobody's doing it then. So I suggested, "let's rotate, by lottery; have somebody [take the position] for a year, and then require the old coordinator to mentor them for six months." (Member, VOKO)

Governance

In the result section on the dimension governance the defining values, popular education and authenticity are described.

Defining values

Via participatory observation, it was possible to attend a session of defining values at the food network *De Meent*. This process is described in the validated narrative of De Meent:

> The time for talking is over: the morning ritual starts with all the people present translating a community value into their mother tongue. People laugh about the different sounds, spelling mistakes when Marten writes down the words and the room fills with levity. Everybody is heard and appreciated for their roots. Patience is translated into Huasa: *anuuri*; into Mandinga: *sasato*; into Dutch: *geduld*, and many other languages. Blessing tells us how she named her daughter Patience: "I gave her that name, so I learn how to be patient. Before, I really wanted to get it, I wanted to fight for it! If I don't have patience, in the end I won't get [what I want] and I will be crying. So then I said to myself, "No, I don't want to cry anymore." I want to learn how to calm down when this happens. So that is how I learned to be patient, and then I stopped crying. I am still worried about some things, but you have to relax."

This story reveals Blessing's understanding of the value of "patience," whereby she provided meaning to a community value. In Flevofood, values have not been explicitly discussed among members. One of the people talks about their main goals:

> With our main goals being traveling fewer kilometers, learning from each other, working circularly (working with each other's residual flows), and of course, working together. (Initiator of Flevofood)

These goals indicate values such as peer learning and cooperation. Interviews also reveal other values such the importance of nutritious food and the right to food. Subsequently, the phenomenon of self-selection occurs when new people choose to become members of a VTFN. New participants have their own values system that exists prior to their participation in a food network, and which aligns with the jointly defined values in the food network. The values that underpin the food networks are diverse. The values that unite food networks in this case are the importance given to the consumption of local food (e.g., close to the location of the production site, a short connection to the producer, etc.), and to knowing the who, where, and how of food production (i.e., transparency). Networks differ in the level of importance ascribed to the environmental and social sustainability of the production method. Furthermore, values related to animal welfare and nature restoration are emerging and shifting. Participatory observations and interviews with people at De Meent show that opinions differ with regard to weeds, and that weeds are counterscripted as "natural material" that builds organic matter. Also, with animal welfare being a significant value in this setting, male livestock, such as the roosters, end up gaining more worth.

Popular education

People at De Meent indicate themselves what they want to learn in terms of knowledge (e.g., horticulture) and skills (e.g., routine). Recently they have had workshops on composting, growing mushrooms, woodworking, and observing and taking

care of chickens. To learn to work with routine, they have formulated house rules such as *be on time* (wait 10 minutes just in case, but that should be an exception) and *uphold daily routine* (coffee break at 11:15–11:30, bell at 13:00 to clean up work equipment, bell at 13:15 for lunch, and appoint dishwashers in the morning).

Flevofood works with peer learning among diverse actors in the food system. Farmers educate fellow farmers and others about grain varieties, such as spelt varieties that do not require fertilizer, and about planting soy or forgotten vegetables. In a cooperative workshop with the farmers, students came up with the idea to market the juices of beets and carrots as "pride juice" in honor of gay pride. This widescale collaboration and alternation of roles by people in a VTFN leads to the acquisition of diversified knowledge and skills. Participants become familiar with other ways of working, including nonhierarchical, less regulated working relations, and intersectional thinking:

> … We face a challenge: we work nonhierarchically, but the non-employed do have a different background and situation then we have as employees." (Employee, De Meent)

> In my country, we "use" those ones in farming who cannot manage to work and you can hire them, and next time, I want to [do this] differently. Here you work for yourself, and by working for yourself, you learn more. My dream for the future, I like to continue with farming, I know now how to grow your own plants from seed, and you can do this yourself and sell those seedlings. I like to have my own nursery. If I have a farm, I want to put everything there, pig, goat, cow, you get meat and manure to plant. You can get food, money to go to the hospital and give other people jobs. (Volunteer, De Meent)

Authenticity

The account of the fruit farmer below shows how industrial standards persist in the network. In a participatory observation, the second author recalls that she is packing a crate of apples for the VOKO network and that the producer gave her the instruction to select certain apples based on the look of their skin:

> S1: "If you have bad ones, with spots, you can take them out."
>
> S2: "You guys still select for that?"
>
> S1: "Yes, definitely. You do have to deliver a good product. Keep a good relationship with the customer, right? [These spots] come with time. And you can put the little one back, too."

These accounts of disputes reveal that as far as we have seen in this research, some cultural scripts related to food are hardly addressed within the relations in VTFNs. The behavior to not buy something anymore when it is not up to current standard in terms of quality, size, and weight is not sufficiently reflected upon. As a result, the quality standards of the conventional supermarkets and large retailers are reinforced. In the case of the interviewed fruit grower from Flevofood, the farmer adjusts by meeting quality standards and by combining fruit production with fruit processing. The farmer uses fruit that can't be sold directly to process in to apple juice and applesauce. In this case, the relational autonomy of the VTFN is entangled with relations outside the territorial food network through cultural scripts enforced by supermarkets and large retailers. The fruit grower ensured circularity through a small on-farm processing industry. Another example of the persistence of cultural scripts is "yearlong same produce," enabled by global trade and greenhouses. In VTFNs, non-human agency is expressed by shaping the seasonal variation in the products that are offered. The continuity of VTFN in terms of sufficient supply and diversity depends on farmers cooperating within the territory and with other territories to ensure a stable and diversified supply of food throughout the year. This interdependence of farmers in together providing sufficient diversified supply in the VTFN demonstrates that the relational autonomy is jointly achieved.

Discussion

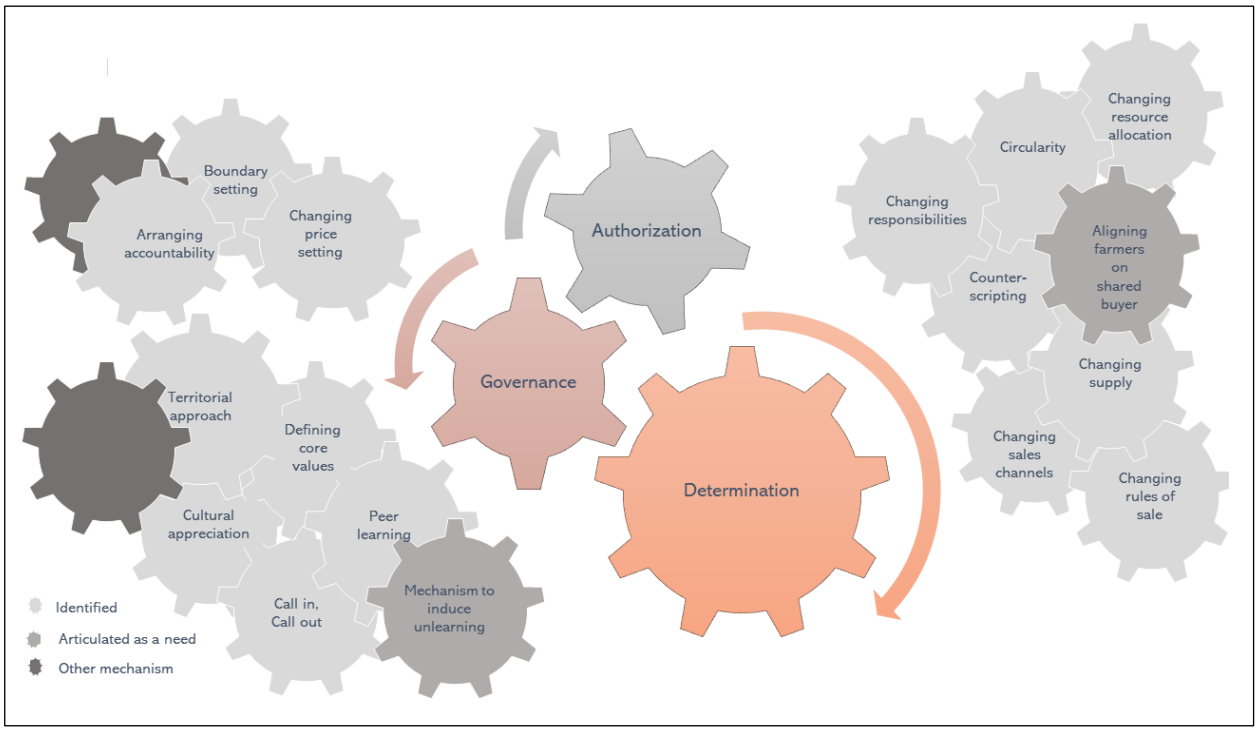
Starting with defining core values such as solidarity, reciprocity, circularity, and taking a territorial

approach, VTFNs employ diverse mechanisms to perform these values and their approach to their practices. These mechanisms provide farmers, more or less, with significant options to shift toward interdependencies with territorial partners. They also underpin natural and circular processes to become less dependent on large, distant, agro-industrial partners and chemical inputs. The extent to which the relations and interdependencies shift substantially differs between the three VTFNs in this study. As Rosset and Martínex-Torres (2012) argue, relative autonomy is thus gained within a new set of interdependencies, and as this article affirms, autonomy is inherently relational. Figure 2 shows the variety of mechanisms, organized according to the dimensions of relational autonomy according to Mackenzie (2019), and enacted to shift interdependencies.

The results show a wide variety of mechanisms employed on the dimension "Determination" across all three VTFNs. De Meent is putting forward major changes in the agricultural and food system by counterscripting food as a public service; rural workers at De Meent are paid by the church for their work in food production and care rather than for the quantities of food produced. And, by providing access to land to people in asylum procedures, they move away from charity and more towards solidarity. At the same time, there is an opportunity to provide people in the asylum procedure with more equal opportunities by creating additional jobs at De Meent or by assisting them in establishing independent businesses based on the farm. Through the latter option, persons in the asylum procedure can become equally involved as rural workers or independent workers on the farm. The citizens organized in VOKO ensure re-embedding in the territory and moderate changes in the agricultural and food system. Farmers and citizens affiliated with VOKO jointly create a significant array of options in terms of food purchasing and selling. The ability to offer seasonal produce provides farmers who operate diversified farming systems with the opportunity to sell their products, resulting in greater diversity in the variety of available food through alignment of the food system with seasonal cycles.

However, freedom in purchasing behavior does not yet guarantee income security for farmers. Farmers engaged in Flevofood and producing bulk

Figure 2. Mindmap of Dynamics of Mechanisms to Shift Interdependencies



food for export have not realized significant options for a large group of farmers all at once. In the case of Flevofood, significant options for farmers consist, on the one hand, of catering to production for big buyers (e.g., public procurement schemes, farmer owned supermarkets with a territorial approach, etc.), and on the other hand, of crop diversification that would direct production toward northwestern Europe as well as a territorial market. To make adjustments such as crop diversification or the stopping of pesticide use, conventional farmers want different contracts with buyers that distribute or compensate for extra risk due to increased interdependency with nature. The latter asks for interfarm cooperation, as Lucas et al. (2019) call it, necessitating alignment and cooperation among farmers who supply to the same buyer. This cooperation enables them to collectively propose to the buyer improved pricing and contract terms for a set of practices that promote regeneration. Flevofood has not yet organized farmers on the basis of a joint buyer, but it does look for inspiration in that direction by visiting farmers who are diversifying, who are experimenting with soy production, and who have united themselves to arrange sales together. EU policy grants rights to agree on price surcharges to achieve sustainability objectives. These are suprastatutory sustainability standards where the agreements made are indispensable for achieving the sustainability goal (Wolberink & Baayen, 2024). Little use is made of this administrative space in the case of the Netherlands. To conclude, the three food networks boost the relational autonomy of both producers and consumers by offering more or less significant options for food system changes. Farmers and rural workers acquire more options to sell or distribute their produce within their territory, and consumers have more options to buy food produced in the territory. However, this does not necessarily lead to better prices, as farmers often lack power in markets without fair regulations and typically are not trained in negotiating skills.

The development of negotiating skills refers to the dimension "governance." The results demonstrate that mechanisms on the dimensions "authorization" and "governance" operate concurrently. In setting prices, the cultural norms (Mackenzie, 2019) of taking things for granted are repeated in food networks. Mackenzie's adapted framework is useful for looking at these issues. The relational autonomy perspective highlights the persistent interdependencies within VTFNS that otherwise tend to be considered independent from the industrial food system. Dependency on the industrial food system persists because in the governance and authorization dimensions the actors reproduce industrial food system rationales related to price-setting, even though the networks provide the opportunity to purchase and sell food in the territory. Alongside Maughan et al.'s (2020) focus on distributive and procedural justice, which examines how access, ownership, and decisionmaking about resources are formally arranged, Mackenzie's framework on relational autonomy also helps visualize whether people have the confidence (dimension: authorization), skills, and imagination (dimension: governance) to propose different price arrangements. Moreover, Wolberink and Baayen (2024) showed that there is administrative space to collectively make price agreements for a set of practices that promote regeneration and that move beyond what is obligated by law.

VTFNs struggle with handling large quantities of food, as seen with conventional food producers in Flevoland. They aim to sell their produce to large buyers like public institutions but have not succeeded so far. Achieving this requires effective policies on public procurement (dimension: governance) and farmer empowerment (dimension: authorization). Campbell (2023) highlights the challenges of setting up value-based institutional food procurement systems, which aim to consider more than just price in their purchasing decisions. Farmers rely on these institutions, which are themselves interconnected and dependent on one another. Aligning with local contexts can be difficult, which can reduce farmers' autonomy in these relationships (Campbell, 2023). Furthermore, a new territorial arrangement with public institutions requires farmers to supply less to old relations or to cut off these relations. Feola (2019) refers to this by the term "unmaking," understood as "a diverse range of interconnected and multilevel processes that deliberatively activated to 'make space' (temporally, spatially, materially, and/or symbolically) for radi-

cal alternatives that are incompatible with dominant modern capitalist configurations" (p. 979). Farmers stated in interviews that this unmaking is difficult because of sustainability schemes with which supermarkets try to attach farmers to one supermarket chain.

Territorial coordination and popular education are mechanisms that enhance the capacities to create relational autonomy within VTFNs. Diverse scholars highlight issues related to these mechanisms but do not connect them to the concept of relational autonomy. Maughan et al. (2020) note that reflexivity, the ability to continuously and critically examine one's own practices, is not a common practice and is not a "fixed and all-or-nothing endeavor" (p. 296). All discussions within the networks expand on what is possible to say, think, and do (Fairclough, 2010). Roodhof (2024) highlights the role of positive emotions in enhancing effectiveness. For instance, participants in a food forest network feel capable, hopeful, proud, and enthusiastic, which can help them handle future challenges. Similar to this study, relational autonomy is fostered through both esteem, trust (dimension: authorization), and reflective competences (dimension: governance).

Jointly defining values is an ongoing, participatory process in De Meent, whereas in the other two VTFNs this has mainly taken place at the start by the initiators. By jointly defining values at De Meent, they deprivilege white values (Session on Participatory Food Systems Governance at the 2021 Global Food Governance Conference et al., 2024). Emerging value creation also takes place around extending the age of male livestock, counter scripting weeds and residual flows for animal feed such as malting barley from beer production instead of using high-quality grains for feed. Value creation around animal welfare and nature restoration resulted in different, circular farming practices (Fairclough, 2010), as well as growers and eaters becoming more interdependent on other living beings and less dependent on inputs such as agrochemicals. The VTFNs in this study do not engage in risk-sharing in the case of failed harvests due to plagues, diseases, or harsh weather circumstances. This implies that the dependence on other living beings is disproportionately higher among farmers.

Roodhof (2024) emphasizes the need for research on power dynamics. The use of the concept "relational autonomy" provides insights into *whether* and *why* the relational autonomy of farmers, citizens, plants, and livestock is mutually promoted by initiatives of the VTFN. The results show that understanding and promoting relational autonomy at the network level for most living beings touches upon issues at the interface of determination, authorization, and governance. Mechanisms that promote mutual autonomy of all living beings become visible when we understand relational autonomy in VTFNs. Mutual autonomy is promoted by mechanisms (depicted in Figure 2) such as cultural appreciation, peer-to-peer learning, alternating roles, counterscripting, and calling in and calling out, among others.

Although Le Velly et al. (2022) did not apply the concept of relational autonomy, their study confirms how collective agency is promoted by diverse mechanisms on the three dimensions of determination, authorization, and governance. They describe how this is achieved by taking rules and values from both conventional and alternative supply chains (authorization). Two French collectives of ranchers and meat distributors reclaimed the determination of supply-chain organization from intermediaries by shifting rights (determination) and transferring knowledge and skill back to farmers and distributors through transparent and collective learning and negotiation with regard to meat quality, prices, and ways of interacting (governance). In one case, counterscripting was applied, which obligated buyers to purchase the entire animal rather than specific parts. However, logistical challenges arose when a buyer failed to uphold this agreement, thereby impacting the collective's autonomy. This underscores the interdependency and dynamic nature of relational autonomy, requiring ongoing attention. The examples in this study show that VTFNs can enhance the relational autonomy of farmers and citizens simultaneously. It reveals the mechanisms employed to shift interdependencies. To date, changes are minor to moderate, but capacities are being created. There is limited attention currently going toward mechanisms, supporting environments, the role of facilitators in unlearning (Van Oers et al., 2023) or unmaking.

The same counts for organizing farmers on the basis of a joint buyer to first create some space for change and include a set of practices that promote regeneration and circularity in their contracts with buyers. The latter can exist well next to multi-actor networks or living labs. These producer organizations can ensure that farmers can participate on an equal footing in VTFNs and living labs, and with more future opportunities to transform or stop "unmake" relations and shift interdependencies to territorial markets and natural processes. This approach aligns with Mackenzie's (2021) suggestion that social equality is a condition for relational autonomy.

Conclusion

The extent to which values-based territorial food networks create significant options for food system changes differs by VTFN and by member, but each provides competences, impulses, and knowledge that allow both human and non-human stakeholders to strengthen their relational autonomy, or at least the future potential for such autonomy. Mackenzie (2019) provides a framework to visualize the different mechanisms, such as alternating roles and counter scripting, that promote the relational autonomy of a network of farmers, citizens, and livestock simultaneously. Reversed, it also shows how relational autonomy of living beings is impaired by the lack of market regulation, well-functioning public procurement, and equal juridical positions of all living beings. The concept of relational autonomy illuminates the emerging and shifting interdependencies at the network level that move beyond the human/nature divide and that reflect the social nature of humanity.

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Putting the P(ee) in perennial agriculture: Reflections on a workplace urine nutrient reclamation project

SPECIAL ISSUE
Community-Based Circular Food Systems

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Abstract

Phosphorus (P) is a finite resource essential for food production currently lost from fields at an unsustainable rate via runoff and crop harvests. These losses could be addressed by pairing perennial crops, which reduce runoff with their deep roots that stabilize the soil, with recovering nutrients from human excreta. Urine contains the majority of P and other nutrients that humans excrete and therefore has been the focus of recent nutrient reclamation efforts. Urine fertilizer has yet to be explored for perennials, however, and understanding the biophysical effects of urine fertilizer on soil nutrients and biomass in perennial crops could inform the design of a more circular food system. To that end, we started the first known workplace urine nutrient reclamation project in the state of Kansas, U.S., to test the feasibility of supplying available soil P from urine to alfalfa (*Medicago sativa*), a perennial legume forage crop. After one growing season, urine fertilizer had no effect on aboveground biomass but did increase

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available soil P which otherwise decreased in the control treatments. Urine also increased soil nitrate and sodium compared to the water-only controls. The field study was coupled with a survey of staff members who participated in urine collection to identify opportunities and potential barriers to urine diversion in the U.S. The survey revealed a lack of awareness of both unsustainable P management and urine recovery as a potential solution, underscoring the need for increased education. Regulatory challenges faced in the second field season also highlighted the need for policy that explicitly defines urine separately from wastewater in the U.S. We hope that results from this project will make it more feasible to conduct additional studies and circular food system community-based projects on a larger scale going forward.

Keywords
nutrient circularity, agroecology, circular economy, community-based research, alfalfa (*Medicago sativa*), food systems, phosphorus, urine

Introduction

Phosphorus (P) is the rock-derived nutrient with the lowest natural abundance in the earth's lithosphere relative to biological demands, and mineable resources are being depleted (Cordell et al., 2009; Vitousek et al., 2010). As a result, P supply could limit future agricultural production. P lost from fields unintentionally via erosion and intentionally via harvest ultimately accumulates in water bodies and landfills in forms inaccessible to soil, driving the need to continuously replace the P removed. Both types of losses could be reduced, however, by pairing perennial crops whose deep roots reduce erosion and runoff (Crews & Brookes, 2014; Culman et al., 2013; Huddell et al., 2023; Jungers et al., 2019) with the practice of reclaiming nutrients from excreta. Applying excreta to crop fields was common in many societies historically, but the practice has been mostly abandoned with our increased reliance on fossil fuel energy and with changes to infrastructure and culture (Kawa et al., 2019). Interest in revisiting this practice has grown, however, with a focus on urine due to its high nutrient content and low risk of disease propagation (Ashley et al., 2011; Kawa et al., 2019; Rose et al., 2015). Studies have shown that urine contributes roughly 79% of the nitrogen (N), 47% of the P, and 71% of the potassium (K) but makes up less than 1% of the volume of municipal wastewater, making urine source separation an attractive option to reduce energy consumption, save water, and conserve finite nutrient reserves (Larsen et al., 2013).

Previous studies on human urine fertilizers have demonstrated their efficacy in increasing biomass production in maize (Andersson, 2015; Kassa et al., 2018), ryegrass (Bonvin et al., 2015; Martin et al., 2021) and lettuce (Chrispim et al., 2017) relative to control plants and even relative to plants amended with commercial fertilizer (Antonini et al., 2012). Experiments have also explored urine-derived P integration into the soil. P fertilizer often becomes quickly unavailable to plants as it adsorbs to soil particles or binds with other minerals; however, a study with spinach grown in pots found that urine fertilizer increased the available pools of P in the soil (Rumeau et al., 2023). Another study found increased available P from urine-derived struvite in a field experiment with maize (Gell et al., 2011). Despite these advances, urine-derived P soil dynamics under a variety of crops, management strategies, and soil types is insufficiently investigated (Harder et al., 2019). To our knowledge, using human urine fertilizer in a perennial system, which has the potential to both incorporate P into the available pool and retain P and other recovered nutrients via their deep root structures, has not yet been studied.

In addition to the biophysical effects of urine fertilizers, the disconnect between understanding the ecological benefits of urine recycling and implementing the practice remains to be fully explored. Many recent reviews highlight the potential of reclaiming nutrients (Larsen, Gruendl, et al., 2021; Martin et al., 2022; Randall & Naidoo, 2018; Simha & Ganesapillai, 2017) and propose scenarios for integrating urine diversion into existing infrastructure (Hilton et al., 2021; Maiza et al., 2024). Surveys also indicate that people appear to be generally favorable towards urine collection and fertilizer use (Ishii & Boyer, 2016; Lamichhane & Babcock, 2013; Segrè Cohen et al., 2020; Simha et al., 2021); however, urine recycling has not been implemented

on a large scale, especially in the U.S. (Aliahmad et al., 2023).

Previous studies have shown that pharmaceuticals and other organic micropollutants are a common concern, and much of the current work in the field is on contaminant removal technologies (Almuntashiri et al., 2021; Köpping et al., 2020; Larsen, Riechmann, et al., 2021; Li et al., 2023; Özel Duygan et al., 2021; Simha & Ganesapillai, 2017). Social norms and opinions of peers are also strong predictors of acceptance, and both are influenced by exposure to nutrient reclamation (Simha et al., 2021). In Sweden and Switzerland, two countries pioneering the technology, pilot projects were crucial to the expansion of urine recycling systems (Aliahmad et al., 2023). There are limited examples of projects in the U.S., however, where there are potentially unique barriers and regulatory challenges. Important work has been done in recent years to assess the concerns and considerations of different demographic groups (Schreiber et al., 2020, 2021), but there have been few opportunities to learn from people who have personally participated in a urine diversion project in the U.S.

To build on nascent work in the U.S., we started the first known project in Kansas on urine nutrient reclamation in the workplace. We had two main goals: (1) Investigate the potential of human urine to increase available P in a silt loam soil and evaluate its effect on other soil nutrient concentrations and on the biomass of the perennial legume alfalfa (*Medicago sativa*); and (2) Identify potential concerns and barriers that might limit participation in future projects, as well as actions and information that best support participation. We hypothesized that urine would increase available soil P and subsequently increase alfalfa biomass compared to water and control treatments. As a small pilot study, this project also identified regulatory and logistical challenges for conducting urine nutrient reclamation projects in the U.S., which may benefit larger scale and community-based projects moving forward.

Project Design and Methods

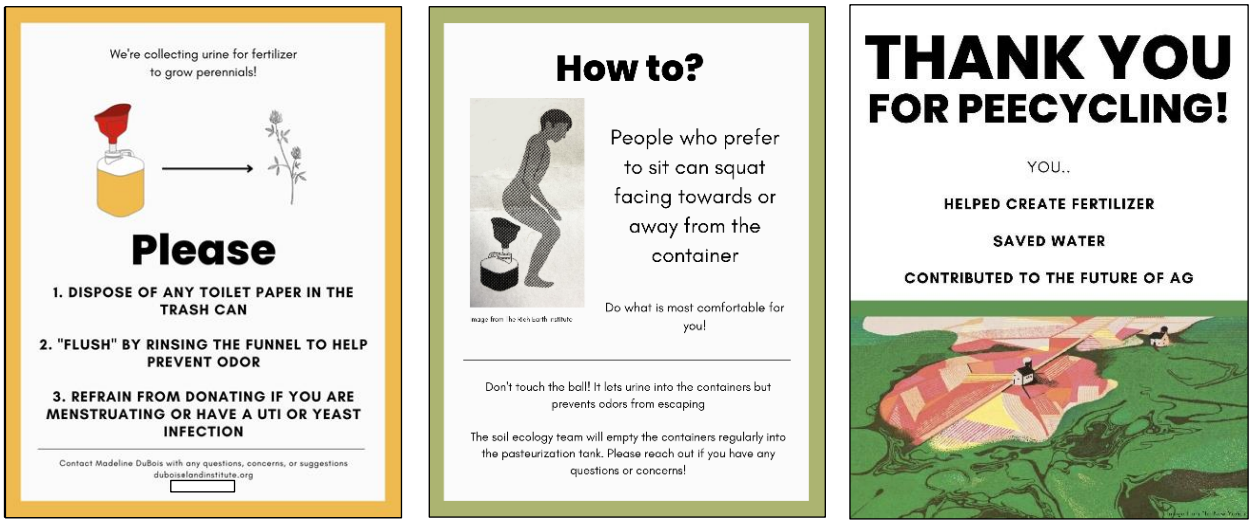
The study was based at The Land Institute (TLI), an organization in Kansas working to develop perennial grain agricultural systems, with logistical advising from Rich Earth Institute. In March 2023, the TLI soil ecology team invited TLI staff to a seminar that contextualized the project within the larger scope of their work. This seminar provided background on the importance of P in agriculture and current P management practices, presented urine diversion as part of the solution for sustainable P cycling alongside perennials, and outlined the opportunity to participate in the project. We installed urine collection units (Figure 1) based on a design used by Rich Earth Institute in five bathrooms on TLI's campus with accompanying signage (Figure 2). We stored urine from collection units in a sealed tank for more than 1 month above 20°C for passive pasteurization in accordance with World Health Organization (WHO) guidelines for urine fertilizer use on fodder crops (WHO, 2013, p. 70).

Field Study

The field study site was located at the Perennial Agriculture Project field station in Lawrence,

Figure 1. Urine Collection Unit Modeled After the Design by Rich Earth Institute

Figure 2. Informational Signage Hung in the Bathrooms Next to the Collection Units

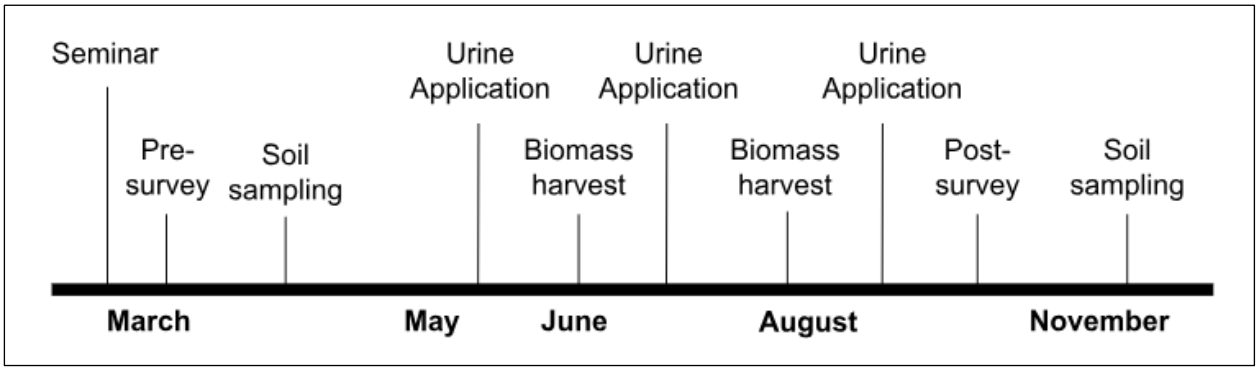


Kansas (39.002039, -95.319313). The soil type is Sharpsburg silt loam with pH values ranging from 5.5 to 6.3. The field has areas with low available P (Appendix Table A3) which may have contributed to poor establishment historically. The field was sown with alfalfa (*Medicago sativa*) in fall 2021. Three treatments consisting of (1) urine fertilizer, (2) water control where water was applied in the same volume as urine, and (3) a control with no manipulation were arranged in a randomized block design with 6x6 m^2 plots. Using a trailer with a 378 L tank and pump (Figure 3), urine fertilizer was applied three times following the alfalfa harvest (Figure 4). A target rate of 20 kg $hectare^{-1}$ (ha) for the field season was determined based on recommended P additions of 30–40 lbs ac^{-1} of P_2O_5 (19.3 kg ha^{-1}) for a field with established, non-irrigated alfalfa stands and "medium" available P (13-25 ppm) (Shroyer et al., 1998). The volume of urine applied per plot (0.185 ha-cm) was calculated assuming a P concentration of 0.36 g P L^{-1} as reported by Rich Earth as a composite result from their community collection program (Rich Earth Institute, n.d.). Actual urine P content was 0.15 g P L^{-1}, likely due to the rinse water used to clean collection units to limit odor. This resulted in P application rate being half the target amount at 10.9 kg P ha^{-1}.

To assess changes in soil nutrients, one composite soil sample (0-20 cm) consisting of six cores per plot was collected with a step probe (2.5 cm diam.) before (May) and after (November) the 2023 field season and analyzed for total and available phosphorus (P), calcium (C), potassium (K), magnesium (Mg), sodium (Na), nitrate (NO_3), ammonium (NH_4), and total nitrogen (N) content at the Kansas State University Laboratory (in Manhattan, Kansas). We assessed aboveground biomass by clipping alfalfa from one 1x1 m^2 quadrat per plot to a height of 10 cm from the soil surface with a sickle (4 weeks and 7 weeks after urine application) (Figure 4); samples were dried (60°C, 48 hrs) prior to being weighed.

Figure 3. The Urine Application Trailer with the 378 L Tank, Pump, and Small Boom

Figure 4. Timeline with Approximate Dates of the Pre-Project Seminar, Survey Distribution, Soil Sampling, Biomass Harvests (Just Before the Field was Mowed), and Urine Applications



Data Analysis

Statistical analyses were performed using R software (R Core Team, 2024, v 4.4.0). We first confirmed normality with a Shapiro-Wilk test. To assess whether there was a treatment effect on aboveground biomass or soil nutrients, we conducted an analysis of variance (ANOVA) test using *lme4* (Bates et al., 2015) and Tukey's HSD post-hoc test with pairwise comparison using *emmeans* (Lenth, 2024) for any differences deemed significant at $\alpha < 0.05$ (Appendix Table A4). In all cases, the block was treated as a random variable with treatment as a fixed effect. Changes to soil nutrients were evaluated based on the difference between the final and baseline soil sample, and biomass harvests were evaluated per plot as the sum of the two harvests.

Survey and Pilot Project Evaluation

To evaluate the social impact of the pilot project and improve the quality of future efforts, we invited all TLI staff to participate in optional, anonymous online pre- and post-project surveys with a two-week window for each. Surveys were hosted on Airtable and distributed via Slack before urine collection began in March 2023 and after the field season concluded in August 2023. Both surveys were compiled and presented to TLI staff in a return-of-results seminar in February 2024.

The initial survey sought responses about whether participants had attended the informational seminar, their likeliness to contribute urine to the project (0–5 scale), and open-ended questions related to any reservations or suggestions they had (see the questionnaire in Appendix Table A1). The final survey inquired about whether respondents had donated urine to the project and how the project affected their perception of the viability of urine nutrient reclamation in current or future agricultural systems (Appendix Table A2). The survey also assessed the likelihood of future participation and perceptions of how the project related to the broader mission of TLI.

To evaluate the survey data, three members of the project team individually coded participant responses ($n = 20$ pre-, $n = 13$ post-survey) and identified common themes and phrases. Quantitative responses were summarized as percentages; common themes were arrived upon by consensus for qualitative responses. All participants whose responses were included in this analysis consented to be quoted anonymously.

Results and Discussion

This study provides a rare U.S. example of a project that enhances our understanding of both the biophysical effects of urine fertilizer and the experience of the study participants. We first outline the physical effects urine fertilizer had on alfalfa biomass and soil nutrients in the field experiment, and then summarize our findings from the staff survey that could inform future work.

Urine Fertilizer Had No Effect on Biomass

We hypothesized that urine fertilizer would enhance forage biomass of alfalfa beyond a water-only control by supplying potentially limiting P

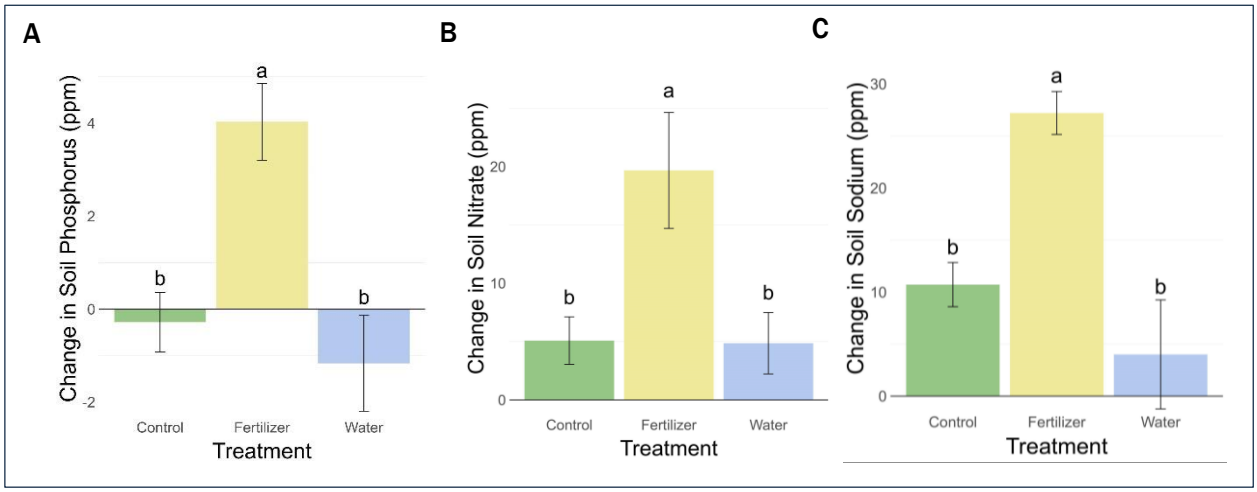
(Crews, 1993). There were no differences in yield, however ($p = 0.9$, *data not shown*). This result contrasts with many studies that found urine fertilizer increased biomass in crops such as maize, kale, beets, lettuce, and spinach (Andersson, 2015; Chrispim et al., 2017; Pradhan et al., 2010; Semalulu et al., 2011). We may not have observed an effect in this instance as our application rate may have been insufficient to alleviate P-limitation, having applied only half the recommended P and raised the soil P to only a "medium" concentration (Shroyer et al., 1998) (Table 1). Two biomass harvests may also have been insufficient to observe possible effects, especially as logistical constraints prevented a third harvest at the end of the growing season following the final fertilizer application.

Urine Fertilizer Increased Soil Available Phosphorus, Nitrate, and Sodium

As hypothesized, urine fertilizer increased soil available P (using the Mehlich-3 test) (Figure 5A). Prior to this study, it was not clear whether urine fertilizer would primarily contribute to the inorganic unavailable soil P (Syers et al., 2008), but our results are consistent with findings from a greenhouse study with spinach showing urine-P contributed primarily to the available and slightly available soil P (Rumeau et al., 2023).

The fertilizer also significantly increased nitrate (NO_3-N) (Table 1; Figure 5B). We applied 192 kg N ha^{-1} (urine fertilizer N application is not recommended after the establishment year for alfalfa) (Shroyer et al., 1998), so the increase in soil NO_3 is

Figure 5. Difference Between Baseline (May) and Final (November) Soil Samples with Three Treatments
The three treatments are control (green; no application), fertilizer (yellow; 3 urine applications totaling 10.9 kg P ha^{-1}, 192 kg N ha^{-1}), and water (blue; addition at equivalent liquid volume as urine (0.185 ha-cm)) for (A) available soil P (Mehlich-3), (B) soil NO_3, and (C) soil Na



Bars represent standard error. Letters denote significant differences among treatments ($p \leq 0.05$).

Table 1. Average Baseline and Final Soil Concentrations of P, NO_3, and Na, the Three Nutrients with Significant Treatment Effects

Treatment	Initial P	Final P	Initial NO_3	Final NO_3	Initial Na	Final Na
Control	15.3 (6.1)	15.1 (5.7) b	17.1 (1.4)	22.2 (1.5) b	24.2 (1.8)	34.9 (2.8) b
Fertilizer	19.0 (6.0)	23.0 (5.1) a	14.8 (3.8)	34.5 (8.4) a	24.8 (1.4)	52.1 (3.2) a
Water	19.0 (6.0)	17.9 (5.4) b	15.9 (1.7)	20.8 (2.6) b	25.9 (2.7)	29.9 (3.5) b

Concentrations are in parts per million (ppm) with standard error in parentheses. Different letters indicate statistically different changes in concentration (Tukey's HSD, alpha = 0.05).

expected. Given the high application rate, we may have expected an even greater increase in soil N, but much of the applied N may have volatilized quickly as N volatilization increases with temperature, wind, and dry conditions (Hargrove, 1988). Our sprayed applications at temperatures between 35℃ and 40℃ with dry winds and no immediate rainfall would have been likely to experience losses. A recent greenhouse study with human urine simulated losses to volatilization of greater than 50% of the N applied (Rumeau et al., 2023), and 31% of N was lost from urine fertilizer that was similarly broadcast-applied in a field trial (Noe-Hays, 2020), indicating that N losses should be further studied and mitigated. The increase in soil NO_3 is notable, as this form of N is readily utilized by alfalfa and would likely have a greater benefit for crops other than alfalfa that are not N-fixing. NO_3 is also a form of N easily leached from soil (Blumenthal & Russelle, 1996; Hussain et al., 2020). Perennial roots have been repeatedly shown to reduce N leaching by one to two orders of magnitude compared to annuals (Culman et al., 2013; Huddell et al., 2023; Jungers et al., 2019), underscoring the promise of pairing urine fertilizers with perennials to close nutrient cycles.

While increases in soil P and N boost soil fertility, the urine fertilizer also resulted in an agronomically undesirable increase in soil sodium (Na) (Figure 5C). Urine's unintended effect on soil sodicity, or the proportion of sodium relative to other cations in the soil, that has been documented in other studies is a concern, especially in semi-arid and arid regions such as Kansas (Kassa et al., 2018; Mnkeni et al., 2008; Rumeau et al., 2023; Sene et al., 2019). There were no treatment differences for any other nutrients, but changes under continuous application have not been fully explored and should be investigated further (Rumeau et al., 2023).

Advancing Nutrient Recovery from Urine Will Require Investment in Efforts to Educate, Understand Contaminant Risk, and Normalize the Practice

Staff members reported having an overall positive experience participating in urine collection, but the survey results revealed several key areas for investment to improve future efforts. Many participants learned about urine diversion and the need for more sustainable P sources in agriculture through exposure to this project. Our results corroborate previous findings that many people support urine diversion and reuse once they are exposed to the concept (Beler Baykal, 2019; Lienert & Larsen, 2010; Simha et al., 2021). However, nearly half of respondents were previously unaware of urine source separation as a solution to unsustainable nutrient management. One person mentioned that "prior to my participation, I imagined that the obstacles to implementing a project like this were simply too complicated in a culture that is so averse to waste recycling in general, so it was really exciting to see this idea put into action." Despite this study taking place at a research organization dedicated to sustainable agriculture systems, nearly half of participants reported that this project was their first exposure to information about current unsustainable P management and about how conventional wastewater treatment does not typically remove pharmaceuticals or organic pollutants (Fatta-Kassinos et al., 2011). This underscores the need for education on current unsustainable practices and the opportunity that urine diversion offers, particularly given that our results were consistent with findings from other studies that sustainability and conserving resources motivated participation in urine cycling projects (Lamichhane & Babcock, 2013; Simha et al., 2021).

Our surveys identified one potential barrier to participation in a urine diversion project: concern about contaminants from urine posing a health or environmental risk. This is consistent with previous studies and highlights the need for continuing research on the fate of pharmaceutical and other micro-pollutants, prioritizing contaminant mitigation strategies, and conducting participatory research to characterize what "safety" means to people (Lienert et al., 2003; McConville et al., 2023; Pahl-Wostl et al., 2003). As there were many questions posed in the surveys following the research seminar but few asked in person, we inferred that another potential barrier to participation may be social discomfort about asking clarifying questions. Other less frequent but common concerns cen-

tered around the unfamiliar collection device and uncertainty around when it is appropriate to participate while on medications, with a urinary tract infection, or while menstruating. We therefore believe that future projects will benefit from a collection unit design resembling familiar toilets, clear guidelines on when and how to donate, and an option to submit anonymous feedback and questions.

Lastly, one of the most important takeaways from our pilot study was the sense of personal agency that this project afforded participants. As a result of their experience, several people approached project facilitators to express an interest in collection units for their home. Also, many people reported that while they were initially disheartened by the huge challenges with P management, participating in this project was inspiring and gave them actionable steps that made a solution feel more accessible. In the post-project survey, one participant wrote, "It's really empowering to feel the literal parts of my body somehow contributing to the well-being of the ecosystem I am a part of, particularly when it's something typically considered unwanted 'waste.'"

Regulatory Challenges

One of our goals in reporting our experiences is to contribute to the feasibility of future projects. We would have benefited if there had been more prior project examples, particularly those that set a regional regulatory precedent. For the 2023 field season, we obtained written permission from the public health department to proceed with our small-scale study. In 2024, county regulators determined that no single individual had the authority to grant permission for an experiment involving applying human urine to soil, and we have faced significant challenges obtaining approval with no clear regulatory pathway for urine fertilizer in Kansas. To make progress in diverting nutrients from our waste system back to agriculture, we need national guidelines giving legal authority for municipal and state entities responsible for wastewater treatment and safety to consider urine separately from biosolids.

Conclusions

Three applications of urine successfully increased available soil P in a slightly acidic, silt loam soil, although the treatment had no effect on short-term aboveground biomass. This demonstrates the feasibility of pairing urine fertilizer with perennial crops as part of the strategy to increase circularity of critical nutrients such as P in the food system. Future research should explore biomass effects over multiple seasons, the forms that human urine P is incorporated into in the soil, nitrate volatilization losses, and the implications of sodium increases across locations and soil types. While the survey sample size was small and not generalizable, the results reinforce findings from similar studies that concerns about contaminants are most common and thus a potential barrier to adoption. Research on ways to mitigate pollutants and understand their effects should be prioritized. This pilot project also highlights the need for more awareness of and education about P management, wastewater treatment, and the potential of urine diversion and reuse as fertilizer. Additionally, policy that specifically defines urine separately from wastewater and development of a clear regulatory pathway for urine fertilizers in the U.S. are critical. We nonetheless saw that engaging with urine collection provides a sense of agency and helps people feel empowered in light of overwhelming environmental challenges. This study provides an example of a project that we believe can contribute to much-needed community-based and workplace projects at a larger scale in the U.S. moving forward.

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Appendix

Table A1. Initial Survey Questionnaire and Type of Answer Choices

No.	Survey statements	Answer choices
1	Did you watch the seminar?	Yes or no
2	Based on what you've learned so far about this project, how likely are you to donate your urine?	1–5 (unlikely to very likely)
	(3–5) If you plan to donate urine, why are you planning to do so?	Open ended
	(1–2) If you answered 1 or 2, why are you unlikely to donate?	Open ended
3	Do you have any concerns with donating your urine or with using urine as a fertilizer?	Open ended
4	If urine fertilizers are to be used on crops, which crops do you feel would be appropriate for this use?	Multiple choice
	a) all crops for which the nutrient profile meets their needs	
	b) forage crops used for animal feed	
	c) pasture	
	d) vegetable crops	
	e) fruits, berries, nuts	
	f) non-edible crops (such as flowers)	
5	Do you have any suggestions for how to improve this project? Is there anything that would make you feel more comfortable about participating?	Open ended
6	Anything else that you would like to share?	Open ended

Table A2. Final Survey Questionnaire and Type of Answer Choices

No.	Survey statements	Answer choices
1	Did you use a urine diverting toilet on campus?	Yes or no
	Based on this experience, how likely would you be to donate urine in the future?	1–5 (unlikely to very likely)
	At this point, do you have any concerns with donating your urine or with using urine as fertilizer?	Open ended
2	Did this project change your perception of the role or viability of urine as fertilizer in our current and future agricultural systems? If so, how?	Open ended
3	Do you see this project relating to our work at TLI? Please elaborate if so!	Open ended
4	Would you be interested in seeing this project continue?	Open ended
5	Did you learn anything through exposure to this project? If so, what did you learn? If not, why not?	Open ended
6	Did your participation in urine collection change your thoughts or feelings about your role in the ecosphere?	Open ended
7	Do you have any suggestions for how to improve this project if it is to be continued in the future?	Open ended

Table A3. Baseline and Final Soil Sample Nutrient Levels in Parts per Million (ppm), Reported as Treatment Averages with Standard Error Below in Parentheses

		P	Ca	K	Mg	Na	NH_4	NO_3	TN	TP
Initial	Control	15.3 (6.1)	2436.3 (142.2)	229.8 (15.9)	349.9 (41.3)	24.2 (1.8)	7.6 (1.6)	17.1 (1.4)	2010.8 (85.8)	498.5 (42.5)
	Fertilizer	19.0 (6.0)	2528.3 (129.1)	250.2 (16.3)	376.3 (34.6)	24.8 (1.4)	16.1 (4.7)	14.8 (3.8)	1940.2 (98.3)	547.5 (25.5)
	Water	19.0 (6.3)	2462.2 (120.8)	235.4 (17.9)	364.1 (36.1)	25.9 (2.7)	9.1 (2.6)	15.9 (1.7)	1866.4 (165.9)	454.5 (2.4)
Final	Control	15.0 (5.70)	2587.5 (198.1)	241.9 (28.3)	369.5 (49.1)	34.9 (2.8)	4.8 (0.7)	22.2 (1.5)	2214.7 (69.3)	475.3 (21.6)
	Fertilizer	23.0 (5.1)	2659.3 (172.2)	279.0 (43.6)	380.2 (42.2)	52.1 (3.2)	12.1 (6.7)	34.5 (8.4)	2186.4 (87.3)	531.5 (70.0)
	Water	17.9 (5.4)	2660.3 (152.3)	255.9 (23.2)	387.2 (35.3)	29.9 (3.5)	4.8 (0.4)	20.8 (2.6)	2061.3 (66.6)	496.3 (76.8)

Table A4. Results of the Mixed Model Analysis of Variance (ANOVA) F-statistic for Differences in Soil Concentrations of P, Na, and NO_3

	F - statistic		
ANOVA results	Average difference in P (ppm)	Average difference in Na (ppm)	Average difference in NO3 (ppm)
treatment	17.8 **	11.8 **	12.8 **

** Significant at the .01 probability level.

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Community-based compost distribution program's role in organic waste diversion and the circular food system

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Community-Based Circular Food Systems

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Abstract

Nearly one-third of the entire U.S. food supply is sent to landfills. As food decomposes, it emits methane, a potent greenhouse gas that fuels global warming. To reduce greenhouse gas emissions and create a more circular food system, states across the country are mandating food waste diversion from landfills through several mechanisms, including composting. In 2016, California passed Senate Bill 1383 (SB-1383), which requires organic (including food) waste diversion from landfills in part by mandating municipal procurement of recycled organic waste products. To comply with SB-1383, the city of Albany, California, established a Compost Distribution Hub in April 2023 in partnership with an urban community farm to distribute free compost to the farm and the community. This paper investigates the successes, challenges, and initial impacts of the Compost Distribution Hub in meeting SB-1383 requirements and contrib-

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uting to a circular food system, as well as a circular economy more broadly. Through 26 semi-structured interviews with implementing partners and community patrons and an analysis of the compost quality, we found the Compost Distribution Hub contributed to organic waste diversion requirements, provided additional social co-benefits, and contributed to the broader circular economy by recycling non-food organic waste. However, it did not contribute to a circular food system, as it sourced compost made from green waste rather than food waste. It also was unable to provide community education due to insufficient funds. To maximize community and circularity benefits, compost distribution programs must ensure that compost is sourced from food waste, incorporate community education, and dedicate funding for the educational efforts.

Keywords
compost, food waste, organic waste policy, compost distribution, Senate Bill 1383, circular food system, circular economy, climate change, qualitative study, case study, community-based circular food system

Introduction

Almost one-third (31%) of the entire U.S. food supply is sent to landfills where it releases methane, a potent greenhouse gas (GHG) that has at least 28 times the global warming potential of carbon dioxide (Agency for Toxic Substances and Disease Registry, 2001; Buzby et al., 2014; Intergovernmental Panel on Climate Change, 2023). In the U.S., landfills are the third largest source of anthropogenic methane emissions, with 58% of these emissions attributed to food waste (U.S. Environmental Protection Agency [EPA], 2023, 2024). In California, landfills—more than the agriculture, dairy, and oil and gas sectors—are the leading methane emitters, responsible for 41% of the state's point-source methane emissions (Duren et al., 2019). A major contributor to these landfill-associated methane emissions is the annual 6 million tons of food waste, which constitutes 17% of the total waste sent to landfills annually (CalRecycle, 2024).[1]

Applying the circular food system (CFS) principle of recycling food waste can be an effective strategy to curb GHG emissions (van Zanten et al., 2019, 2023). A CFS promotes planetary and human health by protecting natural resources and minimizing waste through reduction and reuse in the most sustainable way possible (Figure 1). The CFS concept derives from the circular economy (CE) framework, which has attracted significant attention from scholars and practitioners. The CE establishes closed-loop systems from production to consumption. It "tackles climate change and other global challenges, like biodiversity loss, waste, and pollution, by decoupling economic activity from the consumption of finite resources" (Ellen MacArthur Foundation, 2013, para. 1). Through a systematic literature review of 114 definitions, Kirchherr et al. (2017) defined a CE, in contrast to a "take-make-waste" linear economy, as:

> an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes. It operates at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accom-

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The research team is affiliated with both the University of California, Berkeley, and the UC Gill Tract Community Farm. The authors have no conflicts of interest that create actual, potential, or apparent conflict in roles of author.

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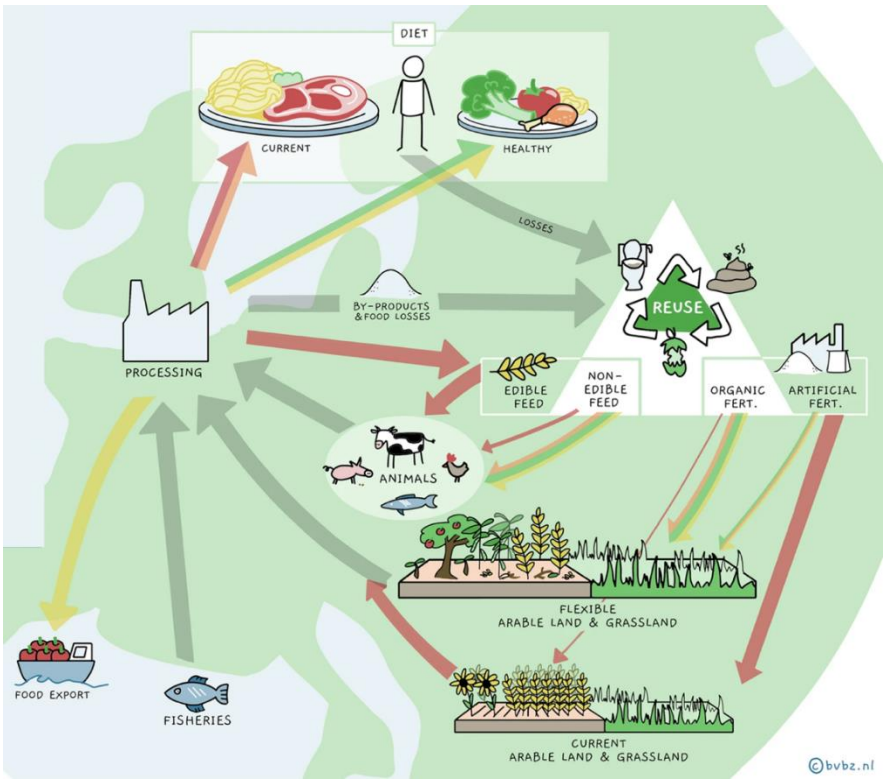
[1] Organic waste accounts for 28.4% of the total waste disposed of in California landfills. Non-food organic waste includes plant matter (leaves, branches, logs) and wood products (CalRecycle, 2024).

> plish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations. It is enabled by novel business models and responsible consumers. (p. 229)

A CFS applies principles of the CE to the food system, closing the loop between food production, consumption, and waste byproducts. Circular food systems can decrease land use, reduce GHG emissions, and provide sufficient food for growing populations. However, achieving this requires long-term, systemic planning and policies (Muscat et al., 2021; van Zanten et al., 2023).

Efforts across the U.S. to reduce methane emissions by diverting food waste from landfills are gaining traction. Nine states, including California, currently have food waste disposal bans (Concerning Organic Materials Management, 2022; Md. Code Ann., 2022; Jones, 2017; Sandson & Leib, 2019). All policies ban landfilled food waste from commercial and institutional entities that generate large amounts of food waste (e.g., more than 1 ton/week). However, California's policy, Senate Bill 1383 (SB-1383), is unique in that it also applies to residents and mandates that local jurisdictions[2] procure recycled organic waste products for distribution and use (Short-Lived Climate Pollutants, 2016). SB-1383, passed in 2016, aims to divert 75% of organic waste from landfills as part of California's broader goal to reduce emissions of short-lived climate pollutants, including methane. As of 2022, this law requires jurisdictions to procure 0.08 tons of recovered organic waste products per resident per year. These products can be used by the jurisdiction or distributed to third parties, such as farmers, businesses, and residents (California, n.d.).

Figure 1. Circular Food Systems Diagram



Adapted from van Zanten et al. (2023).

While recovered organic waste can take the form of compost, mulch, renewable gas, or electricity from biomass conversion, compost purchasing was identified as a primary strategy for meeting SB-1383 goals due to existing composting infrastructure and the myriad agricultural and environmental benefits compost offers (Abbs & Reul-Chen, 2018; CalRecycle, 2020; Recovered Organic Waste Product Procurement Target, 2020). Applying compost derived from organic waste to farmland can significantly contribute to improved soil health and support SB-1383 goals, such as reducing state GHG emissions. However, not all farmland requires annual compost application, so

[2] Local jurisdictions are defined as cities, counties, or local government agencies with regulatory authority over waste management service.

alternative methods for distributing compost must be identified (Harrison et al., 2020).

One compost utilization opportunity is to return it to the residents who generated its organic waste inputs. However, there is public concern about the quality and safety of compost produced from municipal food and yard waste (Zuniga, 2022). For example, Hall et al. (2023) note that urban residential yard waste may contain higher levels of lead dust from buildings painted before 1978. Furthermore, organic waste from public parks can contain high levels of pesticides or herbicides (Hood, 2006; U.S. EPA, 2013). The U.S. EPA also identified per- and poly-fluoroalkyl substances (PFAS) in compost derived from food waste and compostable food packaging and found that compost made from food and green waste had higher PFAS concentrations than compost from green waste alone (Choi et al., 2019; Kenny, 2021). Therefore, it is critical to assess municipal compost quality and safety as its use becomes mandated.

Analyses of SB-1383's implementation and effects to date are limited and focus primarily on technical challenges municipalities have with meeting procurement requirements and capacity limitations of composting infrastructure (Harrison et al., 2020; Mann, 2024). In this case study, we analyze: the successes and challenges of an urban, community-based, and free compost distribution program in Albany, California[3]; how and to what extent it fulfills SB-1383 organic waste procurement requirements; and its role in the CFS and CE more broadly. As more states implement food waste diversion laws, it is crucial to understand how to achieve these policies' goals through the lens of the CFS and CE, as well as recognize the downstream effects on stakeholders and communities, whose involvement is essential.

Methods

We recruited stakeholders of the Albany Compost Distribution Hub in Albany, California. We conducted semi-structured interviews and demographic surveys with them to identify the program's successes, challenges, and initial impacts. Additionally, we tested the compost to determine its safety and quality. Details of our methodology are described below.

Site Selection

The Albany Compost Distribution Hub ("the Hub") was established in April 2023 in partnership with the University of California (UC) Gill Tract Community Farm ("the Farm"), UC Berkeley, the city of Albany, California, and StopWaste of Alameda County. At the time of the study, the Hub was located on the southeastern and primary entrance of the Farm (Figure 2) and was open Sundays from 12-4 pm. During the Hub's open hours, anyone from the public could pick up compost for free without a residency requirement. Visitors could take as much compost as they liked, either by shoveling it into personal containers or into burlap bags provided by the Farm. Signage at the Hub directed visitors to complete a liability waiver and a survey administered by the city of Albany. StopWaste also provided an educational pamphlet about making and using compost that was available for visitors to take. During the study period, T.B., K.C., and I.C. staffed the hub to assist patrons and answer questions while simultaneously recruiting study participants. Data collection occurred from June to August 2023, shortly after the Hub opened.

The Hub was chosen as the site of interest due to the researchers' connections with UC Berkeley and the Farm, as well as its status as a relatively early example of SB-1383 implementation. At the time of the study, T.B. was a master's student at UC Berkeley and a volunteer at the Farm, K.C. was a doctoral student, and I.C. was an undergraduate student at UC Berkeley; none of them were previously connected with other partner entities. J.S. was a faculty member of UC Berkeley and the faculty advisor for the Farm. All research complied with UC Berkeley's IRB approval (IRB approval #2023-03-16203).

Survey

The city of Albany administered a survey to all Hub users through a QR code posted at the Hub (Appendix A) to assess how often users visited and their interest in staying connected with the Farm.

[3] The City of Albany is a relatively small San Francisco–Bay Area city of about 19,000 residents (U.S. Census Bureau, n.d.).

Figure 2. The Albany Compost Distribution Hub was located at the primary entrance of the UC Gill Tract Community Farm in Albany, California (City of Albany, CA, n.d.).

Visitors could complete the survey in English, Spanish, Mandarin, or Arabic. This survey was administered separately from our qualitative interviews, and the city of Albany provided us with anonymized survey responses. We calculated the frequency of multiple-choice answers and categorized open-ended responses by theme for responses between April 23 and August 13, 2023 (16 weeks).

Qualitative Interviews

Participants were recruited via purposive sampling, after which we conducted semi-structured interviews with them. We created interview guides, coded transcripts, and analyzed themes iteratively, as described below.

Sampling and Recruitment

We recruited participants who visited the Hub to utilize its services (users) and those who were involved in the Hub planning and implementation (implementers) between June and August 2023. "Users" included community members who visited the Hub during the study period and collected compost for their personal use (e.g., at home). We recruited users on-site during Hub open hours and invited them to participate in an in-person interview during the Hub's open hours or via phone at another scheduled time. "Implementers" included individuals employed by or associated with an implementing partner entity: the Farm, UC Berkeley, the city of Albany, and StopWaste. Due to the research team's connections with the Farm, we either knew these individuals personally or were referred to them. We emailed them to schedule virtual or in-person interviews. All participants provided verbal informed consent per Institutional Review Board approval and were offered a US$15 gift card as compensation. We offered interviews in English and Spanish, but no one chose to be inter-

viewed in Spanish. All participants were 18 or older.

Semi-Structured Interviews

Interview guides were developed through an iterative process. "User" interview guides focused on experiences with composting, reasons for utilizing the Hub, experiences with the Hub, intended or actual compost use, and opinions of educational resources. "Implementer" interview guides focused on successes and challenges during Hub planning and implementation, key program partnerships, perceptions or knowledge of compost source and quality, and Hub contributions to SB-1383 (Appendix B). T.B., K.C., and I.C. conducted semi-structured interviews in-person, by phone, or by video conferencing (Zoom Version 5.15.5). All interviews lasted no longer than one hour and concluded with a sociodemographic questionnaire (Appendix C). Interviews were audio-recorded and transcribed using either Zoom (Version 5.15.5) or Otter.ai (Otter, 2023), followed by manual review by the research team to ensure accuracy. Users and implementers are identified numerically based on interview order.

Data Analysis

The codebook was developed deductively and inductively through an iterative process (Saldaña, 2009). T.B. and J.S. drafted a preliminary codebook prior to data collection, and T.B., K.C., and I.C. added emergent codes following preliminary coding. All interview transcripts were coded by T.B., K.C., and I.C. using Taguette software (Rampin & Rampin, 2021). Each interview was coded by two research team members who compared findings and discussed discrepancies. A third team member was consulted to resolve any discrepancies. All researchers analyzed the codes using thematic analysis, with data collection and analysis occurring simultaneously (Vaismoradi et al., 2016).

Compost Analysis

Due to public concerns about the quality and safety of municipal compost, the research team investigated the compost's source and tested it for nutrient levels and contaminants. The city provided the name of the compost vendor and product, which allowed us to identify the producer and distributor. We compared compost descriptions from the vendor, producer, and distributor to determine its feedstock, production process, and physical qualities. The city of Albany provided documentation of the volume of compost delivered to the Hub from April 2023 to April 2024.

We tested compost samples from three different compost deliveries in June, July, and August 2023. Each composite sample was composed of six subsamples from different locations in each compost pile at a depth of one foot. Brookside Laboratory Inc. (New Bremen, Ohio) processed the samples to measure nutrient content (nitrogen, phosphorus, potassium, carbon/nitrogen ratio), physical and chemical media properties (mineral content, moisture, pH), and heavy metal content (lead, cadmium, chromium, arsenic).

Results

We begin with a summary of user and implementer sociodemographics, followed by key successes, challenges, benefits, and limitations of the Hub in achieving SB-1383 goals, a circular food system, and a circular economy. From our analysis, five core themes emerged: (1) cross-disciplinary partnerships were key to success but caused delays; (2) educating Hub users was a primary goal but fell short; (3) the Hub was easy to use with room for minor improvements; (4) the Hub was perceived as a high-value program that contributed to SB-1383 procurement requirements and met consumer demand; and (5) the Hub did not close the loop in the circular food system but did reflect broader circular economy principles and aims.

User and Implementer Demographics

During the first four months of the Hub's operation, there were 156 responses to the city-led survey, averaging almost 10 users per week. However, this likely underrepresents the total number of Hub users, as not all visitors completed the survey. Of the users (n = 15) and implementers (n = 11) interviewed, the majority were white and female-identifying (Table 1). Compared to users, implementers were slightly more educated and had higher incomes. None of the implementers lived in Albany, whereas over half of the users did. A

higher percentage of users and implementers were white (73.1%), female-identifying (65.4%), and held a bachelor's degree or higher (92.3%) compared to Albany residents (44.2%, 52.3%, and 75.2%, respectively) (U.S. Census Bureau, n.d.). In contrast, the median income of both users and implementers (between US$75,000-$90,000) was lower than that of Albany (US$124,469).

Theme 1: Cross-disciplinary partnerships were key to success but caused delays.

Four key stakeholders were involved in establishing and implementing the Hub. The UC Gill Tract Community Farm is a volunteer-run, 2-acre urban farm established in 2012 in Albany, California, that focuses on agroecological farming, food justice, and food distribution (Darling, 2014; UC Gill Tract Community Farm, n.d.). It was responsible for physically hosting the Hub and notifying the city when the compost supply was low. UC Berkeley is a public university in Berkeley, California, that owns the land upon which the Farm resides and was responsible for final approval of the Hub. The city of Albany's role was to acquire funding, order compost, and meet SB-1383 procurement requirements. StopWaste, a countywide agency that aims

Table 1. Sociodemographics of Albany Compost Distribution Hub Users (*n* = 15) and Implementers (*n* = 11) Interviewed

	Users (*n* = 15)	Implementers (*n* = 11)	Total (*n* = 26)
Age (mean ± SD)	44.40 ± 16.84	37.82 ± 12.75	41.62 ± 15.32
Gender identity/ies[a], *n* (%)			
Female	9 (60.0)	8 (72.7)	17 (65.4)
Male	4 (26.7)	1 (9.1)	5 (19.2)
Non-binary/Genderqueer/Agender	2 (13.3)	3 (27.3)	5 (19.2)
Prefer not to say	0 (0.0)	2 (18.2)	2 (7.7)
Racial/ethnic identity/ies[a], *n* (%)			
White	11 (73.3)	8 (72.7)	19 (73.1)
Asian/Pacific Islander	3 (20.0)	1 (9.1)	4 (15.4)
Black	1 (6.7)	1 (9.1)	2 (7.7)
Hispanic/Latinx	0 (0.0)	1 (9.1)	1 (3.9)
Highest level of education, *n* (%)			
Some college/associate's degree	2 (13.3)	0 (0.0)	2 (7.7)
Bachelor's degree	8 (53.3)	7 (63.6)	15 (57.7)
Advanced degree	5 (33.3)	4 (36.4)	9 (34.6)
Household income level, *n* (%)			
<US$24,999	1 (6.7)	1 (9.1)	2 (7.7)
US$25,000–$49,999	3 (20.0)	1 (9.1)	4 (15.4)
US$50,000–$74,999	3 (20.0)	1 (9.1)	4 (15.4)
US$75,000–$99,999	2 (13.3)	3 (27.3)	5 (19.2)
>US$100,000	4 (26.7)	5 (45.5)	9 (34.6)
Prefer not to say	2 (13.3)	0 (0.0)	2 (7.7)
Residential distance from Hub (mi[b]), *n* (%)			
<1	8 (53.3)	0 (0.0)	8 (30.8)
1–4.9	3 (20.0)	5 (45.5)	8 (30.8)
5–9.9	3 (20.0)	3 (27.3)	6 (23.1)
≥10	1 (6.7)	3 (27.3)	4 (15.4)

[a] Respondents could select all that apply.
[b] Metric conversions: <1.0 mi = <1.6 km; 1.0–4.9 mi = 1.6–7.9 km; 5.0–9.9 mi = 8.0–15.9 km; ≥10 mi = ≥16.0 km

to educate the public about waste reduction, provided pamphlets about home composting, trained Gill Tract volunteer farmers in composting, and facilitated partnerships, particularly between the Farm and the city of Albany (Alameda County Waste Management Authority, n.d.). The Hub's colocation at a community farm fostered interdisciplinary partnerships among the farm, university, city, county, and community, all of which were critical for program success. Implementers recommended that future hubs similarly be city-funded and located at a community farm, with a neutral third-party facilitating stakeholder relationships.

These partnerships were not only essential to the Hub's success but also a key outcome, especially considering the lack of prior relationships between stakeholders. The Farm shared, "it was also nice to feel legitimized by the partnerships … with the city and with public agencies … wanting to work with us and recognizing … our leverage in the community" (Implementer 10). Implementers noted they hope these partnerships will foster more collaboration in the future.

The Hub also strengthened the Farm's relationship with the community, supporting the Farm's mission to be a community resource for food and education (UC Gill Tract Community Farm, n.d.). Hub users who had not previously visited the Farm expressed interest in becoming involved. Almost half (44.9%) of user survey respondents indicated interest in receiving emails about Farm events, 13.5% donated to the Farm, and 10.9% indicated interested in volunteering. Additionally, interviewed users felt invited to explore the land, learn about plants, and shop at the farm stand—a donation-based market open during the Hub's operating hours that offers herbs, produce, and flowers grown at the Farm. A first-time visitor shared, "I'm gonna walk through … because I've never had the opportunity to come inside and see [the Farm]. … I'm just so glad that it's here so I could see different things that I might not have even thought about planting" (User 6).

Involving different types of partners also meant operating within and across different decision-making structures, which caused significant delays. Establishing the memorandum of understanding (MOU) that was required to create the Hub took 18–24 months and required extensive communication within and among all the stakeholder groups. One implementer noted that there was an email chain with over 400 emails that became difficult to follow. They also pointed out:

> Part of the challenge was we have three organizations that were all pretty different in their structure. You know, the UC Berkeley is just this vast … just a huge organization. They do a lot of things. This is a pretty small piece of a kind of overall pie, right? … And then we've got the farmers who have, you know, more of a really collaborative, small-scale organizational structure where it's a lot of, you know, everybody agreeing on things together, and large group meetings. … And then we have the city, which is like a smaller bureaucracy. So, kind of coordinating between those three different models was really interesting and kind of tricky, because things move at, like, really different speeds between them. And then you have like kind of different needs. … We have to like move the MOU up the ranks of hierarchy along the UC side, and then we also have to like, have a group meeting with all the farmers to talk about it, and then, you know, bring it to the [City] Council, and, like, have all—all of these different kinds of bodies agree on a format. (Implementer 2)

To streamline planning for future hubs, implementers recommended that all partners ensure they are on the same page by clearly communicating their goals and establishing clear channels of communication from the start.

Although the planning process was delayed, the program was ultimately a "win-win-win" with "it [working] in everybody's interests" (Implementers 9 and 5, respectively). For example, the program contributed to the city's SB-1383 procurement requirements, the Farm accessed free compost and strengthened relationships with the community, UC Berkeley engaged six students in the program's planning, implementation, and evaluation, and StopWaste facilitated stakeholder relationships. One implementer shared:

> Throughout all those organizations, everybody was really excited about the project and wanted to make it happen, and it was, like, really mutually beneficial for everyone. And so, when we were able to kind of all connect on the same vision, then it was, like, really powerful and really cool to make that happen. (Implementer 2)

Theme 2: Educating Hub users was a primary goal but fell short.

Implementers intended for the Compost Distribution Hub to also serve as an educational hub. They aimed to install signage and hold workshops and demonstrations to educate the community about compost use, at-home composting, waste sorting, waste diversion, and SB-1383. The Farm was primarily responsible for educational programming but received insufficient funds from the city to realize these goals. The only formal education incorporated into the Hub during the research period was StopWaste's educational pamphlet on making and using compost. The pamphlet, however, was rarely noticed and largely ignored, suggesting a need for more effective educational strategies, as exemplified by this response: "I have not paid any attention to [the pamphlet] because I was so excited about [the compost]" (User 6). Given budget constraints, implementers recommended future Hubs be designed as educational sites from the outset, with additional funding allocated to support educational efforts.

Some implementers also saw the Hub as an opportunity for the public to witness the results of curbside organic waste collection and waste sorting. They believed if residents saw the consequences of improper waste sorting, such as plastic or glass in the compost, it would motivate them to improve their at-home waste sorting practices. However, this was not achieved because the compost distributed was not made from municipal food waste, which is further discussed in Theme 5.

Although participants did not cite education as a reason for visiting the Hub, they expressed interest in learning about the compost's nutrient content, its inputs (particularly food waste), compost use, and the involvement of both the Farm and the city of Albany in the program. They recommended creating flyers and hosting workshops, with one user suggesting:

> One thing that would improve the Hub [was] if there was an explanation of the whole thing. I was curious to know, where did this compost come from? Am I paying for this with my tax dollars, you know, to the city? … And maybe there should be some kind of signage or something on the website that explains the whole thing, because I definitely felt more inclined to come back and get another load when I found out the city is paying for this, and anyone can take it. … It should be an educational experience. It needs to be more than just, "we get free dirt." (User 14)

Theme 3: The Hub was "easy to use" with room for minor improvements.

Users consistently highlighted the Hub's accessibility, citing its welcoming and helpful staff, ease of use, and location. The Hub was straightforward and "easy to use" (User 2) with minimal wait time and available parking: "I think it's very good, and I'm happy with the results, the product. And the people have been really nice so, can't say anything much more than that" (User 7).

However, users noted several challenges prior to their visits, including uncertainty in the process, concern about wait times and compost availability, and limited hours of operation: "If there was compost where you could just come anytime and pick it up, that would be easier because I bike here … a lot. And I see the compost, but I'm usually not here on the weekends [during the Hub's open hours]" (User 2). Implementers similarly want to increase the Hub's hours of operation, but the Farm is limited by volunteers available to staff the Hub:

> I would like to see us a little bit more organized in how we staff it. It would be cool to be able to have it open more often, though that doesn't seem really feasible right now. … Sometimes people will sign up to bottom-line things, and then they're unavailable, which is understandable, because this work is happening, like, at their own volition. There isn't a

> whole lot of incentives behind people showing up to do this work. So, when other things call on them in life, farm work is one of the first things to kind of fall to the wayside. (Implementer 10)

Theme 4: The Hub was perceived as a high-value program that contributed to SB-1383 procurement requirements and met consumer demand.

All compost distributed at the Hub, whether taken by the Farm for use on-site or by users for their personal use elsewhere, contributed to the city's SB-1383 procurement requirements and met consumer demand for compost. During the first 12 months of operation, the Hub distributed a total of 160 cubic yards of compost, equating to about 110 tons of organic waste product procurement.[4] This accounted for approximately 7% of Albany's annual SB-1383 procurement requirements, or the per-capita requirement for 600 of the estimated 19,000 Albany residents.[5]

The Hub was viewed as a low-input, high-value program compared to alternative compost distribution methods, such as annual compost giveaways, which can be time- and resource-intensive:

> Every year [the city of Albany has] a compost giveaway event where we get bagged compost, and there's a huge line of cars, and we have public works people load it into the cars and … it takes weeks to set up. We have to do all of this, you know, mailers about it. We have to staff it. It's like this huge thing. It's a ton of time, and we don't get rid of as much compost. (Implementer 2)

In contrast, the Hub required little time and city personnel beyond the planning stage, and yet it achieved social benefits in addition to SB-1383 goals, such as engaging the community with the Farm and fostering interdisciplinary stakeholder partnerships. Users also preferred the Hub over other local compost giveaway programs due to the former's accessibility and built-in support.

Implementers supported SB-1383 goals to divert organic waste from landfills, reduce GHG emissions, and distribute compost to the community. However, they experienced challenges achieving them, including a lack of composting infrastructure that made it difficult to find a compost vendor; the city's high-density population that caused a procurement requirement disproportionate to the amount of land to which compost can be applied; and a lack of state funding to fulfill the mandate. Albany ultimately funded the Hub via a countywide landfill tonnage tax established in 1990 known as Measure D. As of 2021, the county charges US$8.23/ton for all waste sent to the landfill. The revenue generated is allocated to StopWaste for countywide recycling efforts, including SB-1383-mandated organic waste recycling programs like the Hub (Alameda County Waste Management Authority, 1990, 2021). For implementers, working toward SB-1383 compliance was difficult but necessary:

> The spirit behind [SB-1383] is coming from a great place. Like this is what we should be doing. It's the right thing. I think the systems to achieve the desired outcomes of SB-1383 aren't quite there yet. There's still a lot of troubleshooting to do, a lot of figuring out to do. (Implementer 11)

Despite these challenges, implementers felt SB-1383 was valuable in that it mobilized the city to create community-based compost distribution programs—a model StopWaste had considered for over a decade.

Theme 5: The Hub did not close the loop in the circular food system but did reflect broader circular economy principles and aims.

During the research period, the Hub provided industrially produced compost processed from yard trimmings and certified by the Organics Material Review Institute (OMRI). The Farm selected this

[4] This conversion is based on the CalRecycle standard conversion of 1.45 cubic yards of compost equating to 1 ton of organic waste product (CalRecycle, n.d.)

[5] This percentage represents the compost distributed at the Albany Compost Distribution Hub from April 2023 to April 2024.

vendor and product based on the Farm's prior relationship with the vendor, its desire to support a local, people-of-color-led business, and the perceived quality of the product. When both the research team and implementers inquired about the source and content of the compost, however, the vendor was not forthcoming with accurate information. They provided conflicting and outdated information about the compost source and feedstock, which led to confusion and a desire for more transparency:

> This information [about compost inputs and feedstock] is really important for us to know. And I had wanted to know the same things at the get-go, and I was running into similar barriers, or it just seemed like it was kind of like shrouded purposely. But also not necessarily. … I think it would be a service to [the customers] to like, really push [the vendor] to provide this information, considering that, like across the state, people are becoming more aware of the products that they're using and like, they just need to have that information available. And just on our part to like to insist, because it's great to support a really local business and a minority-owned business, but at the same time, like there are certain things that we would like in exchange for that business. And transparency is one of them. (Implementer 10)

Ultimately, the compost producer informed the research team that the feedstock was 100% recycled yard trimmings from local landscaping and landscape supply companies. It did not include any food waste. Therefore, the Hub did not contribute to closing the food waste loop, but it did contribute more broadly to CE aims of recycling organic byproducts through their landfill diversion, processing, and distribution to the public.

Compost testing revealed a relatively consistent product across the study period. Table 2 compares the Hub's averaged samples with standard ranges of pH, moisture content, organic matter, and various nutrients for mature compost (Crohn, 2016; Sullivan et al., 2018; U.S. Composting Council, 2001b, as cited in Sullivan et al., 2018). Most nutrient levels fell within the standard ranges, indicating that it is a beneficial amendment for increasing soil organic matter and nutrient levels. However, average potassium levels and moisture content were slightly below the standard ranges. Furthermore, one sample exceeded both the California regulatory limit and EPA limit for arsenic (41 mg/kg) (Crohn, 2016; Maximum Metal Concentrations, 1995; U.S. EPA, 2024b) (see Table 3). Although two samples were well below the limit, the elevated sample exceeded it by more than 8 mg/kg. See Appendices D and E for the full compost testing results.

Table 2. Albany Compost Distribution Hub Compost Properties Compared to Standard Ranges for Mature Compost

Property	Albany Compost Distribution Hub average	Standard range for mature compost [a]
pH	7.71	6.0–8.5
Moisture (%)	32.27	40–60
Organic matter, % dry weight	51.77	25–65
C:N ratio	20.98	>20 [b]
Total Nitrogen, % dry weight	1.32	1.0–2.0
Phosphorous, % dry weight	0.75	0.3–0.9
Potassium, % dry weight	0.46	0.5–1.5
Calcium, % dry weight	3.21	1.5–3.5
Magnesium, % dry weight	0.64	0.25–0.7
Sodium, % dry weight	0.16	<0.6
Sulfur, % dry weight	0.30	0.25–0.8

[a] Crohn, 2016; Sullivan et al., 2018; U.S. Composting Council, 2001b, as cited in Sullivan et al., 2018
[b] The Standard C:N ratio range for woody composts was used since compost feedstock was landscape trimmings.

Discussion

In this qualitative case study, we examined the contribution of an urban, community-based compost distribution program to state-mandated organic waste recycling requirements and the circular food system. Our findings show the Albany Compost Distribution Hub made modest contributions to the city's SB-1383 procurement requirements and generated additional social co-benefits. Interdisciplinary partnerships and city funding were key to establishing a

Table 3. Albany Compost Distribution Hub Heavy Metal Analysis Compared to California Regulatory and EPA Limits

Element	Date Collected			California Regulatory Limit (Crohn, 2016)	EPA Limit (U.S. EPA, 2024b)
	6/18/2023	7/23/2023	8/16/2023		
Arsenic (mg/kg)	<2	<2	49.3	41	41
Cadmium (mg/kg)	<0.5	0.7	0.6	39	39
Chromium (mg/kg)	0.127	0.155	19.1	1200	-
Lead (mg/kg)	8.5	12.6	18.6	300	300

community-based Hub that was accessible and provided free compost to the public. However, the lack of funding for education and the distribution of compost sourced from yard trimmings, rather than food waste, prevented the program from realizing its full potential. It did not close the circular food system loop, but it did contribute to and highlight key principles, aims, and drivers of the circular economy more broadly.

Although systematic studies assessing different types of municipal compost distribution programs are lacking, such programs do exist throughout the U.S. Some cities have annual giveaways of bagged compost, but these events require significant time, effort, and resources to organize, often impose residency requirements, and are available on a limited basis (City of Albany, CA, n.d.; City of Hayward, n.d.; New York City, n.d.). There are also year-round distribution sites, but they are often not staffed, require patrons to bring their own tools to load compost, and are not based within a community farm, limiting the accessibility and social and educational benefits of the program (Albany, NY, n.d.; City of Berkeley, n.d.; City of Los Altos, n.d.). In contrast, the Albany Compost Distribution Hub's co-location at a community farm, staffing, regular open hours, and lack of a residential requirement sets it apart from others—a model both implementers and users preferred.

Hub users have the desire to learn, and implementers have the expertise to educate about program logistics, compost use and gardening, food waste sorting, and SB-1383. This match between community desires and implementer capabilities indicates high potential for educational impacts at the Hub. However, funding is necessary to realize this potential. Indeed, an SB-1383 analysis found that educating the public about the bill's goals and their importance, with support of state funding, is critical to the bill's success (Little Hoover Commission, 2023).

Our finding that implementers experienced challenges identifying compost vendors coincides with the well-documented lack of composting infrastructure in California (CalRecycle, 2020; Harrison et al., 2020; Little Hoover Commission, 2023; Mann, 2024). Of the 27 million tons of California's annual organic waste that must be diverted from landfills to meet SB-1383's 2025 goal, the state only has the capacity to process 10 million tons at existing organic waste processing facilities (CalRecycle, 2020). To fill this gap, California needs 75 to 100 more composting facilities (Harrison et al., 2020, 2024). Community compost distribution hubs like Albany's could incentivize infrastructure development by increasing public demand for the final product and guaranteeing an end-use destination as infrastructure and supply grows (CalRecycle, 2020). In fact, consumers are a key enabler of the CE, driving the demand-side of the supply chain (Kirchherr et al., 2017). The state, therefore, should coordinate these efforts with local jurisdictions to enhance compost procurement and grow the end-use market (CalEPA, 2018).

Given the public perception that municipal compost has a higher risk of contamination than other sources of compost, transparency around feedstock is vital in public compost distribution programs. Indeed, studies have shown that municipal organic waste can have high levels of contaminants, especially plastics and lead, that pose risks to human health and the environment (Farrell & Jones, 2009; Okori et al., 2024). Industrially pro-

duced compost processed from municipal organic waste has more contamination than smaller-scale composting systems due to lower degrees of quality control over the feedstock (Barboza et al., 2011; Barrena et al., 2014; Cattle et al., 2020; Farrell & Jones, 2009; O'Connor et al., 2022). The city of Berkeley's free compost distribution program provides a model of a CFS and source transparency, acknowledging the consumer as the most central enabler of circular business models (Gallaud & Laperche, 2016). The city publicly discloses the compost supplier and its content, which is a mixture of food and yard waste from Berkeley's curbside collection program. It also highlights several third-party quality assurance certifications attesting to the safety of their compost, thereby building public trust and encouraging usage (Zuniga, 2022). Public demand for contaminant-free compost and increased transparency, alongside the mandated procurement of final compost products, may improve contaminant removal at composting facilities (CalRecycle, 2020).

While the yard waste compost at the Hub had beneficial nutrient properties, it also had elevated levels of arsenic. Natural soils typically contain arsenic levels ranging from 1 to 40 mg/kg, but natural arsenic levels across California range from 0.6 to 11 mg/kg. This suggests the elevated arsenic content in the compost is likely not due to natural soils but rather from arsenic use in herbicides and the lumber industry (Agency for Toxic Substances and Disease Registry, 2007; Bradford et al., 1996; Chung et al., 2014). This arsenic contamination indicates that, despite the quality testing required to qualify as compliant with SB-1383, compost can still be a source of soil contamination. These results align with existing literature identifying green waste as a source of significant chemical contamination (Rainey et al., 2020).

Ultimately, the Hub contributed to several core aims of the circular economy, including enhanced environmental quality (e.g., end application of compost to urban farmland), economic prosperity (e.g., free compost for urban consumers and farm), and social equity (e.g., support of a minority-owned local business, free community access to compost, increased visibility and legitimacy of a social justice mission-driven community farm through strengthened relationships with the city and university). Recycling yard and landscape trimmings into compost also reflects the 4 Rs of Reduce, Reuse, Recycle, and Recover, a core principle of the CE. Furthermore, the Hub met consumer demand by providing an end-use destination for compost supply and benefitted current and future generations through the training of students, both of which are important but often excluded aspects of the CE (Kirchherr et al., 2017). However, it missed the mark in CFS.

To close the circular food system loop, the Hub would need to procure compost sourced from municipal food waste. SB-1383 currently allows compost to be sourced from either green or food waste (Green Material and Vegetative Food Material Processing Requirements, 2025). However, California could instead require compost facilities to source feedstock from municipal food waste only and not green waste, such as yard trimmings. This would ensure future Hubs only distribute food waste compost, thereby closing the CFS loop.

To further localize this process, community compost distribution programs could also collect residential food waste and compost it on-site. California's AB-2346 amendment, passed in September 2024, allows community- and on-farm-produced compost to count toward SB-1383 procurement requirements (Organic Waste Reduction Regulations, 2024). These changes promote community-based solutions, such as community composting, which is more cost-effective and has additional environmental, economic, and social benefits compared to industrial composting (Brown, 2023; Pai et al., 2019).

Limitations and Future Research

Our study has several limitations and suggestions for future research. First, the small sample size limits the scope of our findings. However, this was intentional and proportional to the limited number of potential study participants. Replicating this study with multiple program locations and a larger sample size would contribute more robust and generalizable findings on community compost distribution programs. Second, efforts to recruit linguistically diverse participants were unsuccessful, and participants were predominantly white and edu-

cated and had relatively high incomes. As a result, the generalizability of our findings is limited with regards to the social equity dimensions of a circular economy. Further research is needed on the socio-economic, health, and environmental justice impacts of compost distribution programs.

Further studies on community-based compost distribution programs that incorporate municipal food waste as compost feedstock, along with public educational components, are also needed. These studies would provide valuable insights into how such components could contribute to closing the urban food system loop. Evaluations of such programs' impacts on long-term CFS goals, such as increasing home food production, soil carbon sequestration, and at-home food waste separation, would also help inform best practices for planning and implementing such programs. Furthermore, SB-1383 procurement requirements intend to create a circular system in which organic waste becomes a resource, but compost contamination levels, especially for currently unregulated contaminants like microplastics, are not yet clear and can hinder compost utilization. Therefore, additional research on the quality, public perception, and use of municipal organic waste compost is necessary.

Conclusions

This qualitative case study has identified the successes, challenges, and initial impacts of a community-based compost distribution hub in meeting California SB-1383 procurement requirements and contributing to a circular food system and a circular economy more broadly. Our findings indicate that compost distribution hubs co-located at urban community farms can be a low-maintenance, high-impact strategy for local jurisdictions to provide free resources to the public, support community organizations, and meet organic waste procurement requirements. Our case study illustrates the power of cross-sector partnerships in implementing climate mitigation efforts and the value of urban consumers as critical drivers of the circular economy. However, to more effectively achieve a circular food system and climate change mitigation goals, compost distribution programs must source compost made from municipal food waste. Coupling these programs with public investments in educational programming about gardening, compost use, and at-home food waste sorting would also contribute to a more robust circular food system.

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Appendices

Appendix A. Albany Compost Hub Check-in Survey and Responses

Albany Compost Hub Check-in Survey

Language?
a. English
b. Español
c. 普通話/國語
d. العربيَّةالعربيَّة

Please do this survey every time you take from the Compost Hub.

Thank you for participating in the Albany Compost Hub at Gill Tract! This hub is a partnership of the City of Albany, UC Berkeley, the Gill Tract Community Farm Coalition, and StopWaste.

What city do you live in?
a. Alameda
b. Albany
c. Berkeley
d. El Cerrito
e. Emeryville
f. Kensington
g. Oakland
h. Piedmont
i. Richmond
j. San Pablo
k. Other in Alameda County
l. Other outside of Alameda County

What is your zip code?
(free response)

Have you taken compost from this Compost Hub before?
a. Yes
b. No

How are you using the compost? (Multi-select)
a. Landscape plants, shrubs, and tree care
b. Grow fruits and vegetables
c. Container gardening
d. Compost tea
e. Sheet mulching
f. Topdressing
g. Digging in
h. Lawn Care
i. Other … (type-in)

How are you taking the compost with you? (Multi-select)

a. Buckets
b. Reusable bags
c. Borrowing container from Compost Hub
d. Tarps
e. Car
f. Public Transportation
g. Bike with wagon
h. Other… (type in)

How did you first hear about the Gill Tract Compost Hub?

a. Gill Tract Farm
b. UC Berkeley
c. City of Albany
d. StopWaste
e. Other Compost Hub Site
f. Friend or family
g. Other… (type-in)

Are you interested in any of the following ways to connect with the Farm? (multi-select)

a. Get email updates about events and workshops at the Farm
b. Volunteer at the Farm
c. None

If you checked any of the boxes above, please write your name and email so we can reach out.
(type-in)

Donations to Gill Tract in support of the compost hub are greatly appreciated and ensure its sustainability. We also want everyone who needs compost to take it, regardless of ability to donate!

A bag of organic compost sells for $7-45 retail. Donations can be made in cash at the Sunday farm stand 2:30-5pm, or online here: https://www.flipcause.com/secure/donate/Njg0Nzl=

Will you be making a donation?

a. Yes
b. Not this time

Albany Compost Hub Check-in Survey Responses

	Number	Percentage
Language	*n* = 156	
English	152	97.44%
Spanish	3	1.92%
Chinese	1	0.64%
Arabic	0	0.00%
What city do you live in?	*n* = 156	
Alameda	1	0.64%
Albany	76	48.72%
Berkeley	22	14.10%
El Cerrito	8	5.13%
Emeryville	1	0.64%
Kensington	0	0.00%
Oakland	19	12.18%
Piedmont	0	0.00%
Richmond	16	10.26%
San Pablo	4	2.56%
Other in Alameda County	3	1.92%
Other outside of Alameda County	6	3.85%
Have you taken compost from this Compost Hub before?	*n* = 156	
Yes	47	30.13%
No	109	69.87%
How are you using the compost? [Multi-select]	*n* = 156	
Landscape plants, shrubs, and tree care	76	48.72%
Grow fruits and vegetables	100	64.10%
Container gardening	59	37.82%
Compost tea	4	2.56%
Sheet mulching	7	4.49%
Topdressing	17	10.90%
Digging in	10	6.41%
Lawn Care	6	3.85%

continued

continued	Number	Percentage
How are you taking the compost with you? [Multi-select]	*n* = 156	
Reusable bags	69	46.94%
Buckets	68	46.26%
Borrowing container from Compost Hub	23	15.65%
Wheelbarrow/wagon	6	4.08%
Tarps	3	2.04%
Car	41	82.00%
Walking	4	8.00%
Public Transportation	3	6.00%
Bike	2	4.00%
How did you first hear about the Gill Tract Compost Hub?	*n* = 156	
Gill Tract Farm	53	33.97%
Friend or family	35	22.44%
City of Albany	29	18.59%
Passing by	21	13.46%
Other	5	3.21%
Internet Search or Social Media	4	2.56%
Other Compost Hub Site	4	2.56%
StopWaste	4	2.56%
UC Berkeley	1	0.64%
Are you interested in any of the following ways to connect with the Farm? [Multi-select]	*n* = 156	
Get email updates about events and workshops at the Farm	70	44.87%
Volunteer at the Farm	17	10.90%
None/no answer	74	47.44%
Help us improve the compost hub by participating in a 30 minute phone interview about the hub and receive a $15 gift card.	20	12.82%
Will you be making a donation?	*n* = 156	
Yes	21	13.46%
Not this time	122	78.21%
N/A or Other	13	8.33%

Appendix B. Semi-Structured Interview Guides

Interview Guide: User

1. Introduction
    a. Have you been to the Compost Hub before? If yes, when did you start coming to the Hub?
    b. Before the Hub, had you been to Gill Tract before? If yes, in what capacity?
    c. How did you hear about the Compost Hub/Gill Tract?
    d. Have you composted before? If yes, what was that experience like?
        i. P: Where did you learn to compost? Where did you compost? For how long? For what purpose?
        ii. P: What did you learn from that experience?

2. Experiences with the Farm
    a. What have your experiences at the Farm been like?
        i. P: How do you feel at the farm?
    b. If you could change anything about Gill Tract (not the Compost Hub), what would it be? Why?

3. Experiences with the Compost Hub
    a. Why are you using the Compost Hub?
    b. What have your experiences with the Hub thus far been like?
        i. P: How is the process of getting here, parking, and loading the soil?
        ii. P: How accessible is it for you?
        iii. P: Are there enough tools?
    c. What do you think is working well at the Hub?
    d. What challenges do you have with the Compost Hub?
    e. What would you change about the Hub?
    f. Do you plan to come back to the Hub? Why or why not?

4. Soil use and quality
    a. Have you used soil from this Compost Hub before? (If yes, go to b., if no, go to c.)
    b. If yes:
        i. What did you use it for?
        ii. What did you think of the soil quality?
        iii. Did you mix it with anything else? Why or why not?
        iv. How does the compost from this Compost Hub compare with other compost you may have used (please name the other compost).
    c. If no:
        i. What do you plan to use this soil for?
        ii. Upon first look, what do you think of the soil quality?
        iii. Do you plan to mix it with anything else? Why or why not?

5. Education
    a. Have you utilized any educational materials at the Compost Hub? Why or why not?
    b. What have you learned about compost or composting systems since visiting the Compost Hub?
    c. Have you shared anything about the compost hub and what you've learned with others? If so, explain.

6. Wrap-up
    a. Is there anything else you would like to share about your experience with the Compost Hub?
    b. Is there anything you would like to ask me at this point?
    c. Would it be okay if I followed up with additional questions later? If yes, please share your contact information.
    d. Would you like me to share the recording and transcript of your interview? If yes, please share your contact information.

Interview Guide: Implementer

1. Introduction
    a. How long have you worked at/been involved with the Farm/UC Berkeley/StopWaste/City of Albany?
    b. What is your role with the Compost Hub, and why did you become involved with planning/implementing the Hub?
    c. What was your experience with composting before the Compost Hub?
        i. P: Where did you compost?
        ii. P: For how long?
        iii. P: For what purpose?
        iv. P: What did you learn from that experience?

2. Successes and Challenges
    a. What has your experience planning/implementing the Compost Hub been like?
        i. P: What have been some successes?
        ii. P: What were some challenges in the planning process?
        iii. P: What lessons did you learn?
    a. If you could change anything about the planning/implementation, what would it be and why?
    b. If you could change anything about the Compost Hub itself, what would it be and why?

3. Partnerships
    a. What were key partnerships that led to the creation of this compost hub, and why were they key? (Key can mean essential and/or helpful–however they interpret or define "key.")
    c. Are you aware of any other compost distribution sites? Please name. If so, what partnerships enabled them to happen?

4. Soil quality
    a. What do you think of the Hub's compost soil quality?
        i. P: Would you use it in your garden/farm? Why/Why not?
        ii. P: How would you recommend using it?
        iii. P: How does it compare to other compost you have used? (Please name other compost.)

5. SB 1383 Contributions
    a. How do you think the amount of compost distributed at the Hub compares to other compost distribution sites you have seen?
    b. Are you aware of Senate Bill 1383 at all? If yes, move on to c-f. If no, move to #6.
    c. What do you think of SB 1383?
    d. How does this Compost Hub contribute to Alameda County's SB 1383 procurement requirements?
    e. Do you think the Compost Hub (and similar programs) is a sustainable way to reach SB 1383 procurement goals? Why or why not?
    f. Do you think compost programs like this are a sustainable way to divert organic waste from landfills? Why or why not?

6. Wrap-up
    a. Is there anything else you would like to share about your experience with the Compost Hub?
    b. Is there anything you would like to ask me at this point?
    c. Would it be okay if I followed up with additional questions later? If yes, please share your contact information.
    d. Would you like me to share the recording and transcript of your interview? If yes, please share your contact information.
    e. Is there anyone else in your organization involved with the Compost Hub that you recommend I talk to? Please share their name and contact.

Appendix C. Demographic Questionnaire

1. What is your age?
    a. [Fill in the blank.]

2. With which gender identity/ies do you identify the most? Select all that apply.
    a. Male
    b. Female
    c. Non-binary/Genderqueer/Agender
    d. Cis-gender
    e. Trans-gender

3. With which racial/ethnic identity/ies do you identify the most? Select all that apply.
    a. Black
    b. Hispanic
    c. White
    d. Asian American
    e. Native American/Alaska Native

4. Education level
    a. Some high school
    b. High school graduate/GED
    c. Some college/associate degree
    d. Bachelor's degree
    e. Advanced degree (masters/PhD)

5. Which income level does your household fall under? [US$]
    a. <$24,999
    b. $25,000–49,999
    c. $50,000–74,999
    d. $75,000–99,999
    e. >$100,000

6. If you have residence, what is your zip code?
    a. [Fill in the blank.]

Appendix D. Compost Nutrient Analysis Results

Table A1. Compost Analysis Test Results: Nutrient Profile

Date Collected	6/18/2023	7/23/2023	8/16/2023	Range
pH	7.84	7.51	7.79	7.51–7.84
C/N Ratio	22.5	23.73	16.72	16.72–23.73
Soluble Salts (mmhos/cm)	1.11	1.47	0.91	0.91–1.47
Moisture (%)	36.37	34.05	26.39	26.39–36.37
Mineral Matter Dry (%)	47.26	54.78	42.66	42.66–54.78
Mineral Matter Wet (%)	30.07	36.13	31.4	30.07–36.13
Organic Matter Dry (%)	52.74	45.22	57.34	45.22–57.34
Organic Matter Wet (%)	33.56	29.82	42.21	29.82–42.21
Total Nitrogen Dry (%)	1.15	1.07	1.73	1.07–1.73
Total Nitrogen Wet (%)	0.73	0.71	1.27	0.708–1.27
Phosphorous Dry (%)	0.96	0.74	0.56	0.56–0.96
Phosphorous Wet (%)	0.61	0.49	0.41	0.414–0.614
Phosphorus as P2O5 Dry (%)	2.21	1.69	1.29	1.29–2.21
Phosphorus as P2O5 Wet (%)	1.41	1.12	0.95	0.949–1.407
Potassium Dry (%)	0.57	0.43	0.38	0.38–0.57
Potassium Wet (%)	0.36	0.29	0.28	0.283–0.36
Potassium as K2O Dry (%)	0.68	0.52	0.46	0.46–0.68
Potassium as K2O Wet (%)	0.43	0.34	0.34	0.341–0.434
Calcium Dry (%)	3.84	2.96	2.82	2.82–3.84
Calcium Wet (%)	2.45	1.95	2.08	1.954–2.445
Magnesium Dry (%)	0.68	0.69	0.54	0.54–0.69
Magnesium Wet (%)	0.43	0.46	0.39	0.394–0.456
Sodium Dry (%)	0.16	0.13	0.18	0.13–0.18
Sodium Wet (%)	0.1	0.09	0.13	0.088–0.13
Sulfur Dry (%)	0.3	0.35	0.24	0.24–0.35
Sulfur Wet (%)	0.19	0.23	0.18	0.178–0.231
Carbon Dry (%)	25.85	25.47	28.85	25.47–28.85
Carbon Wet (%)	16.45	16.8	21.24	16.45–21.24
Boron Dry (ppm)	38.25	28.86	37.62	28.86–38.25
Boron Wet (ppm)	24.34	19.03	27.69	19.03–27.69
Iron Dry (ppm)	13,066.09	16,436.89	9,835.33	9835.33–16436.89
Iron Wet (ppm)	8,313.95	10,840.10	7,239.79	7239.79–10840.1
Manganese Dry (ppm)	408.64	424.11	300.8	300.8–424.11
Manganese Wet (ppm)	260.02	279.7	221.42	221.42–279.7
Copper Dry (ppm)	116.41	97.94	67.72	67.72–116.41
Copper Wet (ppm)	74.07	64.59	49.85	49.85–74.07
Zinc (mg/kg)	301.34	239.95	211.32	211.32–301.34

Appendix E. Compost Data Sheets Provided by Vendor and Manufacturers

WALLACE LABORATORIES, LLC

365 Coral Circle
El Segundo, CA 90245
phone (310) 615-0116 fax (310) 640-6863

June 24, 2022

Conor Davis, conor@CaliforniaSoils.com
California Soils, Inc.
PO Box 345
Westley, CA 95387

RE: Sample received June 23, 2022
West Valley Compost, Our ID No. 22-175-09

Dear Conor,

The pH is moderately alkaline at 7.72.

Salinity is 6.75 millimho/cm. Chloride is 837 parts per million in the saturation extract. Soluble sulfur is high.

Nitrogen is low, about 50% of the soluble mineral nitrogen is nitrate nitrogen. Phosphorus, potassium, iron, manganese, zinc, copper, boron and magnesium are high. Sodium is modestly high. SAR (sodium adsorption ratio) is 3.0. The concentrations of common non-essential heavy metals are low.

Soil organic matter is 39.3% on a dry weight basis. The carbon:nitrogen ratio is 20.0.

The apparent cation exchange capacity is 60.2 milliequivalents per 100 grams. Exchangeable potassium is high. Exchangeable magnesium is good. Exchangeable calcium is good. Exchangeable sodium is moderate. Exchangeable hydrogen is low.

Sincerely,

Garn A. Wallace

Garn A. Wallace, Ph. D.
GAW:n

Paid $595.00, check No. 5148

Soil Analyses Plant Analyses Water Analyses

WALLACE LABS	MEDIA REPORT	Print Date	Jun. 24, 2022	Receive Date	6/23/22
365 Coral Circle	Location	California Soils, Inc.			
El Segundo, CA 90245	Requester	Conor Davis			
(310) 615-0116	graphic interpretation: * very low, ** low, *** moderate				
ammonium bicarbonate/DTPA		* * * * high, * * * * * very high			
extractable - mg/kg soil	Sample ID Number	22-175-09			
Interpretation of data	Sample Description	West Valley Compost			
low medium high	elements		graphic		
0 - 12 16 - 28 32 - 44	phosphorus	440.08	*****		
0-240 240-500 500-700	potassium	5,131.35	*****		
0- 12 12- 20 over 20	iron	172.64	*****		
0 - 2 3 - 4 over 5	manganese	134.41	*****		
0 - 4 4 - 6 over 6	zinc	62.78	*****		
0- 0.5 0.6 - 1 over 1	copper	23.70	*****		
0 - 1 1 - 2 over 2	boron	6.80	*****		
	calcium	2,219.37	****		
	magnesium	857.86	*****		
	sodium	968.32	****		
	sulfur	2,381.28	****		
	molybdenum	0.38	***		
	nickel	2.10	*		
The following trace	aluminum	n d	*		
elements may be toxic	arsenic	1.03	*		
The degree of toxicity	barium	3.09	*		
depends upon the pH of	cadmium	0.19	*		
the soil, soil texture,	chromium	0.31	*		
organic matter, and the	cobalt	1.27	*		
concentrations of the	lead	10.26	**		
individual elements as well	lithium	1.30	*		
as to their interactions	mercury	n d	*		
	selenium	n d	*		
The pH optimum depends	silver	n d	*		
upon soil organic	strontium	7.96	*		
matter and soil content-	tin	n d	*		
	vanadium	2.77	*		
under 5 may be too acidic					
6 to 7 may be good	Saturation Extract				
over 8.0 is too alkaline	pH value	7.72	****		
The ECe is a measure of	ECe (milli-	6.72	*****		
the media salinity:	mho/cm)				millieq/l
good at 200 ppm	calcium	489.3			24.5
good at 25 ppm	magnesium	163.3			13.5
	sodium	300.7			13.1
good at 25 ppm	ammonium as N	8.7			0.6
good at 150 ppm	potassium	1125.6			28.8
	cation sum				80.4
problems over 150 ppm	chloride	837			23.6
good at 100 ppm	nitrate as N	21.1			1.5
good at 40 ppm	phosphorus as P	2.9			0.1
toxic over 800	sulfate as S	777.0			48.6
	anion sum				73.7
toxic over 1 for many plants	boron as B	0.69	***		
increasing problems start at 3	SAR	3.0	***		
est. gypsum requirement-lbs/cubic yard		18.3			
	Total Nitrogen, dry weight basis	0.98%			
	Total Carbon, dry weight basis	19.64%			
	Carbon:Nitrogen Ratio	20.0			
	lime (calcium carbonate)	no			
	organic matter, dry weight basis	39.28%			
	moisture content of media	61.0%			
	half saturation percentage	112.4%			
ideal percentages of cations					% saturation
abt 5 % potassium	millieq K	7.61			13%
< 3% sodium	millieq Na	1.61			3%
abt 70% calcium	millieq Ca	41.37			69%
10 - 15% magnesium	millieq Mg	9.43			16%
5-10% hydrogen	millieq H	0.16			0%
	total millieq/100 grams	60.18			

Elements are expressed as mg/kg dry soil or mg/l for saturation extract.
pH and ECe are measured in a saturation paste extract. nd means not detected.

PACIFIC LANDSCAPE SUPPLY

Pacific Landscape Supply, Inc. P.O. Box 15809 San Luis Obispo, Ca 93406-5809

Office (209) 593-1199

January, 2023

Re: **Organic Compost**

To whom it may concern:

Organic Compost conditions the soil and improves aeration, drainage, water and nutrient-holding capacity. Organic Compost is a good addition for heavy clay soils particularly at new home sites and good pre-plant conditioner for new lawns and gardens. Organic Compost is produced from 100 percent recycled yard trimmings so it qualifies toward LEED certification points, and certified organic by the Organic Materials Review Institute (OMRI) so it may be used in organic farming applications. The compost complies with the Cal-Trans Standard Specification 20-2.03 Soil Amendment.

- **Compost is dark black in color**
- **The particle sizes range from 0 "- 3/8 "**
- **The average full load size is 45 cy**

Sincerely,

David Ray
Pacific Landscape Supply, Inc.

MODESTO ■ VERNALIS ■ STOCKTON ■ SAN LUIS OBISPO

Check us out on the web at: www.PacificLandscapeSupply.com

ANALYTICAL CHEMISTS and BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

TEL: 831-724-5422
FAX: 831-724-3188
www.controllabs.com

Account #: 3020080-1/1-10216
Group: Feb23A #40
Reporting Date: February 15, 2023

California Soils, Inc.
P.O. Box 345
Westley, CA 95387
Attn: Conor Davis

Date Received: 03 Feb. 23
Sample Identification: West Valley Compost
Sample ID #: 3020080 - 1/1

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.7	1.2	%
Ammonia (NH_4-N):	< 10	< 7.2	mg/kg
Nitrate (NO_3-N):	240	180	mg/kg
Org. Nitrogen (Org.-N):	1.7	1.2	%
Phosphorus (as P_2O_5):	1.6	1.1	%
Phosphorus (P):	6900	5000	mg/kg
Potassium (as K_2O):	0.80	0.58	%
Potassium (K):	6700	4800	mg/kg
Calcium (Ca):	3.3	2.4	%
Magnesium (Mg):	0.56	0.40	%
Sulfate (SO_4-S):	960	700	mg/kg
Boron (Total B):	36	26	mg/kg
Moisture:	0	27.6	%
Sodium (Na):	0.15	0.11	%
Chloride (Cl):	0.14	0.10	%
pH Value:	NA	7.28	unit
Bulk Density :	23	31	lb/cu ft
Carbonates ($CaCO_3$):	11	8.1	lb/ton
Conductivity (EC5):	3.3	NA	mmhos/cm
Organic Matter:	60.4	43.8	%
Organic Carbon:	29.0	21.0	%
Ash:	39.6	28.7	%
C/N Ratio	17	17	ratio
AgIndex	> 10	> 10	ratio

Stability Indicator:	
CO2 Evolution	Respirometery
mg CO_2-C/g OM/day	2.6
mg CO_2-C/g TS/day	1.6
Stability Rating	*stable*

Maturity Indicator: Cucumber Bioassay	
Compost:Vermiculite (v:v)	1:2
Emergence (%)	100
Seedling Vigor (%)	100
Description of Plants	*healthy*

Pathogens	Results	Units	Rating
Fecal Coliform	790	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 03 Feb. 23

Physical Contaminants**	% by dry wt
Total Plastic	< 0.1
Film Plastic	< 0.1
Glass	< 0.1
Metal	< 0.1
Sharps	ND
Total	< 0.5

Metals	Dry wt.	EPA Limit	units
Aluminum (Al):	5800	-	mg/kg
Arsenic (As):	2.7	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	19	-	mg/kg
Cobalt (Co)	3.9	-	mg/kg
Copper (Cu):	97	1500	mg/kg
Iron (Fe):	10000	-	mg/kg
Lead (Pb):	16	300	mg/kg
Manganese (Mn):	280	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	3.5	75	mg/kg
Nickel (Ni):	19	420	mg/kg
Selenium (Se):	< 1.0	100	mg/kg
Zinc (Zn):	180	2800	mg/kg

Size Distribution	
MM	% by weight
> 50	0.0
25 to 50	0.0
16 to 25	0.0
9.5 to 16	0.6
6.3 to 9.5	1.1
4.0 to 6.3	9.4
2.0 to 4.0	23.2
< 2.0	65.6

**Greater than 4mm in size (Sharps greater than 2mm)

Analyst: Assaf Sadeh

*Sample was received and handled in accordance with TMECC procedures.

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Retail food loss and waste reduction interventions: A scoping review

SPECIAL ISSUE
Community-Based Circular Food Systems

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Abstract

Globally, one third of food produced goes to waste, which contributes to climate change, negatively impacts air and water resources, and can lead to environmental and human health risks. Mitigation efforts have surged in response to these staggering statistics on food loss and waste, including initiatives such as food rescue and upcycling programs. Circular economy practices are important for a sustainable future. Limited literature is available that compares different food rescue programs worldwide and synthesizes considerations for planning new interventions. This paper is a scoping review of peer-reviewed literature on programs and interventions for food rescue and food waste reduction that occur at the retail level. The search in Scopus and Web of Science yielded 400 records for studies published in the past 30 years. Analysis of 18 full-text reports showed diverse food programs from the United States, United Kingdom, Germany, Greece, New Zealand, Canada, Sri Lanka, and Israel. Studies were conducted in various settings, including restaurants, institutions, and retail food stores. The collection methods of rescued food varied according to the program's capac-

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ity and included accepting donations, redistribution programs, and social enterprises. The results of these reports highlight some of the barriers that food rescue programs face, including logistical and workforce challenges, liability concerns, food availability, and financial restraints. Facilitators that promoted food rescue included the use of complementary technology, cooperative alliances, supportive policies, and favourable incentives. Report findings highlight the key role of volunteers, partnerships, and innovative technological solutions in advancing food rescue and waste reduction programs. Our research focuses on consolidating the lessons previously learned as a means of helping future food waste diversion programs overcome obstacles and improve operational efficiency. While food rescue is an important intermediary endeavour, addressing the root causes of wasted food and reducing inefficiencies in the current modern industrial food system is necessary to meaningfully reduce food waste at a global level.

Keywords
community-based circular food systems, food rescue, food upcycling, food reclamation, food redistribution, food waste, programs, scoping review

Introduction and Literature Review

Food loss and waste (FLW) encompasses all food that is grown, raised, caught, or harvested but ultimately not consumed (Environment and Climate Change Canada, 2019). In 2015, the United Nations (UN) identified 17 Sustainable Development Goals to improve education and health, stimulate economic growth, reduce inequality and combat climate change (United Nations, 2015). Among these targets, Goal 12 aims to ensure sustainable consumption and production patterns by decreasing half per capita global food waste at the distribution and consumer levels by 2030 (United Nations, 2015). According to the Food and Agriculture Organization (FAO), up to one-third of all food produced globally goes to waste with 14% of this waste occurring between harvest and retail (2019). FLW contributes to resource depletion and exacerbates climate change due to the potent greenhouse gasses created during landfill decomposition (Bellemare et al., 2017). FLW can additionally negatively impact air and water sources, leading to environmental and health risks and thus classifying food waste as a global health issue (Environment and Climate Change Canada, 2019). In response, countries worldwide are exploring ways to mitigate the adverse effects of food waste while addressing sustainability challenges (Manzoor et al., 2024). Mitigation efforts often focus on recovering edible food before it reaches landfills as part of broader food waste reduction strategies. These initiatives, however, face significant challenges due to complex and systemic inefficiencies of the modern, industrial food system (Environment and Climate Change Canada, 2019). In 2019, Schroeder and colleagues identified how a circular economy approach can address overconsumption and waste challenges, as well as respond to the needs of waste management.

FLW is a "wicked problem," meaning it is a complex problem that is difficult to solve and is deeply interconnected with other societal, environmental, and economic issues (Coyne, 2005; Rittel & Webber, 1973). Wicked problems are characterized by interconnected elements that often include a high level of uncertainty and multiple, often conflicting, perspectives where simple solutions are not possible (Levin et al., 2012). Efforts to reduce FLW must, therefore, navigate competing priorities, such as food safety regulations, economic incentives for overproduction, consumer behaviour, and systemic inefficiencies in the global food supply chain (Hoehn et al., 2023; Ishangulyyev et al., 2019; Urugo et al., 2024). Addressing FLW requires interdisciplinary approaches at multiple levels and involves coordinated actions that address policy interventions, technological innovations, and community-driven solutions (Hecht & Neff, 2019; Urugo et al., 2024). Without acknowledging its wicked nature, programs designed to address FLW are at risk of being fragmented and can fail to create meaningful and lasting change. It is beyond the scope of this paper to synthesize a meaningful path forward to mitigate total food waste created throughout the system. The focus of this work instead intends to capture and clarify the scope of programs currently in operation that aim to address food recovery and redistribution with

the goal of highlighting what is working well and what gaps need to be addressed further.

Food diversion programs are not sufficient to address the full scope of the wicked problem of food waste, but they can act as a helpful interim measure until broader changes are made. Frameworks presented by the U.S. Environmental Protection Agency (U.S. EPA), such as the Food Waste Hierarchy and the Wasted Food Scale, have emerged, guiding different options for the management of food surplus in all steps of the supply chain (EPA, 2023). These frameworks highlight a prioritized pathway for food waste minimization to decrease edible food disposal (Papargyropoulou et al., 2014), which includes buying and serving only what is needed as the preferred prevention method, and landfill and incineration being the last choice (Papargyropoulou et al., 2014). Following EPA's Waste Food Scale, the second preferred method for food waste minimization is donation/upcycling (EPA, 2023). Donation consists of rescuing and diverting safe and palatable food from the landfill and redistributing it to those in need (Reynolds et al., 2019). Examples of food rescue initiatives include making soup for donation, utilizing programs that use "ugly" and distressed products, and collecting surplus food from public events and farmers markets (Hecht & Neff, 2019). Alternatively, upcycling involves taking unused food and changing it or adding value to become a different product, such as making pasta from wasted spaghetti squash and fish patties from fish off-cuts (Thorsen et al., 2024).

Food rescue efforts have gained popularity in recent years as rates continue to rise for both food waste and the number of individuals universally experiencing food insecurity (Thyberg & Tonjes, 2016). Driven by the popularity of these efforts has been a simultaneous increase in published studies since 2008 of food waste diversion programs (Zhang et al., 2018), reflecting a growing awareness and urgency to address these complex food waste issues. Previous studies have identified different strategies and interventions for upcycling and food rescue (Lai et al., 2022), but there is limited literature comparing the various interventions to reduce food waste. Given the lack of available literature, opportunities exist to address the FLW problem that profoundly impacts social and environmental concerns. One way that this can be changed is by applying new business models based on circular thinking, where retailers connect with charities, food recovery groups, and consumer groups (Schroeder et al., 2018). Using the concept of a circular economy, our research aims to understand how to best use food resources in a continuous process that reduces waste to zero (Cela et al., 2024) while addressing multiple needs through a multisector and multidisciplinary partnership. This scoping review aims to identify global food rescue and upcycling interventions, focusing on the resources used and outcome measurements employed to support ongoing efforts to reduce FLW. By highlighting existing gaps and opportunities, this review may inspire future food rescue program designs and simplify implementation for current initiatives, supporting collective learning and more effective FLW reduction.

Applied Research Methods

This study follows a scoping review methodology to systematically capture existing literature on FLW diversion programs and interventions. Our goal is to identify and analyze different types of existing FLW diversion programs, address barriers and facilitators to FLW recovery, and identify the various metrics used to quantify food recovery. The review process adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework to ensure transparency and methodological rigor.

Search Strategy

A preliminary exploratory search of literature on food rescue and upcycling programs and interventions was conducted to determine the scope of this review and potential keywords. This was conducted through a Google Scholar search using the terms "food rescue programs" and "upcycling food programs." Using the PRISMA framework for scoping reviews (Selçuk, 2019), our research involved identifying and synthesizing literature on programs that focus on food rescue or the reduction of food surplus and waste at the retail level, such as point-of-sale, prepared foods, and grocery store surpluses. One of the university librarians on our team devel-

oped a systematic search strategy using keywords from two main categories. The first category was Food Rescue: gathering rescuable food and redirecting it for human consumption (Hecht & Neff, 2019). Given the study's objective to focus on donation and upcycling methods for minimizing food waste, we also included upcycling under this definition. The second category was Programs: groups of people and resources aimed at achieving desired results, which includes activities to reach specific outcomes (Longest, 2004). To conduct a more comprehensive search, we included any additional terms that referred to activities aimed at improving human health, such as interventions, initiatives, and strategies (Smith et al., 2015). Keywords included "food rescue," "food upcycling," and "food reclamation," in combination with "programs," "initiatives," and "projects." Keywords in each category were joined by the Boolean operator "OR," while categories were joined by the operator "AND." We searched both the SCOPUS and Web of Science databases within a time frame of 1995 to 2024. This period was specifically chosen as the mid-1990s marked a significant shift in food waste diversion efforts, highlighted by the emergence of key policies, such as the adoption of the U.S. Bill Emerson Good Samaritan Food Donation Act in 1996, as well as increased sustainability initiatives focusing on environmental protection (Zhang et al., 2018). Choosing this timeframe enabled us to analyze long-term trends, capturing the evolution from early, policy-driven initiatives to the rapid expansion of food waste recovery programs in recent years, including the adoption of Sustainable Development Goals (SDG) 12.3 in 2015, which aims to reduce food waste by 50% (UN, 2015). Our specific search strategy is detailed in the Appendix, Table A1. Additional studies from the reference list were incorporated and marked as a *hand search* in the scoping review flow chart (Figure 1).

Study Selection and Eligibility Criteria

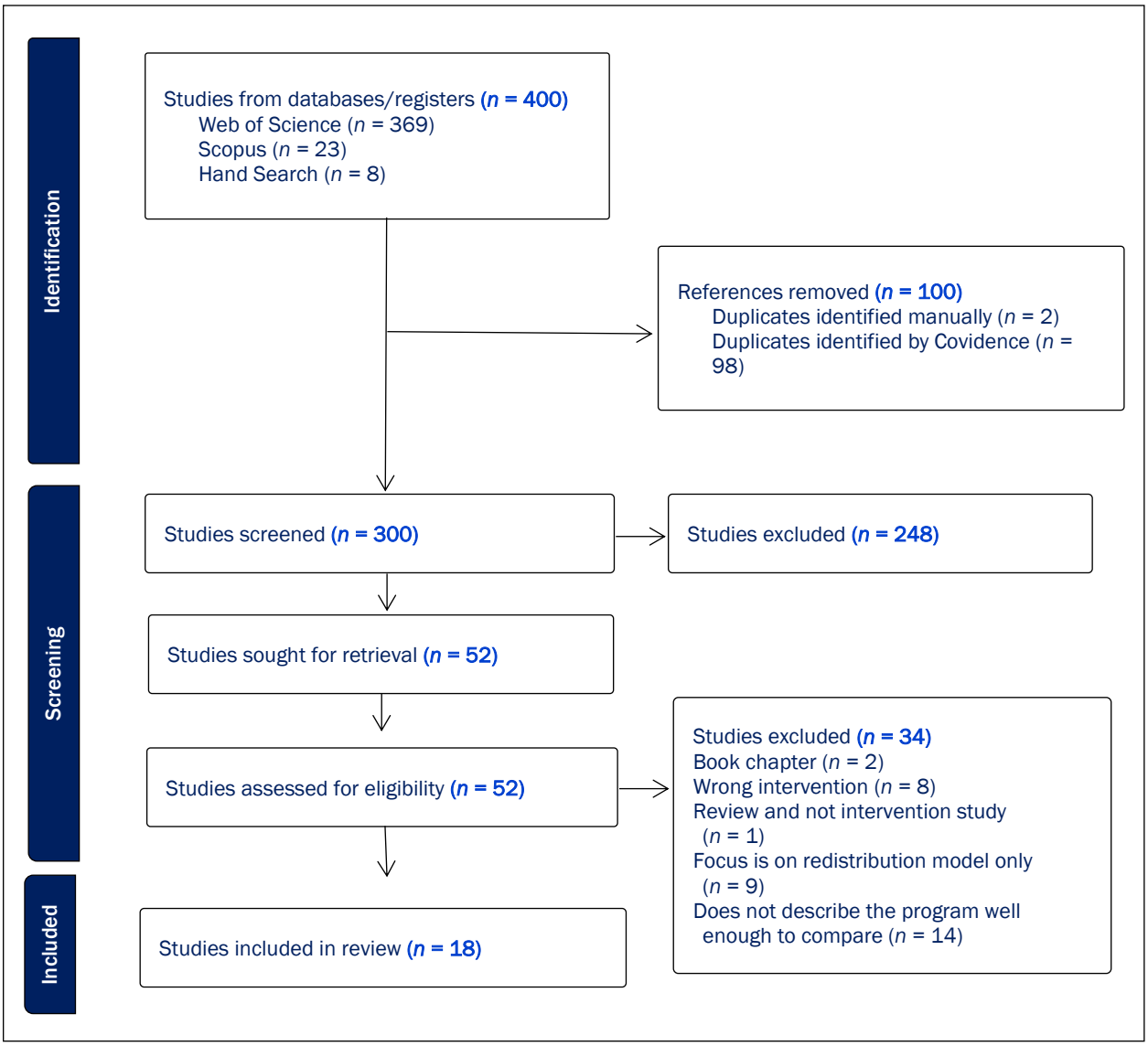
All identified citations were collated and uploaded to the Covidence web-based platform,[1] and duplicates were removed. The inclusion criteria for studies were as follows: (1) focused on food rescue or food surplus and waste repurposing; (2) conducted in settings at the retail level, such as point-of-sale, prepared foods (including restaurants, convention centres, or institutions such as post-secondary cafeterias), and grocery stores; (3) described or evaluated food programs, initiatives, projects, models, activities, or interventions; and (4) published in English. Exclusion criteria were: (1) studies conducted only on farms and/or gleaning (farms were included only if food was also collected from other locations defined in the selection criteria within the same study); (2) studies focusing on machine learning or algorithms; (3) studies on attitudes and perceptions of clients; and (4) reports, book chapters, commentaries, review articles, and opinion pieces. There were no criteria to identify specific countries therefore, we were able to capture the range of programs regardless of the geopolitical and socioeconomic status. Screening of the abstract and title and full-text review were conducted by two independent reviewers (C.O. and W.M.) against the inclusion criteria described previously. Reasons for excluding references were recorded and reported in the PRISMA flow chart (Figure 1). Disagreements between reviewers were resolved through discussion.

Data Extraction and Synthesis

To standardize the process and capture relevant details, including the intervention type and main outcomes, we designed and pilot-tested a data extraction framework on a sample of included references. Categories on the framework were modified and revised accordingly based on the pilot test. Data was extracted by two independent reviewers (C.O.B. and W.M.) using Covidence (*Covidence*, 2024), and compared and categorized to explore the range of interventions and how or if researchers have evaluated these interventions. From each reference, we retrieved data on the study design, location, aim of the study, food sources, food rescuers, transportation type, distributor organizations, consumers, challenges, and facilitators. Two reviewers (C.O. and W.M.) discussed discrepancies in the data extracted until a consensus was reached.

[1] https://www.covidence.org/

Figure 1. PRISMA Scoping Review Flow Chart



The data collected was synthesized in a table to provide a structured overview of the existing approaches and highlight the different methodologies used within the field along with outcomes associated with food waste intervention studies.

Results

The search yielded 400 articles. Removing duplicates resulted in 300 articles being screened by title and abstract. The abstract and title scan resulted in a detailed examination of 52 full texts, with 18 fulfilling all inclusion criteria to undergo final data extraction (Table 1).

Description of the Dataset

The 18 studies selected in this review were conducted in various global locations, focusing most significantly on the United States and Europe. Half of the studies took place at various locations across the United States, examining food rescue and redistribution efforts in areas such as Colorado, Virginia, Nevada, and various university campuses on the East Coast (Adams & Tabacchi, 1997; Ayala et al., 2022; Bankson, 2009; Frank et al., 2021; Mittal et al., 2021; Sewald et al., 2018; Sherman, 2004; To et al., 2019; Warshawsky, 2015). Three articles described programs implemented across

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Table 1. Summary of Literature Included in the Extraction of Data

Reference (Country)	Study Design	Food Source	Food Rescuer	Method to organize pick up	Distributor Organization/ Business	Target Consumer	Key Metrics
Adams, 1997 (United States)	Opinion article informed by survey data	Restaurant/ Institution	Traditional (food banks)	It depends; not a lot of information is provided	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; # of donor agencies
Alexander, 2008 (UK)	Case report	Retail food store	Complimentary (use of apps to manage donation and delivery logistics)	App (FareShare); Pick-up is organized through both pre-scheduled depot deliveries from retailers and ad hoc collections from retail outlets.	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed; # of people served; # of deliveries; # of donor agencies; # of recipient agencies
Aloysius, 2023 (Sri Lanka)	Case report	Restaurant/ Institution; Retail food store	Traditional (food banks)	Pick-up is organized through direct communication between food donors and volunteers, often facilitated by mobile applications or social media platforms like WhatsApp.	Free (pantries, kitchens, food bank)	Experiencing food insecurity; Children; Families; Note specifically elderly, orphanages, homelessness	Weight rescued; Weight redistributed; # of people served; # of volunteers; # of deliveries; # of recipient agencies
Ayala, 2022 (United States)	Qualitative research	Restaurant/ Institution; Retail food store; Schools (public and private)	Complimentary (services and apps to manage donation and delivery logistics and make value added products)	Pick-up is organized through an app that connects food businesses with surplus food to enable on-demand pick-up and tracking of food donations.	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed; Economic value; GHG emissions; # of people served
Bankson, 2009 (United States)	Case report	Restaurant/ Institution	Complimentary (use of apps to manage donation and delivery logistics)	Salvageable food is collected from dining halls and taken to a meal preparation area, where student volunteers package the meals for distribution to the community.	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed; # of people served; Sustainability measured through student involvement and administrative support
Clare, 2023 (New Zealand)	Case report (Multi-case report)	Restaurant/ Institution; Retail food store; Processor; Farm (grower)	Community hub, free store, and mixed model	Food is collected from donors and delivered to recipient organizations, logistics managed by food rescue organizations (ex phone calls), use of volunteers for transportation	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; # of meals, Weight redistributed; # of people served; Tonnes of CO2 reduced, # of recipient organizations
Dresler, 2019 (New Zealand)	Qualitative research (interpretive approach)	Restaurant/ Institution; Retail food store; Wholesaler/ distributor; Farm	Using a "Free Store" model.	Volunteers perform all necessary tasks	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Satisfaction; self-concept

continued

Table 1, continued

Frank, 2021 (United States)	Case report	Restaurant/ Institution	Through Canvas (learning management system)	An announcement is sent to students through Canvas for a "quick and easy" pickup at an on-campus location in a designated time window.	Uses Canvas to alert students to come and pick it up directly from the event	Food insecure University students	# of donor agencies; # of events and student feedback
Mirosa, 2016 (New Zealand)	Case report	Restaurant/ Institution; Retail food store	Complimentary (services and apps to manage donation and delivery logistics and make value added products)	Volunteers and staff accept scheduled donations from food donors and redistribute to recipient agencies	Free (pantries, kitchens, food bank); Discount (retailers, com-plimentary rescue orgs/businesses). Social enterprise	Experiencing food insecurity	Weight rescued; Weight redistributed; # of people served; # of volunteers; Social return on investment
Mittal, 2021 (United States)	Case report (multi-case study)	Restaurant/ Institution; Retail food store; Farm	Varies based on program; some use food banks and others connect directly with volunteers	Combination of direct collection by non-profit organization, volunteer-driven pickups facilitated by mobile applications (ex. Meal Connect)	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed; # of people served
Philip, 2017 (Israel)	Case report	Restaurant/ Institution; Farm	Traditional (food banks)	Computerized call centre that coordinates schedule deliveries with Non-Profit Organizations.	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed; economic value; Savings of disposal/compost cost; GHG emissions; # of people served
Sedlmeier, 2019 (Germany)	Case report (multi-case report)	Restaurant/ Institution; Retail food store; Processor; Farm	Original food source (businesses that implement alternative sale strategies)	Picked up by participating entrepreneurs or delivered by collaborative partners	Sold to consumers	No food insecurity mentioned	Weight rescued; Weight redistributed; # of people served; # of volunteers; # of employees; Satisfaction
Sewald, 2018 (United States)	Case report	Retail food store	Complimentary (services and apps to manage donation and delivery logistics and make value added products)	Web-based app ("Food Rescue Robot")	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued
Sherman, 2004 (United States)	Article describing a research case study	Restaurant/ Institution; Farm	Complimentary (services and apps to manage donation and delivery logistics)	Not described in detail: food rescue agencies provide their containers and transportation	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued
To, 2019 (United States)	Case report	Convention centre catering	Traditional (food banks)	Collected using a refrigerated truck (supplied by Aria convention centre) with scheduled deliveries to Three Square Food Bank	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; GHG emissions; # of meals, EPA's WARM tool

continued

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Table 1, continued

Vander Vennen, 2023 (Canada)	Case report	Not explicitly stated: "Most of the Upcycle Kitchen's food supply is sourced through donation" (p. 6). Surplus from local food bank	Social enterprise (Upcycle Kitchen)	Not described	Resold on a sliding price scale	Experiencing food insecurity	Economic value; cost-revenue estimate
Veeckman, 2018 (Greece)	Case report	Restaurant/ Institution; Retail food store; Farm/Farmers Market	Complimentary and food banks	Use of digital platforms that facilitate matchmaking of food donations with recipient organizations.	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed; Economic value; Savings of disposal/ compost cost; GHG emissions; # of people served; # of volunteers
Warshawsky, 2015 (United States)	Case report	Wholesaler/ Distributor; Processor; Farm; Other: farmers market and backyard gleaning	Complimentary (services and apps to manage donation and delivery logistics)	Glean Team lead and volunteers distribute empty boxes to farmers market vendors, which is collected by one of the 55 charity partner organizations	Free (pantries, kitchens, food bank)	Experiencing food insecurity	Weight rescued; Weight redistributed

Europe, including specific examples from Germany, the United Kingdom, and Greece (Alexander & Smaje, 2008; Sedlmeier et al., 2019; Veeckman et al., 2018). The study published by Greek scholars Veeckman et al. (2018) involved cross-national collaboration and included projects that spanned the countries of Belgium, Hungary and Greece. Also included in this scoping review were three studies that examined food rescue initiatives in New Zealand (Clare et al., 2023; Dresler & Tutt, 2019; Mirosa et al., 2016), one study from Canada (Vander Vennen & Parizeau, 2023), one from Sri Lanka (Aloysius & Ananda, 2023), and another based in Israel (Philip et al., 2017). The breadth of countries included in the scoping reviews highlights the global reach of food waste concerns and their attempts to address these complicated scenarios by implementing rescue initiatives. All studies, aside from one, noted the dichotomy of high food waste with increased food insecurity levels and included the acknowledgment of household food insecurity through food waste diversion as an outcome of interest.

Study Designs

Case study and multi-case study design dominated the literature, with 14 of the 18 studies employing these methods (Adams & Tabacchi, 1997; Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Ayala et al., 2022; Bankson, 2009; Dresler & Tutt, 2019; Frank et al., 2021; Mittal et al., 2021; Philip et al., 2017; Sedlmeier et al., 2019; Sewald et al., 2018; Sherman, 2004; To et al., 2019; Warshawsky, 2015). Case study design helps provide in-depth data from locations and programs that explore food rescue initiatives' effectiveness, challenges, and outcomes (Bellemare et al., 2017). Within the case study designs, the research methods included in this review tended toward qualitative design, with 11 studies using interview data (Ayala et al., 2022; Sewald et al., 2018; Warshawsky, 2015) and two studies describing survey results (Adams & Tabacchi, 1997; Frank et al., 2021). Despite the emphasis on qualitative studies, quantitative measurements of food waste diversion were included in the review as well, with weight of food being the most common metric (Adams & Tabacchi, 1997; Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Ayala et al., 2022; Mittal et al., 2021; Philip et al., 2017; Sewald et al., 2018; Sherman, 2004; To et al., 2019; Veeckman et al., 2018; Warshawsky, 2015). One study exclusively used quantitative methods to measure the environmental impact, measured in metric tonnes of avoided Greenhouse gases (GHG) and the number of meals generated from rescued food over a specified period (To et al., 2019). The influence of case study design allows the collection of rich and specific data on individual programs or interventions, such as the motivations and challenges experienced by stakeholders (Longest, 2004). However, the lack of variability in the types of studies conducted fails to capture any comparison between programs or interventions and limits the comprehensive understanding of how the social, geographical or political context of the food diversion initiatives impacts the outcomes.

Food Source

The process of diverting food from the waste stream involves food rescuers who act as intermediaries between the food source (retailer, restaurant, institution) and the charitable organization, free store, or other consumers (Hecht & Neff, 2019). Food was collected from a variety of sources; nine studies focused on food rescue from restaurants or institutions (Adams & Tabacchi, 1997; Bankson, 2009; Dresler & Tutt, 2019; Frank et al., 2021; Mittal et al., 2021; Philip et al., 2017; Sherman, 2004; Veeckman et al., 2018; Warshawsky, 2015), five studies examined food sourced from retail food stores (Alexander & Smaje, 2008; Dresler & Tutt, 2019; Mittal et al., 2021; Sedlmeier et al., 2019; Veeckman et al., 2018), and another five studies included food rescued from farms, primarily through gleaning, in addition to other sources of rescue (Mittal et al., 2021; Philip et al., 2017; Sherman, 2004; Veeckman et al., 2018; Warshawsky, 2015). Many studies included in the review collected donations from more than one food source (Mittal et al., 2021; Philip et al., 2017; Sherman, 2004; Veeckman et al., 2018; Warshawsky, 2015), and the size of the intervention sites varied as well. For example, the Las Vegas Convention Food Rescue Program focused on rescuing surplus food from large events held at

the Aria Resort and Convention Center, where prepared but untouched food was collected and redistributed to food banks (To et al., 2019). Additional studies focused on smaller quantities of surplus food, primarily from local grocery stores and retail outlets (Sewald et al., 2018). Some interventions, such as Free Food on Campus, did not directly transport food but provided notifications to students of collection sites for leftover food from individual campus events (Frank et al., 2021).

Food Diversion Efforts

The process of collecting rescued food varies across initiatives and is often influenced by the project's scale and resources. Many programs, especially smaller ones, rely heavily on volunteers for tasks like food pick-up, delivery, and quality checks (Aloysius & Ananda, 2023; Ayala et al., 2022; Mittal et al., 2021; Sewald et al., 2018). Larger operations often utilize paid staff along with volunteers to manage roles and logistics (Aloysius & Ananda, 2023; Ayala et al., 2022). Social enterprise models, such as the German-based food rescue entrepreneurs and the Upcycle Kitchen in Guelph, Canada, introduce a potential profit stream in the food redistribution stream to support the continuous sustainability of the food rescue initiatives (Sedlmeier et al., 2019; Vander Vennen & Parizeau, 2023). Other programs, such as Free Food on Campus opt for direct pick up of the surplus food from individual consumers rather than delivery (Frank et al., 2021). Coordination methods for food collection range from traditional phone calls and emails to modern mobile apps, such as WhatsApp or web-based platforms (Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Sewald et al., 2018; Veeckman et al., 2018). Volunteers occasionally use their own vehicles for pick-up (Aloysius & Ananda, 2023; Mittal et al., 2021), while some initiatives combine volunteer and paid staff efforts (Ayala et al., 2022; To et al., 2019), with one study highlighting bicycle deliveries (Sewald et al., 2018). These diverse organizational structures reflect the adaptability of food rescue programs to their specific needs and resources.

Sixteen of these studies shared the goal of redistributing the salvaged food for free to community members in need (Adams & Tabacchi, 1997; Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Ayala et al., 2022; Bankson, 2009; Clare et al., 2023; Dresler & Tutt, 2019; Frank et al., 2021; Mirosa et al., 2016; Mittal et al., 2021; Philip et al., 2017; Sewald et al., 2018; Sherman, 2004; To et al., 2019; Veeckman et al., 2018; Warshawsky, 2015). Several studies commonly cited partnerships with local food banks for redistribution, while other food rescue efforts engaged directly with customers by distributing through home deliveries, pick-up locations, or free stores (Aloysius & Ananda, 2023; Dresler & Tutt, 2019; Frank et al., 2021; Mittal et al., 2021; Warshawsky, 2015). These studies exemplify the mission-based approach to addressing food insecurity through food rescue efforts.

Intervention Outcomes

The primary outcome measurements across many of the studies focused on quantifying the impact of food rescue initiatives on the volume of salvaged food (Adams & Tabacchi, 1997; Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Ayala et al., 2022; Bankson, 2009; Clare et al., 2023; Mirosa et al., 2016; Mittal et al., 2021; Philip et al., 2017; Sedlmeier et al., 2019; Sewald et al., 2018; Sherman, 2004; Veeckman et al., 2018; Warshawsky, 2015). Some studies, such as the one conducted in Las Vegas, provided detailed metrics of the outcome measurements, (including the weight of food rescued during the pilot year) and provided calculations that translated the volume into the number of meals provided to food-insecure individuals (To et al., 2019). This program also used the EPA's Waste Reduction Model tool to calculate the reduction in greenhouse gas emissions from the food rescue intervention, estimating the number of metric tons of CO2 equivalents that were avoided due to the diversion of food from landfills. Limitations existed for interpreting the metrics included in the studies; for example, if the food weight included any packaging or food that would later be discarded due to poor quality. Securing replicable outcome measurements in future studies is critical in demonstrating the tangible benefits of food rescue initiatives, including their contributions to food security and environmental sustainability.

Challenges and Barriers

Despite the reported positive outcomes, these studies also highlighted barriers to food recovery and redistribution success. These difficulties included operational and logistical challenges, liability concerns, workforce irregularities, inconsistency of food availability, and financial restraints.

Logistical/operational

One of the most prominent obstacles identified across many of the studies was navigating the logistical complexity of food rescue operations (Adams & Tabacchi, 1997; Ayala et al., 2022; Clare et al., 2023; Sedlmeier et al., 2019; Veeckman et al., 2018; Warshawsky, 2015). Coordinating food collection and distribution requires careful planning to ensure efficiency and compliance with food safety regulations. The authors of "SavingFood" in Greece emphasized that food redistribution organizations often struggle with promptly connecting food donors to community organizations, which is critical to preventing food spoilage (Veeckman et al., 2018). The authors described how community organizations frequently operate in silos, which can contribute to poor communication and inefficient matching of food surpluses with recipients (Veeckman et al., 2018). Similarly, in Los Angeles, logistical hurdles of food recovery efforts are exacerbated by a decentralized governance model, where food rescue organizations must independently manage collection schedules, often from geographically dispersed locations, all while ensuring the preservation of perishable food during transport (Ayala et al., 2022; Warshawsky, 2015). Small organizations struggled with the lack of necessary infrastructure, such as storage facilities, to accommodate large quantities of food, adding another layer of complexity (Adams & Tabacchi, 1997; Sedlmeier et al., 2019). Coordinating timely pickups, ensuring food safety, and maintaining adequate communication between stakeholders are crucial logistical considerations in food rescue. Maintaining these channels can also present significant problems when managing and assessing the program's effectiveness.

Liability concerns

Another noteworthy challenge in our review was liability concerns, which were particularly prominent in the U.S. studies (Adams & Tabacchi, 1997; Ayala et al., 2022; Sherman, 2004). Authors noted that some potential food donors hesitate to participate in food waste recovery programs due to fears of legal repercussions should the donated food cause harm (Adams & Tabacchi, 1997). These concerns often arise from misconceptions about food safety regulations, leading to the rejection of food that is otherwise safe for consumption (Adams & Tabacchi, 1997). Retail-level confusion about "use by" and "best before" dates can cause potentially edible food to be needlessly discarded (Sherman, 2004). Food businesses still show hesitancy despite the existence of protective laws in many regions, such as the Bill Emerson Good Samaritan Food Donation Act in the United States (Ayala et al., 2022) and New Zealand's 2014 Food Act's Immunity of Food Donors (Mirosa et al., 2016). Some authors also highlighted liability and food safety issues as barriers to recruiting businesses for participation in food recovery initiatives (Adams & Tabacchi, 1997; Ayala et al., 2022; Mirosa et al., 2016).

Volunteer workforce

Several studies described challenges associated with using volunteers in food rescue programs (Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Dresler & Tutt, 2019; Sewald et al., 2018; To et al., 2019; Veeckman et al., 2018; Warshawsky, 2015). Reliance on volunteers can introduce complicated considerations such as schedule coordination and ensuring timely pickups, as described in the Boulder Food Rescue model (Sewald et al., 2018). The creation of a web-based tool called the "Food Rescue Robot" was introduced in response to the burden of managing a volunteer workforce (Sewald et al., 2018). The "Food Rescue Robot" is a mobile app designed to streamline the coordination of pick-ups and deliveries of surplus food from retail stores by volunteers through a centralized platform (Sewald et al., 2018). However, even with such innovations, the volunteer-based model still presents challenges (Sewald et al., 2018). Boroume, a nonprofit organization focusing on food waste in Greece, also noted issues with inconsistent volunteer availability, which hampers the consistent collection and redistribution of food

(Veeckman et al., 2018). To et al. (2019) also reported that the lack of regular volunteers can lead to gaps in food collection, ultimately increasing food waste despite the best intentions. Ensuring proper training and retention of volunteers requires consistent monitoring, as not all individuals have the time or resources to commit to long-term participation (Aloysius & Ananda, 2023; Sewald et al., 2018). While volunteers are integral to the success of food rescue programs, the management of irregular volunteer workforces remains a significant challenge to operational efficiency.

Inconsistent/unpredictable donations

Inconsistency of food donations was another notable issue among the food rescue studies (Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Sedlmeier et al., 2019; To et al., 2019; Veeckman et al., 2018; Warshawsky, 2015). The German food rescue entrepreneurs faced logistical difficulties in acquiring regular and reliable supplies of surplus food, as many businesses only donated sporadically and the items received were not predictable (Sedlmeier et al., 2019). Such inconsistency hinders the ability of food rescue programs to plan and repurpose food efficiently, as the quantity, quality and type of donated food are often variable. In a similar fashion, FareShare in the UK also grappled with uneven donations from retailers, which can lead to gaps in supply or wasted trips to collect unavailable food (Alexander & Smaje, 2008). Rescuing perishable items is particularly challenging, as they often arrive too late in the supply chain to be effectively redistributed before they spoil (Alexander & Smaje, 2008). Establishing standardized systems and planning for staffing requirements on any given day is challenging, and inconsistent situations can adversely affect the efficiency of these food rescue operations.

Funding/financial resourcing

Funding and financial resourcing are other critical considerations for food rescue programs, as highlighted in various studies (Alexander & Smaje, 2008; Ayala et al., 2022; Sedlmeier et al., 2019; Vander Vennen & Parizeau, 2023; Veeckman et al., 2018; Warshawsky, 2015). Alexander and Smaje (2008) described these challenges in the case study of FareShare, which encountered ongoing financial strain due to the operational costs associated with collecting, storing, and redistributing food, as these labour-intensive activities are not fully covered by financial donations or governmental support. Relying on grants and charitable donations often leaves food rescue programs vulnerable and limits their ability to scale or invest in necessary infrastructure, such as refrigerated storage and transportation (Alexander & Smaje, 2008; Sedlmeier et al., 2019; Sewald et al., 2018; Vander Vennen & Parizeau, 2023). The administrative burden of securing and maintaining funding sources can also detract from the core mission of food rescue, forcing many programs to prioritize fundraising over direct service provision (Alexander & Smaje, 2008; Vander Vennen & Parizeau, 2023). To navigate financial hardships, some organizations have adopted social enterprise models that generate internal income through the sale of rescued food or related services (Alexander & Smaje, 2008; Ayala et al., 2022; Mittal et al., 2021; Sedlmeier et al., 2019; Vander Vennen & Parizeau, 2023). In Germany, some food businesses monetize surplus food through discounted sales of rescued food and upcycled products for social supermarkets. Feed Iowa First collaborates with local farms to share resources (like storage) in exchange for part of the produce (Mittal et al., 2021; Sedlmeier et al., 2019). In the same way, Los Angeles-based technology companies offer subscription fees for participating food donors to help supplement the program costs (Ayala et al., 2022). These innovative approaches aim to help create continual funding streams that allow organizations to better plan for long-term sustainability. The resulting literature, however, does not describe the actual financial outcomes in detail.

Facilitators

Despite the reported challenges and barriers, the studies highlighted several facilitators to food recovery and redistribution success. These included technology, partnerships, supportive policies and incentives, and innovative ways to reduce stigma.

Use of technology

Technology and innovation play a critical role in

streamlining operations and increasing efficiency. Several of the reviewed studies incorporated technology, such as apps and online platforms, to facilitate food pick-up and delivery, with seven studies specifically highlighting the use of these tools (Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Ayala et al., 2022; Frank et al., 2021; Sewald et al., 2018; Veeckman et al., 2018; Warshawsky, 2015). One example is the "FareShare" app, which streamlines the coordination of surplus food collection from retail stores by organizing pick-ups through a centralized platform (Alexander & Smaje, 2008). The Boulder Food Rescue created a "Food Rescue Robot," which allows volunteers to coordinate real-time pick-ups and deliveries, optimize their routes, and reduce logistical challenges, ultimately making the food rescue process more efficient and responsive to community needs (Sewald et al., 2018). In Greece, the SavingFood project leveraged a digital platform to directly connect food donors, such as farmers' markets and retailers, with charities and organizations in need, allowing surplus food to be quickly and effectively redirected to those most in need (Veeckman et al., 2018). Some studies did report concerns with the initial costs of developing and maintaining these platforms as well as the sustained need for consistent user engagement to ensure their effectiveness (Sewald et al., 2018; Warshawsky, 2015). Another important consideration is that technological solutions might not be accessible to all potential users, particularly in regions with limited digital infrastructure or among populations less familiar with digital tools (Mirosa et al., 2016). These challenges suggest that while technology holds significant promise for enhancing food rescue efforts, carefully considering its implementation and user accessibility is crucial for continued success.

Partnerships

Community engagement and partnerships are essential facilitators of food waste diversion efforts, especially when formal agreements are needed to define specific roles and responsibilities (Adams & Tabacchi, 1997; Sewald et al., 2018; To et al., 2019; Veeckman et al., 2018). Collaborations between food banks, local businesses, and volunteers are crucial, as they create shared and delineated responsibilities and provide essential resources for food rescue operations. Some of the studies described the benefits of informal but well-coordinated partnerships between entities such as local grocery stores, volunteers, and community organizations in fostering regular communication and shared goals that drive the program's success (Clare et al., 2023; Mittal et al., 2021; Sewald et al., 2018). Formal agreements were discussed as a necessity in the To et al. (2019) study to ensure that food safety protocols are strictly followed during collection and redistribution, particularly when handling prepared foods. Consistency between the nature of the agreements and partnerships varies, but many authors consider these relationships as beneficial and suggest that they enhance the scalability, safety, and impact of food waste diversion efforts.

Policy support/incentives

Another integral facilitator of food recovery efforts is policy support. This includes the laws and guidelines that encourage food donation and protect donors from liability, as well as tax incentives that make participation more appealing to businesses (Adams & Tabacchi, 1997; Bankson, 2009; Sewald et al., 2018). Both the University of Virginia and the Boulder food rescue programs advocate for increased awareness of the Good Samaritan Food Donation Act, which protects donors from legal liabilities and can make businesses more comfortable with donating surplus food (Bankson, 2009; Sewald et al., 2018). The Las Vegas Convention Food Rescue Program also highlights local health policies and protection in food recovery through formal agreements ensuring that donated food adheres to safety standards and complies with health regulations (To et al., 2019). These policies and legislation provide an important legal framework for safe and protected food donations by providing clear guidelines for food safety, making it easier for businesses to participate and contribute to food recovery efforts.

Reducing stigma through creative redistribution

Stigma remains a significant barrier in food charities, often discouraging individuals from accessing

needed resources (Aloysius & Ananda, 2023; Dresler & Tutt, 2019; Frank et al., 2021; Mittal et al., 2021; Sewald et al., 2018). Creative redistribution models can help to reframe food assistance as a positive community initiative rather than a charitable handout. Programs like "Free Stores," highlighted by Dresler and Tutt (2019), empower customers and volunteers by normalizing participation and fostering a sense of individual ownership over the process rather than dependency. Comparably, the "Free Food on Campus" initiative shifts the focus from food insecurity to environmental sustainability, encouraging students to participate by highlighting food waste reduction rather than need (Frank et al., 2021). By involving participants in the process and reframing the narrative around food rescue, these programs foster dignity and increase participation while simultaneously addressing food insecurity and waste.

Discussion

The question of the best option for food reuse for human consumption through upcycling or donation remains. Of the 300 articles obtained through the search process, only 18 met the inclusion criteria of adequately describing the programs to be assessed and compared. Within these 18 studies, wide variability in the data collection and methods of outcome metrics made comparison difficult. There is an overall lack of theoretical influence and evaluation in the literature, which suggests that interventions may be missing components to reduce FLW and provides fertile grounds for future research. There are also contextual considerations for planning new interventions, as well as a need for policy support to move the food system in the direction of structural change while meeting the challenges of food redistribution. We briefly consider these opportunities below.

Use Comparable Metrics

A predominant metric used in nearly all studies was the weight of food rescued (Adams & Tabacchi, 1997; Alexander & Smaje, 2008; Aloysius & Ananda, 2023; Ayala et al., 2022; Bankson, 2009; Clare et al., 2023; Philip et al., 2017; Mirosa et al., 2016; Mittal et al., 2021; Sedlmeier et al., 2019; Sewald et al., 2018; Sherman, 2004; Veeckman et al., 2018; Warshawsky, 2015). However, the method for weighing the food varied widely across these studies, and oftentimes it was unclear whether the weight of the food included packaging or other materials that would later be discarded. While the weight of rescued food is a valuable metric to track program effectiveness, the inconsistency in recorded data makes comparison difficult. Encouraging and increasing standardized metrics in future studies would help quantify the initiatives' direct impact and offer a framework for evaluating both the sustainability and scalability of food rescue efforts. Additional guidance, such as that provided by the U.S. EPA in the form of the Waste Reduction Model (WARM) tool, may help provide additional assistance to meet this need in future research (EPA, 2023). Hecht and Neff (2019) likewise suggested that adapting The International Food Loss and Waste Accounting and Reporting Standard could help address the need for consistent metrics and methodology. Encouraging organizations to report on economic metrics, such as the cost recovery of food rescue and redistribution, may help influence policy reform to support food waste reduction and potentially offer tax incentives. Reporting on land and water use impacts of food waste may also help contextualize the environmental toll of the current food system. Finally, incorporating temporal elements through longitudinal food recovery studies can be valuable for tracking the impact of such efforts, as it allows for evaluation of changes and trends over an extended period. This additional dimension enables an inclusive analysis of how food recovery programs evolve, assessing whether they remain effective over time, as well as monitoring long-term contributions which reduce the amount of food waste reaching landfills.

Lack of Theoretical Influence

The literature on FLW diversion is rich with diverse methodologies and findings, yet it also reveals the need for more rigorous, theoretically informed designs and longitudinal studies. The application of theory use is necessary in food waste programs to offer uniformity and guiding metrics for program creation, implementation, and evaluation (Kim et al. 2022). While universal theoretical

models are not yet available to guide food waste behaviour change, the development of a practical, conceptual framework that integrates insights on the multitude of factors and influences contributing to food waste reduction would aid in advancing this field of knowledge (Beretti et al., 2013; Dessart et al., 2019; Pollitt & Shaorshadze 2013). Scholars working to address waste diversion in New Zealand have suggested that combining theories based on behavioral, sociological, and Indigenous theories may be useful for waste minimization due to the complexity of food systems (Sharma et al., 2021). Other research has suggested that varied approaches may be considered appropriate at different stages of the food lifecycle; for example, theories directed at individual-level change may be useful in initial stages (i.e. food provision) and stochastic, environment-level theories are better suited for later phases (i.e. food disposal) (Kim et al., 2022). A review of food waste theory application by Kim et al. did not endorse any deterministic, individual theory explored in the articles they reviewed (ex. Theory of Planned Behaviour) but instead suggest that stochastic approaches (ex. Nudge Theory) appear promising for advancing theory-application within this field and are therefore worth further exploration (2022). Continued interdisciplinary research and the development of standardized metrics are essential guidelines for advancing the field and achieving meaningful reductions in food loss and waste.

Contextual Considerations

Context plays a critical role in the development and success of food rescue programs, as local cultural norms, socioeconomic conditions, and logistical frameworks vary widely across regions. Future research that considers the unique cultural values surrounding food distribution, community engagement, and economic structures can significantly influence how such programs are received and implemented. Understanding local practices, from food safety perceptions to the economic viability of redistribution models, is essential for designing programs that meet the community's needs. Additional logistical considerations such as transportation infrastructure, volunteer management, and local regulations must also be tailored to fit the specific needs and capacities of each individual region. Investigating and adapting to these contextual factors is crucial to ensure long-term sustainability and effectiveness of food rescue programs in diverse global settings.

Volunteer management can be significant work, as described above. In addition to the responsibility of managing a volunteer workforce, it is important to consider what role volunteers play within food recovery efforts in terms of scalability, ongoing economic feasibility, and the ethical considerations of unpaid work (Biewener, 2016. In their discussion on alternative agriculture systems, Biewener expressed concern about the reliance on unpaid labor, questioning whether these initiatives can provide "good jobs" alongside "good food" and avoid exploitative practices (2016). While unpaid work can foster community and skill-building, it also risks exploitation resulting from systemic challenges (like economic inequality) that can be difficult to resolve (Biewener, 2016). Significant progress is needed to advance the current food system practices and policies on a broader level that supports equitable and sustainable economic practices of unpaid labour, rather than relying on individual organizations to self-regulate (Biewener, 2016).

Structural Change

The modern industrial food system often prioritizes producing large quantities of inexpensive food over minimizing waste. Shifting this focus requires policy support which values food as a vital resource rather than a disposable commodity. By promoting system-level approaches that reduce the ecological footprint of food production, such policies can counter profit-driven practices. Academic research on FLW, combined with community advocacy, plays a crucial role in informing policymakers and government officials. Together, these efforts can help guide the transition toward more sustainable food production and consumption practices.

Several authors spoke to the need for robust system change, while also noting the importance of addressing community-level food rescue, redistribution and FLW as a short-term or intermediatory solution (Mirosa et al., 2016; Mittal et al., 2021; Sherman, 2004; Warshawsky, 2015). Food rescue,

while important, may inadvertently reinforce a neoliberal framework that shifts the responsibility for feeding vulnerable populations and reducing FLW onto individuals and communities, effectively absolving governmental agencies from their duty to be stewards of environmental sustainability for future populations and ensuring food security for the current population (Warshawsky, 2015). Sherman (2004) voiced similar concerns by stating that food waste diversion is a temporary measure that does not address the underlying systemic issues, such as poverty and unequal food distribution, which are the primary drivers of food insecurity. The reliance on food rescue as a primary strategy is not a permanent solution and risks normalizing a response that prioritizes individual action over structural change. Adopting more comprehensive policies to eradicate the wastefulness of food through each stage of its lifecycle is required for sustained change (Mirosa et al., 2016). Until considerable political action is taken toward meeting this goal, assisting the development of rescue and redistribution program by sharing existing approaches can help reduce the burden of waste that is created within the current system.

Strengths and Limitations

This study has some important strengths. First, we conducted our search worldwide, which allowed us to compare programs with various food sources, challenges, and facilitators, leading to our contextualized considerations for planning new opportunities. Second, we conducted pilot testing to select the search terms, including additional search words such as reclaim*, redirect*, service* and model*, thus broadening the reach of the literature reviewed. Third, we conducted our scoping review following the PRISMA framework to ensure the rigour and transparency of the review process.

Some limitations should be considered. First, given the scoping nature of this study to map the current evidence of food rescue and upcycling interventions used worldwide, we did not assess the quality of the studies. We did, however, evaluate the methodologies used in each reference to understand the context, validity and impact of the study's findings. Second, our research team exclusively reviewed peer-reviewed literature and we did not include gray literature in our study, potentially signifying the absence of relevant programs. Given this, it is possible that some food rescue programs may lack the capacity for a full evaluation. When initial gray literature searches were conducted on food rescue and upcycling programs, the resulting information on funding, resources and outcome measurements was limited. As such, it would be key to do a scoping review of the excluded grey literature to understand the breadth of such programs, and to capture the complete range of opportunities that could be adopted for the local context. Third, our search was limited to references written in the English language, thus leading to a gap in information on programs developed in non-English speaking countries.

Conclusions

This scoping review explores the current breadth of available studies on food recovery models to learn best practices and cultivate improved capacity for future programs. These studies revealed the critical role of volunteers, collaborative partnerships, and innovative technological solutions in overcoming logistical and operational barriers. However, inconsistencies in data collection and metrics across all studies hindered comparability, emphasizing the need for standardized evaluation methods. Future research should prioritize developing and adopting standardized metrics, such as those outlined in the International Food Loss and Waste Accounting and Reporting Standard, to enhance the comparability and scalability of food rescue initiatives. Furthermore, incorporating longitudinal studies could provide deeper insights into the long-term impact and sustainability of these interventions.

While food rescue initiatives can help address certain aspects of FLW, they remain short-term solutions that do not address the systemic causes of food insecurity or the structural inefficiencies within the food system. Future research should explore the intersection of food rescue efforts with broader socio-economic and environmental issues, focusing on tackling the root causes of food waste and food insecurity. The application of theoretical frameworks, such as behavioural and sociological theories, can help guide the development of inter-

ventions that account for cultural, economic, and logistical factors unique to specific regions.

Community-led advocacy can encourage policymakers to recognize the limitations of viewing food rescue as a primary strategy and instead support systemic reforms to create sustainable and equitable food systems. Policies that incentivize sustainable production and consumption patterns, offer support for social enterprise models, and invest in infrastructure which enhances the efficiency of food redistribution networks are all recommended practices. Fostering public awareness and reducing the stigma associated with consuming rescued food can also improve participation and acceptance of food rescue efforts.

This review offers a current summary of work being done by organizations working to reduce food waste while addressing the need for more comprehensive solutions and strategies that acknowledge systemic barriers. By combining practical solutions with policy support and theoretical advancements, future efforts can contribute to a more sustainable, equitable, and efficient global food system. It is important to remember that the food system is complex, and the ultimate goal is to maximize food production and distribution within a circular economy model (Vilarino et al., 2017). To build a truly circular and equitable food economy, we must strive to ensure that every stage of food production and consumption, including both edible and non-edible, is optimized, repurposed, and reintegrated into the system to nourish both people and the planet.

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Appendix.

Table A1. Search Strategy

Terms	Scopus	Web of Science
Food Rescue	food W/3 (rescue OR rescued OR rescues OR redirect* OR upcycl* OR reclaim*)	food NEAR/3 (rescue OR rescued OR rescues OR redirect* OR upcycl* OR reclaim*) (title)
Programs	program* OR initiative* OR strateg* OR project* OR model* OR activit* OR service* OR intervention*	program* OR initiative* OR strateg* OR project* OR model* OR activit* OR service* OR intervention*

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Towards a cohesive circular food economy: A motivation opportunity ability (MOA) approach to understanding an emerging group of practitioners in Metro Vancouver

SPECIAL ISSUE
Community-Based Circular Food Systems

Sponsored by
the Thomas A. Lyson Center for Civic Agriculture and Food Systems

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Abstract

Nearly half of the food produced in Canada is lost or wasted, leading to negative environmental impacts and contributing to rising levels of food insecurity. The circular food economy (CFE) has been proposed by stakeholders and policymakers as a potential framework for solving the food waste problem through a variety of business and non-profit food-related waste reduction and prevention initiatives, creating a community-based circular food system. This research asks: How do individuals working in the food sector mobilize CFE

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practices in their work? What are the motivations, opportunities, and abilities influencing those working in the emerging CFE sector in Metro Vancouver? To answer these questions, this research analyzed interview data from food sector stakeholders (n = 22) contributing to the Metro Vancouver CFE. This study applies the motivation opportunity ability (MOA) framework to guide data analysis. The findings indicate that there are conflicting priorities to CFE approaches in Metro Vancouver, leading to a lack of cohesion among initiatives and to barriers to a more equitable CFE. Stakeholders contributing to the CFE notice competing visions in best practices to reduce waste leading to a paradox of managing waste instead of prevention.

Keywords
circular economy, circular food economy, food waste, MOA framework, motivation opportunity ability framework, Metro Vancouver

Introduction

In Canada, 46.5% (21.18 million metric tonnes) of all food produced is lost or wasted, costing the Canadian economy CA$58 billion annually and contributing 25.69 million metric tonnes to greenhouse gas emissions (Nikkel et al., 2024). In the province of British Columbia, it is estimated that CA$516.5 million worth of food from the retail sector is wasted (Ministry of Environment & Climate Change Strategy, 2019), and within the region, food makes up 15% of Metro Vancouver's solid waste sent to landfills (Tri Environmental Consulting, 2019). This massive food waste harms the environment and is detrimental to food security (Santeramo, 2021), making it critical that food resources are managed more sustainably (Göbel et al., 2015). Reducing food waste and ensuring equitable distribution can enable feeding more people while making the food value chain more sustainable and resilient (Garrone et al., 2014).

A circular economy (CE) attempts to solve the broad problem of waste by eliminating waste and pollution, reusing products and materials, and regenerating nature (Ellen Macarthur Foundation, n.d.). A circular food economy (CFE) addresses waste in the food supply system and seeks a sustainable destination for food products that is restorative, healthy, and offers financial benefits for stakeholders (Lugo et al., 2022). A CFE design eliminates waste from the food system (Soma, 2022) by using circular loops to reuse, recycle, recover, and reprocess edible and inedible food (Lugo et al., 2022), a practice growing in popularity among policymakers to advance sustainable development (Ashton et al., 2022).

Political will exists in Canada to make the shift toward a CFE. In the province of British Columbia, the CleanBC Roadmap to 2030 plan targets reducing waste and turning it into resources (Government of British Columbia, 2018). The goal is to keep 95% of residential food and yard waste out of landfills by 2030 (Government of British Columbia, n.d.). At a regional level, Metro Vancouver's Climate 2050 Strategy commits to a CE transition that reduces greenhouse gas emissions (Metro Vancouver, 2018a). Many municipalities within the region are integrating CFE goals into plans and policies (City of Richmond Recycling and Solid Waste Management, 2021; City of Vancouver, 2018). For example, the City of Richmond's Circular City Strategy plans to shorten the food chain from farm to fork by encouraging food service establishments to prefer locally sourced foods (City of Richmond, 2023). Metro Vancouver encourages restaurants to prevent food waste or donate it before recycling it into compost (Metro Vancouver, 2018b). Although governments seek to make this shift, businesses and other stakeholders are also taking responsibility for preventing loss (Leipold et al., 2021), and creating their own community-based circular food systems. However, there is no broadly recognized definition, or singular practice, within the CFE (Lugo et al., 2022). As a result, stakeholders, including nonprofit organizations and food businesses with different and often competing interests and varying levels of influence, take a range of actions (Lugo et al., 2022) that may or may not be consistent with the goals of advancing a CFE.

In the current dominant food system, wasting food is easy, contributing to a throwaway society (Evans, 2012). It has become easy to waste because food waste prevention can be difficult due to food

safety concerns, confusing date labelling, lack of staff training, and marketing that encourages over-purchasing (Huang et al., 2021). Moreover, expectations such as stringent aesthetic standards result in nutritious food being discarded simply due to cosmetic reasons (Soma, Kozhikode and Krishnan, 2021). Although food retailers are in a powerful position to diminish food waste (Huang et al., 2021), saving food that would otherwise be wasted is not part of business as usual (Gollnhofer, 2017). With all of the regulatory, economic and cultural barriers hindering efforts toward circularity, and to better support their food waste reduction efforts, it is important to understand the perspectives of an emerging group of stakeholders in the food sector who are swimming against the current to participate in the CFE.

Drawing on interviews with 22 informant CFE stakeholders working in the CFE, this study asks two research questions: 1) how do individuals working in the food sector mobilize CFE practices within their work, 2) what are the motivations, opportunities and abilities influencing those working in the CFE sector in Metro Vancouver? The research applies the Motivation, Opportunity, and Ability (MOA) theoretical framework, which states that when an individual has motivation, opportunity, and ability, they can mobilize them to accomplish their goal (van Geffen et al., 2020). Understanding stakeholder motivations, opportunities, and abilities can provide a comprehensive picture of the CFE landscape in Metro Vancouver and lay out relevant information for policymakers about the drivers to CFE participation. The Metro Vancouver food system relies on its provincial regulatory framework but needs a cohesive circular plan for success. This study provides the data that can help align CFE actions and fill the policy gaps with opportunities to reduce and/or prevent food waste. Policymakers should not develop CFE policies in silos as there is no "one size fits all" approach and should consider the flexibility needed by businesses and organizations to pivot and adapt when mobilizing CFE solutions.

Literature Review

The circular economy (CE) is an alternative economic model that incorporates resource efficiency, regeneration of natural systems, and recycling or recovering materials at the end of their life cycle (Bolger & Doyon, 2019; Mukherjee et al., 2023). It is proposed as an alternative to the linear economy that could replace the take-make-use-dispose system (Bolger & Doyon, 2019; National Zero Waste Council, 2021). Morseletto (2020) states that the CE reduces the use of primary resources and closes the loop of materials within the limits of environmental protection and socioeconomic benefits (Figure 1). The CE model meets the needs of the growing population within the boundaries of ecological systems (Cairns et al., 2021). Ghisellini et al. (2016) argue that the CE calls for radical alternative design solutions at the intersection between the life cycle process, the environment, and the economy.

The CE has emerged within the last decade to advance sustainable development through supply chain management and managing products at the end of their life (Ashton et al., 2022), a reliable way for businesses to support environmental integrity and regenerate eco-industrial development (Ghisellini et al., 2016). Although the CE is open to a variety of interpretations (Morseletto, 2020), Temesgen et al. (2020) argue that it does not answer the ontological and epistemological questions needed to address the complex environmental, economic, and social problems of society, perhaps because the CE is practice-based, and led by businesses, consultants, policymakers, and political think tanks (Ashton et al., 2022).

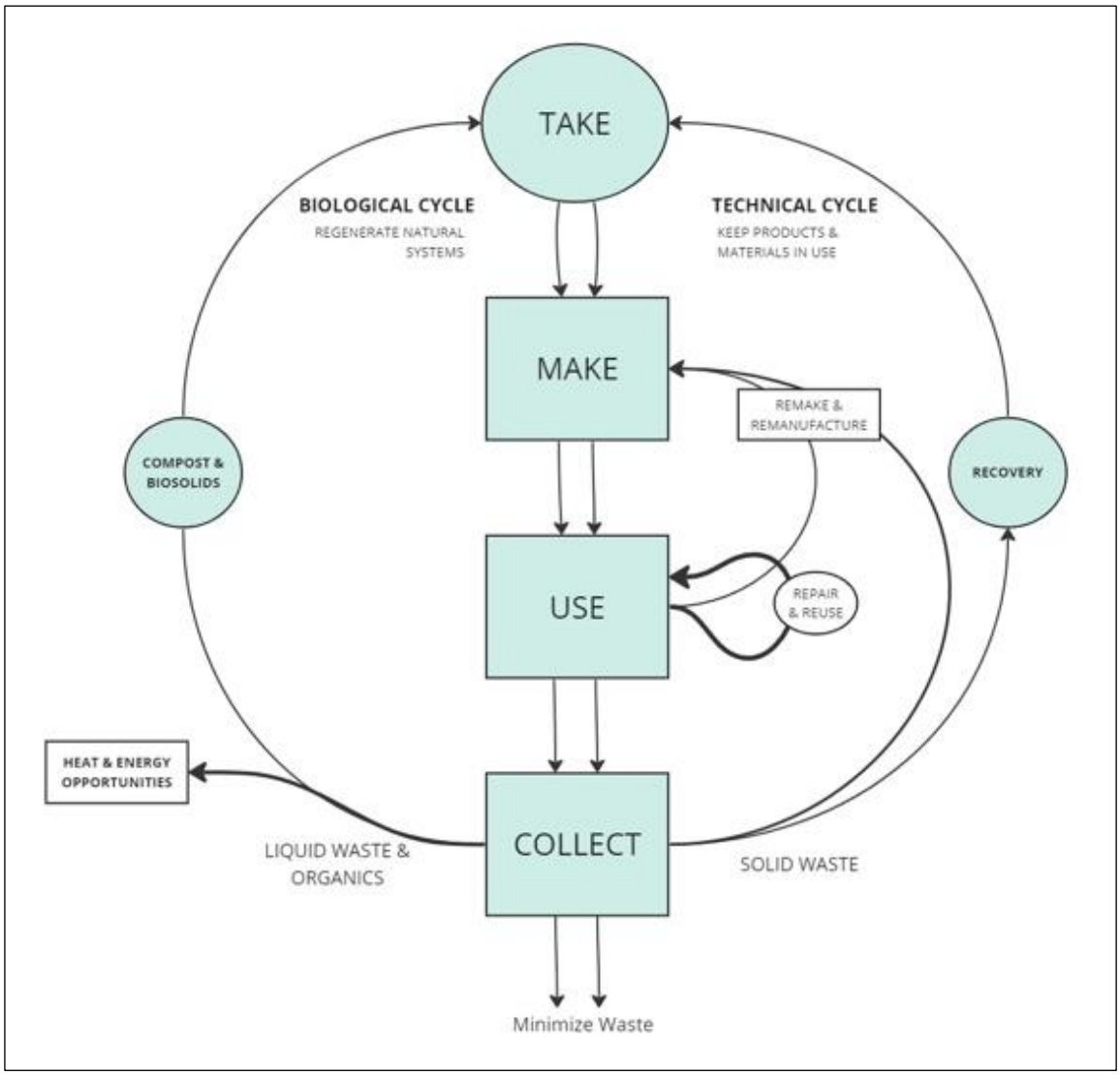
There are several types of CE models, particularly among business models in sectors such as agriculture and food products (in which this research is situated), furniture, textiles and apparel, electronics, and equipment and machinery (Bocken et al., 2019). Mukherjee et al. (2023) explain how the CE can exist among businesses that adopt a variety of structures and ways to contribute to the economy. These include upstream solutions such as value creation, partnerships and collaborations, and downstream solutions such as revenue mechanisms, offerings, valued delivery, and products. Although businesses play a large role in CE implementation, governments can play a supportive role through strategic planning (Bolger & Doyon, 2019). However, as defining CE in urban systems is difficult, it is challenging for local governments

to measure their success in using CE as a tool to reduce waste.

As CE proponents aim to advance economic prosperity, ecological integrity, and social well-being, Ashton et al. (2022) recognize that in practice some of these pillars will win while others will lose, and criticize the current approach to CE for not addressing social inequalities and power structures that exist within circular practices and neglecting the aspirations of community members, particularly the marginalized. Furthermore, some have argued that dominant CE practices can dismiss real issues around worldviews to achieve economic profit, that CE practices can be implemented for "feel-good" reasons or for greenwashing and continuing to promote a consumerist culture (Temesgen et al., 2021). Mukherjee et al. (2023) argue that CE initiatives are often done at only a surface level among G20 countries.

There may also be paradoxical tensions when two of the three pillars of sustainability— economic, social, environmental—conflict (Daddi et al., 2019). De Angelis (2021) defines a CE paradox as "competitions versus collaboration in innova-

Figure 1. The Circular Economy



Adapted from National Zero Waste Council, 2021,

tion for circularity; efficiency versus resilience" (p. 4). When a paradox is present, tensions and contradictions arise among CE initiatives (De Angelis, 2021). Companies within the circular economy could pursue environmental outcomes, such as reusing and recycling raw materials, while raising the quality of the products and simultaneously increasing product competitiveness (Daddi et al., 2019). The increase in production may then contradict the environmental objective of reducing waste. Since the CE is rooted in traditional economic growth-oriented ideology, Ashton et al. (2022) have pointed to the divide that has developed between grassroots CE initiatives and initiatives seeking economic growth. These specific critiques showcase the common CE pitfalls that can arise, some of which are highlighted in this study.

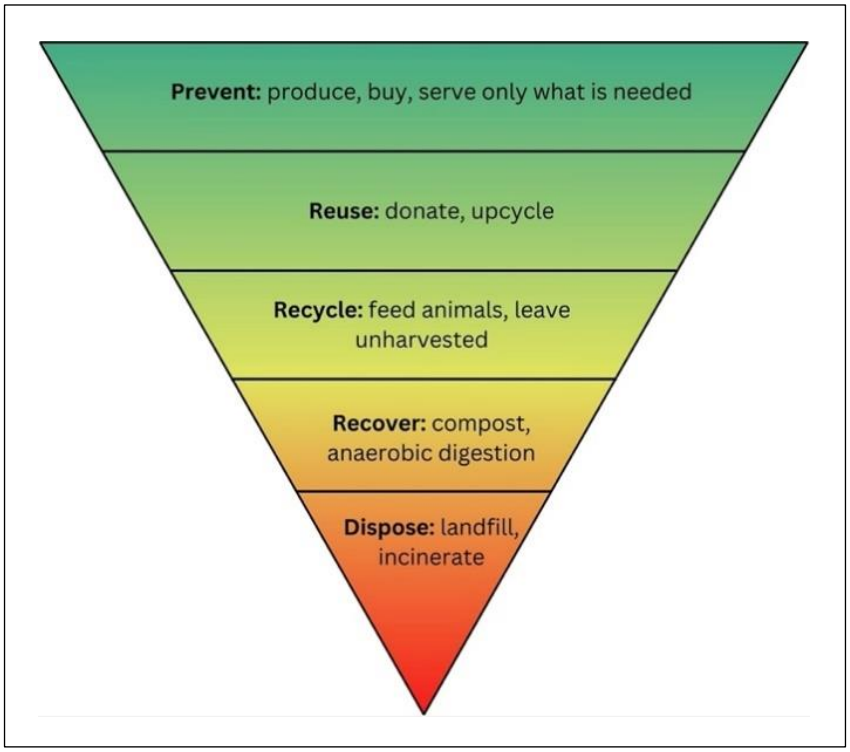
Circular Food Economy

Lugo et al. (2022) define CFE as:

> a co-creative food ecosystem that enhances food safety, food security, and biodiversity conservation, preventing food losses and waste, managing perishability, and using regenerative agriculture through reusing, recycling, recovering, and reprocessing edible food and inedible parts into circular loops and alliances. (p. 29)

The aim of a CFE is to close the loop along the supply chain line and reuse food, minimize surplus, and avoid waste, involving three interconnected stages: food production, food consumption, and food surplus and waste management (Jurgilevich et al., 2016). The process reduces food waste generated within the food system, reuses food, uses by-products, and regenerates nutrients. To support CFE, the food recovery hierarchy (Figure 2) adapted from Kenny et al. (2023) and Papargyropoulou et al. (2014) offers guidelines for preventing and managing food waste most appropriately, with the most preferred method at the top to the least preferred at the bottom. Soma (2022) identifies limitations of this hierarchy, including limiting innovation, lack of consideration of scale, and lack of distinction between types of food. Regardless, food waste prevention is the highest and most important component of the hierarchy, followed by feeding people, then animals, before recovering nutrients and energy (Varney, 2021). Leaving food for landfill and incineration is the least preferred method. Soma (2020) encourages scale to be considered when focusing on preventing waste and on food waste outputs. When wasting food becomes commodified and creates value, there will always be a demand for more waste and less effort to reduce at the source. Therefore, a new framework for a CFE that is also based on justice, reconciliation, and innovation has been proposed (Soma, 2022). It is thus clear that transitioning to a CFE is complex

Figure 2. The Food Recovery Hierarchy



Adapted from Kenny et al. (2023) and Papargyropoulou et al. (2014).

and multi-dimensional, requiring systemic innovative solutions (Cairns et al., 2021).

CFE is unique from other CEs (e.g. textiles, construction waste) due to the perishability of the materials. In the food supply chain, there are varying levels of production, availability, and seasonality which result in different conditions than those of CEs whose materials could be used in a variety of ways (Lugo et al., 2022). Therefore, some of the barriers and opportunities in the CFE may be specific to the food sector.

Coghlan et al. (2022) suggest that considerations of CE social benefits are often missed. Leipold et al. (2021) found that in CE narratives in France, social issues are often excluded from political conversations, leaving them solely economics-based. The social sector is complex in a CFE. as there are several stakeholders, with competing interests and varying levels of influence (Lugo et al., 2022). These opposing interests raise new questions about the ability to plan for a cohesive future with a common set of visions (Barry et al., 2018). However, diverse visions and solutions can also be a tool for resiliency in CFE, as recognized in other food systems resiliency studies (Cabell & Oelofse, 2012; Worstell, 2020). Mourad (2016) identifies these competing interests to contribute to either "weak" or "strong" sustainability. For example, recycling and recovery may support incremental change, as they are considered "weak" solutions compared to waste prevention, a "strong" solution (Mourad, 2016). To go beyond weak solutions, Mourad (2016) argues that food systems governance structure needs to be rethought, including the power relationship between producers, manufacturers, retailers, food banks and other actors.

A CFE aims to transform the economy, presenting new, innovative business opportunities so that food is reused, recycled, recovered, and reprocessed (Lugo et al., 2022). Businesses would have the opportunity to redirect food, perhaps giving it to people in need (Leipold et al., 2021; Papargyropoulou et al., 2014), creating upcycled products from material that would otherwise be wasted (Jurgilevich et al., 2016) or creating fuel and energy through anaerobic digestion (Usmani et al., 2021). A CFE leads to new business models, creating innovative jobs (Lugo et al., 2022) and generating technological innovations to promote sustainability models (Springle et al., 2022). All these alternatives fall at various points of the food recovery hierarchy. Their implementation by actors in CFE can better be understood through the lenses of the motivation, opportunity, and ability framework.

Motivation Opportunity Ability (MOA) Framework

The MOA theoretical framework is used in this study to analyze CFE practitioner experiences. According to MOA, if an individual has motivations, opportunities, and abilities, they can mobilize these elements to accomplish their goals and change a behaviour (Ajzen, 2002; Ölander & Thøgersen, 1995; van Geffen et al., 2020). Motivation involves one's desire, readiness, intention, values, or willingness to make the change; Opportunities refer to the extent to which preconditions or limitations impact actions to make the change; and Abilities are the skills, knowledge, proficiencies and habits available to make the change (MacInnis et al., 1991; Ölander & Thøgersen, 1995). When tackling food waste reduction, motivations can go beyond personal interests to include values, yet these values can be hindered by other factors (Soma et al., 2021). For example, if one wants to reduce their household food waste because they value environmental conservation, they are considered to have high motivation; if they are educated on ways to reduce waste at home through meal planning they have a high ability; however, if they lack the time to meal plan they have a low opportunity (National Academies of Sciences, Engineering, and Medicine [NASEM], 2020). Therefore, an individual's value may not be supported by an enabling environment that would allow them to act accordingly. This phenomenon is also known as the "value action gap" (Barr, 2006). Various scholars have adopted the MOA framework to better understand environmental and sustainability behaviours (de Jonge et al., 2014; Ölander & Thøgersen, 1995), including reducing food waste (Soma et al., 2021). The novelty of this study is that using the MOA framework it explores the practices of an emerging group of CFE practitioners, and therefore

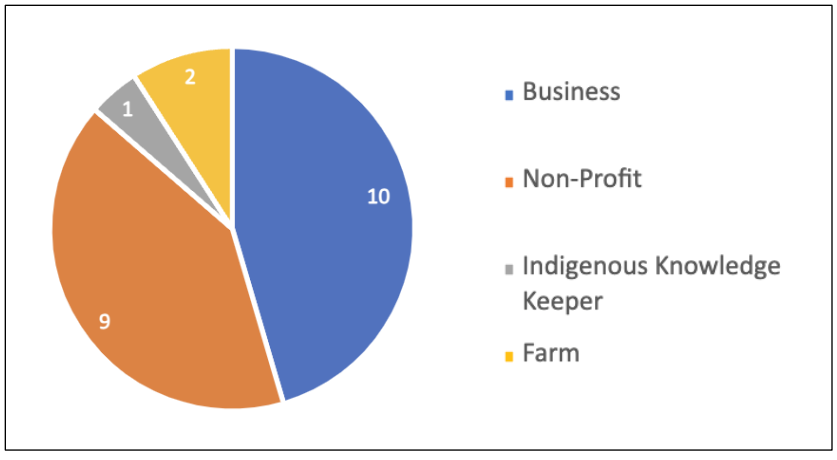
provides useful insights for future interventions to encourage involvement in CFE.

Methods

The participants targeted for this study were working on various CFE initiatives in Metro Vancouver. Purposeful sampling was used to ensure that interviewees presented information-rich cases (Baxter & Eyles, 1997). The participants targeted for this study were working on various CFE initiatives in Metro Vancouver. An initial list of potential informants meeting the criteria was created based on researchers' networks and reports published on best practices of circular food economy initiatives (Cairns et al., 2021; National Zero Waste Council, 2021). There was a conscious effort to ensure that a diversity of voices was included as research participants. Once an initial round of potential interviewees was established and interviews were underway, snowball sampling was used to purposefully obtain additional information about potential interviewees (Naderifar et al., 2017). From January 2023 to March 2023, 22 semi-structured informant interviews were conducted with various CFE stakeholders in Metro Vancouver. It is important to note that several groups declined the interview invitation due to capacity constraints; some organizations noted that their CFE work in the region had ceased to exist when they were contacted. These challenges highlighted the emerging nature of many of the start-ups and social enterprises working in this sector and are included below. Among the 22 stakeholders interviewed, 10 represent businesses, entrepreneurs, or for-profit enterprises, eight represent nonprofit organizations, two represent farms, and there was one Indigenous Knowledge Keeper, Leona Brown, who expressed consent and preferred to be fully named. Interviewees represented a variety of cities in Metro Vancouver, including Vancouver, Burnaby, Richmond, North Vancouver, Delta, Langley, Abbotsford and Tsawwassen. The sectors represented are shown in Figure 3.

Interview questions were open-ended and semi-structured, and focused on participants' motivations, opportunities, and abilities working in the CFE sector in Metro Vancouver. The questions were designed to better understand why people do their work (e.g., values), what supports or barriers they face, and how they define a CFE. Interview questions attempted to avoid using the terms CE or CFE to avoid any confusion around this emerging jargon and to ensure accessibility. Instead, questions focused on food waste reduction and prevention, as well as food-related efforts in sustainability, all of which can be connected back to the CFE concept. Analysis of the interviews started with the first author coding using NVivo and developing a coding tree based on the MOA framework. The preliminary codes (coding tree) and quotes were then shared with the team, and we collectively applied Ryan and Bernard's (2003) thematic approach for qualitative research. Based on further reviews, the team proceeded to winnow the themes, identifying subthemes and then ensuring that that code is categorized and linked back to the theoretical framework (Ryan & Bernard, 2003).

Figure 3. Distribution by Sector of Those Interviewed



Limitations

The participants and organizations contacted were not an exhaustive list of CFE initiatives in the region due to personal network limitations, or failure to identify through online searches. Although there were a variety of attempts to diversify the interviewee group, they were met with challenges, especially with

capacity constraints in smaller initiatives. A major limitation of this study is that of the 22 participants, very few were from minority groups and only one identified as Indigenous. Lack of adequate representation of racialized communities in the sustainable food sector may indicate the variety of barriers to entering the CFE space and green innovation in Metro Vancouver (Varney, 2021; Warshawsky, 2021).It is important to note that this study focuses on the MOAs of individual practitioners in the CFE: the broader systematic aspects of CFE are beyond its scope. Since many stakeholders interviewed are leaders of their organization, their identity and their MOA can be strongly tied to the group they are representing, making it difficult to distinguish between their MOA and their organization's MOA. Despite these limitations, this paper allows for a fairly realistic overview of the current CFE landscape in Metro Vancouver.

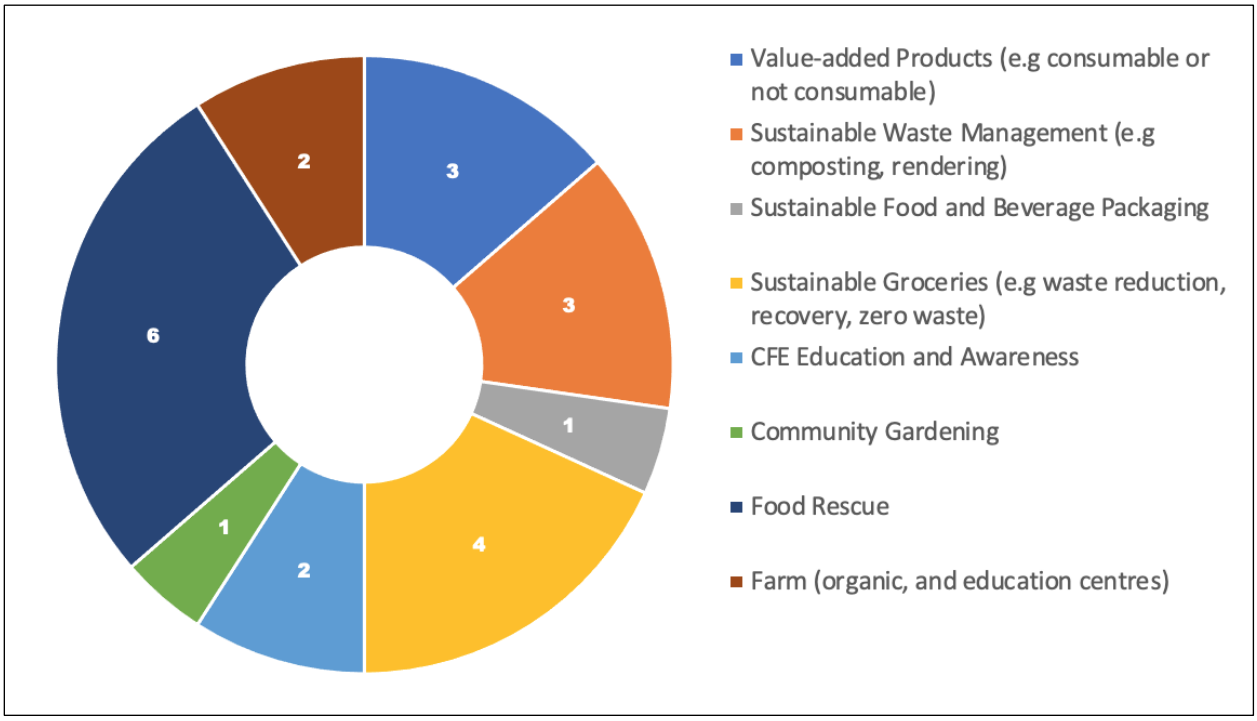
Results

This section summarizes the main findings from the key informant interviews. The findings from this study explain the complexity existing around a CFE in Metro Vancouver that will be considered in the discussion. The following sections outline how individuals working in the food sector mobilize CFE within their work, followed by their motivations, opportunities, and abilities.

Circular Food Economy Mobilization Practices

Figure 4 outlines the eight different ways the CFE is mobilized through the work of stakeholders in this study. Many (n = 10) of the groups interviewed apply CFE approaches to rescue and/or redistribute food. They include nonprofit organizations that acquire food from grocery stores that would otherwise be wasted and redistribute it locally to those in need, following a food banking-type model. Many of the food rescue nonprofits receive their donated food from large grocery stores. Other rescue groups take food from farms that would otherwise be wasted, and either distribute it to those in need or turn it into value-added products. Stakeholders interviewed contribute to CFE through value-added initiatives, through their food retail businesses. Food retail businesses sell food in various forms, through alternative grocery stores such as zero-waste grocery. Those working in the composting sector mobilize in a variety of different

Figure 4. Overview of the Circular Food Economy Mobilization Practices of the Interviewees



ways, such as through nonprofit and community education, consulting services, or soil restoration. Finally, a variety of these stakeholders, particularly the farmers, reduce waste at the source and contribute to the CFE by circulating nutrients back into the soil.

Conflicting Landscape and Competing Visions of Circular Food Economy in Metro Vancouver

There was a clear divide between CFE approaches, which at times led to tensions between CFE practitioners. This was especially true between individuals working in larger organizations/ companies and smaller ones. There were also tensions between a charity or small-scale approach and a for-profit approach to CFE. One farmer felt that small-scale operations are not to be compared to large corporations: "[the name of a large-chain supermarket], they have food waste, we don't have food waste" (Farm 1).

Several participants also alluded to the dependency of CFE on the charity model, particularly focused on food rescue. As one nonprofit worker noted, large grocery stores have food rescue charities to fall back on when they produce a lot of waste: it is their "get out of jail free card" (Nonprofit 3). This focus on putting the responsibility of food waste reduction on nonprofits led one business to question the mission of food charities, and whether their work is based on social services and needs, or is a way to let companies producing waste off the hook. One CFE business argues that charities are having to pay for the inability of companies (often grocery stores) to manage inventories (Business 5). They stated that nonprofits focusing on food rescue are the ones receiving much of the grant money, which leads to greater competition among initiatives. Further, they alluded to how this approach is reducing the supply of food waste: "[The] upcycling business, they are competing against nonprofits, for feedstock, guess what that does? It drives down the supply for these not-for-profits" (Business 5).

Some of the individuals felt conflicted about making a profit from CFE, especially when there is dire food insecurity. This was perceived by one participant as a lack of values (Nonprofit 8); that while there is a range of people doing CFE work for environmental sustainability, in the last five years, they have seen more approaches entrenched in profit-making.

Motivations

Under the category of motivation within the MOA framework, we sought to understand what made the participants motivated to be involved in CFE initiatives. These motivations are the values, beliefs, and attitudes that propel the stakeholders to participate in CFE despite numerous obstacles.

Environmental motivations

Reducing food waste for environmental and sustainability reasons was the primary motivation for the majority (n = 14) of the participants, who felt proud to be able to contribute to something that supports environmental protection, especially with the growing pressures of climate change and inequity in the agri-food system. One individual from a food rescue organization said that reducing food waste is a "very apolitical way to dramatically cut emissions because it doesn't matter what side of the political spectrum you're on, nobody likes food waste" (Nonprofit 1).

For-profit stakeholders see the need for businesses to behave more responsibly within the food industry, in which there is a lot of waste. Furthermore, individuals from nonprofit and for-profit organizations alike found personal reasons to contribute to a CFE. An industry leader working in composting noted "I've got three kids, and I want them to have a future that is not the way it's going right now" (Business 5). There was a sense of accomplishment and gratification among those who felt good about contributing to a different type of business practice and challenging the status quo.

Social equity and health motivations

Interview participants were also motivated by social justice considerations such as solving food insecurity. One nonprofit participant identified low income and the high cost of living to be the causes of food insecurity and stated that their food rescue programs give people the resources needed to move towards food independence (Nonprofit 4). For one industry participant, CFE practices can be

a tool to support marginalized communities: "I really see the circular economy…as a mechanism to support community to empower and uplift communities as a whole" (Business 3). Several interviewees recognized the health benefits their initiatives provide community members; for example, through upcycling food with added nutrients or providing healthy food to people in need.

Economic motivations

Participants were motivated when they felt that their initiatives were providing something different, not as common in the current linear economy. One farmer discussed how the CFE can be a model for cooperative economic development (Farmer 2). A group felt that through direct sales from farm to consumer they are developing an alternative economy, that removes the "middleman" or intermediary and reduces the risk of waste (Nonprofit 3). Nonprofit and for-profit participants alike were motivated by the educational opportunities that a CFE presents, bringing food waste knowledge and education into people's homes.

Indigenous values

The majority of stakeholders were motivated to reduce food waste by various values they felt underpin the CFE. Circularity in the case of Indigenous Knowledge Keeper Leona Brown (who expressed consent and preferred to be fully named) was motivated by Indigenous values:

> Circular food is something that Indigenous people lived by. We had no waste, there was no waste of anything. Every part of food or plant medicines was used in some shape or form, whether we're eating it, or we're wearing it or, we pray and we give it back to the land, to the trees [and] we never had garbage, we never had a landfill pre-colonization. So, what did we do? We actually would bury food by a tree. If it is bones or something, we leave it out, and we pray and give it back to the land. So another animal will come along and finish off those bones or whatever meat that we did not eat. We give it back to the land, and the land feeds back with what we need. So, it is a circular motion.

Opportunities

In the MOA framework, opportunities include the structures, systems and materials that may support the participants in creating an enabling environment to act in accordance to their values. The findings highlighted current opportunities that facilitate CFE work, as well as gaps in opportunities that may hinder CFE work despite high levels of motivations and abilities.

Supporting opportunities in the CFE

Partnerships and collaboration. Many stakeholders highlighted the support to contribute to CFE they receive from community and business partnerships and collaborations. One nonprofit participant shared an internal motto: "Do what we do best and partner for the rest" (Nonprofit 1). This opportunity was common among organizations that identified having limited capacity. Some stakeholders were also provided funding by government partnerships (Nonprofit 4, 5; Business 7) and provided research work by academic partnerships (Nonprofit 1, 5; Business 8). Collaborative learning opportunities helped support stakeholder opportunities, such as the Circular Food Innovation Lab through the City of Vancouver (City of Vancouver, 2023).

Collaboration was deemed important for ongoing initiatives with the CFE in Metro Vancouver. Two nonprofit participants believed that collaboration is critical to a successful CFE (Indigenous Knowledge Keeper and Nonprofit 4). Some groups were interested in building a "food hub" for circular food services, so that, for example, if one group receives a large donation of a food type, they can distribute it to where it is needed more. It was clear that partnerships can streamline operations. Three business interviewees described how partnering with food rescue nonprofits was useful to their operations (Business 8, 9, 10).

Existing systems and structures. Regionally, provincially, and nationally, existing systems and structures have helped CFE initiatives. Organizations that have charitable status found certification critical when applying for grants. The green bin or composting system within municipalities was crit-

ical to many organizations that did not want to see food go to landfills (Nonprofit 7; Business 4, 7; Farmer 2). The Buy BC logo, which identifies a packaged product as produced in BC, and the B Corp certification, which ensures companies meet certain social and environmental standards, were recognized as important to consumers, and therefore important to stakeholders (Business 1, 10; Farmer 2). These are trusted labels on packaging that consumers recognize, possibly making shopping decisions easier. Canada Helps, a system that streamlines donation administration for nonprofits, was helpful in operations (Nonprofit 9). One interviewee's business exists within the Agricultural Land Reserve, a British Columbia region set aside for agriculture and the food industry. They stated that having this land and the farm designation helped their operations because they would not have been able to find similar space in Metro Vancouver (Business 5).

Political and economic opportunities. Participants noticed that there seems to be a political and public window of opportunity with increased attention to CFE. They stated that as CFE relies on the will of political leaders, organizations feel supported if leaders are interested. "It depends on what the interests of policymakers are, these initiatives could be important or not," said one interviewee working with farmers (Nonprofit 3). A nonprofit participant recalled many decades ago when there was "suddenly a provincial mandate to keep waste out of landfills" and composting became of interest to the government (Nonprofit 5). Multiple stakeholders noted how the public has been paying more attention to food and environmental issues over the last few decades. Some stakeholders working on CFE initiatives in Metro Vancouver saw a gap, or opportunity within the market, to advance a circular initiative in a collective manner.

With the growing prioritization of CFE, participants have observed an economic window of opportunity due to some changes in behavior that support CFE in the food industry. For example, stakeholders shared that they are seeing more of a market opportunity for "ugly" or misshapen produce, dehydrated food, and frozen foods that reduce food waste (Nonprofit 3, 5). In addition, businesses are noticing that suppliers are also more open to circular packaging, or reducing plastic packaging, than they were five years ago (Business 8, 10). One business interviewee finds hope in the growing number of upcyclers, academics, and food rescue groups contributing to the CFE (Business 4), which as will be demonstrated in the section below (see Abilities) are creating professional and intellectual support for CFE action. Therefore, the opportunities created by new niche markets and social networks are aligning the motivations, opportunities, and abilities of the participants.

Lack of opportunities in the CFE

Conventional industrial food system. The main challenge stakeholders face in their CFE work is the entrenched practices of the conventional industrial food system, such as high aesthetic consumer standards and over-purchasing to fill grocery shelves (Nonprofit 1, 3, 4, 7, 8). Others pointed to how easy it is to waste food due to the current "best before" date system (Nonprofit 4), and because how time-consuming processing and cooking food can be with busy schedules (Nonprofit 8). As one interviewee argues, "waste costs are too cheap and reinforce the status quo of food ending up in our waste streams" (Business 4). This interviewee also noted that there is no regulation for businesses to report their food waste, which they identify as a problem for measuring a baseline and reducing waste.

For-profit participants pointed to the high barriers to entering the retail/grocery business in Canada due to the few dominating corporations with the largest buying power. This makes it difficult for innovative grocery shopping alternatives. One company said that it is difficult to incentivize the CFE because the end product can be expensive to consumers (Business 8). A interviewee suggests a potential underlying cause of the expense problem: "in the food industry, there's constant fighting for margin…the most unsustainable thing has been our food prices, I think our foods been subsidized for so long" (Business 1).

Lack of funding and high operational costs. Not surprisingly, a lack of funding and high opera-

Table 1. Frequency of Barriers Identified

Barrier	# of Participants
Lack of funding	9
High staff turnover/Reliance on volunteers	7
Limited ability to grow the organization	5
High cost of land or real estate	5
High cost of labor	5
High cost of living, supplies, food	6

tional costs were considered key barriers by stakeholders working in the CFE. Table 1 shows the frequency of barriers identified by the 22 participants; some spoke about multiple barriers.

Some individuals from businesses felt limited in the support or opportunity to grow within the CFE. For example, one stated that because they do not make edible products, they have been eliminated from food funding sources despite their usage of food waste (Business 6). It was clear that CFE businesses wanted investment to move toward circularity and business model innovation. The lack of funding limited their ability to grow: a participant stated it was "really hard to do system change whilst doing operational stuff" (Nonprofit 1).

While most nonprofit and for-profit participants identified negative issues around funding, various stakeholders have received funds from municipal, provincial, and federal grants including the Canada Summer Jobs program, and two nonprofits have ongoing funding (Nonprofit 2, 5). Although the funding of running a small business is difficult wherever it is located, businesses stated that "one of the biggest problems is doing this in Metro Vancouver" due to the lack of land or warehouse space and the high costs associated with the region (Business 2).

Regulatory challenges. Nonprofit and for-profit interviewees alike have found difficulty advancing CFE initiatives due to a variety of regulatory challenges. Interviewees experienced restrictions involving red tape, bureaucracy, and business permits. One farm identified the extensive health restrictions and guidelines small farms must follow in order to access larger grocery markets (Farmer 2). Two participants noted the temporary restrictions during the COVID-19 pandemic when they were unable to reuse plastic containers (Business 9) or redistribute food from open packages (Nonprofit 7) for public health objectives.

Businesses are also frustrated by the lack of regulation around reporting amounts of food waste, leading to greenwashing. Currently, businesses are not obliged to make public their waste reduction techniques, and many for-profit stakeholders believe this lack of transparency has led to greenwashing. One participant is waiting to see how Metro Vancouver will support the CE and green entrepreneurs through supportive regulation. They believe governments speak about supporting green initiatives, but there is little action. Therefore, they are considering moving their business elsewhere (Business 1).

A nonprofit participant asserted that the government needs to take a leadership role in CFE (Nonprofit 4) instead of businesses having to convince the government of its importance. A business participant discussed how government regulation can inhibit innovation; for example, strict composting regulations can inhibit a business's ability to be creative with compost (Business 3). However, this issue is complex, as other CFE stakeholders want to see stronger food policy from governments. Multiple interviewees stated that having a policy around food not going to waste could be an effective way to support the CFE (Nonprofit 7, 8; Business 10).

Abilities

The category "Abilities" within the MOA framework refers to the knowledge, expertise and skills that would be needed to support CFE work. As CFE is an emerging sector in the Metro Vancouver area, the findings can help identify existing resources that can support new practitioners as well as gaps in training and education.

Education and training

Among the stakeholders interviewed, many stated

that their university degrees and certificates have helped them navigate their work in the CFE. A nonprofit employee emphasized the learnings they have received from Elders and First Peoples (Nonprofit 4), whose teachings on circularity and values resonated enough for them to integrate them into their work and circular initiatives. Some stakeholders were motivated to acquire their own education and conduct research. Many interviewees entered their current role with previous relevant experience that led them to learn about food waste. For example, many nonprofit participants had previous volunteer experience. Others had worked in the food industry and in restaurants as chefs. Some interviewees had been employed in the nutrition, science, or healthcare sectors. Lived experiences outside of formal education were also relevant. For example, one participant vividly learned a good deal about waste from the experience of having young children.

Professional networking and resources

After education, the most frequent "ability" was the organizational relationships and collaborations in Metro Vancouver CFE, both for-profit and nonprofit alike. A nonprofit participant stated that their whole work on CFE was "literally built upon connections" (Nonprofit 7). Nonprofit organizations frequently found that community events allowed them to learn from experts what is possible for a CFE. Many stakeholders felt that relationships they have developed have been critical to their success. Many groups found connecting with other organizations, sharing resources, and collaborating on ideas to be effective ways to reach goals: "We rely on a network of professionals across the food supply chain, in policy, technology, hunger relief, food systems, data analytics, and community development space, to help us do what we do" (Business 4).

Discussion and Recommendations

Address Competing Priorities

The findings of this study highlight the deep tensions and competing priorities that exist within individuals engaging in CFE. Some participants from for-profit companies thought nonprofits were compensating for the mismanagement of inventory by grocery stores. Grocery stores have been determined to be contributing to "charity washing," along the lines of greenwashing (Mourad, 2016). Charities recognize this as a problem, as businesses may "download all of the costs and the labour onto charities" (Nonprofit 1). Some CFE individuals wanted to turn the nonprofit model on its head and were motivated to reinvent an economically profitable solution to food rescue. However, this approach was criticized by the nonprofit participants, who claimed that a for-profit approach did not recognize the social inequalities that could develop within circular models (Ashton et al., 2022). For example, by profiting off surplus food or unmarketable food, they fear that it may reduce the amount of food that can be used by charitable organizations and not-for-profit food rescue groups to support individuals who are food insecure. At the same time, individuals working in both nonprofit and for-profit food rescue CFE could be criticized for not focusing on systemic changes (Temesgen et al., 2021), or the root causes of the food waste problem, thus ignoring the food recovery hierarchy, which prioritizes waste prevention above all (Papargyropoulou et al., 2014). Long-term sustainability efforts such as prevention could be difficult to quantify for CFE initiatives, as they lack tangible characteristics such as recycling and diversion (Messner et al., 2020).

Further tensions arise when all CFE initiatives in Metro Vancouver are competing for the same supply of food surplus and nonmarketable foods from corporate donors. When there is competition for food waste as a feedstock, there are real concerns that prevention will not be prioritized (Soma, 2022). The commoditization of food waste (Mourad, 2016) in Metro Vancouver CFE aligns with the concept of "prevention paradox": initiatives want to end food waste, but their responses focus on management instead of waste prevention (Messner et al., 2020). Krones (2020) describes how competition in the food waste market has led to a commodity frontier, such that food continues to be commoditized, and the market will eventually exhaust itself and push initiatives to move on to the next commodity (e.g., see Lant et al., 2023, as an example of commoditization of corn and biofu-

els). Thus, the competing CFE solutions do not challenge the underlying power relations between food system stakeholders, pushing food waste concerns further away from political attention (Mourad, 2016). In addition, the findings of this study are consistent with the paradox theory that is widely discussed in circular approaches (Daddi et al., 2019; De Angelis, 2021). The competition between various initiatives for food waste has led to a paradox in Mero Vancouver CFE where the commoditization of unmarketable food can lead to prevention being contrary to their interest and the growth of the sector. Even among the nonprofit models, their economic goals, needs to acquire grants, and to sustain large outputs of food are pitted against individuals' environmental motivations to prevent food waste or tackle root causes. In Metro Vancouver, an organizational paradox (De Angelis, 2021) is present which exists when organizations compete with others in the CFE sector to acquire the surplus/ unmarketable food instead of collaborating. Therefore, rather than mobilizing circularity for resiliency, circularity becomes a tool for further commodification (Spring & Biddulph, 2020).

The Need for Systems-Based Solutions

Despite the commonalities in individual motivations including environmental, equitable, and economic, the competing priorities within Metro Vancouver's CFE have led to deficient waste prevention which frustrated several stakeholders. A nonprofit interviewee was very adamant in their frustration over CFE solutions because they felt initiatives were not addressing the root cause of the issue (Nonprofit 10). Mourad (2016) has identified the need for a collective approach to CFE to go beyond "weak sustainability" solutions, such as donations, and implement "strong sustainability" which would tackle the root causes. Weak sustainability contributes to a two-tiered food system, that while the well-off enjoy premium food retail opportunities, many Canadians are left dependent on food charities and food banks, pushing responsibility for change onto NGOs and charities (Riches & Tarasuk, 2014). This approach allows large corporations, as one business owner noted, to have a "get out of jail free card" (Business 7) regarding wasteful practices. This two-tiered food system forces us to question what the motivations of the CFE are. One nonprofit participant summed up their struggles with the two-tiered food system of functioning in a system whereby those who are food insecure are reliant on recovered food and their internal conflict of wanting a more transformative solution versus applying an incremental approach, as they note "change the world or keep people alive" (Nonprofit 1). This is consistent with the analysis that circular goals need to incorporate both upstream and downstream architecture (Mukherjee et al., 2023). Despite wide interest in strong sustainability, the lack of opportunities in CFE initiatives is a barrier to enabling systems change. As a result, several business and nonprofit participants face challenges mobilizing their vision due to high operational costs (e.g., expensive real estate, supplies, food, living and labour in Metro Vancouver). Despite their high motivations, some of these factors are beyond their control and could force them to cease operations.

Identify Pathways, Direction and Vision through Intersectoral and Intergovernmental Collaboration

Although there is collaboration in various spaces of the CFE, many initiatives are working in a silo, independently fighting for resource and creating conflicts among their proposed solutions. In addition, some initiatives have neglected the food recovery hierarchy (Soma, 2022), which emphasizes the importance of reducing waste at the source. Since there is no one pathway toward CFE, an overarching vision would help mobilize an overall direction for change and harmoniously weave various pathways together. This study found missing initiatives that aim to bring the sector together through governmentally established CFE pathways. An example of a collective approach was studied by Varney (2021) in the City of Vancouver, using a theory of change model highlighted by diverse stakeholders to identify collective pathways to a CFE and what this might look like from different sectors. It is important to note that the model must be formed in a participatory manner, engaging with more community members to ensure clear, achievable targets (Varney, 2021). While this visioning

process can be facilitated by government, it can also be carried out by other actors and sectors depending on context, place, and culture.

To develop visions and pathways, intergovernmental support in the CFE of Metro Vancouver is necessary. Mourad (2016) insists that varying levels of government rethink their authority around food systems, reconsidering the power relations that governments have with producers, manufacturers, retailers, food banks and other actors. Rethinking could include further regulation and taxation to redistribute wealth within the food system (James et al., 2021). Participants in this study agreed that for an intergovernmental approach to happen, there needs to be political will. An intergovernmental approach would ensure that the invested interest and prioritization of the CFE is not at the will of elections and instead is embedded in policy. There is considerable potential for a progressive food policy that shares contributions from various levels of government, nonprofits, private enterprises, and communities (Warshawsky, 2021). An intergovernmental approach would incorporate actions from all levels of government and clarify whose jurisdiction covers various actions, helping to communicate and design pathways toward CFE and bring resilience to the Metro Vancouver CFE.

Strengthening Motivations, Opportunities, and Abilities for a Circular Food Collective Pathway

When a stakeholder's MOA is inadequate, they are more likely to revert to societal cues, social norms, or the business status quo of business as usual, reducing their ability to make a behavioral change (NASEM, 2020). Increasing motivations among stakeholders can support and strengthen the CFE movement. CFE motivations could be stronger if prevention were seen as a social norm (NASEM, 2020). For example, if food rescue as a means to decrease food waste was not perceived as the only option, initiatives could turn towards a more preventative circular approach. In addition, creating the right opportunities within the CFE landscape can support initiatives when they shit to circular principles. For example, diminished opportunity due to economic pressures such as lack of funding and high rent can reduce motivation to continue with CFE practices.

Various participants in this study are looking for better opportunities in Metro Vancouver CFE, seeking collective action to improve efficiencies and increase capacity. There is a collective interest in the environmental and social consequences of food waste. It is critical to keep this momentum among initiatives in order to hone in on the shared priorities and opportunities which could in the long term change linear business models and policy (Mourad, 2016). Increasing the abilities of CFE stakeholders to participate can bring more impact and even transformation as well, as motivations for CFE cannot solely change behaviours (NASEM, 2020). Educational and skills building for CFE can include collaborative meetings for businesses, nonprofits, academics, and public sectors to connect and learn and strategize around shared targets. Most important, CFE stakeholders repeatedly raised the need to increase education and skills to better prevent food waste through their initiatives.

Conclusion

The increasing level of food waste is causing significant environmental, economic, and social concerns. To address this issue, individuals in businesses, nonprofits, and leaders in CFE are taking on the responsibility of developing circular initiatives. This study asked the following research questions: How do individuals working in the food sector mobilize CFE within their work? What are the motivations, opportunities and abilities influencing the practices of those working in the CFE sector in Metro Vancouver?

The findings indicate a variety of ways that individuals working in the food sector can support a CFE, thus creating their own community-based circular food system. Many initiatives are reducing waste through operations and production, minimizing ordering, growing in smaller volumes, and redistributing excess. Numerous organizations interviewed support a food rescue model, in which food that would be wasted is donated or purchased from various sources and redistributed. Other organizations follow a food bank-style system. Many businesses interviewed contribute to CFE through upcycling and value-added products. How-

ever, within this diverse landscape, there is conflict and competing visions, which lead to tension.

Furthermore, stakeholders were motivated to contribute to the CFE for environmental, socially equitable, and economic reasons, as well as to incorporate Indigenous values. Stakeholders found support in partnerships and existing structures in the food system, and through windows of opportunity. However, their opportunities were inadequate due to the conventional food system, lack of funding with high costs of operations, and lack of government support. Participants indicated their abilities to contribute to the CFE were substantially due to education and professional networking or resources.

The findings of this study indicate competing priorities within the CFE, leading to a paradox among motivations and conflict as numerous CFE practitioners struggle to follow the food recovery hierarchy, which prioritizes reducing food waste at the source. Strengthening the motivations, opportunities, and abilities of CFE practitioners in Metro Vancouver can help identify diverse CFE pathways. Future CFE studies may explore how diverse CFE approaches can contribute to overall food systems resiliency.

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Farm stops: Understanding a new model for local food distribution

SPECIAL ISSUE
Community-Based Circular Food Systems

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Abstract

Farm stops are year-round markets that support primarily local farmers and strengthen community-based circular food systems (C-B CFSs). They operate on consignment: the farm stop gives the local producers they work with 70–80% of the retail price, while taking a small percentage to maintain operations. This gives producers a higher price for their goods and flexibility with their time and product offerings, and enhances community connections. The purpose of this research is to understand how farm stops contribute to developing C-B CFSs through strengthening community connections and resilience, as C-B CFSs are local and regional food systems that emphasize a community's health and well-being while minimizing waste and protecting shared natural resources. This project surveyed the customer base of four U.S. farm stops to gauge their perceptions of farm stops' overall support of a circular economy and of resilience within their communities. Results indicate that respondents believe that farm stops have a strong presence in the communities they serve, that they help individuals feel they are contributing to the development of C-B CFSs, and that they increase long-term community resilience by providing reliable, year-round sales outlets for local producers. This paper also serves as an introduction to a guidebook on how to develop farm stops in any locale.

Keywords

sustainable food systems, circular economy, community resilience, regional food systems, community-based circular food systems

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Introduction

Introduction to Farm Stops

Farm stops are a new, little-researched retail concept. They are brick-and-mortar, mission-driven grocery stores that are open year-round and prioritize supporting local farms by sourcing within a radius of their own definition. Farm stops are unique compared to other local food distribution models, such as farmers markets, food hubs, or co-ops, because they operate primarily on high-margin consignment. This enables farmers and producers greater capacity to control prices, own their products until sold, and generally earn more revenue than they would in a typical retail sale. While operating on consignment may have possible drawbacks for farmers, such as increased risk and competition, consignment gives farmers the opportunity to obtain the real value of their products.

For example, Argus Farm Stop in Ann Arbor, Michigan works with over 200 local farmers and producers. They give all vendors 70% of the retail price and take a 30% commission to maintain operations. This gives farmers a fairer wage year-round, saves them time and labor from participating in seasonal farmers markets, which can be costly and time-consuming (Warsaw et al., 2021), and helps them expand and maintain their operations while building stronger community connections. As of 2024, in 10 years of operation Argus Farm Stop has given over US$26 million to local farmers and producers through its use of consignment (Argus Farm Stop, n.d.-a). While operating on consignment may pose some risk to farmers as sales are not always guaranteed, farm stops employ added revenue streams, which may reduce risk and enhance stability by providing additional sales opportunities for their products. Additional research is needed to better understand the capacity of farm stops to mitigate financial risk.

Diversified revenue streams is another defining feature of a farm stop. Streams include cafés, incubator kitchens and spaces, entrepreneurial services, community supported agriculture (CSA) programs, online sales, educational classes and events, mobile markets and more. Multiple revenue streams may enhance community resilience to crisis events by generating multiple market opportunities for small growers through value chains, instead of a singular and thus more vulnerable supply chain. As long as the farm stop does not overtax its resources, these additional revenue streams can help farm stops better meet their community needs and further support small-scale farmers, food producers, and other local businesses. For example, at the height of the COVID-19 pandemic many farm stops were able to shift their sales online, utilize delivery services, aggregate CSA boxes, provide production spaces, and aggregate storage spaces for local farmers and businesses to keep up with a heightened demand for local food (Hobbs, 2020; Schmidt et al., 2020; Thilmany, Canales et al., 2020). This kept farmers in business and communities fed at a time when large-scale agricultural supply chains faltered. Farm stops can also benefit their communities by enhancing access to communal spaces, educational classes and community events. These "third places" have been shown to enhance community cohesion and quality of life within built environments (Jeffres et al., 2009; Oldenburg, 1989).

As of 2025, there are 18 known farm stops operating in 12 states, with more likely to be operating that may resemble the farm stop model. Most farm stops operate as nonprofits, co-ops, or low-profit limited liability companies (L3C). Farm stops are flexible in their business structure, as they can incorporate as either mission-driven for-profit entities such as L3Cs, or as nonprofits and cooperatives to enhance their eligibility for increased funding opportunities. While L3Cs can make a profit, they must first define their organization on the foundation of providing charitable benefits for their communities. L3Cs can only make a profit so long as they prioritize supporting their communities (Legal Information Institute, 2022). Flexible business structures allows farm stops to remain responsive to their communities' specific needs.

Farm stops also represent a new form of civic agriculture enterprise. Civic agriculture involves methods of community-based food production that "not only meet consumer demands for fresh, safe, and locally produced foods but [also] create jobs, encourage entrepreneurship, and strengthen community identity" (Lyson, 2004, p. 2). Civic agriculture enterprises are characterized by farmers markets, community and school gardens, CSA pro-

grams, grower or member-owned co-operatives, community kitchens, and small-scale local on- and off-farm processors (Lyson, 2004).

Both traditional civic agriculture enterprises and farm stops contribute to developing a C-B CFS, a local and regional food system that emphasizes community health and well-being while minimizing waste and protecting shared natural resources (Journal of Agriculture, Food Systems, and Community Development, 2023). These enterprises are foundational for the development and maintenance of C-B CFSs, which supports small-scale local farmers. These farmers are more likely to implement sustainable agricultural practices that use fewer fossil fuels, reduce carbon emissions associated with food transportation, and, most important, minimize reliance on long-distance national and international supply chains (U.S. Department of Agriculture [USDA], 2019; Warsaw et al., 2021). Furthermore, because these enterprises support farmers more likely to implement sustainable practices (Warsaw et al., 2021), consequent C-B CFSs may be better able to preserve natural resources (Jurgilevich et al., 2016; USDA FNS, 2023), enhance food access (Gans et al., 2018; Garrity et al., 2024; Johnson et al., 2003; Leone et al., 2018; Sandström & Kummu, 2023; USDA FNS, 2023), and support overall community resilience to crisis events such as recessions and pandemics (USDA FNS, 2023).

It should be noted that farm stops bear similarities to food hubs, "businesses or organizations that manage the aggregation, distribution, and marketing of source-identified food products primarily from local and regional producers to strengthen their ability to satisfy wholesale, retail, and institutional demand" (Barham et al., 2012, p. 4). The key differences between a farm stop and a food hub seem to be that a farm stop prioritizes high-margin consignment, and the varying scales at which food hubs operate. Farm stops are brick-and-mortar operations with a stronger emphasis on high-margin consignment and direct-to-consumer sales. Food hubs have a wide variety of operational methods, many of which focus primarily on institutional or even online sales, do not have brick-and-mortar locations, and may not prioritize food aggregation as their primary focus within a community (Bielaczyc et al., 2023). Food hubs often rely on mark-ups to drive profitability (Barham et al., 2012; Rysin & Dunning, 2016), while farm stops do not mark up their products. Some food hubs have experimented with a high-margin consignment model similar to that of a farm stop, but have faced challenges maintaining consignment due to operational scale and logistical overhead for delivery services (Feldstein & Barham, 2017). Additional research is needed to quantify the differences between farm stops and food hubs.

Historical Context for the Need for Civic Agriculture Enterprises in the U.S.

There are more than two million farms in the U.S., of which 86% are small-scale family farms that gross less than US$350,000 annually and account for only 20% of total food production; by contrast, large-scale farms grossing over US$1,000,000 annually account for 4% of farms, yet yield nearly 48% of total food production (Kassell, 2024). Large-scale farms typically use industrialized agricultural methods to produce raw materials for further processing, or produce large quantities of meat and dairy products (Warsaw et. al., 2021). Raw materials, such as corn, soy, cotton, and other grain products, are typically processed into feed for livestock, biofuels such as ethanol, or sweeteners and preservatives found in packaged foods (Warsaw et. al., 2021). The decline of small-scale family farms is also driven by increasing consolidation of retail markets and processing facilities (Held, 2023; McClain, 2022; USDA AMS, 2024), as the average farm size increases (USDA, 2017). From 2012 to 2022, U.S. farms declined 10%, totaling 1% of farms lost per year (Hodder, 2024; Lacy, 2024).

These statistics reveal a system of consolidated large-scale farms and increasing homogeneity, increasing farmers' reliance on middle-men supply chains. Within this system, farmers on average only receive approximately 16 cents for every dollar of goods sold through wholesale or retail channels, leaving the majority of profits supporting middle-men supply chains (USDA ERS, 2025). In addition, small-scale farmers make most of their profits through direct-to-consumer sales such as farmers markets and CSA programs, which account for 7% of U.S. food purchases (Whitt et al., 2021, p. 19).

This leaves 93% of food purchased indirectly from middle-man supply chains, further contributing to the decline of small-scale farms (Whitt et al., 2021).

When the COVID-19 pandemic hit the U.S. in March of 2020, this homogenized system was left scrambling. While many economic sectors floundered, the agricultural sector continued operating, as it was necessary and essential. Large-scale farms experienced severe labor shortages, increased demand for fresh food, lack of viable economic outlets, and large quantities of food waste that resulted in supply chain disruptions (Clapp, 2020; Held, 2020; Hobbs, 2020; Lakhani, 2020; Lush, 2020; Poppick, 2020; Thilmany, Jablonski et al., 2020; Yaffe-Bellany & Corkery, 2020). As supermarket shelves grew empty, communities increasingly turned to local farms and other local food distribution outlets (Held, 2020; Hobbs, 2020; Thilmany, Canales et al., 2020). The COVID-19 pandemic highlighted the fragility of the homogenized food system, and heightened the urgency of exploring alternative, resilient models of local and regional systems of food distribution.

As farm stops are an up-and-coming civic agriculture enterprise, this study seeks to understand how farm stops contribute to C-B CFSs by enhancing community resilience and cohesion, and to encourage additional research on farm stop features.

Methods

Survey responses (N = 278) were collected in 2021 from four identical surveys distributed to four farm stop locations: Argus Farm Stop in Ann Arbor, Michigan, Local Roots Market and Café in Wooster, Ohio, Random Harvest in Craryville, New York, and Boone Street Market in Jonesborough, Tennessee. The purpose of the survey was to measure three main constructs: (1) the reasons people visit farm stops, (2) attitudes about farm stops, and (3) the perceived importance of the operational features of farm stops. Additional informal interviews were conducted with the managers of two other farm stop locations not surveyed: The Wild Ramp in Huntington, West Virginia and Acorn Farmer's Market and Café in Manchester, Michigan (Figure 1). These interviews aided in understanding the operational features of each farm stop (Table 1).

Farm Stop Selection and Profiles

The six farm stop locations were chosen because they have been in operation for the longest duration relative to other existing farm stops, are in different geographic regions, and have varied business structures. Following are brief profiles of the six farm stops. Key features of each location are summarized in Table 1.

Local Roots Market and Café (Wooster, Ohio)

Local Roots Market and Café (Local Roots) is the

Figure 1. Farm Stop Locations

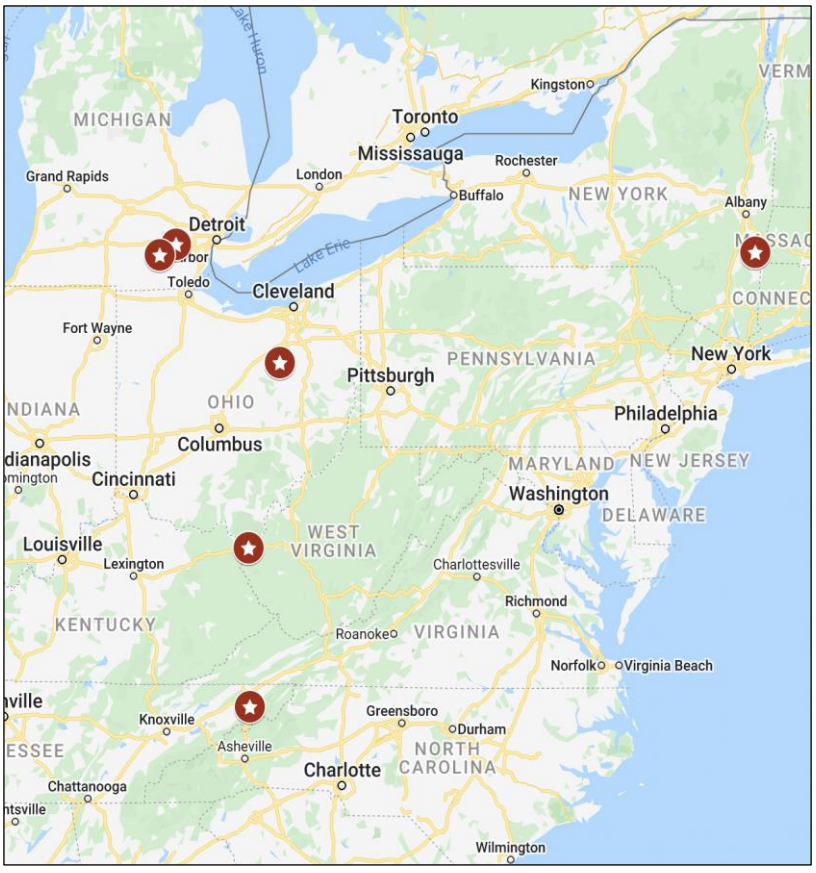

Table 1. Farm Stops Included in This Study

Farm Stop	Business Structure	Location[a]	Diversified Revenue	Founding Date	Consignment Ratios (%)
Acorn Farmer's Market and Café	Registered 501(c)(3) nonprofit with a board of directors	Manchester, Michigan (pop. 4,732)	• Café • Outdoor farmers market • Educational classes	2019	75/25
Argus Farm Stop	Low-profit limited liability corporation (L3C)	Ann Arbor, Michigan (pop. 119,980)	• Café • Subscription service food boxes • Educational classes • Community events • Trainings	2014	70/30
Boone Street Market	Registered 501(c)(3) nonprofit with a board of directors	Jonesborough, Tennessee (pop. 5,611)	• Café • Grants • Community events • Commercial kitchen	2014	75/25
Local Roots Market and Café	Member-owned cooperative with a board of directors	Wooster, Ohio (pop. 26,394)	• Café • Commercial kitchen • Incubator kitchen • Outdoor farmers market • Merchandise • Community events • Subscription service food boxes	2009	82% for produce, baked goods and milk. 75% for shelf-stable goods and dairy. 70% for artisanal goods and gifts.
Random Harvest	Worker-owned cooperative	Craryville, New York (pop. 5,630)	• Café • Community events • Educational classes • Incubator kitchen + community space • Commercial kitchen	2018	75/25
The Wild Ramp	Registered 501(c)(3) nonprofit with a board of directors	Huntington, West Virginia (pop. 45,110)	• Commercial kitchen • Incubator kitchen • Mobile market • Community events • Educational classes • Outdoor farmer's market	2012	80/20

[a] Population data: USDA, 2019.

oldest known farm stop. Founded as a member-owned co-operative in 2009, Local Roots is a year-round market open seven days a week. They work with over 150 local producers, and offer a three-tiered commission system depending on the types of products sold. Producers who make highly perishable products, such as produce, baked goods, and milk receive 82% of the retail price. Producers who make shelf-stable food such as frozen foods, eggs, dairy (with over seven-day shelf life), jams, syrups, grains, granolas, pet treats, and artisan goods such as candles, cards, soaps, lotions and cleaning products receive 75% of the retail price. Producers who create non-consumable artisanal products such as pottery, jewelry, fiber arts, wood products, books, and baskets receive 70% of the retail price. As a member-owned co-operative, all producers are required to purchase a US$50 annual membership.

Local Roots also has a rentable commercial kitchen available for other local businesses, a weekly food box subscription service, and recently launched FoodSphere: the Entrepreneurial Center at Local Roots to provide further business and development support to small farmers and food producers in the community. They collaborate with students from The College of Wooster to educate others about their model and local food systems.

According to the 2017 U.S. Census, Wooster, Ohio, is a semi-urban city with a population of 26,394 and a median household income of US$47,944. The average resident age is 37 (USDA, 2019).

Argus Farm Stop (Ann Arbor, Michigan)
Argus Farm Stop was founded in 2014 as a L3C. It is a year-round market open seven days a week that works with over 200 local producers. All producers receive 70% of the retail price. They have three locations in Ann Arbor, some having cafés and taverns, and serve ready-made meals from local restaurants and food producers. They offer community events at each location, and collaborate with students at the University of Michigan to educate others about their model. They offer weekly Produce Box subscriptions, educational classes, and consulting services for those interested in starting a farm stop in their own community.

Ann Arbor, Michigan, is a city of approximately 119,980 people, with a median household income level of US$65,745. The average age of residents is 27 (USDA, 2019).

Random Harvest (Crayville, New York)
Random Harvest is a worker-owned and operated co-operative founded in 2018. It is a year-round market open six days a week that works with over 100 local producers. All producers receive 75% of the retail price.[1] Random Harvest has a café, a rentable commercial kitchen and events space, educational classes, and community events.

While not the oldest farm stop, Random Harvest was chosen to participate due to its varied demographics compared to the other farm stops in this study. Craryville, New York, is a rural town with a population of 5,630. The median household income is US$59,343 and the average age of residents is 44 (USDA, 2019).

The Wild Ramp (Huntington, West Virginia)
The Wild Ramp is a registered 501(c)(3) nonprofit organization with an 11-member board of directors founded in 2012. They operate year-round, seven days a week, and work with over 100 local producers. All producers get 80% of the retail price. They also have a commercial kitchen that produces ready-made meals and value-added products, educational programs for producers and consumers, and host yearly community festivals.

Huntington, West Virginia, is a semi-urban city with a population of 45,110, and a median household income of US$31,162. The average age of residents is 35 (USDA, 2019).

Boone Street Market (Jonesborough, Tennessee)
Run by a 501(c)(3) non-profit, Jonesborough Locally Grown, Boone Street Market (BSM) is a year-round market open six days a week. BSM was developed in 2014, works with over 150 local producers, and gives them 75% of the retail price. They have a commercial kitchen where they produce ready-made meals and value-added products,

[1] Since the completion of this study, Random Harvest no longer operates on consignment due to operational challenges.

they host community events and educational classes, and have an online store.

Jonesborough, Tennessee, has a population of 5,611 and a median household income of US$56,550. The average age of residents is 45 (USDA, 2019).

Acorn Farmer's Market and Café (Manchester, Michigan)[2]

Acorn Farmer's Market and Café is a registered 501(c)(3) non-profit organization located in Manchester, Michigan and founded in 2019. It is a year-round market open seven days a week that works with over 75 producers, and gives them 75% of the retail price. They have a café, and offer educational programming and community events for producers.

Manchester, Michigan, is a town with a population of 4,732 and a medium household income of 59, 453. The average age of residents is 47 (USDA, 2019).

Survey Methodology

This study used a convenience sampling approach. Surveys were distributed online via Qualtrics (N = 278). Participants accessed surveys using QR codes or links embedded in farm stop e-newsletters and social media posts, or via posters placed around each store. The survey consisted of 30 questions in four question categories: Food Purchasing, Community Values, Accessibility, and Demographics. It should be noted that convenience sampling draws on a small subset of individuals who have the time and technology available to complete the survey, who use English as a first language, and who regularly frequent farm stops. This method of sampling did not provide insight into the full scope of each community's perspective on farm stops. Additionally, it should be noted that certain questions within the survey may have been leading, and that future iterations of this research would require stronger and more comprehensive survey development.

Food Purchasing questions refer to whether farm stops may influence purchasing decisions. Community Values questions refer to whether farm stops may add additional value to communities. Accessibility questions refer to whether respondents felt that farm stops are accessible via personal or public transportation, and are enhancing resilience and food access. Demographics questions asked respondents about their race and ethnicity, annual income, age, education level, and size of their household. Optional demographic questions were used in descriptive statistical analysis, and as controls for a series of linear stepwise regressions.

Descriptive statistics were performed for the questions in Table 2, as well as for the demographics in Table 3. Data was analyzed across all four farm stop sites. A factor analysis was used to determine common themes, or "constructs,, of how respondents perceive the value of farm stops in their communities. Constructs were extracted from a total of three question banks in the survey (Appendix, Table A1). All question banks used a 5-point Likert rating scale. Constructs were extracted using principal component analysis, Varimax rotation, and Kaiser normalization in SPSS Statistics software. Factor analysis was based on item loadings of at least .45, Eigenvalues greater than 1.0, and alpha coefficients of at least .70. Items loading on more than one factor above the .45 level were excluded. This analysis deduced three constructs, each made up of nine statistically relevant categories defined in Table 4.

The nine factor analysis categories were then used to determine patterns in the data through a total of nine stepwise linear regressions using stem questions from the survey (Appendix, Table A2). Results from the nine stepwise linear regressions were organized in four major themes: Economics, Resilience, Community, and Advocacy.

Results

Results are organized according to descriptive statistics, factor analysis, and stepwise linear regressions.

Descriptive Statistics

While the average respondent purchases 25% of their monthly groceries at farm stops, the majority

[2] Since the completion of this study in 2021, Acorn Farmer's Market and Café has closed due to operational challenges.

of respondents stated that they would be willing to pay more for groceries at a farm stop and that farm stops have a strong presence in their community. While respondents spend an average of 15–30 minutes during a visit to a farm stop, almost all respondents stated they enjoy spending time at farm stops. Almost all respondents felt they were helping to grow a local food economy[3], and that farm stops increase the long-term resilience of their neighborhood to crisis events. This is supported by a majority of respondents stating that they felt that farm stops provided an essential service during the height of the COVID-19 lockdowns. Notably, 30% of respondents did not feel that farm stops enhance food access options to ensure all populations could shop there. This aligns with the demographic statistics, which highlight that the majority of respondents are older, wealthier, highly educated, and live in smaller households. The lack of diversity in demographics may be a result of the convenience sampling methodology.

It should again be noted that certain questions within the survey may have been leading, which may have affected the outcome received. Future iterations of this research would require stronger and more comprehensive survey development to confirm and expand on these findings.

Factor Analysis

Factor analysis generated three distinct constructs: Reasons for Visiting Farm Stops, Attitudes about Farm Stops, and Importance of Operational Features. These analyses extracted two categories that informed Reasons for Visiting Farm Stops, four categories that informed Attitudes about Farm Stops, and three categories that informed Importance of Operational Features. Each construct is expanded below, and summarized in Table 5.

Table 2. Descriptive Statistics

Stem Question, *N* = 278	% of responses
How willing are you to pay more for your food at a place like [site name]?	
Willing	82
Unwilling	8
Neutral opinion	10
Do you feel that [site name] has a strong presence in the Ann Arbor community?	
Yes	91
No	7
Neutral opinion	2
Do you enjoy spending time at [site name]?	
Yes	90
No	5
Neutral opinion	5
On average, approximately how much time do you spend during one visit to [site name]?	
5–30 minutes	89
31–45 minutes	9
46–60+ minutes	2
Do you feel you are helping to grow a local food economy by purchasing food at [site name]?	
Yes	95
No	3
Neutral opinion	2
Do you believe this form of food distribution increases the long-term resilience of the neighborhood to crisis events (ex. economic downturns, Covid-19, climate-related disasters)?	
Yes	92
No	5
Neutral opinion	2
To what extent do you agree with the following statement: [site name] provided an essential service to the community during the height of the Covid-19 pandemic lock-downs.	
Agree	76
Disagree	10
Neutral opinion	14
To what extent do you agree with the following statement: [site name] offers additional food access options to ensure all populations can shop there.	
Agree	57
Disagree	30
Neutral opinion	13

[3] Local food economy is defined according to the USDA *Local and regional food systems resource guide* (2023, p. 3).

Table 3. Demographics

Stem Question, *N* = 278	% of responses
What is your age?	
18–39	27
40–49	12
50–60+	61
What is your total household income? [US$]	
Less than $25k	$
$25k–$74k	27
$75k–$125k	23
$126k–$150k+	29
Prefer not to answer	16
What is your highest level of education?	
Up to high school, no diploma	0
High school graduate or equivalent	0
Some college credit, no degree	9
Associate degree or equivalent	3
Bachelor degree	30
Advanced degree (ex., Master's, PhD)	56
Other	2
How many people live in your household?	
1–4 people	86
5–9 people	14
9–10+ people	0

Reasons for Visiting Farm Stops

Reasons for Visiting Farm Stops contains two statistically independent categories, Provisioning (Mean = 2.65) and Events (Mean = 1.68), which represent the main reasons why respondents visit farm stops. Provisioning included four questionnaire items in descending order of endorsement by the survey respondents: Purchase groceries, Support local farmers and producers, Purchase to-go meals, and Visit the café. Events included two questionnaire items in descending order of endorsement: Participate in community events, and Participate in educational events. Provisioning is the more highly endorsed reason for visiting farm stops.

Attitudes about Farm Stops

Attitudes about Farm Stops contains four statistically independent categories that comprise respondent attitudes about physical and social attributes of farm stops: Support of local foods (Mean = 4.81), Positive Facility (Mean = 4.57), Support for local businesses (Mean = 4.45) and Good selection (Mean = 4.13). The Support of Local Foods category includes three questionnaire items in order of descending endorsement: Sup-

Table 4. Factor Analysis Constructs and Categories

Constructs and Corresponding Categories [a]	Definition of Categories
Reasons for Visiting Farm Stops	
Provisioning	Whether respondents felt farm stops support the majority of their household needs.
Events	Whether respondents felt farm stops engage with the community.
Attitudes about Farm Stops	
Support of local foods	Whether respondents felt that farm stops support a local food system, or C-B CFS.
Positive facility	Whether respondents felt that farm stops created a positive and supportive shopping experience with passionate and supportive staff.
Support for local businesses	Whether respondents felt that farm stops support local businesses.
Good selection	Whether respondents felt that farm stops offer a wide selection of products.
Importance of Operational Features	
Supporting local food systems	How important it is to respondents that farm stops support the development, or maintenance, of local food systems, or C-B CFS.
Unique and engaging	How important it is to respondents that farm stops provide a unique shopping experience that piques their interest.
Selection of products	How important it is to respondents that farm stops have a wide variety of products available for purchase.

[a] Color coding was added to aid in the interpretation of the Stepwise Linear Regressions seen in Tables 5, 6, and 7.

ports local farmers and producers, Prioritizes seasonal products, and Is transparent about where they get their products. The Positive Facility category includes four questionnaire items in order of descending endorsement: Fosters an inclusive and welcoming space, Has a warm and friendly atmosphere, Hires staff who are passionate and professional, and Is accessible and easy to navigate. The Support for Local Businesses category includes five questionnaire items in order of descending endorsement: Collaborates with local businesses, Educates consumers about local food and farmers, Makes an effort to engage with their community, Supports other local businesses, and Helps strengthen a local food economy or C-B CFS. The Good Selection category includes four questionnaire items in order of descending endorsement: Meets the majority of my household's food needs in a typical week, Offers a wide variety of products, Has products that cannot be found elsewhere, and Enhances access to fresh, high quality food.

Table 5. Factor Analysis Results

Constructs and Corresponding Categories[a]	Mean	S.D.	Alpha
Reasons for Visiting Farm Stops			
Provisioning	**2.65**	**.78**	**.71**
Events	**1.68**	**.82**	**.81**
Attitudes about Farm Stops			
Support of local foods	4.81	.44	.85
Positive facility	4.57	.71	.92
Support for local businesses	4.45	.66	.84
Good selection	4.13	.80	.74
Importance of Operational Features			
Supporting local food systems	4.21	.74	.86
Unique and engaging	3.68	.85	.87
Selection of products	2.83	.96	.70

[a] Color coding was added to aid in the interpretation of the Stepwise Linear Regressions seen in Tables 5, 6, and 7.

By a small margin, Support for Local Foods is the most highly endorsed attitude about farm stops, while having a Good Selection is the least endorsed attitude (Table 5).

Importance of Operational Features

The third construct, Importance of Operational Features, contains three statistically significant categories that describe the elements of a farm stop respondents felt were most important, according to their values: Supporting local food systems (Mean = 4.21), Unique and engaging (Mean = 3.68), and Selection of products (Mean = 2.83). The Supporting local food systems category includes four questionnaire items in order of descending endorsement: Supports local farmers and producers, Is transparent about where they get their products, Prioritizes seasonal products, Educates consumers about local food and farmers. The Unique and engaging category includes six questionnaire items in order of descending endorsement: Delivers a unique shopping experience, Supports other small businesses, Makes an effort to engage with their community, Collaborates with local businesses, Has products that cannot be found elsewhere, and Fosters an inclusive and welcoming space. The Selection of products category includes two items in order of descending endorsement: Offers a wide variety of products, and Meets a majority of my household's food needs in a typical week.

Supporting local food systems is the most important operational feature to survey respondents, and Selection of products is the least important operational feature (Table 5).

Stepwise Linear Regressions

All stepwise linear regressions were statistically significant ($p < 0.001$), except for the dependent variable measuring the approximate time spent during one visit to a farm stop. To clarify interpretation of these results, all dependent variables from the stepwise linear regressions were grouped into four main themes: Economics, Resilience, Community, and Advocacy (Tables 6 and 7). The predictor variables were color coded to identify them with their associated factor analysis constructs previously presented: Reason for Visiting Farm Stops (red), Attitudes about Farm Stops (green), and Importance of Operational Features (blue) (Table 6). They are

Table 6. Predicting Attitudes Toward Farm Stops

DEPENDENT VARIABLE (organized by theme)	PREDICTOR VARIABLES (Categories in bold, shown in stepwise order)	R	Adjusted R^2	F-value	*P*-value
ECONOMIC THEME:					
Percentage of groceries spent at farm stops	Selection of Products Provisioning Good Selection Age Number of people in household	.64	.40	20.31	<0.001
Willingness to pay more for groceries at farm stops	Good Selection Supporting Local Food Systems Provisioning Support of Local Foods	.56	.29	16.39	<0.001
RESILIENCE THEME:					
Attitudes about farm stops providing an essential service during Covid-19 lockdowns	Provisioning Unique and Engaging	.46	.20	18.88	<0.001
Attitudes about farm stops increasing community resilience	Unique and Engaging Good Selection Level of education	.57	.31	21.47	<0.001
COMMUNITY THEME:					
Attitudes about farm stops having a strong community presence	Positive Facility Supporting Local Food Systems Support for Local Businesses	.61	.36	24.95	<0.001
Approximate time spent during one visit in farm stops	Provisioning	.24	.05	8.95	.003
Attitudes about spending time in farm stops	Positive Facility Provisioning Supporting Local Food Systems	.76	.57	63.51	<0.001
ADVOCACY THEME:					
Attitudes that farm stops are accessible to all populations	Positive Facility Good Selection	.47	.21	20.42	<0.001
Attitudes about farm stops helping others contribute to a local food economy	Good selection Unique and Engaging Positive Facility	.61	.36	27.94	<0.001

Note: Category construct colors: Red = Reasons for visiting Farm Stops; Green = Attitudes about Farm Stops; Blue = Importance of Operational Features

listed in Table 6 in the order they were selected by the stepwise linear regression.

Economics

Within the Economics theme, three significant categories emerged that influenced the percentage of monthly groceries purchased at farm stops (Table 6): Selection of Products, Provisioning, and Good Selection. The categories come from each of the three separate constructs of Reasons for Visiting Farm Stops, Attitudes about Farm Stops, and Importance of Operational Features, respectively, which increases the robustness of this prediction. Age, and the number of people in respondent households, were also found to significantly impact the percentage of monthly groceries purchased at farm stops.

Willingness to pay more for groceries at farm stops was significantly supported by the categories: Good Selection, Supporting Local Food Systems, Provisioning, and Support of Local Food (Table 6). This result is also supported by categories from all

three construct groups, thus enhancing the stability of this prediction.

Resilience

Within the Resilience theme, two significant categories influenced respondents' attitudes about whether farm stops provide essential services during crisis events: Provisioning, and Unique and Engaging, which fall under the constructs of Reasons for Visiting Farm Stops and Importance of Operational Features (Table 6).

Two significant categories influenced respondents' attitudes about farm stops increasing long-term community resilience: Unique and Engaging, and Good Selection, which fall under the constructs of Attitudes about Farm Stops and Importance of Operational Features, respectively. Level of education was also found to be a significant category that influenced attitudes about whether farm stops enhance community long-term resilience.

Overall, the most significant categories of the Resilience theme were Unique and Engaging, and Provisioning.

Community

Within the Community theme, three significant categories influenced whether respondents felt farm stops had a strong presence in their community: Positive Facility, Supporting Local Food Systems, and Support for Local Businesses (Table 6). The categories come from each of the three separate constructs Attitudes about Farm Stops, Reasons for Visiting Farm Stops, and Importance of Operational Features, respectively, which increases the robustness of this prediction.

Constructs and Category Patterns

Table 7 offers a visual of the distribution of constructs across the four dependent variable themes of Economics, Resilience, Community and Advocacy. It also breaks down the various patterns that emerged from the data that support how farm stops promote both C-B CFSs and resilient communities. For example, the predictor Unique and Engaging appears twice in the Resilience theme and once in the Advocacy theme, indicating that the unique and engaging elements of farm stops may enhance community resilience.

How much time respondents spend in farm stops during one visit was not significantly supported by any of the nine categories; however, Provisioning emerged as the best fit for the statistical model. Because no statistical significance was found for this category, this regression was eliminated from further analysis.

Attitudes towards spending time in farm stops was significantly supported by the categories Positive Facility, Provisioning, and Supporting Local Food Systems. The categories come from each of the three separate constructs Attitudes about Farm Stops, Reasons for Visiting Farm Stops, and Importance of Operational Features, respectively, which increases the robustness of this prediction.

Overall, the most significant predictors of the Community theme were Positive Facility and Provisioning.

Advocacy

Within the Advocacy theme, two significant categories influenced respondent attitudes that farm stops are accessible to all populations: Positive Facility and Good Selection, which fall under the construct of Attitudes about Farm Stops (Table 6). Attitudes about whether farm stops help others to contribute to a local food economy were significantly supported by the categories Good Selection, Unique and Engaging, and Positive Facility. These categories fall under the constructs of Attitudes about Farm Stops and Importance of Operational Features.

Overall, the most significant categories of the Advocacy theme were Positive Facility and Good Selection.

Positive Facility only appears under the Community and Advocacy constructs, which suggests that there are elements of how farm stops operate, and how they foster and maintain relationships with farmers and community members, that increase feelings of cohesiveness and that strengthen the community.

Good Selection, in combination with Selection of Products, are spread throughout the dependent variable categories, which suggests that the selection offered at farm stops is an important element that farm stops should continue to pursue as it may maintain and increase community engagement.

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Table 7. Matrix of Categories for Stepwise Linear Regressions

	PREDICTOR VARIABLES										
	Categories from factor analysis								Background variables		
DEPENDENT VARIABLES (by theme)	Provision-ing	Good Selection	Supporting Local Food Systems	Unique and Engaging	Positive Facility	Selection of Products	Support of Local Foods	Support for Local Businesses	Age	House-hold Size	Education Level
Economics: Percentage of groceries spent at farm stops	X	X				X			X	X	
Economics: Willingness to pay more for groceries at farm stops	X	X	X				X				
Resilience: Attitudes about farm stops providing an essential service during Covid lockdowns	X			X							
Resilience: Attitudes about farm stops increasing community resilience		X		X							X
Community: Attitudes about farm stops having a strong community presence			X		X						
Community: Attitudes about spending time in farm stops			X		X			X			
Advocacy: Attitudes that farm stops are accessible to all populations		X			X						
Advocacy: Attitudes about farm stops helping others contribute to a local food economy		X		X	X						

Note: Category construct colors: Red = Reasons for visiting Farm Stops; Green = Attitudes about Farm Stops; Blue = Importance of Operational Features.

This result may suggest that survey respondents believe farm stops should continue developing strong relationships with farmers and producers in order to increase farm stop holdings.

Other predictors only show up once among the themes, including Support for Local Businesses, and Support of Local Foods. This suggests that these particular predictors are not as significant when considering the impact of farm stops in their communities.

Discussion

Discussion is broken down according to the four main themes: Economics, Resilience, Community and Advocacy. The Community and Advocacy sections were combined into one.

Economics

Survey respondents generally thought that farm stops offered a wide variety of products, that farm stops supported local producers, and that it was important that farm stops support local producers. Results also showed that respondents are willing to pay more for groceries at these locations because they offer a wide variety of products, support local farmers and businesses, and have an inclusive and welcoming environment. These results could indicate a heightened desire from a subset of community members to support local businesses who are actively reinvesting in their communities in multiple ways, and that respondents may be aware of the ways in which farm stops do so.

As a growing method of civic agriculture, farm stops are evolving in their definition, largely by taking the form of locally owned businesses designed to use local resources sustainably, employ local residents, and produce at least enough goods and services to satisfy residents' needs. These kinds of business are described by economist Michael Shuman as LOIS businesses: locally-owned and import substituting businesses (2012). LOIS businesses are self-sufficient based on the resources available to them locally or regionally, only import additional resources when necessary, and invest in the health and vibrancy of a community. Shuman further argues that LOIS businesses perpetuate the "multiplier effect": "the more times a dollar circulates within a defined geographic area and the faster it circulates without leaving that area, the more income, wealth and jobs it generates" (Shuman, 2012, p. 88). Thus, Shuman argues, the more LOIS businesses in a community, the stronger and more resilient it is.

Farm stops operate on consignment, giving 70–80% of every sale to producers, while also employing local residents and partnering with other local businesses. Data collected on farm stops participating in this study indicates that by operating on consignment, farm stops funnel substantial amounts of money into their local food economies via direct payments to producers. For example, Agricole, a farm stop in Chelsea, MI not included in this study, earned US$2 million in revenue in 2024. Of that amount, they kept US$30,000—approximately 1.5%—for their operations, likely for staffing and expenses. (Maynard, 2024). Abby Hurst, one of the four owners of Agricole stated, "I'm happy with this because none of us do this for the money." (Maynard, 2024, par. 10). At the time this study was conducted in 2021, Argus Farm Stop had reinvested US$15 million with local producers since opening in 2014, hence supporting an important component of the local food economy (Argus Farm Stop, n.d.-b; USDA, 2023); Local Roots reinvested US$1 million to local producers in just one year (Local Roots, 2021); Boone Street Market reinvested approximately US$3 million to local producers since opening in 2014 (Jonesborough Locally Grown, n.d.); and in 2022 The Wild Ramp reinvested US$484,192 to local producers (Wild Ramp, 2023, "Where we are"). These numbers indicate that U.S. farm stops in different regions have a consistent capacity and motivation to funnel revenue into their local food economies. Even with a small sample size, this trend is widespread within the data, suggesting that it may be a common practice among other farm stops not surveyed. Due to their capacity and motivation to reinvest in their communities, farm stops may encourage support from those who consistently shop there, though additional research is needed to better understand the impact of the multiplier effect in strengthening local food economies and impacting consumer choices (Benedek et al., 2020).

Respondents may also be made aware of how farm stops reinvest in their communities through

farm stop business structures, mission statements, and educational outreach. There are no expressly for-profit entities included in this study; all farm stops included are structured as non-profits, cooperatives, or L3Cs. Since the collection of this data in 2021, twelve additional farm stops have started operating across the U.S., of which none is a singularly for-profit entity (Farm Stop Conference Central, 2024). Similar to other civic agriculture enterprises, all participating farm stops also included within their mission statements their intentions to expand and strengthen their local food economy directly. For example, the Argus Farm Stop states, "Our mission is to grow our local agricultural economy" (Argus Farm Stop, n.d.-a, para. 1). The Wild Ramp has a mission to "grow and support a vibrant economy and community for local food" (Wild Ramp, 2023, "Our mission"). Random Harvest, "envisions a relational food economy where food builds bridges towards a generous, just, and nourished community" (Random Harvest, n.d.).

Farm stops also advertise their missions through their websites, yearly reports, social media platforms, and even in the stores themselves. All farm stops included in this study use social media platforms to advertise their mission and their perceived impact. They also offer a high level of transparency around their consignment ratios and sourcing, and offer education around the impact of local sourcing on the local food economy. This may inform consumers that farm stops may purposefully generate low profit margins for the sake of consistently reinvesting in their communities, and may account for respondent willingness to pay more for goods at these locations. Additional research is needed to confirm this hypothesis.

Farm stops do not facilitate the transport of products they source from local growers; farmers regularly enter the stores to drop off their goods, and in some cases, set up their own displays. While this does constitute a cost for growers as it takes time to deliver their product and set up a display, consumers have opportunities to meet and talk with farmers directly as they are bringing in their goods, or as they are getting a cup of coffee. Through these interactions, consumers may have more direct and in-depth conversations with a grower about their practices, their products, or their involvement with the farm stop and community, which may help them develop a stronger relationship with growers and their products. This opportunity is seldom found in a typical retail environment, and may also support the survey results indicating that respondents enjoyed spending time in farm stops.

While there is yet to be a comprehensive economic analysis of the financial impact of farm stops on their communities, and while the sample size presented is small, there at least is evidence in the data to support the notion that farm stops maintain their core commitments to consistently reinvest in their communities. The farm stop overt mission to support its community, combined with its educational and conversational environment, may define farm stops as LOIS businesses. As LOIS businesses, farm stops may allow consumers to learn more about, and contribute directly to, their local food system. This may account for survey respondents' willingness to pay more for groceries, and for their emphasis on the importance of sourcing a wide variety of local products; more data is needed with a larger and more diverse sample size to assess the financial impact of farm stops on communities, and whether a farm stop influences consumer choices.

Resilience

Respondents felt that farm stops provide essential services during crisis events by meeting a portion of their household needs, and by offering a unique and engaging atmosphere. These results may indicate that because farm stops prioritize local sourcing they are better able to pivot to alternative methods of distribution to support communities when national supply chains are compromised. Farm stops may also help to ensure the long-term resilience of communities to disruptive events. This was most evident during the 2020 COVID-19 lockdowns.

At the height of the lockdowns, large-scale farms were faced with labor shortages, lack of transportation, and a lack of viable economic outlets as hospitals, restaurants, schools and universities closed (Molla, 2020; Yaffe-Bellany & Corkery,

2020). The total amount spent in food service locations (e.g., restaurants, schools, sports venues) fell from US$68 billion in February, 2020 to US$54 billion in March and US$36 billion in April (USDA ERS, 2023). As outlets closed, many farms did not have the resources available, were tied up in corporate contracts, or were simply too big to shift to alternative sales outlets such as CSA programs, drive-thru farmers markets, or online prepaid ordering systems (Yaffe-Bellany & Corkery, 2020). Many large farms had no choice but to dump or compost hundreds of thousands of pounds of fruit and vegetables, resulting in higher prices for these commodities, high levels of food waste, and rising rates of food insecurity across the country as large-scale grocery shelves remained empty (Clapp, 2020; Lakhani, 2020; Lush, 2020; Yaffe-Bellany & Corkery, 2020).

Conversely, while smaller producers also faced financial distress, labor shortages, and food waste (Thilmany, Canales et al., 2020), their relatively smaller size and higher level of diversification ensured that these effects were not nearly as damaging (Hadavas, 2020; Thilmany, Canales et al., 2020). Smaller producers did, however, experience escalated demand and pressure for local produce because of breakdowns in national supply chains (Crampton, 2020; Danovich, 2020; Elbein, 2020; Gao, 2020; Hadavas, 2020; Held, 2020; Hobbs, 2020; Lush, 2020; Thilmany, Jablonski et al., 2020; Worstell, 2020). Heightened demand and pressure for local produce forced farm stops to quickly pivot to alternative food distribution methods by expanding their diversified revenue streams. They developed online stores, alternative delivery and pick-up systems, and subscription services. These services allowed farm stops to expand their offerings, take on more small producers, and move more goods into the community. Furthermore, while many small-scale businesses were forced to furlough a portion of their staff (Gao, 2020), farm stops engaged a steady local labor force, incorporating volunteers as well. Farm stops' ability to source locally and expand their revenue streams may serve as one reason why survey respondents felt that farm stops provided essential services during a crisis event, and thereby enhanced community resilience.

Respondents also felt that farm stops enhanced community resilience by creating a unique and engaging atmosphere. One reason may be how well farm stops are able to create a sense of place, embodying the "emotive bonds and attachments people develop or experience in particular locations and environments" (Foote & Azaryahu, 2009, abstract). Farm stops may enhance community bonds and attachments by generating a welcoming and inclusive environment where people can interact beyond simply purchasing groceries, often by taking advantage of their diversified revenue streams. For example, as farm stops were able to remain open and flexible during the COVID-19 pandemic, they were better able to meet the rising demand for local food and to support local producers by providing additional market outlets. When asked how they felt farm stops impacted their communities, some respondents offered positive recollections of how the stores handled the pandemic. One said, "They were so present for us during the first year, it was incredible. I felt safe there, and it got us through the period when we felt we could not safely visit larger supermarkets." Another stated, "A big help during lockdown. Safe way to buy good food." Another said, "Most remarkable to me was that Argus was there to reliably supply groceries during the pandemic when the big Whole Foods type of stores were not." Beyond staying open during crisis events, farm stops may enhance a sense of place through their cafés, taverns, educational classes, community events and other meeting spaces where community members can spend time with friends and family. For example, one respondent stated, "It brings neighbors together. It provides a welcoming space right in the neighborhood which livens up the area. It has made it so much easier to get local food! It is all in the store."

While this sample size is small and does not fully represent an entire community's perspective, farm stop flexibility in generating additional revenue streams, and their ability to engage a subset of customers beyond purchasing groceries may serve as reasons why respondents felt farm stops enhance overall community resilience. Additional research with a broader and more diverse sample size is needed to confirm these results.

Community and Advocacy

Respondents felt that farm stops have a strong presence in their communities as a result of creating a positive and supportive environment, and their ability to provide respondents with a portion of their household needs. Respondents also felt that farm stops' accessibility related to their positive and supportive environment and whether they offered a wide selection of products. These results align with respondents stating they enjoy spending time at farm stops, which was tied to respondents' feelings that farm stops have a unique and engaging atmosphere.

One reason respondents feel that farm stops have a positive and supportive environment may again result from their ability to enhance a sense of place, and may also relate to the enthusiasm of their staff and their store culture.

As previously mentioned, farm stops may develop a sense of place through their diversified revenue streams, which allow consumers to engage with a farm stop beyond just purchasing groceries. Consumers may be able to connect with family and friends over a cup of coffee, participate in an educational class or community event, or chat with farmers as they drop off their goods. Developing a sense of place helps strengthen community bonds and values (Ackerman-Leist, 2013; Foote & Azaryahu, 2009), and may serve as a reason for respondents' perception that farm stops have a strong presence in their community, and for enjoying their visits to farm stops. For example, when asked about whether their lives would be impacted if these stores were to close, one respondent stated, "It would be much harder for me to find locally sourced, organic food. I would be devastated." Another said, "It would be like losing a valuable member of the community," and another stated, "I would have less access and walkability to a business that I trust with my family's health. Also I would feel as if I'd lost [my] community." Additionally, when asked about farm stops impacting their communities, one respondent stated, "It adds value to the community by offering fresh locally grown produce and supporting small farmers. It's these kinds of small businesses that create charm and demonstrate the progressive attitude of a community." A respondent stated of Boone Street Market (BSM):

> BSM's mere presence highlights the local community's desire for and support of local agriculture. BSM serves as an outlet for local agriculture and creates visibility for its importance, promoting local producers. BSM's events also highlight local food and introduce it to many who might never have considered it. For others, it reaffirms their values.

A respondent said of Argus Farm Stop:

> Argus means more to me than quality and convenience in values-based healthy food shopping. Argus also helped me feel at home in Ann Arbor. This city would feel less like home to me without it.

While these statements do not necessarily represent the values and perspectives of the broader community, they help to reinforce that at least a subset of the farm stops' communities have had a positive and supportive experience.

Another reason why respondents believe that farm stops cultivate a positive and supportive environment may be due to their staff culture. While not studied in this survey, staff culture may be an important variable that warrants further research on farm stop presence in communities. Staff culture has been defined as the work environment consisting of the leadership, beliefs, values, attitudes, behaviors, and interactions within that environment (Siu, 2014). Studies show consumer experiences improve when a store cultivates a supportive staff culture in which employees feel supported, and that allows employees to connect with the store's mission (Boyce et al., 2015). If farm stops are able to cultivate a supportive staff culture, employees may enhance customer shopping experiences, perhaps contributing further to developing a sense of place. Additional research is needed to confirm this hypothesis.

It may also be worth understanding whether employees gain a sense of meaningful action by actively supporting the mission of farm stops, whether employees impart this sense of meaningful action to customers, and whether this sense further supports a farm stop providing a positive and supportive shopping experience. Meaningful action

has been defined as the "desire to be needed and to make a difference" (Kaplan & Kaplan, 2012, p. 235), inherent in all individuals to a greater or lesser extent and a main driver for how we choose to interact with our communities (Kaplan & Kaplan, 2012). If farm stops do indeed cultivate a strong staff culture, which employees are enthusiastic to work in and to support, employees may also educate consumers about the impact of their purchases, perhaps further contributing to a supportive shopping experience and sense of place. It may be worth understanding whether employees feel that by working at a farm stop they are making a difference in their community (Kaplan & Kaplan, 2003), and whether interactions with enthusiastic employees impart that same experience of meaningful action to consumers. Building the desire of consumers and employees to make a difference may support their valuing and even prioritizing regularly purchasing at least some goods at farm stops, participating in their events, or simply spending time there, which may enhance the strength of the presence a farm stop has in a community. Additional research is needed to confirm this hypothesis.

While respondents felt that farm stop accessibility related to their positive and supportive environment and whether they offered a wide selection of products, it should be noted that 30% of respondents did not feel farm stops enhance food access. This may be because locally sourced products are often perceived as being more expensive than what consumers would find in traditional grocery stores (Szegedyné et al., 2020); however, recent research highlights that this perception may not be the case and local options may be less expensive (Charlebois et al., 2022; Donaher & Lynes, 2016). Additionally, survey responses only account for a small subset of each community, and only represent a specific demographic. Additional research is needed to better understand the role farm stops play in enhancing food access.

Limitations

The results of this study suggest that developing C-B CFSs is as much about enhancing local food provisioning and resilience to crisis events, as it is about generating support for and prioritization of local food. The results suggest that farm stops may represent one method of promoting and enhancing a community's perspective towards local foods, which may strengthen C-B CFSs. It should be noted, however, that the results of this study only represent a targeted sub-population of the communities involved, a population that may already prioritize local foods and that has the capacity and resources to prioritize purchasing local foods. This population was characterized by respondents who are older, wealthier, highly educated, and live in smaller households. Additionally, certain questions within the survey may have led respondents to answer in a particular way that may have skewed the results.

More research with a broader and more diverse sample size, and stronger and more comprehensive survey development, would be required to understand farm stops' impact on communities, and their contributions to strengthening C-B CFSs.

Recommendations and Conclusions

The primary recommendations from this report are to encourage additional research with a broader and more comprehensive sample size on the impacts of farm stops on the communities they serve. As an up-and-coming method of local food distribution, there are many gaps in our knowledge about the impact of farm stops. This study highlights the need for additional research to better understand whether farm stop staff culture plays a role in generating a positive and supportive shopping experience, and whether in doing so consumers feel a stronger sense of meaningful action by purchasing goods at a farm stop. Other potential research topics could include the role farm stops play in enhancing food access within their communities, whether farm stops enhance relationships between farmers and consumers, and how potentially enhanced relationships between farmers and consumers may impact consumer purchasing decisions. Additional research is also needed to understand how farm stops exist in the larger context of other civic agriculture enterprises. These topics can better quantify whether farm stops do indeed strengthen C-B CFSs.

How to Start a Farm Stop: A Pattern Language for Local Food Systems

This research also supported the development of a guidebook, *How to start a farm stop: A pattern language for local food systems*. This document is a variation of a Pattern Language, established by Christopher Alexander to analyze the behavioral and psychological interactions in urban and architectural design (1977). Pattern Languages consist of a series of interrelated patterns that identify a specific challenge to an element or situation of a designed environment and suggest solutions.

This guidebook highlights some of the most essential farm stop elements, helps map out exactly how to make the store look, feel, and operate, and offers resources to help achieve a community's local food system goals. Each chapter discusses a specific element involved in developing farm stops, and suggests solutions and resources gleaned from successful iterations of existing farm stops. Chapters are organized within sections: Introduction, Getting Started, Financials, Location, Communication, and Operations. At the end of each chapter is a list of related chapters. This allows for a more fluid and interactive experience in which the reader may choose the chapters that pertain most to where they are in developing their own store. All resources are summarized at the end of the guidebook in a Resources and References section.

For those interested in starting their own farm stop, the results of the study indicate that it is worth paying attention to the mission you develop, the variety of products you offer, the relationships you generate between producers, community members, and other local businesses, and the atmosphere your store generates. These elements go towards ensuring that the store supports your community, and that your community financially and culturally supports your presence.

A copy of the guidebook is available online.[4]

The purpose of this study was to understand how farm stops enhance community resilience, strengthen community connections, and support generating or strengthening C-B CFSs. The results suggest that farm stops may enhance local food economies and community resilience through their support of local farmers and producers, their use of diversified revenue streams, and in the ways they can generate a sense of place among participating community members. Additional research is needed to further understand the impact farm stops have on the communities they serve, and how they contribute to strengthening a C-B CFS, specifically via food access, staff culture, impacting consumer behavior, and developing relationships between producers and consumers.

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Appendix

Table A1. Stem Questions for Factor Analysis

Category	Stem Question and Rating Scale
Reasons for Visiting Farm Stops	"How often do you visit [site] to": The rating question was, "Please rate the following statements using the scale provided. Please consider your answers in terms of pre-Covid." Pairwise comparison of means is significantly different at $p < 0.001$. $N = 228$
Attitudes about Farm Stops	"To what degree do the following statements reflect your opinions?" The 5-point Likert scale ranged from 1 = *Strongly Disagree* to 5 = *Strongly Agree*. All pairwise comparisons of means are significantly different at $p < 0.001$. $N = 172$
Importance of Operational Features	"How important is it to you that [site] … :" The 5-point Likert scale ranged from 1 = *Not at all important* to 5 = *Extremely important*. All pairwise comparisons of means are significantly different at $p < 0.001$. $N = 217$

Table A2. Survey Questions Used in Stepwise Linear Regressions

Survey Question	
Q1	What percentage of your monthly groceries do you purchase at [site name]?
Q2	How willing are you to pay more for your food at a place like [site name]?
Q3	Do you feel [site name] has a strong presence in the community?
Q4	Do you enjoy spending time at [site name]?
Q5	On average, approximately how much time do you spend at [site name]?
Q6	Do you feel you are helping to grow a local food economy by purchasing food at [site name]
Q7	As a result of the Covid-19 pandemic, and increasing pressures of climate change, there is heightened concern for the resilience of local food economies. Do you believe this form of food distribution (i.e. consignment-based grocery stores) increases the long-term resilience of the neighborhood to crisis events (e.g., economic downturns, Covid-19, climate-related disasters)?
Q8	To what extent do you agree with the following statement: [site name] provided an essential service to the community during the height of the Covid-19 pandemic lock-downs.
Q9	To what extent do you agree with the following statement: [site name] offers additional food access options to ensure all populations can shop there.

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Reconsidering the wholesale food market: The Ontario Food Terminal and the role of public infrastructure in a corporate consolidated food system

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Abstract

The wholesale food terminal, public infrastructure that connects farmers with wholesale intermediaries, largely has been superseded in North America by major supermarkets and their private supply chains. Yet the Ontario Food Terminal, Canada's largest wholesale food terminal and the third largest on the continent, continues to play a key role in Toronto. Drawing on field and archival data in our case study of this public institution, we argue that the wholesale food market supports a diverse retail foodscape that widens food access in Toronto. Further, it provides a reliable marketplace for Ontario produce farmers, thus supporting both agriculture of the middle in the region as well as retail of the middle. We demonstrate how the wholesale food market can contribute to territorial food systems and should be considered as an institutional component of circular food economies.

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Keywords
produce supply chains, territorial food system, agriculture of the middle, supermarkets, wholesale food market, commodity chain, community-based circular food systems

Introduction

In June 1954, the Ontario Food Terminal opened in Toronto, a middling Canadian city that would become North America's fourth largest metropolis by the end of the century (Toronto, 2017). The provincial government of the time sought to modernize the sale of fruits and vegetables by founding a wholesale marketplace on Toronto's outskirts, connecting the rural hinterlands to the city. The Terminal was seen as a public utility: it provided an essential service, establishing a marketplace where Ontario farmers could sell their product to the many wholesale buyers of the midcentury foodscape (Dipieri, 2023; Elton, 2010). When the Terminal opened, the chairman of the board made a statement that spoke to the vision of the new institution, promising "fresh produce available to consumers in a much-improved condition, lower prices, increased opportunities to dispose of [excess] produce and improved returns to growers" (Perkin, 1954, p. 2). What the founders of the Terminal did not know at the time was that they were not only building a public institution to manage the mid 20th century food system. As we argue in this paper, this institution would come to support midscale, regional agriculture and a diversity of retailers. In so doing, it offers a public institution as an alternative to the supply chains dominated by food businesses consolidated into major chains.

Wholesale food markets are urban infrastructure projects, and thus interest in them largely has been in the urban planning and history literature. Focus has been on the regulatory planning environment and evolving urbanization (Bressi, 1997; Burns, 1968; Donofrio, 2014; Lesh & Myers, 2022; Vitiello & Brinkley, 2014). Public wholesale markets are integral to food systems and are important to consider in this field. This is especially true because major supermarket chains now dominate, shifting the grocery industry away from public supply chain infrastructure and toward private ones. North American public wholesale food markets in many cases have been closed or privatized (Friedland, 1994; Tangires, 1997, 2019). These industry changes have been naturalized and understood discursively as the evolution of the marketplace. However, the cumulative research in this area demonstrates the role of government policy—or lack of it—in creating the market conditions that allow the largest corporate actors to replace small and midscale businesses. In our analysis of the Ontario Food Terminal's history, we aim to problematize this view that major supermarket chains represent the "natural" evolution of food retail. Are such supermarkets really the future and wholesale public markets the past? What is the role of the public food terminal today?

The moment is now to study and contemplate the role of public wholesale food terminals. It is widely recognized that the dominant industrial and globalized food system is unsustainable and unjust (Anderson et al 2019; Blay-Palmer et al, 2013). The climate crisis adds urgency: the long-distance transport of produce that the seasonless supermarket depends upon contributes substantially to emissions (Crippa et al., 2021; Li et al., 2022). Agricultural areas that have been sites of export agriculture are experiencing ecological impacts of climate change and anthropogenic environmental destruction, such as water shortages, extreme weather events, and diminishing soil fertility (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services IPBES, 2019). For example, for more than a century, agricultural entrepreneurs in California's Salinas Valley built fortunes shipping produce such as iceberg lettuce (Freidberg, 2009) to locations across North America. But the future success of such production is threatened by water shortages, pesticide contamination, and soil erosion (Carlin et al., 2023; IPBES, 2019). In the summer of 2023, hurricanes devastated agricultural areas across the U.S. and Mexico, where some produce sold at the Terminal is sourced. A produce industry newsletter reported in September 2023 that in the U.S. state of Georgia, farmers could not plant their beans on schedule due to rain-soaked soil (Campbell, 2023). That same year in Baja California, Mexico, it was reported that Hurricane Hilary threatened wind-sensitive plants such as cucumber.

Several hurricanes have damaged citrus and avocado production in Florida including Hurricane Helene in 2024 (Beaton, 2024) with the U.S. Department of Agriculture (USDA) reporting a 16% reduction in orange production compared to the previous year (USDA, 2024).

Another reason to consider the significance of the wholesale food market at this time is the political context. In Canada, the federal government has written the first-ever national food policy to "build a healthier and more sustainable food system" (AAFC, 2019, p. 3). and in 2024 it funded a national school lunch program (AAFC, 2019). The role of public investment in food system infrastructure is critical, not only in Canada and other high-income countries, but globally. This paper contributes to discussions about the public good and food systems.

Using a mixed-methods design, including archival research, field site visits, and qualitative interviews (see Methods), we make sense of this public institution in an increasingly global, complex, and consolidated food system. We consider its potential contribution to territorial food systems, as well as the circular systems that are the topic of this special set of papers in JAFSCD. We engage with the concept of a territorial food system as an emerging idea in the literature (Food and Agriculture Organization of the United Nations (FAO), 2022; International Panel of Experts on Sustainable Food Systems [iPES-Food], 2024; Lamine, 2023). Territorial food systems, including supply chains and markets, are "a set of agri-food supply chains that integrate sustainable development, that are localized on a regional scope and that are coordinated by a territorial system of governance" (Rastoin in Martorell, 2014, p. 4). Rastoin (2014) describes a territorial food system as one that assigns value to regional production, creates opportunities for small and midscale businesses as well as alternative marketing channels, and is better able to support health and sustainability while providing business opportunities to a wider range of actors than the dominant food system. Such territorial food systems can more feasibly contribute to circularity as their shorter supply chains can be refashioned away from complex, linear systems such as global produce chains. These global produce chains extract resources in the shape of zucchinis, tomatoes, and lettuce, and ship them to other territories, never to be returned, even as waste. As has been observed, circular economies can benefit food system actors such as farmers and retailers (Ouro-Salim, 2022), while the system needs to better support consumers' sustainable options (Jurgilevich et al., 2016). Further, it is held that circular economies can provide solutions to market failures, including in the food system (Curry, 2021).

After describing our research methods, we block out periods in food system history that have impacted wholesale food terminals generally in North America and specifically in Toronto. We discuss how the supermarket industry has shaped food systems on the continent. We describe "agriculture of the middle," a food systems concept that we apply in an analysis of the Terminal's role. Drawing on our empirical research, we argue that the public wholesale marketplace of the Ontario Food Terminal supports a diverse retail foodscape that widens neighborhood food access in Toronto. It also provides a reliable local marketplace to Ontario produce farmers, thus supporting the agriculture of the middle. We underline why the Ontario Food Terminal remains a cornerstone for strengthening a regional food system. In so doing, we argue that a wholesale food market can contribute to territorial food systems and should be considered as an institutional model that could be incorporated into a circular food economy.

Researching the Terminal: Methods

We conducted research at the Ontario Food Terminal, along its supply chains, as well as in public archives. Starting in 2020, Elton and collaborators—including Cole, Dipieri, and research assistants[1]—have been tracking the institution's produce supply chains from farms, through the Terminal, and then out into the community. We began with an investigation into the impact of

[1] The research assistants who contributed to this project as students are Matilda Dipieri, Jannatul Islam, Mohini Mehta, Aparna Menon, Tanjot Grewal, Kyle Resendes, Jasleen Sohal, and Ruth Siew.

COVID-19 on produce supply chains (Elton, 2023; Elton et al., 2023). With the support of external funding and academic colleagues at collaborating universities, the project widened into an ongoing multiyear study of the Terminal's role in the Ontario food system, addressing questions of food security, sustainability, and resiliency. Research included monthly visits to the Terminal for 13 months (June 2022–July 2023) to document produce sold and the farms selling directly to consumers at the market. We documented what produce was sold at points along produce supply chains, from farms to off-site warehouses to Toronto retailers. Research into international supply chains including agriculture, logistics, and trucking was conducted over the phone, drawing on the language skills of research assistants in Bangla, Hindi, Urdu, Punjabi, and Spanish. Research questions were informed by partners at the City of Toronto in the Poverty Reduction Office and Environment and Climate Division.

Key informant interviews (N = 110) provided an overarching view of the Terminal, its role in the urban food system, and its position vis-à-vis other fresh food supply chains in Toronto. We interviewed a range of food system actors, such as farmers, produce brokers, wholesalers, grocers, mobile produce vendors, restauranteurs who source there, Terminal staff and board members, and many other people in the city working to move produce from farm to fork. We also interviewed people who work in distal parts of the supply chains, for example in India and the Dominican Republic. The team conducted data-generating visits to the Terminal and to retail locations across the city, where many informal conversations about retail and wholesale sales took place. Photographs and field notes were produced, including photos to document shipping labels that recorded produce points of origin. Interviews were transcribed and these data were thematically analyzed by Elton and research assistants (Braun et al., 2019).

Archival research, informed by environmental history approaches, was conducted by Dipieri, who completed her master's thesis on the history of the Terminal (Dipieri, 2023). Much of the historical data is from the Archives of Ontario and the Toronto Public Library Archives, which includes the local newspapers *The Toronto Star* and *The Globe and Mail*. Focus was on materials from 1912 to 1956 that discuss the Terminal's planning and opening. This archival research was combined with a scan of the relevant scholarly literature and produce industry media, as well as interviews conducted with long-time industry insiders. We begin by presenting a periodization (Sparshott, 1970) of the Terminal's history.

Historical Findings

Here we situate the Ontario Food Terminal in a historical context.

1800s–1930s: Diverse Public Market Infrastructure in Settler Colonial City-Making

Public markets and market districts in North American settler-colonial cities of the late 1800s and early 1900s were important in fostering a food system that was both "equitable" and "efficient," according to Tangires (1997). Helen Tangires's (2019) landmark scholarly work, *Movable Markets: Food Wholesaling in the Twentieth-Century City*, has been key to our understanding of the role of these institutions in the wider food system. Tangires documents how there was a strong belief, specifically in American society, that governments had a role to play in making food accessible and affordable, and also in minimizing food waste. In fact, public market spaces were valued by late 19th and early 20th century governments because they eschewed waste and supported food security. Municipalities were growing with newcomers arriving largely from the United Kingdom and Europe (with additional immigrants from Asia, the Americas and the Caribbean) to work in settler-colonial agricultural, extraction, and industrial economies. The public marketplace helped ensure that all social classes had access to food and that farm labor and resources did not go to waste (Tangires, 1997, 2019). Wholesale markets founded during this period include Philadelphia's Reading Terminal Market in 1893 (Reading Terminal Market, n.d.) and Chicago's South Water Street Market in 1925 (Department of History, n.d.).

1940s–1950s: Social Production of Food Retail

During this period, concern arose among city plan-

ners that public markets were antiquated and inefficient, as informed by their appearance of disorder. Until the Second World War, market districts in cities such as Toronto, Baltimore, New York, and Chicago were jumbled agglomerations of carts, vendors, and fresh food sellers. For example, at Toronto's St. Lawrence Market in the downtown core, live cattle were traded alongside produce. The streets in the area were jammed with farmers' trucks (Dickau et al., 2021). Downtown food markets were seen by officials as inefficient in ensuring a steady supply of food. Spoilage and surplus production had increased in the post-war period alongside industrialized changes to food production. It was often the case that fruits and vegetables were left to rot in the market square because of oversupply and a lack of cooling infrastructure. While new technological advancements in agriculture promised Ontario farmers increased earnings, infrastructure challenges and supply and demand mismatches meant that earnings were instead stagnant or dropping in the 1940s (Dipieri, 2023). This was reported on extensively in the news media, as well as described in detail by the Terminal's proponents following the results of the study on the state of Toronto's food market retailing, commissioned by the Ministry of Agriculture after the Second World War.

These disorderly spaces ran counter to the visions of North American midcentury urban renewal projects. A motivation was to "clean up" cities, including by razing low-income communities in what were called "slum-clearing projects." As Kwate (2023) describes, in the U.S., urban renewal projects "transformed cities and particularly downtowns to make them more attractive to the White middle class, to attract capital and reinvestment" (p. 46). Many Black communities were razed, along with Black neighborhood businesses (Kwate, 2023, p. 51). As Kwate documents, a vision of modernity and whiteness not only informed new city designs but also food retail. At the same time that freeways were built to connect the city to the developing suburbs, a new kind of supermarket was advancing not only a different way to provision food but powerful ideas of whiteness (Kwate, 2023), modernity, hygiene, and femininity (Deutsch, 2012).

1950s–1960s: Food System "Modernization"

Mid-20th-century planners were uninterested in farmers driving their produce-filled trucks to downtown markets (Dickau et al., 2021) and wanted to transform urban food distribution (Donofrio, 2014). Part of "cleaning up" the city involved moving wholesale food trade to the suburbs and urban periphery (Donofrio, 2014; Elton, 2010; Tangires, 1995). This is how the Ontario Food Terminal came to be. In the U.S., the Department of Agriculture played a key role in coordinating national food system planning (Tangires, 2019). Conversely, in Ontario it was the province that took action and moved wholesale from the downtown to a new, modern facility on the city's periphery. A similar approach was taken in European countries such as France and Italy, where post-war governments, often funded by the Marshall Plan, invested in public wholesale food markets to build food security (Cadilhon et al., 2003). The goal was to convene a place to aggregate agrifood products, thus permitting quality control, market competition, and transparent, fair pricing. The wholesale food market was understood to be a public good.

In 1946, the Ontario Legislature passed the Ontario Food Terminal Act (Cavicchia et al., 2019). It positioned fruit and vegetable wholesaling as a "public utility" for the province. The choice to pursue a *public* approach to fruit and vegetable wholesaling was significant. According to proponents, an investment in modern, efficient infrastructure unlike any other in Canada, would help secure Toronto's place as a flourishing urban metropolis. In 1954, the Terminal's first chairman's words captured the feelings of the day, juxtaposing the modernity of the new Terminal with what was viewed as the outdated market downtown: "Produce is still moving through a market established seventy-five years ago and originally designed for horses and wagon traffic when the city was only a fraction of its present size, whereas receipts now arrive at the Terminal by refrigerated express, freight and modern trucks and tractor-trailers" (Perkin, 1954, p. 2)

The Terminal's proponents saw the fruit and vegetable industry as an economic growth opportunity. The produce trade showed financial prom-

ise, as long as issues of redundancy, oversupply, and waste could be mitigated. State intervention in the food system was justified by the large capital investment required to build modern refrigeration and distribution facilities. These could not be made by the private sector because the size of Ontario's farms and related businesses could not sustain the scale of investment to secure the land and pay for terminal market infrastructure. Importantly, the Terminal would be positioned between new highways connecting the city to the hinterlands and also the Canadian National Railway, which would bring trains loaded with produce directly onto the grounds. This effort can be seen as part of a larger investment in mid-20th century public infrastructure, such as electricity utilities through the Hydro-Electric Power Commission of Ontario (Dipieri, 2023; Nelles, 2003). The provincial support was not matched by federally coordinated efforts for fruit and vegetable distribution in the rest of the country.

1980s–2020: The Corporatization of Supply Chains and Food Retail

The rise of the major chain supermarket[2] is key to understanding the public wholesale food market's diminished status today. While supermarkets have operated in the U.S. since the early 20th century, these corporate entities began their rise to prominence after the Second World War and continued to grow in importance over the next decades (Deutsch, 2012; Wrigley, 2001). Whereas a century ago, many North Americans would have purchased food from a variety of retailers, in the U.S. today, 65% of the grocery retail market is controlled by four companies; in Canada, the big five major chain supermarkets control just under 74% of the retail grocery market (USDA, 2023). These large companies have profound influence not only on the grocery sector but on the entire food system. Researchers have found that major chain supermarkets have shaped food safety and sustainability standards on the farm as well as in food manufacturing and distribution along the supply chain to the consumers (Burch et al., 2013). Further, the supermarket has affected purchasing habits and even diet profoundly (Burch et al, 2013).

Burch and colleagues (2013; also see Food & Power, 2023; Food & Water Watch, 2013) describe the power of major chain supermarkets in the marketplace largely deriving from their monopsony, though others call it an oligopsony, defined by Wilmers (2018) as a "collusive group of buyers … that reduce demand to force suppliers to lower prices below a competitive rate" (p. 239). Food retail is an economic marketplace where there are few buyers (wholesale buyers in this instance) and many sellers (farmers, food processors). This oligopsony has empowered major chain supermarket corporations to set industry standards, for example in food safety as well as in prices paid to suppliers. It has even had a negative impact on major chain supermarket worker wages (Wilmers, 2018) and contributed to higher grocery prices (Food & Water Watch, 2013). A further influence in the sector has been the financial interests of investment capital that funded supermarket expansion through debt (Wrigley, 2001). This kind of "financialization" in food and agriculture is not unique to supermarkets (Burch, 2013; Clapp, 2013; Howard, 2021). In the case of retail, it turns food provisioning into an economic investment driven by the need to produce financial returns for investors and speculators as opposed to profits for the people who own and operate businesses along the supply chains, from farms to retail.

There used to be more opportunities for a larger number and wider range of businesses to operate in food retail. That is, there were numerous small and midsized companies who competed in

[2] What is the difference between a supermarket and a grocery store? The terms used to describe retail grocers vary in the literature, in the food industry, as well as in common parlance. We follow the Oxford English Dictionary (n.d.) and define a supermarket as "A large store, typically one of a chain, selling a wide range of food and groceries, as well as household goods and other products" (para.1). Deutsch (2012) details the history of this institution. People at the Ontario Food Terminal call the largest supermarket chains the "majors." In this article, we refer to these institutions that dominate 76% (USDA, 2023) of the Canadian market as "major supermarket chains." We use "independent grocer" or "grocery store" to describe independent grocery businesses. These also could be chains—some independent grocery stores operate several locations—or cooperatives, worker-owned organizations, or privately held businesses.

the grocery business. Whereas the supermarket sector up until the 1980s was characterized by a diversity of businesses, more likely to be regional in scale, since the 1990s there has been corporate consolidation (Fold & Pritchard, 2005; Zwiebach, 1999). Corporations that owned supermarkets acquired other supermarkets. Private equity firms "bundled" smaller-sized chains into units that were then sold as investments or market consolidation opportunities for the largest supermarket corporations (Food & Power, 2023). Corporate consolidation has led to the mega-firms we know today (Wrigley, 2001). In Canada, nearly 74% of the food and beverage market is controlled by the top five supermarket chains: Loblaws, Sobeys, Metro, Walmart, and Costco (USDA, 2023). In 2013, Food & Water Watch calculated that 53.6% of American grocery dollars went to four major chains, with Walmart capturing a third of all sales. Supermarket consolidation continues, with supermarket mergers ongoing (Monteros, 2022).

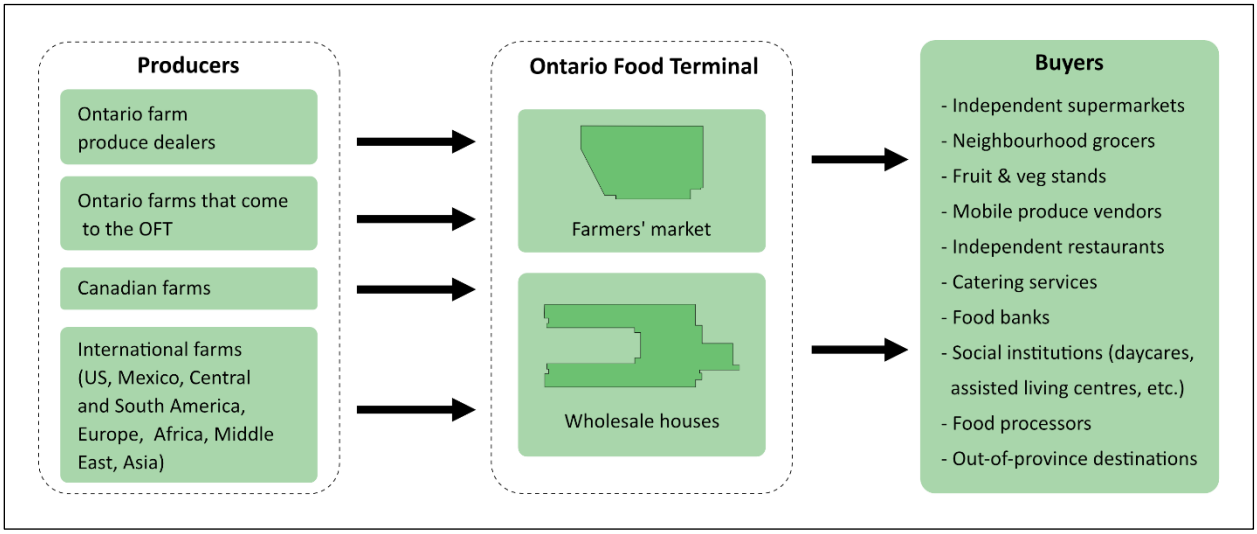
Another factor to consider about the consolidated major supermarket chains is how their businesses work differently than smaller companies. Unlike an independent grocery chain in our study—whose business involves sourcing produce at the Terminal that they then sell alongside other groceries (such as dry goods, dairy, meats) and meals they prepare in their own canteen with Terminal produce—a corporation such as Walmart does not only earn money through selling food. In 2022, the corporation earned US$2.1 billion in advertising revenue unrelated to grocery sales. The Loblaw company that owns the supermarkets with the highest number of Canadian shoppers (USDA, 2023) also generates revenue from its financial services business, real estate, and a sector called pharmacare that includes pharmacies and health clinics (Moscrop, 2024). The company's revenue in the fourth quarter of 2023 was CA$14.53 billion, with CA$541 million in profit (Loblaw Co., 2024). As reported in the business press, diversification allows supermarket companies to continue to sell food at "low-margin" prices (Hercher, 2022). The consolidated supermarket sector drew the attention of free-market regulators during the COVID-19 pandemic. When food prices spiked during this time, the Competition Bureau in Canada and the Federal Trade Commission (FTC) in the U.S. released reports that blamed supermarkets for higher food prices. In Canada, it was found that a lack of competition in the supermarket industry led to higher food prices; increased competition with more retailers was deemed a solution (Competition Bureau of Canada, 2023). In the U.S., the FTC found that supermarket corporations took advantage of supply chain disruptions to increase their profits (FTC, 2024). These criticisms of the consolidated supermarket industry were made by organizations promoting capitalist, free-market values of fair competition that have been deemed under threat by oligopsony in the sector.

Ontario Food Terminal: 70 Years in Operation

There used to be numerous wholesale food markets across the U.S. Some specialized in produce like the Ontario Food Terminal, while others sold a wider range of foods including eggs, fish, and meats (Tangires, 2019). Over the last century, public terminal markets have either shrunken, been privatized, or been shuttered entirely (Vitiello & Brinkley, 2014). For this reason, much of the literature that speaks of wholesale food markets discusses their origins and subsequent decline. While the Ontario Food Terminal remains open, its customer base has changed. These days, it is mostly independent food businesses—small grocers, midsized family-owned grocery stores, restaurants, and caterers—that pull past the secured-access gates six days a week to do their buying. These businesses are depicted in Figure 1.

When the Terminal first opened, the companies that grew into some of today's major supermarket chains also depended on it. As we learned in key-informant interviews, this practice started to wane in the 1990s as major supermarket chains built their own supply chains, sourcing directly from farms in Canada and around the world. This shift in corporate sourcing took place across the grocery sector in North America, largely cutting out this kind of wholesaler (Burch et al., 2013). The Terminal became a place where the major supermarket chains would go to fill "shorts" in their purchasing. Thus, wholesale food markets have faded from both the political and public consciousness on this continent. As one man who spent dec-

Figure 1. The Ontario Food Terminal's Supply Chains



Produce flows from farms, through the institution, and into a diversity of retail and food service businesses.

ades managing such supermarket produce supply chains said in an interview about the Terminal, "One time it used to be mainstream. It used to be the portal into the industry." Now, he notes that it's mostly for the independents: "It's kinda like the mice run around the elephant's feet."

But the Terminal remains seen as a public utility by the farmers, wholesalers, and buyers who run their businesses through the institution. Whether policymakers and the public recognize its importance is questionable. In 2019, it was rumored that the provincial government was considering selling off the land for development. However, there was major outcry from businesses with vested interest in the institution, and nothing happened (Knope, 2019). However, the incident highlighted what could be interpreted as a fading appreciation of the Terminal by policymakers. This view has been corroborated in our research by bureaucrats at three levels of government. Sources have commented in interviews and in friendly exchanges that beyond the inner cadre of businesses that use the Terminal, and a handful of people who think about food systems in their government work, the significance of a public wholesale food market in the mostly corporate global foodscape is not understood by many. Further, judging from the responses we have received from people to whom we have explained our research, many members of the public do not know that the institution exists, let alone see its contribution to the variety of fresh produce on Torontonian's plates. Nevertheless, our empirical research at the Terminal leads to the conclusion that it has an important role in supporting the part of the food system called agriculture of the middle.

Framing the Terminal as Midscale: Agriculture of the Middle

The Terminal is best conceived of as a central node in a food system that serves agriculture of the middle. This term refers to producers who straddle the space between smaller, direct-sale alternative markets and commodity chains that serve the major supermarket chains (Lyson et al., 2008). Farms in this category produce volumes too high for the direct-marketing initiatives that have flourished through the alternative food movement but are not large enough to participate in global commodity markets (Bloom & Hinrichs, 2011a; De Master, 2018; Kirschenmann et al., 2008). There is concern that these midscale farms are disappearing (Stevenson et al., 2011). While there are many reasons to explain the diminishing number, some factors relate to major supermarket chains and supply chains. The global produce supply chains, led by these supermarkets, require agricultural systems that can meet their scale and time requirements.

We know that midsized and small-scale Canadian farmers have long faced marketing and distribution challenges (Beckie et al., 2012; Rosol & Barbosa, 2021; Cole et al., 2022). Midsized farms lack the volume to supply major supermarket chains year-round, so even stores located in areas where there is locally grown produce in season, the major chains are not able or allowed to stock produce from their area (Cole et al., 2022; Hasdell et al., 2020). These major supermarket chains expect long-term contracts committing farmers to produce a certain amount of produce for a certain price over an agreed-upon period. The major supermarket buyers typically do not want to contract with many small farms and prefer to buy from a few that can meet their specifications (Elton, 2010; MacCallum et al., 2014). Also, midscale farms often do not have technological investments such as in-field cooling equipment that lengthen the lifespan of produce, facilitating long distance transit (Brislen, 2018; MacCallum et al., 2014). This privileges large-scale producers (Bloom & Hinrichs, 2011a; MacCallum et al., 2014) and shrinks market opportunities for midsized farms. Even if mid- and small-scale farmers have the capacity to produce for major supermarket chains, MaCallum et al. (2014) found in their study of a major Canadian supermarket that the company's purchasing requirements for volume and quality were challenging for the farms outside their conventional, long-distance supply chains.

Agriculture of the middle is an important component of a regional food system, contributing to both rural (Jablonski & Schmit, 2015) and urban communities by enabling a marketplace that exists outside of the ones dominated by major supermarket chains. Such farms often are part of a network of regional businesses from companies that supply farm equipment to the kinds of retail establishments that frequent the Terminal (Elton, 2013; Kirschenmann et al., 2008). The observed benefits of the wholesale food markets that serve farmers who count as agriculture of the middle, as well as smaller farmers, are so significant that organizations such as the FAO promote agriculture of the middle as a strategy to help countries in the Global South build food security, protect ecosystems, and generate wealth in local economies (FAO, 2024). There is a similar emphasis placed on wholesale food markets (FAO, 2020). Also, states in Europe and Asia currently are investing in and modernizing wholesale food markets, such as Simummuang Market in Thailand (Laotian Times, 2024) and Paris's Rungis market, where management is investing millions of euros into the institution (ActuParis, 2024). As one European interview participant who works in the sector noted, "It is the moment for the wholesale food market."

Stahlbrand (2016, 2018, 2019) builds on the concept of agriculture of the middle and coins the term "infrastructure of the middle" to characterize the necessary infrastructure to support a midscale food system. This includes logistics operations, warehouse facilities, and commercial relationships connecting different parts of the food system. According to Stahlbrand, what she calls "food hubs" are key to infrastructure of the middle. These are described as "warehouses, loading docks, processing facilities and meeting spaces" (Stahlbrand, 2016, p. 38). While food hubs in the current discourse are framed as community-based, grassroots organizations (Blay-Palmer et al., 2013), they have much in common with the Ontario Food Terminal's infrastructure. That is, the Terminal provides the kind of midscale infrastructure, connecting a diversity of actors and providing services such as warehouse space and cooling, that has been identified as key to remedying problems of conventional supply chains (Marsden, 2012). Thus, within the consolidated supermarket context of the Canadian retail landscape, we will now explore how the Terminal supports both agriculture of the middle and a diverse retail landscape—retail of the middle. This provides a midscale market for Ontario produce farmers of the province's agriculture of the middle. It also widens neighborhood access to fresh produce.

A Marketplace for Midscale Ontario Farmers

There are two distinct purchasing areas at the Terminal: the main building, where the wholesale tenants are located, and an outdoor area, covered by a parking arcade known as the farmers' market (see Figure 1). Farmers bring their produce to the farmers' market to sell directly to the range of Terminal buyers, alongside dealers in Ontario pro-

duce. During the local growing season, the area is packed with produce grown in the province. We documented 46 different kinds of fruit and vegetables on display (see Table 1).

There are potted flowers for sale and, in the spring, seedlings to be sold to home gardeners. From late fall through the winter we observed storage crops for sale such as carrots and potatoes as well a greenhouse production. In 2012, one study estimated that 30-40 %of produce sold at the Terminal was grown in Ontario (Coutu et al., 2012). In the Terminal's 2022–2023 annual report, it was estimated that "the volume of produce distributed annually through the Terminal is nearly 2 billion pounds and there are approximately 400 different varieties of produce" (Ontario Food Terminal Board, 2023, p. 3.). Terminal staff told our researchers that this number is estimated to be 2.11 billion pounds in 2023–2024. They estimate the quantity of food based on truck activity. Facilities provided to farmers who sell direct include the opportunity to rent space in the cooling rooms and place to sell from at the farmers' market.

What we learned by documenting the farmers who sell direct at the Terminal is that the postal codes of 87 % of the farms that sell direct are within in a 200 kilometer drive (124 miles) (see Figure 2).

The farms are of varying sizes. For example, one farmer we interviewed cultivates 600 acres while another cultivates 200 acres of produce. In 2016, the average area dedicated to field vegetables in the province was 135,420 (Statistics Canada, 2017). In peak season, midsize Ontario farms can provide large volumes of produce and need buyers—which was one motivation for building the wholesale food market in 1954. Interviewees reported that the diversity of buyers at the Terminal acts as a sales security net for the farmers, whereby their fruits and vegetables are assured a buyer. One farmer who sells at the Terminal, a country market, and their on-farm market, described the Terminal demand as a weekly cycle: "We go to the Terminal two days a week. Strategically on the days that, over the years, people have come the heaviest to the market. Thursday because they are stocking up for the weekend. And Tuesday because they are stocking up on whatever they sold on the weekend."

Also, participants reported that the Terminal market facilitates long-standing relationships. The farmers, dealers, wholesalers, and buyers at the Terminal we spoke with underlined the importance of these relationships mediated by the facility. One

Table 1. The Different Fruits and Vegetables, Grown in Ontario, That Were Documented as Being for Sale at the Ontario Food Terminal Farmers' Market During Five Site Visits in June–August 2022 and in October 2024

Apples	Eggplant	Peach
Asparagus	Endive	Kale (multiple varieties)
Beets	Escarole	Pears
Bell Pepper	Fenugreek (methi)	Peppers
Broccoli	Garlic	Plum
Cabbage (red, green)	Ginger	Potatoes
Carrots	Grapes	Radish
Cauliflower	Green Beans	Rapini
Chard	Kohlrabi	Raspberries
Chilli peppers	Leeks	Squash (multiple varieties)
Cilantro	Lettuce (multiple varieties)	Strawberries
Collard greens	Melon	Tomatoes
Cucumbers	Mushroom	Turnips
Daikon	Napa cabbage	Watermelon
Dandelion	Onion	Other: Eggs, apple cider, maple syrup, flowers, potted herbs and potted plants
Dill	Parsley (flat and curly leaf)	

grocer, whose family business relied on the Terminal for decades, said: "You know the people that you've been dealing with the past twenty, thirty years. It's important. To me it's important because they *know* the kind of quality of products I want." In particular, he stressed that these relationships helped him through the challenging times at the start of the pandemic. These relationships reach out from the Terminal into smaller communities as described by one wholesaler we spoke to: "I buy produce for customers who aren't as close to the city, so I'm kind of like a third-party buyer. Meaning if you would own a grocery store out of town, you would contact me and I would buy on behalf of you. So I provide that service for them." In this way the Terminal facilitates a plurality of business relationships connecting farms with a range of buyers (see Figure 1).

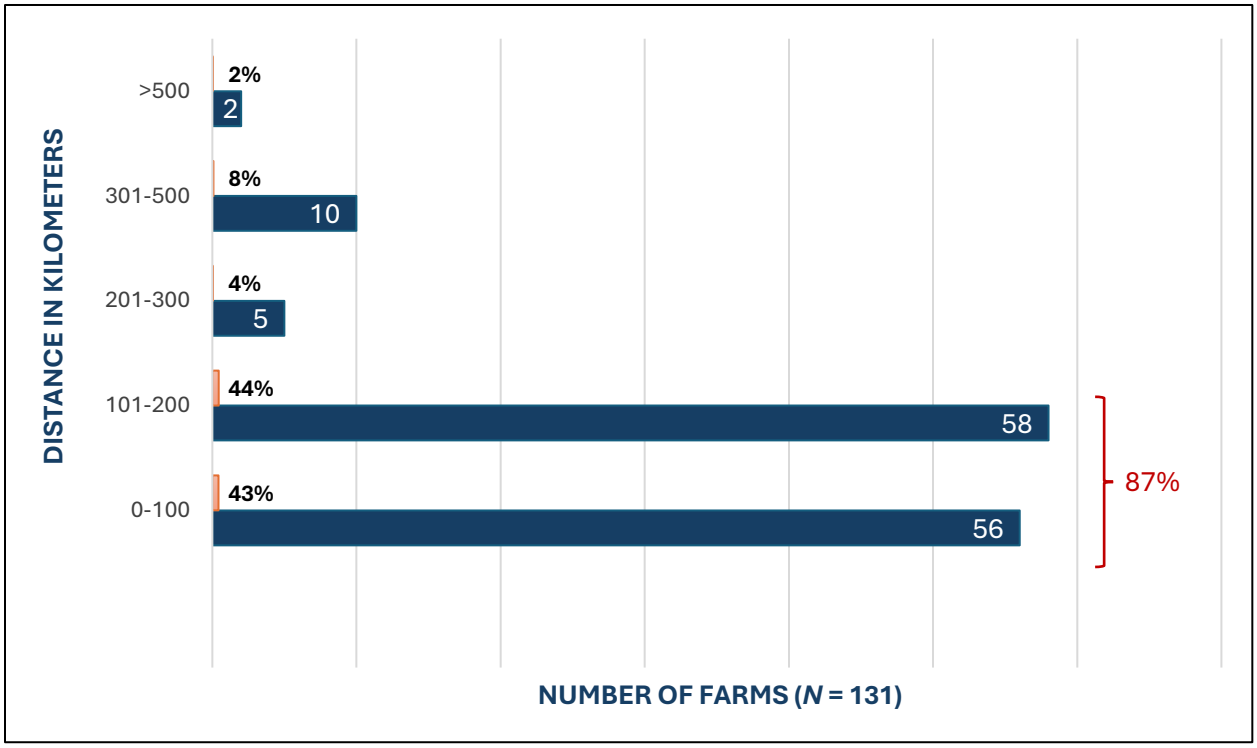
In interviews, farmers compared selling into the major supermarket supply chains versus selling to Terminal buyers. Firstly, they characterized their relationships with Terminal buyers as being more secure than those with the major chain supermarkets. One farmer described how they sold between 15-20% of their crops at the Terminal, with most of their products going to the three large Canadian major chain supermarkets. While the Terminal did not represent the majority of their sales, they stressed the importance the institution played in providing a steady, loyal customer base. This farmer said:

> The people that buy from the Terminal are the stores that I personally would rather shop at. They're local stores that buy their few skids a week. But they pay right away. They want quality. They want to know where it's coming from.

They saw major chain supermarkets as inferior clients:

> You can't do it without relying on the chain stores just because of the volume that they take. They pretend they're all about loyalty and local and supporting the farmer and blah,

Figure 2. Driving Distance Between Postal Code of Farms that Sell Direct at the Terminal's Farmers' Market and the Ontario Food Terminal in Toronto, as Calculated by Google Maps



> blah, blah, blah. . . . You can get promises [from major chain supermarkets] at the start of the year. "We'll take this volume of your crop." And then stuff happens and they get it cheaper from who knows where, or maybe demand isn't there. Then all of a sudden, "Yeah, sorry, all that stuff we were going to take from you, we don't need that." And, yeah, it's hard.

This quote highlights the importance to farmers of having many possible buyers for farm produce, rather than having to rely on one big buyer. When a major chain supermarket buyer chooses not to buy what they had previously "promised" to purchase, the farmer needs another buyer, and quickly because produce has a short shelf life. Major chain supermarkets have many options for sourcing, such as strawberries from California when Ontario ones are ripening, and do not necessarily purchase Ontario crops at harvest time (Elton, 2010). Conversely, participants explained that the Terminal provides a steady source of sales for farmers during the few months of the year when Ontario produce must move quickly from field to plate. This is possible because every day, a range of buyers arrive at the Terminal with varying needs. If one buyer does not need the broccoli that an Ontario farmer has harvested, there are many possible buyers including a range of independent grocers from Toronto, further afield in Ontario and the Atlantic provinces, as well as small-time wholesalers who sell to restaurants and grocers, flea market sellers, mobile produce vendors, food banks, and food service including restaurants, caterers, and institutional food buyers. Thus, one farm dealer described the Terminal in terms of business protection:

> Well, it's like a safety valve actually for the farmers. See, like my farmer. He goes to the chain [and has] extra stuff, which is like 20 percent [of his harvest]. What are you going to do with it? So you ship it here to the market. If you don't have no default terminal—you know how hard it is to go from store to store to try to sell? You show up at the store with the truck and you want to sell? They think you're desperate and they'll kill you on the price. Meantime, here you got a few thousand buyers.

That said, the Terminal does not guarantee sales. Another farmer who chooses not to market to major chain supermarkets reported that they often did not sell everything they bring to the Terminal in a day. This led their farm to start a farm store on their property where they move unsold produce.

The Terminal also serves midscale Ontario farms by creating a marketplace for produce dealers who specialize in local product. Dealers bring produce from farmers who do not want to—or cannot—invest in the infrastructure and labor needed to travel there themselves. Our team has tried to enumerate all the farms that sell at the Terminal, including through dealers. We were unable to complete this task, however, because dealers often have informal buying relationships with many different farms. One dealer addressed these informal connections:

> There's [someone] always popping up. Somebody comes in. Like some brokers even dropped those tomatoes over there. They came in, the guy needed help. He said, Could you sell them? So we took from him. . . . It's like I buy from these friends, but I also buy from that guy and he buys from these farms. It's like a Russian doll that never ends. . . . I would say 90 percent of the [fruit and vegetable] farmers from Ontario come to the Terminal, directly or indirectly.

This quote illustrates the business networks that branch out from the Terminal.

That the Terminal supports agriculture of the middle is not only significant for the farms themselves. There are food systems benefits. Kirschenmann et al. (2008) find that midscale farms play a distinct role in the food system. Firstly, they can be "flexible and innovative" (p. 8). Secondly, they fill a niche between the smaller direct sales operations, that can only produce so much food, and the larger farms servicing major chain supermarkets. This flexibility and position in the system was observed

in our research. In the first phase of this study, we documented the resilience of people at the Terminal as they rapidly adapted to the emerging pandemic (Elton, 2023; Elton et al., 2023). In early spring 2020, farmers had to decide what to plant that summer. One farmer described shifting his planting to serve grocery customers and away from the restaurant clients whose businesses were not operating due to the lockdown. This nimbleness was possible in part due to the size of his operation and the fact that he had close relationships with his clients through the Terminal. Thus, a diverse intermediary and retail landscape provides protection and flexibility for farmers. This is particularly important given the heightened risks of climate unpredictability and current labor shortages.

There is a range of small and midscale businesses at the Terminal. Warehouse tenants have held leases for many years, and independent produce wholesalers outside of the institution expressed frustration in interviews because they could not get procure leases at the Terminal. It is easier to gain access to the Farmers' Market. Farmers who want to sell direct there must demonstrate that they are a veritable farm and then can rent space from the Terminal board on a daily, semi-annual, or annual basis. It was reported to our study that no farmer has ever been turned away from renting space at the Farmers' Market. We met numerous people who were second and even third generation in their family businesses, both farms and farm dealers. But not all businesses were surviving. In the summer of 2023, the word at the Terminal was that numerous Ontario farmers had decided to retire and sell their property, as land value continues to increase and the profitability of small and midscale farming around the Greater Toronto Area (GTA) is in jeopardy. When confirming postal codes for the Ontario farms selling directly at the Terminal, we came across several farmers' obituaries from the last few years and struck their farms from our list of farmers. The dealers who source produce direct from regional farms and sell it at the Terminal's farmers market, with whom we spoke, had noticed a similar trend. They explained having to source more produce from the neighboring province of Quebec, which is hundreds of kilometers further afield than the Ontario farms.

A Diverse Retail Landscape for Fruits and Vegetables

The Ontario Food Terminal has shaped Toronto's foodscape by providing independent retailers with access to a diversity of wholesale and farm sellers (Friedmann, 2014). Any business looking to source produce can pay CA$275 for a two-year pass to enter the marketplace and buy food. It is repeated often in Toronto, including during interviews, that independent grocery retailers would not exist without the institution. While this may sound like hyperbole, our research at least partly substantiates this claim. As we have described, the Terminal offers buyers access to a variety of wholesalers and farmers. There, buyers can choose what quality and quantity of specific products they wish to buy at a price they negotiate with whichever of the sellers they prefer to do business with. It is not only brick-and-mortar retailers that use the Terminal. Companies that sell food to the public through online platforms, we were told in interviews, also source produce there. One example provided to us by a former wholesale house employee was the online business arm of a major chain supermarket that sells groceries to consumers via a website. This digital company had ordered oranges from the wholesale house rather than from the supply chains of their own parent company, the major chain supermarket. This company came to the Terminal for the oranges, it was explained, because produce purchased at the wholesale house could be easily trucked to a local company that would then break down a crate into small bundles, suitable for direct delivery to their online consumers' homes by the digital grocer's trucks.

The fact that the Terminal provides wholesale access to a diversity of small and midsized businesses is not unique to the Terminal among wholesale food markets. These institutions in Europe, for example, are known to provide key services to smaller businesses such as storing produce, especially chilled products, when independent retailers may not have space on their premises to do this in bulk (Cadilhon et al., 2003). Wholesale markets also perform what is called "de-bulking." That is, the wholesalers at the Terminal buy in bulk, such

as by the truckload, and then break down these units into pallets or half-pallets that smaller retailers can manage. One dealer who sells food from the Terminal outside of Toronto, who participated in the study, described the cost-advantage of this process: "I've got multiple customers. So the more buying power you have, the cheaper the commodity is. Whether my customer is buying 200 cases of bananas, or whether somebody's buying 10, usually that person's that's buying 10 would feel the benefit of getting that large volume price."

These services, facilitated by the existence of the public infrastructure that is the Terminal, enable a range of businesses to operate in the foodscape. We define them in three categories:

1. In addition to the major supermarket chains, the Toronto foodscape is characterized by small and midsized independent grocers and larger independent supermarkets catering to a variety of cuisines that some people in the industry call "ethnic supermarkets" (Kwon, 2013). Across the city, in high-income communities as well as in low-income enclaves, these independent grocers operate alongside the major supermarket chains. There is no local vernacular for the smallest scale of independents. They are a made-in-Toronto version of New York City's bodega or Montreal's *dépanneur*. The produce sold is a mixture of locally grown and international imports. They typically source from the Terminal either themselves or through an intermediary. Starting in May, when the first Ontario field crops like asparagus are ready, it can be easier to find local produce at these small grocers than at the major supermarket chains. Produce is the focus of these stores, but they often sell a limited selection of shelf-stable products.

2. The Terminal also supplies large independent grocers. Over the last 20 years, there has been a rise in the wider Toronto area of 'ethnocultural' supermarkets (Kwon, 2013). This includes large-scale grocers servicing Asian cuisines and other non-Euro Western foodways. These stores sell a wide range of products beyond fruit and vegetables, including meats, dairy and cooking equipment. Many stores, including ones where we conducted field observations, cater not to one cuisine but to many. Thus, customers can find fresh banana flowers from Vietnam sold alongside moringa from the Caribbean. Our team's research has found that many of these independent grocers source produce from the Terminal; parallel supply chains for produce grown in regions closer to the equator that do not operate through the Terminal also supply them with culturally specific produce.

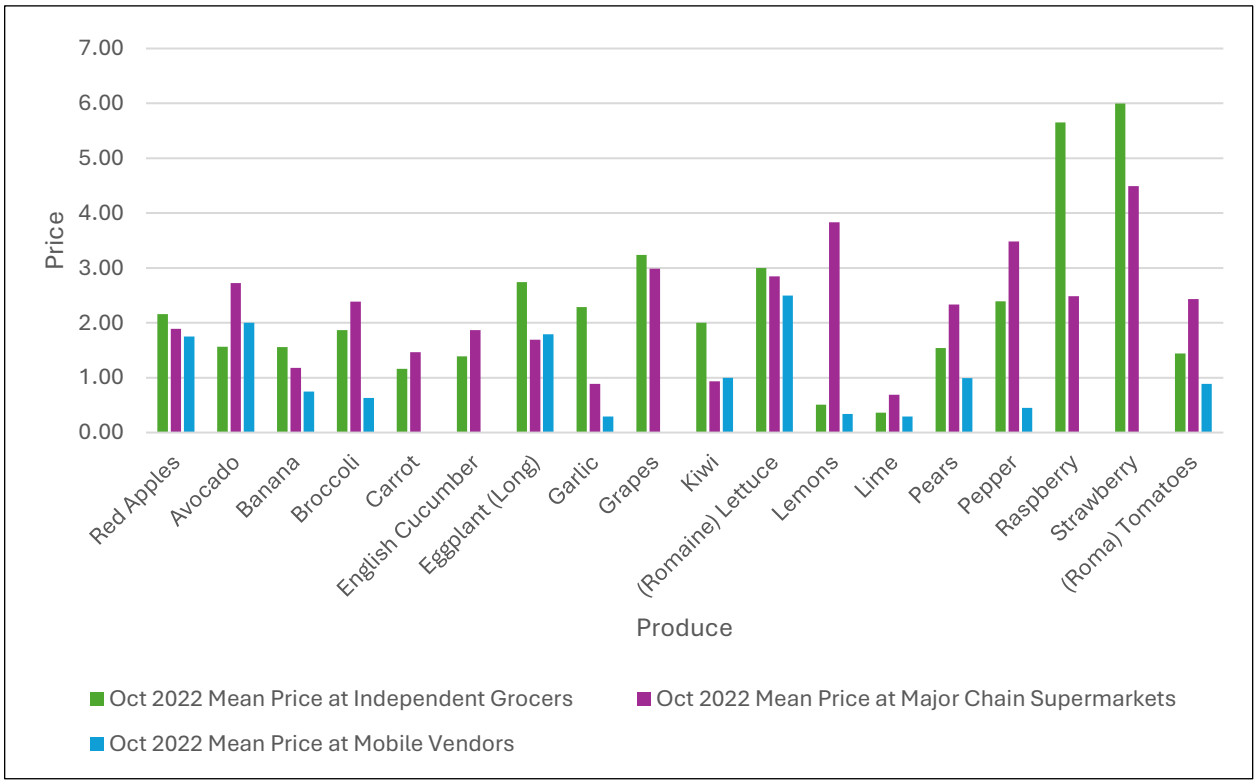
3. Other retail businesses that source at the Terminal include food delivery boxes (ordered online as part of the consumer trend toward digital procurement, as described above), flea markets, and farm-stand sellers, as well as mobile produce vendors who sell from their trucks in low-income neighborhoods and mosque parking lots. Restaurants, catering, other food service companies, and institutions also source there.

By following the produce down the retail supply chain, we have tracked where Terminal produce ends up. This confirmed that the Terminal is a main source of produce at the non-major supermarket chain establishments we studied. While there are numerous independent wholesalers in the city that do not hold leases at the Terminal and operate independently, the public institution plays a significant role in supplying retailers. In the words of one produce buyer for an independent grocer, the Terminal is "Number one. Why? Because every single thing I need is available there." This stands in contrast to other Canadian cities that lack a public wholesale food market. In 2023, when food prices rose in Canada, the Competition Bureau (a federal Canadian law enforcement agency promoting competition in business) released a report calling for increased retail competition to mediate price increases by the major chain supermarkets that dominate the industry (Competition Bureau of Canada, 2023). It noted that across Canada, "Many independents have to buy groceries from their competitors. Unlike the grocery giants, most independents are not big enough to have their own warehouses or to buy directly from suppliers.

Instead, many of them buy the grocery products they sell from the likes of Loblaws and Sobeys, which in addition to their retail stores, also have large wholesale businesses. According to independents, this dependency makes it more difficult for them to compete on price" (p. 16). This is not the case for produce in Toronto. Montreal is another large Canadian city with a wholesale produce sales facility, with roots traced to the city's public market founded in 1847. However, La Place des Producteurs differs from the Toronto Terminal in that it is owned by a Quebecois wholesale company in partnership with the Quebec Produce Growers Association. Independent grocers who source at the Ontario Food Terminal or La Place des Producteurs in Montreal have access to these other supply chains and therefore do not rely on the major chain supermarkets, which is not the case in many Canadian cities. While we focused specifically on produce and not on groceries in general, our research demonstrates how the Terminal provides wholesale access to precisely those retailers identified in the Competition Bureau's report— those who do not operate the scale of business with warehouses or direct supply connections to farmers. In this way, the Terminal shapes the retail foodscape in Toronto and region by providing smaller players with a market to buy produce.

We also looked at retail prices and found the independent sector that we describe here to be competitive on price with the major chain supermarkets. Over the last quarter of 2022 (October to December), we assembled listed price data for 18 fresh fruits and vegetables sold at three independent grocers located on main streets in two lower-income neighbourhoods in Toronto, two major chain supermarkets' discount stores, and three mobile vendors operating in lower-income neighborhoods. Of the 13 products with complete October data for all three food distributor types, the mean prices for 10 products were lowest at the mobile vendors; two were lowest at the major chain supermarkets; and one was lowest at the independent grocers (see Figure 3). For data availa-

Figure 3. Mean Food Prices for 18 Fruits and Vegetables Sold at Major Chain Supermarkets, Independent Grocers, and Mobile Vendors in Toronto in October 2022



bility reasons across the three months of the quarter, we could only compare independent grocers and major chain supermarkets. For the entire quarter, an equal number of nine products had lower mean prices for each type of store.

From our analyses, we conclude that the diversity of businesses selling fresh produce from the Ontario Food Terminal widens neighborhood access to fruits and vegetables in important ways. Osorio et al. (2013) posit that higher-income communities are more likely to have better access to high-quality, nutritious, affordable food than lower-income communities. We found a different scenario in Toronto, where the Terminal supplies a diversity of retail establishments in a lower-income area. In following Terminal supply chains into the community to understand where produce was sold, the research focused on the east side of Toronto, including the inner suburb of Scarborough. The average household income in this area is 82% of the city average (CA$99,600 of CA$121,200; see City of TO [2024]). In Scarborough, there are 150 independent grocers as documented in a Google map (Alawi, 2024) that was produced by the Scarborough Environmental Association. Research assistants on our team conducted regular site visits to several of the small grocers on this map. Not only did grocers sell food from the Terminal, but we also found that these independent supermarkets and grocers offered a wide variety of culturally significant fruits and vegetables. The stores cater to the cuisines of people living in the area by selling items not typically found in major supermarket chains. The products we found for sale in these stores, but not at major chain supermarkets included amla, curry leaf, and a range of varieties of fresh beans from South Asia.

It was not possible to ascertain how much of this culturally significant produce came via the Terminal. Store owners are reticent to share information. Shipping tags on produce boxes identified the origin of the produce, yet it was often unclear which hands these boxes passed through. Still, it was confirmed by those who did speak with our team that the grocers sourced at least some of their produce from the Terminal. Further, at the Terminal we frequently saw trucks bearing the names of independent Scarborough grocery stores that were picking up produce. That these grocers cater to diverse cultural groups is important. Other research has found that grocers that cater specifically to 'ethno-cultural' communities are better able to serve their needs than major chain supermarkets (Bégin & Sharma, 2018; Komakech & Jackson 2016; Mankekar, 2002; Perry et al., 2020). Thus, not only does the Terminal support a retail foodscape of independent businesses, but in Scarborough, it also serves the community's food needs. In this way, the Terminal supports retail of the middle.

Concluding Discussion

The way the Ontario Food Terminal operates illustrates the role that public food system infrastructure can play, strengthening both agricultural and retail of the middle and promoting a diverse 21st century urban foodscape. Specifically, the role of such public infrastructure should be considered in the building of circular food economies. Jurgilevich et al. (2016) write that a "circular economy regarding the food system implies reducing the amount of waste generated in the food system, re-use of food, utilization of by-products and food waste, nutrient recycling, and changes in diet toward more diverse and more efficient food patterns" (p. 2). The role the Ontario Food Terminal plays in the food system elucidates what a wholesale food terminal can do in a region. These characteristics inform what kind of institutions might support a circular food economy and should be considered by policymakers.

As we see in Toronto, the Ontario Food Terminal makes space for many actors in the food system. It is an inclusive marketplace where small- and medium-scale food system actors have a chance to do business. The Terminal houses a wide group of intermediaries, buyers, and sellers that, our research has found, channel produce from farm to consumers via a network of independent retail grocery enterprises. The Terminal enables a multiplicity of businesses, from microentrepreneurs to intergenerational independent grocery chain businesses, to operate in the grocery retail sector. Competition between a number of businesses, rather than a consolidated marketplace, has been identified by the Canadian Competition Bureau as

an important feature of a food system. The 2023 report by the Canadian Competition Bureau noted that "it can be difficult for small and medium-sized businesses to compete effectively against Canada's grocery giants" (p. 3). The Terminal counters this trend by supporting the independents in the region.

Also, the wholesale food market enables key food system processes to happen outside of the major supermarket chains. The Terminal serves as a physical marketplace where midscale sellers and buyers do business. It offers services such as cooling facilities that can be rented, and space where truckloads, crates and pallets of produce can be broken down into smaller units so that retail actors of all sizes can purchase only what they need for their businesses. Further, as our data illustrate, the institution supports business relationships between a variety of parties. As we have shown, these business networks provide security for midscale Ontario farms with reassurance that their produce will likely be sold. Baritaux and Billion (2016) provide an in-depth look at the roles intermediaries play in the food system, emphasizing this sector's relevance to system-level resilience. They position wholesalers and distributors as having a unique role in mediating between small and medium agricultural producers and retailers of various sizes; certainly, the Terminal plays this role. Then, when food leaves the Terminal, we have documented how prices at the independent grocers where we recorded price data are competitive with the major supermarket chains' discount stores. These data demonstrate the benefits of a public wholesale food market.

Toronto's wholesale food market thus provides institutional support to a regional food system that provides consumers with an alternative to the consolidated major supermarket chains. This model holds promise for community-driven circular economies, as it provides a time-tested institutional model that could be incorporated in the redesign of unilinear supply chains into circular ones. The public investment in this institution was made more than 70 years ago. At the very least, this legacy infrastructure should be investigated further as a component of territorial food systems generally and circular ones specifically.

We do not argue that the Ontario Food Terminal is perfect. Participants have pointed out problems, such as how it is almost impossible for a newcomer to obtain a lease for the wholesale facilities. There has been consolidation in the wholesale sector, too, as companies operating out of the Terminal have consolidated over the years. Also, the Ontario supply chains that produce food for the Terminal may be regional, but labor is international. Agricultural guest workers are flown in annually to do the hard work of actually growing the vegetables, and this program was deemed highly exploitative by the United Nation Special Rapporteur (Obokata, 2024). However, faults in the system do not mean the institution has failed, nor the wholesale food market model. Evidently, it can be improved upon with appropriate food system governance.

Our analysis makes visible the benefits of the public wholesale Ontario Food Terminal. We trust it can inspire other jurisdictions to consider the role of public wholesale food markets in boosting the resilience of regional food systems. Given the limited public appreciation for wholesale food markets, it is important to enact protective measures that allow these wholesale food markets to continue operating, and to consider the food system factors that allow them to thrive and invest in those as well.

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Co-creative rapid assessment for actionable circular food systems

SPECIAL ISSUE
Community-Based Circular Food Systems

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Abstract

This paper focuses on the use of rapid assessments for local food systems in eight African cities (Bamenda, Cameroon; Franceville, Gabon; Ibadan, Nigeria; Lagos, Nigeria; Moyamba, Sierra Leone; Nairobi and Nakuru, Kenya; and Tamale, Ghana). The INCiTiS-FOOD project (INtegrated and Circular Technologies for Sustainable city region FOOD systems in Africa) conducted a food systems assessment using a bottom-up and living lab approach to gain insights into the local potential for circular technologies centered around aquaponics, hydroponics, and insect farming. The findings allowed us to define a strategic direction and highlights the need for more fish and locally grown indigenous vegetables, as access to these disciplines has been limited by a lack of knowledge facilities and finances. We learned that co-creative rapid

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assessments are a promising method to raise awareness of the specific opportunities, challenges, and bottlenecks in the community, and to align the local community with actionable food system transformation.

Keywords
aquaponics, fish, food production, healthy food consumption, African food systems, hydroponics, insect farming, rapid assessment, re-circular aquacultural systems (RAS), vegetables

Introduction

The INtegrated and Circular Technologies for Sustainable city region FOOD systems in Africa project (INCiTis-Food) establishes city region food living labs for circular technologies centered around aquaponics, hydroponics, and insect farming (https://incitis-food.eu/). These are located in eight African cities (Bamenda, Cameroon; Franceville, Gabon; Ibadan, Nigeria; Lagos, Nigeria; Moyamba, Sierra Leone; Nairobi and Nakuru, Kenya; and Tamale, Ghana) in close relationship with academic competence centers to address local food system challenges. These challenges encompass environmental degradation (Subramaniam & Masron, 2021), the need for food security in a growing population (Riggs et al., 2018), and health-related concerns (Lindgren et al., 2018). There is insufficient evidence on the level of peri-urban food region to support the wider use of circular technologies as a response to unmet community needs in food systems (Carey, 2017; Deconinck et al., 2021; Fanzo et al., 2020, Galea et al., 2019). We addressed this gap with a co-creative rapid assessment. The main research question of this paper is whether the use of co-creative rapid assessment approaches can contribute to the strategic direction of consumption and production systems in the community, and whether the assessment approaches provide sufficiently reliable information to guide living labs engaging in local food systems transformation. Living labs are a relatively new scientific research approach. They are based on open innovation ecosystems and user-centric needs evaluations. They are a systemic co-creation process in real-life communities (Higgins et al., 2011) and have, therefore, similarities with rapid assessment. The use of co-creative rapid assessment provides an efficient way of rapidly collecting information about a community's direction, paired with a mechanism to support innovative engagement and innovation to support the establishment of community-based living labs.

Literature Review

The use of rapid assessments for food systems was first suggested by Borman et al. (2022) as a response to the 2021 UN food systems summit. Rapid assessment refers to a quick and efficient process of evaluating a situation, condition, or environment to gather essential information and make informed decisions. Rapid assessment methodology is based on expert opinions rather than sample surveys. Recently, it was applied to minimize the impact of environmental disruptions (Legge et al., 2022), to evaluate the effect of COVID-19 on African seed sectors (de Boef et al., 2021; Villasante et al., 2021), to formulate a national response to pollution (Royle et al., 2022), and for evaluating development programs (Pearson & Kessler, 1992).

Rapid assessment is a mixed methods approach; in our case, it combines expert elicitation (Brown, 1968; Dalkey & Helmer, 1963; Linstone & Turoff, 1975; Sackman, 1974), opinion ratings (Likert, 1932), visualization via heat maps (Food Systems Dashboard, 2023) and focus group discussions. Tsusaka et al. (2015) successfully showed that expert elicitation results regarding agricultural technology adoption were better suited and more precise than data obtained from household studies for strategic decision-making. Rapid assessment is a cost-effective and time-efficient approach (Pearson & Kessler, 1992); however, it requires a lot of care and preparation in the use of different qualitative and quantitative tools (Cernea, 1992). Rapid assessment methodology is considered suitable for building alliances between community groups (Stimson et.al., 2009). The drawbacks are the lack of a supportive decision-making apparatus (Pearson & Kessler, 1992) and that rapid assessment might lead to premature decision-making regarding short- and long-term objectives, for example, balancing economic profit versus health aspects (Varker et

al., 2015). Rapid assessments are prone to cultural and political bias as well as anchoring. The results are usually of little use for long-term programs such as disease control or global food safety (Guha-Sapir, 1991), but they are important for living lab approaches that start directly from practice without an initial research phase (Gu et al., 2021; Herrero et al., 2020).

Applied Research Methods

The Rapid Actionable Food Systems Assessment bases its approach on the work of Carey (2017), van Berkum et.al. (2018), Borman et al. (2022), and de Boef et al. (2021). It uses a mixed method approach combining expert elicitation, surveying, and visualization of opinions via heat maps (Food Systems Dashboard, 2023), followed by focus group discussions (Kraaijvanger et al., 2016; Tregear et al., 1998) to produce actionable results on a community level. It follows the steps of a value chain assessment (de Boef et al., 2021) including:

(1) a definition of the boundaries and the institutional setting, based on urban or value chain–based food systems approaches,
(2) identification of an expert and practitioner hybrid panel for the development and completion of a rapid assessment questionnaire,
(3) and visualization and discussion of results and validation of focus areas in focus group discussions.

This method was considered economically feasible and timely for the project, which required the delivery of results in just 6 months to inform the strategy of the living labs.

Step 1: Questionnaire

In the first step, we used Carey's (2017) indicators for city region food systems evaluations to formulate the questionnaire for actionable food systems. Carey defined a dataset of local food systems indicators with the purpose to inform local policymakers on the performance of the local food system. The dataset requires the collection and monitoring of four categories of data on accessing healthy food and nutrition, improving social conditions of the workforce, building a local food culture, and creating parameters for an equitable food system for citizens from various backgrounds. A specifically formed panel of experts and practitioners then discussed the questions and agreed on the questionnaire. (The full questionnaire is in the Appendix.) Carey's urban food systems evaluation was targeted at policymakers and assumed access to city region household-level data and health data, which had not been available in the INCiTiS cities, or the local experts had ruled out cooperation with public authorities to get this information. It was also unclear whether available household, industry, and health data would provide a sufficiently reliable picture of the local situation after the pandemic. Therefore, questions were reformulated for this study and rated based on expert opinions.

Step 2: Panel

We used van Berkum's (2018) food systems actor framework to identify local stakeholders for the expert and practitioner panel. This framework helped us to address a predefined number of topics in health, nutrition, trade, and industry relevant to food security and provided insight on the trade-offs with other policy objectives. It also identified various vulnerabilities in the food system and their impact on resilience to climate change (van Berkum, 2018). Finally, the extension of this framework toward gender-related vulnerabilities and empowerment (McDougall, 2021) made our approach fit for purpose. We added expertise where the stakeholder framework fell short; specifically, the project defined specific objectives, such as inclusiveness (Osorio et al., 2019) and examined market potential for fish, insects and vegetables. The hybrid expert-and-practitioner panel was formed from local representatives. It comprised 97 members from the eight cities. Three cities participated online from in-person meetings of 25 participants each. A minimum of six people from each stakeholder group were included in the panel, allowing for an adequate degree of representation in access to nutritious food, gender, policy, consumer matters, aquaculture, hydroponics, and insect farming as well as upstream and downstream

value chain representation. A particular effort was made to increase the number of women and young people in the panel through local and international nongovernmental organizations (NGOs) and associations such as Women Engage for a Common Future and Youth for Development. Participants used Miro boards, responded to online polls, and were provided the opportunity for reflection in the panel on provided inputs and specific research questions.

The panel met for the first time in May 2023 to agree on a questionnaire to inform the living labs. It then met again in July to discuss the answers, clarify outcomes, and define actions to influence the local community food systems. In the discussion of the questionnaire, the expert panel considered it imperative to collect additional information reflecting the informal economy. Therefore, additional responses from consumers and retailers at three different markets (one each in a high-income neighborhood, middle-income neighborhood, and low-income neighborhood) were collected by students from the participating universities. This increased the number of questions from 20 to 80 questions, making it necessary to introduce skip logic to direct questions toward the most relevant respondent groups, so that none of the respondents had to answer more than 20 questions.

Step 3: Answering the Questionnaire (Rating Opinions)

Following the input from the expert panel, the questionnaire was finalized and disseminated through snowballing to include more food systems stakeholders and capture their views on the current situation in the city. Again, it is important to state that the aim was to agree on strategic actions, and not to sample representatively. Bias was mitigated by balancing the respondents according to the previously defined stakeholder groups and taking weighted averages per stakeholder group in the response rates. The survey was coded with Kobo Toolbox software using skip logic, so that none of the respondents needed to answer more than 20 of the 80 questions. Responses would otherwise have been too low, or the survey would have exceeded the capacity of the local internet, making it impossible for people to answer the questions. The students collecting additional responses received training, guidance, and information on the food system analysis methodology and the survey from the leading organization Wageningen University and Research and its local project partners. The survey was also promoted through social media posts and was accessible through an online link, which respondents could fill out either on a smartphone or another device. Table 1 presents the number of total survey respondents.

Table 1. Survey Respondents

	BA	TA	NAK	IB	LA	MA	NAI	FR	Total
Consumers	36	17	19	60	23	16	22	5	197
Vendors	7	5	3	28	12	12	33	1	101
Researchers	4	19	19	7	2	8	5	3	65
Consumer organizations	2	5	3	0	0	8	0	0	18
Nongovernmental organizations (NGOs)	4	10	5	1	2	6	0	0	28
Farmer organizations	5	5	6	4	0	4	2	2	28
Governmental institutions	4	9	13	1	5	8	3	6	46
Input technology suppliers	0	10	1	1	1	5	0	1	18
Financial organizations	3	7	4	5	5	5	0	0	24
Processors	2	5	10	1	1	9	0	1	29
Total	67	92	83	108	51	81	65	19	554

BA = Bamenda, Cameroon; TA = Tamale, Ghana; NAK = Nakuru, Kenya; IB = Ibadan, Nigeria; LA = Lagos, Nigeria; MA = Mayomba, Sierra Leone; NAI =N airoby, Kenya; FR = Franceville, Gabon; NGO = Nongovernmental organization

Step 3: Visualization of Results from Survey Responses and Validation of Impact Areas Through Focus Group Discussion

The survey respondents rated the communities' food systems performance from *severely negative* to *highly positive* on a Likert scale from 1 to 5. Answering *neutral or not able to assess* was also one of the options. The information gathered was visualized in combined impact areas (Table 2) and heat maps. The heat maps showed the weighted average scores on a colored map using a traffic light system from red (very bad performance, challenging) to green (very good performance or opportunity) (Table 3). The indicators covered the ratings for several questions combined for different dimensions.

The heat maps showed color-coded scores defining the intensity of positive impact for each indicator and different stakeholder groups or sectors. Since respondents could also vote "I do not know," there were several blanks or research gaps in the results, which we noted as such.

The ratings in the survey ranged from 1 to 5, and the results used weighted averages. A higher number means that experts perceived the level of equality in the food system more positively. The empty cells mean that the Bamenda local team could not provide

Table 2. Impact Areas of INCiTiS-FOOD Systems (FS)

Impact areas	Indicators give insights into:
Socially sustainable FS	(1) Stakeholders' perception of **healthy diets** for all, with a focus on the overall ability of the city to provide healthy nutritious food for all. Answers have been integrated into four indicators: • accessibility • affordability • availability of healthy nutritious food to all • food security (2) **Food governance** as an enabler of FNS and channelling retail influences. They focus on policies and regulations to promote • health and well-being • equitable and just decision-making • accountability and monitoring • the health consequences from exposure to unsafe food (3) **Equitable outcomes** for • men and women • young people • consumers buying from informal markets
Environmentally sustainable FS	(1) **Protecting resources by reducing:** • food waste • recycling • food loss • hazard elimination (2) stakeholder's perception of the **effectiveness** of policies for: • environmental governance for circularity • stewardship of environmental resources
Economically sustainable FS	Opportunities for entrepreneurs and innovators regarding: (1) **Market potential** of new technologies in terms of • competition • access to inputs • supply and demand of produce (2) **Value chain development** in terms of • linkages and connectivity for addressing FS change • sustainable employment (3) **Decent jobs** with a focus on the quality of employment in terms of • equality • influence • inclusion and diversity • career opportunity • attractiveness of jobs • job security in the new production and business area (4) **Resilience and income** in terms of • access to knowledge • access to finance to overcome barriers and develop business models that secure an income.

information from input providers such as fertilizer manufacturers or aquaponics manufacturers. Empty cells are also a result of the skip logic used to reduce the number of answers per participants. For example, we did not ask consumer organisations about equal opportunities for farm employees. Experts could also make no ranking when they did not know.

Based on the outcomes of the survey, the supporting or contradicting literature, and the subsequent validation of the expert panel members, the team provided briefs on the performance of each city region's food system. To verify results, we used triangulation with national and international nutrition, household, and income studies such as national business studies (Business in Cameroon 2023), the Global Nutrition Report (2022), and World Bank (n.d.). The expert panel also submitted studies to support the survey results.

After evaluating the results together with the experts, the expert and practitioners panel met again in July to reflect on the results and to select the three most important impact areas per city. For those impact areas, actions were defined to enable a smooth integration of circular technologies into the city food region. The discussion groups could use a Miro board to outline their actions. The WR team summarized the responses and triangulated them with literature from general sources and sources provided by experts. The experts reviewed the responses and tried to interpret them. Together, we defined the three most important impact areas per city and discussed what actions the living labs should prioritize to ensure the successful introduction of circular technologies in their cities.

Results

Overall, the results from the rapid assessment showed potential for the introduction of aquaponics, hydroponics, and insect farming units in all communities. There was a clear need for more fish provided in all cities and an even greater need for indigenous or locally grown vegetables. While consumers and experts, particularly women, saw a greater need for vegetables, young people, men, producers, and retailers saw more economic potential in providing fish. Thus, the combination of both technologies would provide a better balance in the city food region. Lack of access to financial aid and educational and knowledge facilities in the region were perceived as the main bottlenecks to the introduction and access to high-quality jobs in these disciplines.[1]

Some results were more controversial. While

Table 3. Example Heat Map: Stakeholder Perception on Social Equity in Bamenda

	Consumer organizations	Farmer organizations	Financial organizations	Governmental institutions	Input/technology providers	Other NGOs	Processors	Producers	Researchers	Consumer rganizations	Traders, etc.	Vendors	Weighted average
Food safety						3.00	2.00	1.56	3.00	1.67			2.24
Inclusion		2.67	3.83	4.13		3.13	3.00	2.72	2.63	2.17		3.79	3.12
Infrastructure	2.50			4.00		4.25		3.58	3.50	2.33			3.36
Participation of women	2.50			2.00		3.00	3.50		3.50				2.90
Participation of youth	2.50	3.20	2.67	2.80		2.50		3.04	2.33		2.92		2.74
Presence of informal business	3.00										4.06		3.53
Processing							2.00	1.56		1.67			1.74
Production				3.00									3.00
Retail	2.75	3.08	3.83	3.43		3.19	3.25	2.77	3.19	3.67	3.49	3.41	3.28

The weighted average scores (1–5) are displayed using a traffic light system, with red (very bad performance, challenging) to green (very good performance or opportunity).

[1] The full results of the food systems assessment will be displayed after acceptance of the report by the European Commission at https://INCiTiS-Food.eu

prospects for young people were perceived negatively, particularly in Kenyan cities, young people in Tamale stated opposite expectations, opening a pathway for cross-community learning.

The following is a description of the selected impact areas and recommendations per city. Challenges, opportunities, bottlenecks, and research gaps were identified based on the survey results. The community-level experts and practitioners then selected certain challenges and opportunities and identified actions based on these results. They could also choose to work on research gaps when information was not provided, not known, or needed more elaboration. As this was a co-creation process, the authors did not draw conclusions but merely visualized and summarized results and reported actions agreed on by the local communities in the second expert and practitioner panel meeting.

Bamenda

The survey results confirmed by international household nutrition studies for Cameroon show that Bamenda faces challenges related to healthy diets such as the access and affordability of healthy food, and also related to non-inclusive food policy-making. Local stakeholders agreed to take action to increase the awareness about healthy diets and mobilize relevant stakeholders, such as through joining the Milan Urban Food Policy Pact. Low awareness and low governance, along with few policies on circularity and recycling in the city, are challenging for local actors. Stakeholders believe there are many opportunities to eliminate hazards from food waste, which should be systematically explored. There were also concerns regarding the access to and availability of inputs, knowledge sharing, and lack of services. Experts agreed on the use of training and flyers to increase collaboration across disciplines and to increase business potential. With the proper development of cooperatives, especially cooperatives of women, the business potential can be strengthened. The career attractiveness of aquaponics, insect farming, and hydroponics for women and youth in this area is well rated by experts and considered a major leverage for positive change.

Franceville

Experts rated food security in Franceville as being low, with the lack of access to affordable healthy diets and the high presence of informal markets providing challenging conditions. If well exploited, the living labs' newly created production units and education courses can provide an avenue for opportunities, as they provide small-scale food options close to consumers and have the potential to improve formal business structures, which then can enhance access to finance. For developing the value chain, more information on age and gender structures in the current sectors for fish, vegetables, and insects should become available to target information, which is currently undetaken through GESI surveys. Identifying local value streams is important for governance approaches in the city.

Ibadan

Ibadan's experts identified awareness of dietary requirements and availability of evidence-based information on circular production technologies an opportunity to be explored. Waste management could be transformed through local collaborations, which also will identify waste streams in the city with additional research. Insects are a low-cost protein source that could be better exploited by moving insect farms closer to the city. Also, business model analysis and low-cost start-up constructions can be developed to model the potential of new technologies and demonstrate urban farming alternatives to farmers in the vicinity. The promotion of new technologies is targeted at women and young people to circumvent current land access issues with soilless farming alternatives.

Lagos

In Lagos, a major bottleneck for aquaponics farmers is the shortfall in knowledge, finance, and access to land and services. Enhancing access to start-up capital for women and young people can support the already well-perceived job and career opportunities for women in aquaponics, aquaculture, and, in particular, vegetable production in the city. It is recommended to research the opportunities for more integrated value chain finance and a well-developed enabling environment in the city. The main activities focus on developing structures

or platforms where practitioners can seek advice and demonstrate the potential of circular technologies. Environmental sustainability and market potential can be strengthened with effective waste management through proper education and knowledge sharing. Stakeholders should capitalize on the perception that insect farming is seen as a game changer in Nigeria.

Moyamba

Moyamba experts believe that urban soilless food production can alleviate major challenges in affordable food, overfishing, and depletion of soils around the city. Since a large proportion of food is imported, there is particular demand for local vegetables, and increasing the use of indigenous vegetables can address the overall low vegetable consumption in the city. As a result, this can improve awareness and further push for the development of production facilities. With the government interested and engaged in enhancing circularity and waste management, there is a good prospect for circular technologies. The vegetable and fisheries sectors are the most promising in terms of youth engagement. However, more effort should be given to research and knowledge sharing on issues such as land prices. There is also the need to strengthen the enabling environment with more efficient services and to boost market linkages.

Nairobi

Nairobi's actions focus on changing the perceptions of healthy foods in the urban environment. The change is already supported by good diversification of food sources and increased awareness. Food policies to ensure an efficient, enabling environment are also in place. Increased communication and market research for circular technologies are seen as great avenues to further engage stakeholders in the food system, for example, through the living lab. Building a network of investors and entrepreneurs to further increase the business potential of circular technologies, especially in the fish value chain, could enhance financial support, education, and market readiness among value chain partners, in particular young farmers and women in the city.

Nakuru

In Nakuru, recent policies have strengthened the consumption of healthy food, building on the high availability of healthy dietary options. Environmental hazards, waste management, circularity and food safety issues, however, remain underexplored and could help overcome obstacles in the fish and insect value chains. More focus on knowledge and information creation is necessary, as well as strengthening technical support and enhancing capacity building. Building a network of enterprises and investors with an increased focus on financial access and inclusion of women and young producers can support business development in the city.

Tamale

More awareness and promotion of healthy diets and consumption patterns has the potential to increase the consumption of fish and vegetables and even insect farming in Tamale. Consumption in all three categories is considered low at the moment. Increasing consumption requires the proper implementation of food and nutrition policies by local authorities, raising awareness among consumers, promoting local insect-rearing technologies (specifically for caterpillars) and aquaponics technologies, and providing more start-up financing or public incentives. Given local circumstances, the living lab should adopt a strategic approach, prioritizing economic growth and decent jobs and increasing market potential through collaborations and cooperatives. Environmental sustainability, circularity, and food loss are also seen as potential leverage points for change, as there is growing interest in recycling activities.

Discussion

This discussion section interprets our approach and compares it to other research. The choice of rapid assessment has implications for the results and the suggested use of this approach.

Context Strongly Shapes the Food Systems' Outcomes

The integration of various food system assessment frameworks within this study serves as the cornerstone for achieving a comprehensive and insightful analysis of community-based circular food systems

in African cities. Situated within the broader context of our research objectives and motivations, this section delves into the significance of combining these frameworks and adapting them to the specific needs of our study.

Against the backdrop of major value chain disruptions in Africa following the COVID-19 pandemic, the INCiTiS-FOOD project aims to create inclusive and sustainable food systems in African cities. The COVID-19 pandemic made us more aware of the systemic vulnerabilities and led to a nuanced understanding of the complexities within African peri-urban food systems. The multifaceted approach to establishing agrifood technologies extends beyond the traditional boundaries of soil-based agriculture and food production and incorporates a wider spectrum of factors that influence food system outcomes.

The diverse range of food system assessment frameworks enabled us to draw upon their collective wisdom and adapt their principles to our specific context. For example, the methodology by Borman et al. (2022), combining food system and sector frameworks, helped in deep-diving into sector-specific information related to the fish, vegetable, and insect sectors as proxies for a yet non-existent industry (circular technologies such as aquaponics). Additionally, the incorporation of food system elements as guided by van Berkum et al. (2018) and the RUAF Food system framework for city food regions (Carey, 2017) provided a structured framework for our analysis. These elements helped us identify the most pertinent aspects of food systems to evaluate in each city. As a result, we tailored our assessments to each location's unique characteristics and priorities, ensuring that our findings would be relevant and actionable.

This integration was not a mere academic exercise but a strategic move toward actionable insights and co-creation processes. By comprehensively understanding the multifaceted challenges and opportunities inherent in community-based circular food systems, participating experts identified key leverage points for intervention on the city level in the second panel meeting and focus group discussion. This knowledge, rooted in the integrated frameworks, serves as a robust foundation for designing effective strategies and policy recommendations.

Our approach was further fortified by the inclusion of experts and practitioners who brought their domain-specific local insights to the table. This collaboration was crucial in bridging the gap between theoretical frameworks and the lived experiences of community-based circular food systems in African cities in a vacuum of empirical evidence. It allowed us to fine-tune the assessment process, ensuring it remained grounded and capable of addressing real-world challenges.

The integration of these frameworks offered us a comprehensive lens through which to view peri-urban food systems. We scrutinized governance structures, examined food production techniques, assessed market dynamics, considered environmental sustainability, evaluated social equity, and explored numerous other dimensions. For example, gender experts expressed general discontent with local food systems policies and employment policies, which could be addressed on the living lab level. This can be achieved by providing information to local leadership on the opportunities for women and youth employment and demonstrating examples of best practices for inclusive work conditions. This integrated approach enabled us to gain a nuanced understanding of the intricate web of factors influencing food system outcomes.

In conclusion, the integration of food system assessment frameworks was not merely a methodological choice but a fundamental addition to sector analysis and to unraveling the local intricacies of peri-urban food systems in African cities. This approach allowed us to transcend the limitations of a one-dimensional analysis and provided us with the tools to offer actionable insights aimed at enhancing food security, environmental sustainability, and social inclusion within evolving peri-urban landscapes.

The Use of Co-creation Techniques Helped to Build the Ecosystem

Our approach of using an expert and practitioner panel to reach a consensus on actions for the strategic development of the living labs can be described as co-creative. All experts were involved in the entire process of knowledge creation. Fur-

thermore, established contacts are useful in the follow-up of the project for onboarding participants in the living labs. The process was more participatory than a policy evaluation of city-level health and household data would be. The results were generated and developed together with other parties (Ind & Coates, 2013). In effect, the approach involved a diverse array of stakeholders, ranging from local academic and sector experts to supply chain actors, government representatives, and financial sector participants. Their inclusion was pivotal in ensuring a holistic analysis. The participatory nature of our approach, which began with co-creation sessions and workshops, allowed food systems actors to actively shape the research agenda, from agreeing on the questions they would answer to rating different challenges and defining recommendations and actions. This collaborative process enriched our study, ensuring that research objectives were aligned with practical needs and concerns.

Our consortium partners who specialized in gender and informal-sector perspectives contributed to a nuanced understanding of community-based circular food systems, which policy evaluations often omit. Women farmers in the panel could effectively give us a clear picture of how women collaborate differently in business than men, namely in women fishery collectives as opposed to single-owned male farming operations. An informal leader from the slums in Nairobi could explain to us how new technologies are implemented by women and how produce is supplied to local consumers. The engagement of experts with specialized knowledge in these domains underscored the importance of addressing gender dynamics and informal sector contributions within food systems transformation efforts.

Hybrid interactions, combining in-person and digital engagement, contributed to bridging the local technical divide and promoted inclusivity and collaboration among stakeholders. This approach transcended geographical constraints and encouraged stakeholders to take ownership of the local food systems transformation.

Beyond the immediate scope of our study, the engagement process contributed to building an ecosystem of collaboration among stakeholders, which is contributing in other ways to the project, for example in the onboarding of innovation actors in the living labs or in their contributions to other studies, such as the follow-up gender study that stakeholders are now willing to participate in. This ecosystem fosters ongoing dialogue, knowledge sharing, and coordinated action, creating a fertile ground for future initiatives aimed at enhancing food system sustainability and inclusivity. We try to nourish this ground through WhatsApp communication and various digital platforms through which the local living lab participants are knowledge exchange agents to the community.

Our commitment to inclusivity extended to the deliberate effort to involve vulnerable groups in expert meetings and co-creation sessions. Recognizing that marginalized populations, particularly women, young people, and those engaged in the informal sector, often face unique challenges and vulnerabilities within food systems, we prioritized and recognized their participation in the transformation process. Other project partners are continuing these efforts with additional research to fill the knowledge gaps revealed by this assessment and through projects with peer-to-peer support for women.

In the expert meetings and workshops convened to shape the research agenda, we proactively sought the insights of experts on gender dynamics and informal sector approaches. These experts played a crucial role in elevating the voices and concerns of vulnerable groups within peri-urban food systems. Their perspectives provided a nuanced understanding of the specific challenges faced by these marginalized communities, such as limited access to resources, market opportunities, and decision-making power. A simple example is that participants in the FSA came into contact with the living labs that provided waste that was used as feed for insects. This made them aware of the value of recycling, and they started to negotiate on waste delivery with others.

The Lessons We Learned by Applying This Mixed Approach

Our journey through the analysis of peri-urban food systems in African cities has been marked by valuable lessons that have enriched our under-

standing and approach. In this section, we reflect on the key lessons learned during this study.

Complexity of food systems reduced through expert ratings and visualization of results

By integrating multiple food system assessment frameworks and tailoring them to the specific contexts of each living lab, we were able to navigate the intricate web of interdependencies within community-based circular food systems. Moreover, the visualization of results through heat maps helped to identify straightforward trade-offs and synergies identified in the systems. This approach allowed us to identify distinct impact areas for each living lab, recognizing the uniqueness of their challenges and opportunities. However, this process also highlighted the need for flexibility and adaptability in food systems analysis, as one size does not fit all.

Quality of information: Representativeness, usefulness, and timing

The quality of the information gathered during our assessment was critical to our study's success. While our engagement with diverse stakeholders enriched our data, questions arose about the representativeness of the data and whether expert elicitation would indeed give us equivalent results to empirical analysis. We grappled with the question of how representative the input received was for the broader community and for vulnerable and marginalized groups. Additionally, assessing the usefulness of the data was an ongoing process, as its value became more evident during the analysis and synthesis stages through the triangulation with literature. Timing was another consideration, as the rapid nature of the assessment demanded efficient data collection without compromising depth.

Gender, vulnerable groups, and age data

One notable lesson was the project's need for more explicit attention to gender and vulnerable groups within our analysis. While we sought to be inclusive in our engagement process by asking specific questions related to gender and vulnerable groups, we did not specify gender and vulnerable group markers within the survey population. As a result, we could not cross-reference responses to gain insights and verify whether gender and age dynamics were addressed properly by the survey respondents. This oversight highlighted the importance of collecting disaggregated data in future assessments to better inform interventions on the living lab level. However, we ensured that gender was a main focal point in the multidisciplinary FSA through gender experts and women practitioners who had equal weight in the selection of questions and impact areas as well as in giving their expert opinions. If we had excluded them, we would not have known what questions to ask. The survey results did not depend on the number of responses from men and women experts and practitioners in the community but on the agreement of all experts on the impact that addressing these issues has for the local community, as well as their contribution to actions related to inclusive conduct and representation.

These omissions raised questions about whether our approach adequately addressed the unique challenges and opportunities faced by women and other vulnerable populations within community-based circular food systems. We do believe that this was the case, as valuable insights on how the sector could support or hinder these groups were gathered, discussed, and included in final recommendations.

Challenging assumptions about food systems

Our engagement with practitioners and experts challenged underlying assumptions about food systems. We encountered instances where traditional policy assumptions were questioned by those actively engaged in food systems transformation. For example, in Tamale, policymakers and consumers saw greater value in fish than vegetables as contributors to the protein transition and to economic development. From the literature and the discussion of the results in the expert panel, stakeholders agreed that they were misinformed, that fish consumption was already higher than expected in a balanced diet and that the local market was especially in need of local vegetables and caterpillars. We considered it important to discuss the possible limitations of the methods we used with the main stakeholders of the project. This experience underscored the importance of maintaining an open and dynamic dialogue with practitioners, as

their real-world insights can challenge and refine theoretical perspectives.

In conclusion, our journey through this analysis of community-based circular food systems has been a learning experience that has deepened our understanding of the complexities, challenges, and opportunities within these dynamic landscapes. These lessons will inform our future research and engagement efforts, guiding us toward more inclusive, representative, and effective approaches to food systems transformation in African cities.

Conclusions

The results obtained from our food system analysis for eight African cities were unique and distinct for each city. This highlights a fundamental aspect of our research: the inherent diversity and complexity of community-based circular food systems. Our approach challenged traditional, static models of understanding food systems and value chains. Instead of drawing direct comparisons between cities and stakeholder groups, we emphasized the importance of recognizing and appreciating their differences.

Moreover, our research has catalyzed action within these living labs to distribute more information specifically targeted at women, promote comanagement of living labs by both men and women, and increase access to finance and specifically enhance education and knowledge provision. There is currently an uptake of the recommendations proposed, reflecting a proactive response to the insights and challenges identified through our analysis. This demonstrates the practical impact of our research, not just in terms of academic contribution but also in tangible improvements in urban food systems.

However, a key lesson from this endeavor has been the transient nature of connections within community-based circular food systems. In fact, our approach relies on the use of expert knowledge and the availability of immediate, localized information. These elements are consistently accessible in urgent situations globally, provided that appropriate contextualization is applied. In the dynamic landscape of these systems, connections and collaborations, though crucial, can fade rapidly. This underscores the need and the importance for ongoing engagement and the nurturing of these relationships to ensure sustained impact.

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Appendix. Questionnaire

A. PERSONAL DETAILS

A1. If relevant, for which organisation do you work?
A2. To which area does your profession belong?
- a. Production
- a. Processing
- b. Logistics (storage, transport, trade)
- c. Food retail or catering
- d. Financial sector
- e. Extension services
- f. Policy
- g. Research

A3. In which sector are you involved?
- a. Vegetables
- b. Fish
- c. Insects
- d. Food in general
- e. Sector independent

A4. Are you an expert in one of the mentioned areas? Multiple answers possible.
- a. Gender
- b. Youth
- c. Aquaponics
- d. Hydroponics
- e. Insect farming
- f. No expertise

A5. In which country do you work or is your expertise based on?
- a. Cameroon
- b. Gabon
- c. Ghana
- d. Kenya
- e. Sierra Leone
- f. Nigeria

B. FOOD AND NUTRITION SECURITY IN THE CITY

B1. How do you rate the ability of your city to feed its population now and in the near future (1–5 years)? (Food security)
B2. (Health and wellbeing and nutrition utilization)
B3. How do you rate the number of households in your city that reach the WHO dietary recommendation of consuming a minimum of 400 grams of fruits and vegetables per day? (Health and wellbeing and nutrition utilization)
B4. How do you rate the number of households in your city that reach the dietary recommendation of consuming 2 portions of animal products like meat, fish, or eggs per week?
B5. How do you rate the accessibility to a variety of food retail outlets located in or near to low-income neighborhoods that sell [vegetables/fish/insects]? (Accessibility)
B6. How do you rate the ability for consumers to access different types of food? (Accessibility)
B7. How do you rate the ability for women to access different types of food? (Accessibility/Gender)
B8. How do you rate the ability for consumers to afford buying food? (Affordability)
B9. How do you rate the ability for women to afford buying food? (Affordability)
B10. How do you rate women's decision-making on the expenditure of purchase food? (Affordability)
B11. How do you rate the importance of informal food markets for ensuring food and nutrition security in the city? (Informality)

B12. How do you rate the presence of food and nutrition policies in your region? (Food policy)
B13. How do you rate the implementation of food and nutrition policies in your region? (Food policy)
B14. How do you rate the presence of food safety policies? (Food safety)
B15. How do you rate the implementation procedure of food safety policies? (Food safety)

C. SUPPLY CHAIN DEVELOPMENT

C1. How do you rate the extent to which the city's [vegetables/fish/insects] supply chains are in place enabling consumers to access a diversity of local food outlets? (Chain diversity)
C2. How do you rate the participation/leadership of women within the [vegetables/fish/insects] supply chains? (Governance/inclusiveness)
C3. How do you rate the participation/leadership of youth within the [vegetables/fish/insects] supply chains? (Governance/inclusiveness)
C4. How do you rate to what extent social and gender norms affect participation of women in their specific function, positions and tasks in the [vegetables/fish/insects] supply chains? (Inclusiveness)
C5. How do you rate the linkage of producers in the [vegetables/fish/insects] to various buyers and markets? (Linkages)
C6. How do you rate the presence of registered businesses compared to unregistered businesses in the [vegetables/fish/insects] supply chain? (Informality)
C7. How do you rate the rules and regulations governing the [vegetables/fish/insects] sector? (rules & regulations)
C8. How do you rate the participation of [vegetables/fish/insects] supply chain actors in policy discussions relevant to the sector? (policy participation)
C9. How do you rate the level of existing infrastructure (i.e. roads, internet access, power) enabling [vegetables/fish/insects] supply chain actors to maximise their operations/practices? (infrastructure)

D. PRODUCTION

D1. How do you rate the access to land and secure ownership/tenure arrangements in the city for the production of [vegetables/fish/insects] ? (Access to land)
D2. How do you rate the cities' ability to produce a diverse range of healthy foods? (Production diversity)
D3. How do you rate the cities' capacity to produce [vegetables/fish/insects]? (Production capacity)
D4. How do you rate the appropriate and efficient use of inputs for [vegetables/fish/insects] production? (Inputs)
D5. How do you rate the access to energy for [vegetables/fish/insects] production? (Energy management)
D6. How do you rate producers' capacity to invest in inputs and/or improved practices? (Inputs investment)
D7. How do you rate women's capacity to invest in inputs and/or improved practices? (Gender/ Inputs investment)
D8. How do you rate producers' access to knowledge and skills? (Access to knowledge and skills)
D9. How do you rate women's access to knowledge and skills? (Gender/Access to knowledge and skills)
D10. How do you rate water management practices at production level? (Water management)
D11. How do you rate access to clean water at production level? (Water management)
D12. How do you rate the availability of labour for [vegetables/fish/insects] production? (Labour availability)
D13. How do you rate [youth/women] engagement in [vegetables/fish/insects] production (i.e., young people increasingly growing vegetables)? (Gender and youth inclusion in production)
D14. How do you rate the career attractiveness of working in the food system for [youth/women]? (Gender and youth inclusion in production)
D15. How do you rate the presence of registered businesses compared to unregistered businesses at the production phase? (informality)
D16. How do you rate the management or reduction of post-harvest losses at the production facilities? (post-harvest loss)

E. STORAGE, PROCESSING, TRANSPORT AND TRADE

E1. How do you rate the ability for food processors to provide healthy, safe and sustainable [vegetables/fish/insects] products in the city? (Processing)
E2. How do you rate the reliability of [vegetables/fish/insects] supply in terms of volume? (food supply)
E3. How do you rate the ability for traders to provide healthy, safe and sustainable [vegetables/fish/insects] products in the city? (Trade)
E4. How do you rate the quality of [vegetables/fish/insects] supply regarding required or desired standards? (food supply)
E5. How do you rate the extent to which processing sectors comply with sanitation and food safety regulations? (Food safety)
E6. How do you rate the ability to safely store [vegetables/fish/insects] products in the city? (Storage)
E7. How do you rate the ability of the urban plan to support the safe movement of products from production areas to consumers? (Transport)
E8. How do you rate access to affordable and suitable (e.g., cold chain transport system) product transport services? (Transport)
E9. How do you rate access to formal financial services by informal value chain actors?
E10. How do you rate the presence of women in processing in the [vegetables/fish/insects] supply chains? (gender)
E11. How do you rate the presence of women in storage in the [vegetables/fish/insects] supply chains? (gender)
E12. How do you rate the presence of women in transport and trade in the [vegetables/fish/insects] supply chains? (gender)
E13. How do you rate the presence of youth in processing, storage, transport and trade in the [vegetables/fish/insects] supply chains? (age)
E14. How do you rate the difference between ethnic groups in being able to participant in supply chain activities? (Inclusiveness)
E15. How do you rate the presence of registered businesses compared to unregistered businesses in the processing, storage, transport and trade? (Informality)

F. FOOD ENVIRONMENT AND FOOD CONSUMPTION

F1. How do you rate the consumption of [vegetables/fish/insects] at household level? (Household consumption)
F2. How do you rate the infrastructure for the city's food marketing, catering and retail for the [vegetables/fish/insects] products? (Market infrastructure)
F3. How do you rate the ability for food outlets to be tailored to the different needs of people based on individual factors (e.g., sex, age, ethnicity, religion)? (Inclusion)
F4. How do you rate consumers' acceptance of [vegetables/fish/insects] products? (Consumers' acceptance)
F5. How do you rate the awareness on the nutritional value of [vegetables/fish/insects] among consumers? (Consumers' awareness)
F6. How do you rate the presence of registered businesses compared to unregistered businesses for food outlets? (Informality)
F7. How do you rate the extent to which retail and catering sectors comply with sanitation and food safety regulations? (Food safety)

G. WASTE GENERATION AND CIRCULARITY

G1. How do you rate the scale of food loss (produce loss in the supply chain before it reaches the consumer) in your sector [agriculture (vegetables, fruits & cereals), livestock (cattle, pigs, poultry) and aquaculture)]? (food loss)
G2. How do you rate the level of food waste (waste from households, restaurants and industrial waste) in your sector? (food loss)

G3. How do you rate the level of food loss and food waste being recycled (composting, biodigester, bio-incineration etc.) in your sector? (food waste recycling)
G4. How do you rate the level of food loss and food waste 'not' being recycled (landfill sites, incineration etc.) in your sector? (food waste recycling)
G5. How do you rate the efficiency of waste segregation (separation of plant and animal waste, dry waste, wet waste) in your sector? (waste segregation)
G6. How do you rate the process of eliminating hazards from food waste (for example; drying, boiling, blanching, acidification, fermentation and freezing) in your sector? (hazards from food waste)
G7. How do you rate the pre-treatment of residual organic streams (pasteurization, fermentation etc.) in your sector? (waste management practices)
G8. How do you rate the availability of land for circular waste management (biodigester, bio-incineration, insect farming etc) in your sector? (waste management practices)
G9. How do you rate the technology adoption of circular waste management in question 3.7 & 3.8 (pasteurization, fermentation, biodigester, bio-incineration, insect farming etc.) by existing businesses?
G10. How do you rate the technology adoption of circular waste management in question 3.7 & 3.8 (pasteurization, fermentation, biodigester, bio-incineration, insect farming etc.) by 'new potential businesses?
G11. How do you rate the business (cost-benefit analysis) of the waste produced in your sector (formal approach by institutes, for example by local municipality, companies etc.)? (waste management practices)
G12. How do you rate the business (cost-benefit analysis) of the waste produced in your sector (informal approach for example by farmers, consumers etc.)? (waste management practices)
G13. How do you rate the knowledge and information on the circularity of food loss and waste for the actors in the formal food sector(s) (national government, local municipality, supply-chain actors etc.)? (knowledge circular waste management)
G14. How do you rate the knowledge and information on the circulation of food loss and waste for the actors in the informal food sector(s) (farmers, consumers etc.)? (knowledge circular waste management)

H. BUSINESS POTENTIAL OF HYDROPONICS, AQUAPONICS, INSECT FARMING, RE-CIRCULAR AQUACULTURAL SYSTEMS (RAS)

H1. How do you rate the current presence of different types of production systems in the city? (Business diversity)
H2. How do you rate the current business potential in [hydroponics/aquaponics/insect farming/RAS] in the city? (Business potential)
H3. How do you rate the competition between [vegetables/fish/insects] production and other farming systems (i.e., cereals or livestock) to various buyers and markets? (Competition)
H4. How do you rate the initial cost of investment/start up in [vegetables/fish/insects] production compared to other traditional systems? (Competition)
H5. How do you rate the access to formal and informal financial services by stakeholders (other than farmers) in [hydroponics/aquaponics/insect farming/RAS] sectors? (Services)
H6. How do you rate to what extent are these 'services' catering for the needs of women in their existing positions in the sectors? (Services - Gender Inclusiveness)
H7. How do you rate the availability of labour along the [vegetables/fish/insects] value chains (for activities other than production)? (Labour availability)
H8. How do you rate the access to information services (e.g., price, or market information, city planning) for [hydroponics/aquaponics/insect farming/RAS] sectors? (Access to information services)
H9. How do you rate the level and role of informality in determining the business potential for [hydroponics/aquaponics/insect farming/RAS] ? (Informality)
H10. How do you rate availability of energy supply (electricity) as a challenge to business potential in your region? (energy)
H11. How do you rate the availability of clean water supply as a challenge to business potential in your region? (water management)

I. URBAN FOOD POLICIES

I1. Do you rate the presence of an active municipal government body that is concerned with food policies? (structure of government bodies)
I2. How do you rate the implementation of an active municipal government body that is concerned with food policies? (structure of government bodies)
I3. How do you rate the degree of multi-stakeholder representation in urban food policy making? (structure of government bodies)
I4. How do you rate the presence of assembling and analyzing urban food system data for monitoring and evaluation purposes? (structure of government bodies)
I5. How do you rate the implementation of assembling and analyzing urban food system data for monitoring and evaluation purposes? (structure of government bodies)
I6. How do you rate the presence of programs/policies that promote the availability of nutritious and diversified foods? (social sustainability)
I7. How do you rate the implementation of programs/policies that promote the availability of nutritious and diversified foods? (social sustainability)
I8. How do you rate the presence of food-related programs/policies with a specific focus on socially vulnerable groups? (social sustainability)
I9. How do you rate the implementation of food-related programs/policies with a specific focus on socially vulnerable groups? (social sustainability)
I10. How do you rate the presence of programs/policies that promote agricultural production and processing in the municipal area? (economic sustainability)
I11. How do you rate the implementation of programs/policies that promote agricultural production and processing in the municipal area? (economic sustainability)
I12. How do you rate the presence of programs/policies that specifically promote technologies like hydroponics, aquaponics, insect farming, or RAS in the municipal area? (economic sustainability)
I13. How do you rate the implementation of programs/policies that specifically promote technologies like hydroponics, aquaponics, insect farming, or RAS in the municipal area? (economic sustainability)
I14. How do you rate the presence of support services for the informal food sector (e.g., in the form of business planning, finance, and development advice)? (economic and social sustainability)
I15. How do you rate the implementation of support services for the informal food sector (e.g., in the form of business planning, finance, and development advice)? (economic and social sustainability)
I16. How do you rate the presence of programs/policies that address environmental sustainability (e.g., through more sustainable land use, the use of organic fertilizers, the promotion of mechanization)? (environmental sustainability)
I17. How do you rate the implementation of programs/policies that address environmental sustainability (e.g., through more sustainable land use, the use of organic fertilizers, the promotion of mechanization)? (environmental sustainability)

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COMMENTARY

Community-based circular food systems in Pakistan: A path to sustainable food security

SPECIAL ISSUE
Community-Based Circular Food Systems

Sponsored by
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Introduction

Pakistan, a nation grappling with the imperative of food security amidst environmental degradation and resource limitations, stands at a pivotal juncture in its agricultural trajectory. The transition to community-based circular food systems emerges as a promising avenue to address these pressing challenges sustainably (Patel, 2009; El Bilali et al., 2021). Circular food systems, characterized by their emphasis on waste reduction, efficient resource utilization, and localized production-consumption cycles, offer a holistic approach to food production and distribution (Fassio and Chirilli, 2023; De Bernardi et al., 2023). In the unique context of Pakistan, where agriculture serves as a cornerstone of the economy and communities are deeply interconnected, the adoption of such systems holds significant potential. By integrating circular principles into the fabric of its agricultural landscape, Pakistan could not only enhance its food security but also promote environmental sustainability and bolster community resilience (Amanullah, 2020; Fanzo et al., 2020). This commentary highlights the potential of circular food systems to address Pakistan's agricultural challenges while fostering sustainable development.

The agricultural sector in Pakistan is a vital component of its economy, supporting livelihoods and contributing significantly to the nation's gross domestic product (GDP). However, the sector faces multifaceted challenges, including water scarcity, soil degradation, and fluctuating market conditions (Amanullah & Khan, 2024; Perdana et al., 2022). In this context, the shift toward community-based circular food systems (presents an opportunity to transform agricultural practices (Sachet et al., 2021). These systems encourage the efficient use of resources, such as water and nutrients, while

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minimizing waste through practices like composting and recycling (Parfitt et al., 2010; Żmieńka & Staniszewski, 2020). By fostering local production and consumption loops, circular food systems can reduce dependency on external inputs and strengthen local food networks (Bonilla Cedrez et al., 2023). This commentary underscores the potential of circular food systems to address the challenges confronting Pakistan's agricultural sector, offering a pathway toward sustainability and resilience.

Furthermore, the implementation of circular food systems in Pakistan aligns with broader sustainability goals, including climate resilience and social equity (Martinho, 2021; Perdana et al., 2022). Climate change poses a significant threat to agricultural productivity in Pakistan, with increasing occurrences of extreme weather events and shifting precipitation patterns (Amanullah et al., 2023; De Bernardi et al., 2023). Circular food systems, with their focus on diversified cropping systems and sustainable land management, offer resilience against these climate impacts. Additionally, these systems can promote social inclusivity by empowering local communities, particularly small-scale farmers and marginalized groups, through improved access to markets and equitable participation in food production (Fassio & Chirilli, 2023; El Bilali et al., 2021). Thus the adoption of community-based circular food systems (C-B CFSs) in Pakistan represents a transformative step toward a more sustainable, resilient, and equitable food future. This commentary emphasizes the potential of circular food systems to address climate change impacts and promote social inclusivity in Pakistan's agricultural sector.

Discussion

Community-based circular food systems (C-B CFSs) hold significant potential in Pakistan to address both food insecurity and malnutrition among the country's poor population, ultimately contributing to a healthier nation. Pakistan faces formidable challenges concerning food security and nutrition, with a significant portion of its population struggling to access nutritious foods. This issue is exacerbated by environmental degradation, resource constraints, and limited access to diverse food options. In response, the concept of C-B CFSs emerges as a holistic approach that integrates principles of a circular economy and community participation to ensure sustainable food production, distribution, and consumption. By focusing on local production-consumption loops, waste reduction, empowerment of small-scale farmers, and nutrition education, C-B CFSs offer a pathway to improve access to nutritious foods, diversify diets, and enhance community resilience against food insecurity and malnutrition. This discussion explores how C-B CFSs can be a transformative solution for Pakistan, addressing the root causes of food insecurity and malnutrition while promoting environmental sustainability and community well-being.

Figure 1 illustrates how C-B CFSs can serve as a transformative approach to addressing Pakistan's agricultural and food security challenges. By emphasizing resource efficiency, local food networks, and sustainable practices, C-B CFSs contribute to a more resilient and self-sufficient food system.

One of the key benefits of C-B CFSs is *increased access to nutritious food*, ensuring that communities, especially vulnerable populations, have a steady supply of fresh, locally produced food. This leads to *diversification of diets*, encouraging consumption of a wider range of fruits, vegetables, and grains, which improves overall public health and reduces malnutrition. Furthermore, these systems *empower small-scale farmers* by creating direct market linkages, reducing dependency on middlemen, and enhancing their economic stability through fair pricing and local demand-driven production.

Another significant advantage is the *reduction of food waste*, as C-B CFSs promote efficient resource utilization, composting, and redistribution of surplus food within communities. By integrating local production with waste management strategies, food systems become more sustainable and environmentally friendly. Moreover, incorporating *nutrition education* into these initiatives can enhance awareness about healthy eating habits, fostering long-term improvements in public health and food consumption patterns.

By adopting C-B CFSs, Pakistan can create a more equitable and sustainable agricultural landscape that benefits both farmers and consumers. These systems not only support food security but

Figure 1. The Role of Community-Based Circular Food Systems in Sustainable Agriculture

also contribute to environmental conservation and economic empowerment at the grassroots level.

1. Increased Access to Nutritious Food

One of the primary advantages of C-B CFS is the emphasis on local production and consumption loops. By promoting small-scale farming and community gardens, these systems can ensure a steady supply of fresh, nutritious foods to local communities. This increased availability of diverse, locally grown produce can combat malnutrition by providing essential vitamins, minerals, and other nutrients that are often lacking in diets of the poor.

Increased access to nutritious food is a significant advantage of C-B CFSs, particularly through their emphasis on local production and consumption loops. In Pakistan, where malnutrition is a pressing issue among impoverished communities, C-B CFSs can play a pivotal role in addressing this challenge.

Local Production and Consumption Loops

C-B CFSs promote small-scale farming and community gardens, which create local production and consumption loops. This means that food is grown locally and consumed within the community, reducing the need for long-distance transportation and its associated carbon footprints. This not only supports local farmers but also ensures a steady and reliable supply of fresh, nutritious foods to local residents.

Diverse, Locally Grown Produce

By encouraging crop diversification and the cultivation of a wide range of fruits, vegetables, grains, and legumes, C-B CFSs promote a diverse food supply. This diversity is crucial for addressing malnutrition as it provides a variety of essential nutrients that may be lacking in monotonous diets. For instance, micronutrient-rich vegetables like spinach, carrots, and tomatoes can be grown locally and made readily available to communities.

Nutrient-Rich Foods

Local and fresh produce tends to be more nutrient-dense compared to processed and imported foods. For example, leafy greens, fruits, and legumes grown in local gardens are rich in vitamins (such as vitamin C and vitamin A), minerals (like iron and calcium), and dietary fiber. These nutrients are

essential for overall health, growth, and development, particularly in vulnerable populations such as children and pregnant women.

Combatting Malnutrition

Malnutrition is not just about lack of food; it is also about the lack of essential nutrients. C-B CFSs addresses this issue by ensuring that communities have access to a variety of nutrient-rich foods. For instance, a community garden may grow a mix of vegetables like spinach, carrots, and bell peppers, providing a diverse array of vitamins and minerals to combat deficiencies.

Empowerment of Local Farmers

C-B CFSs empowers small-scale farmers to grow nutritious foods and sell them within their communities. This not only supports local livelihoods but also ensures that the foods produced are culturally appropriate and familiar to residents. When people have access to foods they are accustomed to, they are more likely to consume them regularly, contributing to improved nutrition outcomes.

Long-Term Health Benefits

The consistent consumption of fresh, locally grown produce can lead to long-term health benefits for communities. Reduced reliance on processed and packaged foods, which are often high in unhealthy fats, sugars, and additives, can help prevent diet-related diseases such as obesity, diabetes, and cardiovascular disorders.

The emphasis on local production and consumption loops in C-B CFSs offers a promising solution to address malnutrition in Pakistan. By promoting small-scale farming, crop diversification, and the availability of diverse, locally grown produce, C-B CFSs ensures that communities have access to nutrient-rich foods that are essential for good health. This approach not only addresses immediate nutritional needs but also contributes to the long-term well-being and resilience of communities.

2. Diversification of Diets

C-B CFSs encourage crop diversification, which means growing a variety of fruits, vegetables, grains, and legumes. This diversity in food production not only improves soil health and ecosystem resilience but also translates into diverse diets for consumers. In Pakistan, where many people rely heavily on staple crops such as wheat and rice, the introduction of a wider range of nutritious foods through C-B CFSs can address the malnutrition caused by a lack of dietary diversity.

The following points describe how C-B CFSs encourages and supports this diversification.

Crop Diversity

C-B CFSs initiatives promote the cultivation of a wide range of crops including fruits, vegetables, grains, and legumes. This contrasts with conventional farming practices that often focus on monoculture or a limited set of crops. The introduction of diverse crops improves soil health, reduces the reliance on chemical inputs, and enhances ecosystem resilience.

Improved Nutrition

The diverse range of crops grown in C-B CFSs translates directly to more varied and nutritious diets for local communities. For instance, incorporating fruits like mangoes, guavas, and citrus alongside staple grains like wheat and rice provides essential vitamins (A, C, E), minerals (iron, calcium), and dietary fiber. Legumes such as lentils and chickpeas add valuable protein and micronutrients to diets, addressing common deficiencies.

Addressing Malnutrition

In Pakistan, where malnutrition remains a significant challenge, particularly among the poor, the lack of dietary diversity contributes to nutritional deficiencies. C-B CFS initiatives can play a pivotal role in addressing this issue by promoting the consumption of locally grown, diverse foods. For example, adding leafy greens, carrots, and tomatoes to diets provides essential vitamins (K, A, C) and minerals (iron, potassium) that are often lacking.

Cultural Relevance

C-B CFSs also consider cultural preferences and local food traditions, ensuring that the introduced crops are well-accepted and integrated into local diets. This cultural relevance increases the likelihood of sustained consumption of these diverse

foods, contributing to long-term improvements in nutrition.

Resilience to Climate Change

Diversified cropping systems in C-B CFSs are inherently more resilient to climate variability and extremes. For example, in times of drought, certain drought-tolerant crops like millets and sorghum can still thrive, providing a food source when others fail. This resilience ensures a more stable food supply even in the face of climate challenges.

Economic Benefits

Diversification also brings economic benefits to small-scale farmers participating in C-B CFSs. Growing a variety of crops allows for more stable incomes, as farmers are not solely reliant on one crop that may be vulnerable to price fluctuations or environmental risks. This economic stability can further contribute to improved access to food and nutrition for farming households.

The diversification of diets through C-B CFS initiatives in Pakistan offers a multifaceted solution to address malnutrition. By promoting crop diversity, improving nutrition, addressing cultural preferences, building resilience to climate change, and providing economic benefits to farmers, C-B CFSs lay a foundation for healthier and more sustainable food systems. This approach not only addresses immediate nutritional needs but also contributes to the overall well-being and resilience of communities.

3. Empowerment of Small-Scale Farmers

C-B CFSs prioritize the involvement of small-scale farmers and marginalized communities in food production. By providing training, resources, and market access to these farmers, C-B CFSs not only boost their livelihoods but also ensure a sustainable supply of locally grown, affordable food. This empowerment helps to lift farmers out of poverty, enabling them to feed their families nutritious meals and contribute to the overall health of their communities. C-B CFSs in Pakistan are empowering small-scale farmers in significant ways, leading to improvements in both livelihoods and local food systems.

Training and Capacity Building

C-B CFS initiatives provide essential training and capacity-building programs to small-scale farmers. These programs cover sustainable farming practices, organic cultivation methods, efficient water management, and integrated pest management. By equipping farmers with these skills and knowledge, C-B CFSs enhance their ability to produce high-quality, nutritious crops in an environmentally friendly manner.

Resource Access

Access to resources such as seeds, tools, and organic inputs is crucial for small-scale farmers. C-B CFS projects often facilitate the provision of these resources, either through direct distribution or by establishing community seed banks and resource-sharing networks. This ensures that farmers have the necessary inputs to grow a diverse range of crops sustainably.

Market Linkages

One of the significant challenges for small-scale farmers is accessing markets to sell their produce. C-B CFS initiatives work on creating market linkages, connecting farmers directly with consumers, local markets, restaurants, and institutions like schools and hospitals. This direct marketing approach not only ensures fair prices for farmers but also provides consumers with fresh, locally grown produce.

Income Generation

Empowering small-scale farmers through C-B CFSs leads to increased income generation. By diversifying their crops and accessing premium markets for organic and locally produced foods, farmers can fetch higher prices for their produce. This economic empowerment lifts farmers out of poverty, enabling them to invest in their farms, homes, and children's education.

Food Security

When small-scale farmers have the resources and knowledge to grow a variety of crops, it directly benefits their families' food security. They are no longer solely reliant on a single crop for sustenance. Instead, they can cultivate a mix of fruits,

vegetables, grains, and legumes, ensuring a diverse and nutritious diet for their households.

Community Health Impact

The empowerment of small-scale farmers has a ripple effect on community health. As farmers adopt sustainable practices and produce nutritious foods, the overall health of the community improves. Reduced pesticide use, increased consumption of fresh fruits and vegetables, and access to organic foods contribute to lower rates of malnutrition and related health issues.

Sustainable Agriculture

By promoting sustainable practices such as agroforestry, crop rotation, and soil conservation, C-B CFSs not only benefit farmers but also promote long-term sustainability. Healthy soils, diverse cropping systems, and reduced chemical inputs contribute to ecosystem health and resilience, ensuring that future generations can continue to benefit from the land.

The empowerment of small-scale farmers through C-B CFSs in Pakistan is a critical step toward building resilient and sustainable food systems. By providing training, resources, market access, and income opportunities, and improving food security and community health, C-B CFS initiatives create a positive impact on both farmers and their communities. This approach not only addresses immediate challenges of poverty and malnutrition but also lays the groundwork for a healthier, more prosperous future for Pakistan's agricultural sector.

4. Reduction of Food Waste

Circular food systems place a strong emphasis on reducing waste throughout the food supply chain. By implementing practices such as composting, recycling, and efficient use of resources, C-B CFSs can minimize food loss. This means more food reaches those in need, reducing food insecurity and ensuring a healthier population.

In the context of Pakistan, where food insecurity and malnutrition are pressing issues, the reduction of food waste through C-B CFSs holds immense importance.

Here is how the reduction of food waste can have a significant impact:

Minimizing Losses

Pakistan faces challenges in food production, storage, and distribution, leading to significant losses along the supply chain. C-B CFS initiatives focus on minimizing these losses by implementing efficient practices. For example, improved post-harvest handling techniques, proper storage facilities, and transportation systems help prevent spoilage and wastage of fresh produce.

Composting and Recycling

C-B CFSs promote the use of organic waste for composting, turning waste into valuable resources. Farmers can use compost to enrich their soils, improving soil fertility and crop yields. Additionally, organic waste can be recycled to create biogas for cooking or heating, reducing reliance on fossil fuels and promoting sustainable energy practices.

Efficient Resource Use

In C-B CFSs, every part of the food system is considered valuable. By using resources efficiently, such as utilizing food scraps for animal feed or creating nutrient-rich soil amendments, C-B CFSs minimizes waste generation. This holistic approach ensures that all resources are maximized, contributing to a more sustainable and efficient food system.

Increased Access to Food

The reduction of food waste means more food is available for consumption. In a country like Pakistan, where millions suffer from food insecurity, every bit of saved food can make a difference. By ensuring that edible food reaches those in need instead of being wasted, C-B CFSs directly addresses the issue of hunger and malnutrition.

Healthier Population

Wasting less food means more nutritious meals for individuals and families. In Pakistan, where malnutrition is a significant concern, access to fresh, nutritious food is crucial for improving health outcomes. By reducing food waste and ensuring that surplus food reaches vulnerable populations, C-B

CFSs contributes to a healthier and more nourished population.

Economic Benefits

Food waste reduction also has economic benefits for farmers and communities. When less food is wasted, farmers can sell more of their produce, increasing their income. This, in turn, stimulates local economies and creates opportunities for small-scale producers to thrive. Additionally, reducing waste reduces the financial burden on consumers, making nutritious food more accessible and affordable.

Environmental Impact

Food waste is not just a social and economic issue but also an environmental one. When food is wasted, all the resources used to produce that food, such as water, energy, and land, are also wasted. By reducing food waste, C-B CFSs contribute to a more sustainable use of resources and reduces the environmental footprint of the food system.

The reduction of food waste through C-B CFSs in Pakistan is crucial for several reasons. It directly addresses food insecurity and malnutrition by ensuring that more food reaches those in need. It also has economic benefits for farmers and communities, promotes environmental sustainability by minimizing resource wastage, and contributes to a healthier population overall. As Pakistan works towards building a more resilient and sustainable food system, reducing food waste must be a central focus to achieve a healthier and more prosperous nation.

5. Promotion of Food Sovereignty

C-B CFSs promote food sovereignty, which means communities have control over their own food systems. This allows communities to prioritize nutritious, culturally appropriate foods that meet their dietary needs. By strengthening local food systems, C-B CFSs reduce reliance on imported, processed foods that are often less nutritious and more expensive.

The promotion of food sovereignty through C-B CFSs in Pakistan is a critical aspect that can significantly impact the health and well-being of its population. Below is a detailed discussion on how C-B CFSs promote food sovereignty.

Community Empowerment

C-B CFSs empower local communities to take control of their food systems. This means that communities are actively involved in decision-making processes regarding what crops to grow, how to grow them, and where to distribute them. This empowerment allows communities to prioritize their nutritional needs and cultural preferences when it comes to food choices.

Diverse and Nutritious Diets

Food sovereignty emphasizes the importance of diverse and nutritious diets. In Pakistan, where malnutrition is prevalent, promoting diverse food options is crucial for addressing nutrient deficiencies. C-B CFSs encourage the cultivation of a variety of fruits, vegetables, grains, and legumes, ensuring that communities have access to a wide range of essential nutrients.

Cultural Relevance

One of the key aspects of food sovereignty is respecting and preserving cultural food traditions. C-B CFSs support the production of traditional crops and foods that hold cultural significance for communities. This not only promotes cultural heritage but also ensures that people have access to foods that they are familiar with and enjoy.

Reduced Reliance on Imported Foods

Many developing countries, including Pakistan, rely heavily on imported and processed foods. These foods are often less nutritious and more expensive than locally produced alternatives. C-B CFSs aim to reduce this reliance by promoting local food production. By growing their own food, communities can access fresh, nutritious foods at a lower cost, improving their overall health and well-being.

Resilience to External Shocks

Food sovereignty also enhances community resilience to external shocks, such as economic crises or natural disasters. When communities have strong local food systems, they are less vulnerable to disruptions in global food supply chains. This resili-

ence ensures that communities can continue to access food even during challenging times.

Environmental Sustainability

C-B CFSs promote sustainable farming practices that are in harmony with the environment. By reducing reliance on chemical inputs and promoting agroecological methods, C-B CFSs contribute to healthier soils, cleaner water, and biodiversity conservation. This sustainable approach ensures that future generations will also have access to nutritious and culturally relevant foods.

Economic Benefits

Food sovereignty can also have economic benefits for communities. By promoting local food production and consumption, C-B CFSs support small-scale farmers and local food businesses. This, in turn, creates economic opportunities in communities and strengthens local economies.

The promotion of food sovereignty through C-B CFSs in Pakistan has the potential to transform the nation's food landscape. By empowering communities, promoting diverse and nutritious diets, respecting cultural food traditions, reducing reliance on imported foods, building resilience, promoting environmental sustainability, and creating economic opportunities, C-B CFSs lay the foundation for a healthier and more prosperous nation. It is an approach that not only addresses immediate food security and malnutrition issues but also fosters long-term sustainability and resilience in Pakistan's food systems.

6. Integration of Nutrition Education

Alongside C-B CFS implementation, nutrition education programs can be integrated into communities. These programs can teach people about the importance of balanced diets, proper nutrition for different age groups, and how to make the most of locally available foods. Empowering individuals with knowledge about healthy eating habits can have a lasting impact on reducing malnutrition.

In Pakistan, where malnutrition and food insecurity are prevalent issues, integrating nutrition education into C-B CFS initiatives can have a profound impact. Below is a discussion of how the integration of nutrition education can contribute to a healthier nation.

Promoting Balanced Diets

Nutrition education programs in C-B CFSs can teach communities about the importance of balanced diets. Individuals learn about the various food groups and the role each plays in maintaining health. By understanding the need for a diverse range of foods, people are more likely to make informed choices when it comes to their meals, leading to improved nutrition.

Customizing Nutrition for Different Age Groups

Nutrition education can tailor information to different age groups, focusing on the specific dietary needs of children, pregnant women, and the elderly. For example, educating mothers about the importance of breastfeeding and introducing complementary foods at the right age can prevent malnutrition in infants. Similarly, educating the elderly about nutrient-dense foods can address issues related to aging and nutritional deficiencies.

Utilizing Locally Available Foods

C-B CFSs emphasize local food production, and nutrition education can highlight the nutritional value of these locally available foods. Communities can learn about the benefits of indigenous crops, seasonal fruits and vegetables, and traditional recipes that are both nutritious and culturally significant. This not only promotes food sovereignty but also encourages the consumption of fresh, nutrient-rich foods.

Cooking and Meal Preparation Techniques

Nutrition education can also include practical lessons on cooking and meal preparation. Communities can learn how to prepare nutritious meals using local ingredients, emphasizing simple yet healthy cooking methods. This empowers individuals to make the most of the foods available to them, maximizing nutritional intake and minimizing food wastage.

Addressing Malnutrition

By integrating nutrition education into C-B CFSs, communities are equipped with the knowledge and

skills to combat malnutrition effectively. They learn about the signs and consequences of malnutrition, preventive measures, and strategies for improving nutritional status. This proactive approach can lead to a reduction in malnutrition rates, especially among vulnerable groups such as children and pregnant women.

Creating Sustainable Behavior Change

Education is a powerful tool for behavior change. By instilling a deeper understanding of nutrition and its impact on health, nutrition education in C-B CFSs can create lasting behavior change within communities. This includes choices related to food purchasing, cooking practices, and dietary habits, all of which contribute to improved nutrition outcomes.

Empowering Communities

Integrating nutrition education empowers communities to take charge of their health and well-being. When individuals understand the importance of nutrition and how it affects their lives, they are more likely to advocate for improved food systems, access to nutritious foods, and healthier environments. This bottom-up approach to community empowerment fosters sustainability and resilience in the face of food-related challenges.

The integration of nutrition education into C-B CFSs in Pakistan is a multifaceted approach to addressing malnutrition and promoting a healthier population. By promoting balanced diets, utilizing locally available foods, and teaching practical cooking skills, communities are empowered to make informed choices about their nutrition. This not only improves individual health outcomes but also contributes to food sovereignty, sustainability, and community resilience. As Pakistan works to build a healthier nation, nutrition education within C-B CFSs plays a vital role in shaping positive health behaviors and ensuring a brighter future for all.

C-B CFSs in Pakistan offer a transformative solution to address food insecurity and malnutrition among vulnerable populations. Through increased access to nutritious foods, diversified diets, empowerment of small-scale farmers, reduction of food waste, promotion of food sovereignty, and integration of nutrition education, C-B CFSs can pave the way for a healthier nation. This comprehensive approach not only meets immediate nutritional needs but also establishes sustainable and resilient food systems for Pakistan's future.

To build upon existing agricultural practices and community networks, C-B CFSs can leverage farmers' cooperatives, local markets, and community supported agriculture initiatives as foundational elements. These systems aim to minimize waste by promoting practices such as composting, recycling nutrients, and utilizing agricultural by-products efficiently. For instance, agricultural residues can serve as valuable inputs for animal feed or compost, contributing to waste reduction and improved soil health. Establishing local food processing units can further enhance the circularity of the system by creating value-added products.

In terms of resource efficiency, integrating precision agriculture technologies and water conservation practices into C-B CFSs can yield significant benefits. Techniques like drip irrigation can reduce water usage, while organic fertilizers and biopesticides can minimize chemical inputs, promoting sustainability. Community engagement is vital for success, as educating farmers and consumers about the advantages of C-B CFSs and encouraging participation in local food networks fosters a sense of ownership and responsibility.

Moreover, C-B CFSs can enhance community resilience in the face of climate change. Practices such as diverse crop varieties, agroforestry, and integrated pest management contribute to ecosystem health and resilience. During climate-related shocks such as floods or droughts, these diversified and locally adapted food systems are better equipped to ensure food security.

The development of C-B CFSs in Pakistan presents a significant opportunity to tackle the intertwined challenges of food security and environmental sustainability. By reducing waste, improving resource efficiency, and fostering community participation, these systems can contribute to a more resilient and sustainable food system. Collaborative efforts involving government, NGOs, farmers, and consumers are essential for the successful implementation and scaling of C-B CFS initiatives.

Conclusion

Community-based circular food systems offer a promising avenue for Pakistan to address food insecurity and malnutrition while promoting environmental sustainability. By integrating access to nutritious foods, diverse diets, empowerment of small-scale farmers, reduction of food waste, promotion of food sovereignty, and nutrition education, C-B CFSs lay the foundation for a healthier and more resilient nation. Collaboration between stakeholders and community engagement are key to the success of these systems.

Recommendations

Figure 2 outlines key recommendations for developing a resilient and sustainable food system in Pakistan. *Investment in small-scale farming* is crucial to enhance productivity and livelihoods, while the *promotion of agroecological practices* ensures environmentally friendly and climate-resilient agriculture. Strengthening *support for local markets* helps create direct farmer-consumer linkages, reducing dependency on imports and stabilizing food prices. *Education and awareness* initiatives can empower communities with knowledge about sustainable agriculture, nutrition, and food security. Effective *policy support*, backed by *research and innovation,* will drive long-term solutions for food sustainability. Lastly, fostering *partnerships and collaboration* among stakeholders and implementing *monitoring and evaluation* mechanisms will ensure that sustainable practices are effectively adopted and continuously improved.

Figure 2. Recommendations for Building Sustainable Food Systems in Pakistan

1. **Investment in Small-Scale Farming:** Provide support and resources to small-scale farmers to enhance their productivity and sustainability.
2. **Promotion of Agroecological Practices:** Encourage the adoption of agroecological practices such as crop diversification, agroforestry, and organic farming.
3. **Support for Local Markets:** Strengthen local markets and value chains to promote the consumption of locally produced foods.
4. **Education and Awareness:** Increase awareness about the benefits of C-B CFSs and sustainable food practices among farmers, consumers, and policymakers.
5. **Policy Support:** Develop and implement policies that incentivize and support the transition to circular and sustainable food systems.
6. **Research and Innovation:** Invest in research and innovation to develop technologies and practices that enhance the efficiency and sustainability of food production.
7. **Partnerships and Collaboration:** Foster partnerships between government, NGOs, academia, and the private sector to drive forward sustainable food system initiatives.
8. **Monitoring and Evaluation:** Establish monitoring and evaluation mechanisms to assess the impact of CBCFS on food security, nutrition, and environmental sustainability.

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COMMENTARY ON COMMUNITY-BASED CIRCULAR FOOD SYSTEMS

Lessons from building a regional food system in Eastern Connecticut

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SPECIAL ISSUE
Community-Based Circular Food Systems

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Summary
This is a reflection on a small Connecticut-based nonprofit organization's attempt to scale its community-based work to a regional level through a U.S. Department of Agriculture (USDA) Regional Food Systems Partnership grant. Organized around five lessons learned, it addressed the challenges faced when building a regional network across diverse communities and geographies.

Keywords
community-based food systems, food system nonprofits, regional food system partnerships, community-based circular food systems

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Author Disclosure
Sydney Clements is the former director of the Windham Community Food Network.

Introduction
In 2021, the Windham Community Food Network (WCFN), a small nonprofit organization based in Windham, Connecticut, received a Regional Food Systems Partnership (RFSP) grant from the USDA in partnership with Grow Windham, FRESH New London, the Connecticut Food Systems Alliance, and Community Foundation of Eastern Connecticut, all of which are organizations working to increase food justice in their respective communities. Our proposal, titled "Rooting Deep and Scaling Up: A Roadmap for Food System Equity and Viability in Eastern Connecticut," was meant to leverage the consumer trends experienced during the early days of the COVID-19 pandemic and scale them up to increase farmer economic viability and low-income consumer access to locally produced food in the region.

As many will remember, grocery stores were a difficult place to navigate in 2020, affected by supply-chain disruptions, item limits, and a seemingly ever-changing safety rules for customers. With the convenience of the industrial food system

removed, we saw many consumers seeking alternative methods of sourcing food. For example, local farmers reported having waitlists for their community supported agriculture (CSA) shares, selling out their spring seedling sales, and seeing higher attendance at farmers markets.

At the same time, we saw a spike in the need for food assistance programs and a desire among our community members to help their neighbors in need. The WCFN led crowd-sourced fundraising initiatives to support struggling restaurants to cater meals at pantries when the pantries lost volunteers. We also saw other innovations taking place, like sliding-scale CSA shares that subsidized shares for low-income families and even national programs like the USDA's "Farmers to Families" food box programs.[1]

Our partnership sought to explore and build on these opportunities by convening producers, community members, stakeholders, and allies. This two-year project was to be divided into two phases:

- **Year 1: Rooting Deep:** Capture community innovations, needs, and opportunities through regional surveying, interviews, and asset mapping.
- **Year 2: Scaling Up:** Identify leverage points and develop them into regional projects, campaigns, and initiatives.

This essay is a personal reflection on what I learned from working on this project and does not necessarily reflect the views of the WCFN or any of our partnering organizations. The work we embarked on was one of the biggest challenges I have faced in my career to date. Navigating organizational alliances is messy, and while there is no clear pathway to success, I believe I have valuable insight to offer food systems leaders when it comes to working on large-scale regional projects in this work, trust and relationships are the most valuable resources toward building our circular economy.

Background

Prior to receiving this grant, the WCFN was focused solely on helping our small post-industrial city of Windham, Connecticut (CT). Our work has been centered around redistributing resources already existing in our community. We embraced this ethos long before the term "circular economy" entered the food system zeitgeist, and not just because it aligns with our mission of building a just, equitable, and sustainable food system but also out of necessity.

The WCFN facilitates a variety of food systems projects, and managing these relationships is at the heart of this work. The WCFN was launched in 2015 through an initiative to broadly survey local food system partners as well as a "dialogue-to-action" process that was facilitated by Everyday Democracy and Grow Windham. This process engaged diverse community members and food system partners in a series of community dialogues and an "action forum." Our projects and priorities emerged out of this process and therefore have the mandate of our constituents as well as represent the leveraging of local resources to meet local food system needs and opportunities. For the first few years our organization was organized into working groups around different aspects of our food system. See Figure 1.

However, we found that members were not connected and little action was being taken beyond discussing these issues. When I stepped into a leadership role in 2018, one of my first actions was to dissolve these siloed working groups. I felt it was a symptom of a larger trend I was seeing in food system work. Organizations were not communicating, and as a result they were wasting valuable time and resources duplicating programs instead of working together.

We shifted to a project-based perspective, which not only engaged more community members around tangible projects but also fostered collaboration between entities and community members to achieve our goals of redistributing resources. We still touch each aspect of this original food system diagram, but we have blurred the lines in making sure they all feed into each other. See Figure 2.

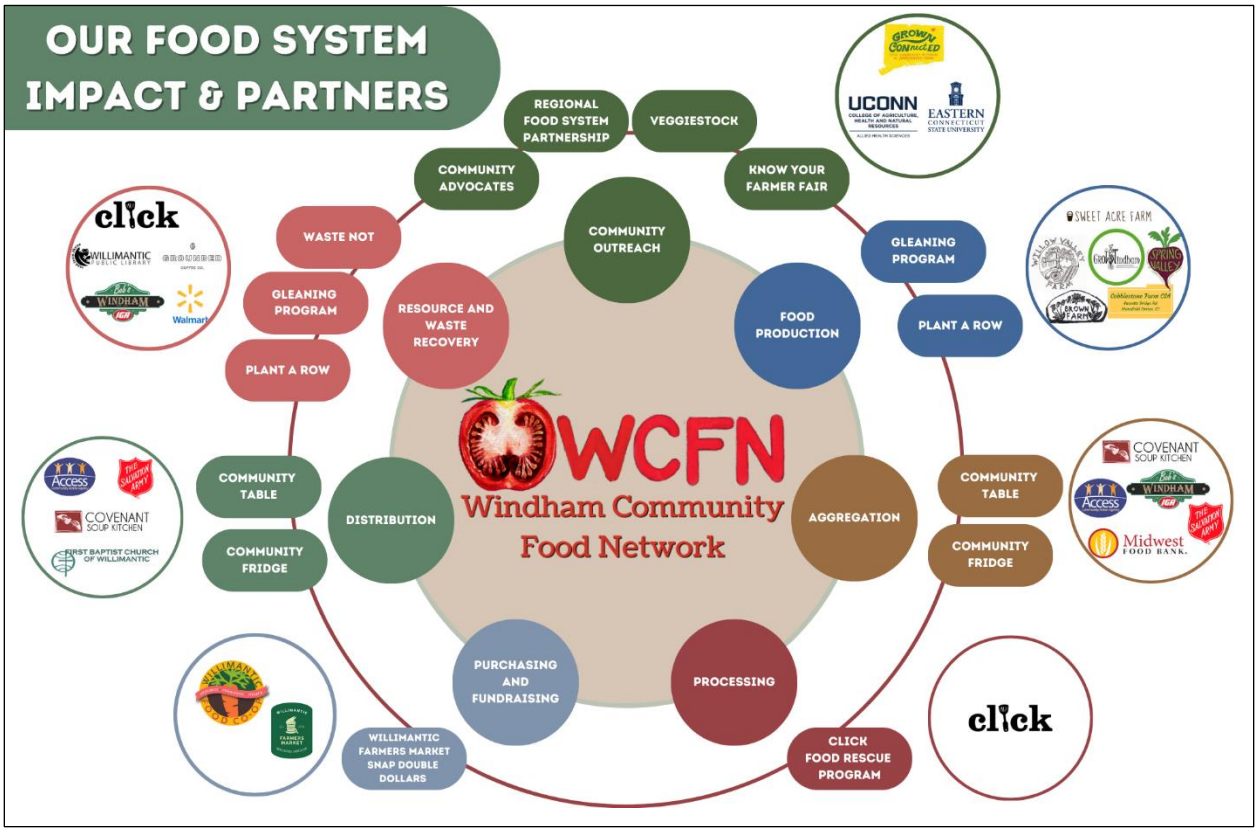
[1] https://www.ams.usda.gov/selling-food-to-usda/farmers-to-families-food-box

Figure 1. Windham Community Food Network Food System Working Groups

For example, the Community Table/Mesa Comunitaria (CT/MC), a program of WCFN, is a constituent-led food pantry that increases access to nutritious food and community voice. Originally a response to COVID-19, the program has continued beyond its initial funding through crowdfunding, shareholder participation, and integration with other local food resources. Both the participation of its recipients and fundraising support demonstrate the community's commitment to the program to continue and evolve.

Through the CT/MC program, we deliver weekly boxes of food to 35 families, with an emphasis on reaching Latinx women, teens, and elderly in Willimantic. These boxes are filled with food gleaned from local farmers, gardeners, and pantries, and supplemented with items purchased through community fundraising

Figure 2. Windham Community Food Network Food System Working Group Projects and Partners



efforts. We provide stipends to recipients to enable them to play a role in administering the program.

The CT/MC, like all other WCFN programming, is committed to reducing waste and redistributing food resources (such as seeds, seedlings, and produce) that are already available in our community. We facilitate seed and plant distributions to community members with the help of "Plant-a-Row" donations from agricultural schools and farms. Community members can access a catalog of seeds year-round at our local library, and we distribute donated seedlings at our "Veggiestock" event, where local organizations also provide gardening support to the public. Any surplus food collected is brought to other pantries in town or to a cooperative licensed kitchen, where it is processed into shelf-stable items, limiting waste even further and extending the reach of our resources long past our limited growing season. We also operate a "Waste Not" composting program that collects food scraps at local events which is then made into compost and redistributed back to the community for free to use for community gardens and "Plant-a-Row" participants. Through shared values for sustainability, we have been able to be responsive to both constituent needs and environmental concerns in our community.

Lessons Learned

In 2021, I felt like we had figured out much of the puzzle of our local community and were excited to see how we could scale our work throughout the Eastern Connecticut region. While I am proud of all the work we accomplished during this time as a team, I feel the most valuable result of this project were the lessons I learned as an individual around what it takes to administer regional food system projects. I would like to share five of these key lessons so other organizations and researchers can learn from our Regional Food System Partnership journey.

1. Be intentional and relationship-oriented when building a structure.

In the nonprofit community, we talk at length about the need to break down silos. Silos lead to a duplication of work being done across communities that ultimately wastes valuable resources as organizations reinvent the wheel instead of building on one another's work. Our Regional Food System Partnership sought to break down these silos by gathering stakeholders to discuss our region's work together. However, a partnership is only as representative as who shows up. With much of our work led by the WCFN, our partnership was overrepresented by stakeholders based in Windham.

In the beginning stages of our research, we had strong representation from the nearby community of New London, but their representatives' engagement waned during year two, when operationalizing our work was becoming increasingly Windham-based. I cannot fault us for this, as it was the system we knew best, but we should have made a more concerted effort to have equal representation. We ran into a similar issue during our initial research phases with another city, Norwich. We had limited connections to the community, and as a result we were not nearly as effective in identifying challenges or opportunities for their communities.

If given the option to embark on this journey again, it would not be framed as a Windham-based project looking to scale up. Instead, it would be framed as multiple hubs, with dedicated staff in each hub, working on bridging the divides between our communities.

2. Think beyond the immediate scope of the issue.

To build on the need to bridge communities, I have seen firsthand that achieving what we think of as a "regional" food system is again not simply a matter of scale. There is no "one-size-fits-all" solution. During our research phases we were able to identify many of the same needs across towns, such as a desire for more culturally relevant crops or transportation for local food. However, when it came to operationalizing these opportunities into pilot projects, the similarities ended. In Windham, we have a high number of Latinx immigrants and the crops they were asking for reflected that, such as certain varieties of peppers and herbs. In New London, where there is a large Afro-Caribbean population, those communities were looking for different crops. This was contrasted even further in Mansfield, where we saw people asking for Asian varieties of vegetables and more halal items.

We ran into this same issue when we discussed

transportation. Residents in urban areas, where there is already access to public transportation, were seeking more local options downtown. Meanwhile, in the more rural communities we saw a demand for door-to-door delivery programs.

The socioeconomic, cultural, and political situations were so drastically different between communities that it became difficult to operationalize this information. Instead of building projects around these identified needs, we should have fallen back onto these geographical hubs and to build location-specific solutions that could address problems more effectively and holistically.

3. Begin with the limits of your data.

Knowing what is missing from your data is just as important as what your data contains. In our case, since the relationships with some communities were weak, we struggled in our wider community surveying efforts, resulting in a large portion of our community-based data coming from Windham and entirely missing voices of other communities, like those of Norwich. This provided us with ample opportunities to draw conclusions about Windham, but we were not able to extrapolate this across the region since each community varies so much.

Even in Windham, though, we were limited in the conclusions we could draw. Much of our food access surveying was done at food pantries in our community. While this is an important population to capture, these individuals have already found ways to access food. What about the individuals who have not found a way to utilize the existing pantries in our community? We were missing the voices of perhaps the most vulnerable in our population.

Our work was built and conducted in stages where we collected all the data, analyzed them, and then worked to operationalize the results. Instead of viewing our project as linear, however, we should have been building a more intentional cycle of data collection where we identified these missing voices in a preliminary analysis and sought them out through additional rounds of surveying and interviewing.

4. Your research is only as good as your question.

During our research we surveyed hundreds of community members, asking them how much local food they consumed. Instead of getting a clear answer to this, we found a huge variation on how consumers defined local. Some considered food grown in their town local, some considered all New England to be local, while others considered shopping at the closest grocery store to be local, regardless of where the food was grown.

Moving forward, it is important to us to come up with a unified definition around this term and properly train surveyors to explain this to survey participants, giving us a much clearer understanding of the "local" issue. What may seem obvious, or even just familiar, to you as an organizer or researcher may not be shared in terms of its understanding by the community you are working with. Again, this is where having a cyclical, not linear, mode of data collection becomes important in your work. It provides you the space to revise your questions as you move forward.

5. Effective community and university partnerships are key.

In the Northeast, there are no shortages of universities, professors doing research, and students looking to volunteer. Windham is located within a 10-minute drive of two major Connecticut universities. With limited resources, nonprofits often feel dependent on these relationships to get their work done, with this project being no exception. However, during my tenure with the WCFN I have had to learn the most effective ways to navigate these relationships that benefit both the community and the university. Oftentimes our communities can feel like a petri dish, with research being conducted but little benefit of the results coming from it. Other times, students are just handed over with little to no supervision, ultimately creating more work for the nonprofits to minimize any harm they may cause due to lack of training. I have also seen students be used for their labor but not learn any valuable lessons for their time.

I have found the best partnerships are those that have active engagement from both the community and university. A discussion needs to be had between the organization and university supervisors with clear objectives laid out ahead of time: What are the goals the community is trying to

reach through this partnership? What are the university's research plans? What do they plan to do with these results? What are the students' learning objectives? Who will oversee what? If any of these questions cannot be clearly defined, I have learned it is best to walk away from the opportunity—something that is not easy to accept in a field where there is always a shortage of labor—but ultimately worth it in the long run.

Conclusion

I fully believe that embracing circular economies is the way forward for community food system development. Nonprofits have become adept at stretching and recycling resources to make the most out of what they have. However, these programs all exist in a state of fight or flight when it comes to funding their work. We are beholden to chasing grants and bending our mission to fit the goals of funders rather than those in our actual communities. In the case of our Regional Food System Partnership, we realized that we needed to focus more on networking locally based solutions than trying to build sweeping regional solutions. However, this was not a part of our grant narrative, and we were forced to continue down a path and timeline that no longer made the most sense. I am so proud of the work we did and the partnerships that we built, but six months after our project funding has ended, I can already see the impacts of our work starting to diminish. We have retreated to keeping our own programs alive now that our funding source is gone.

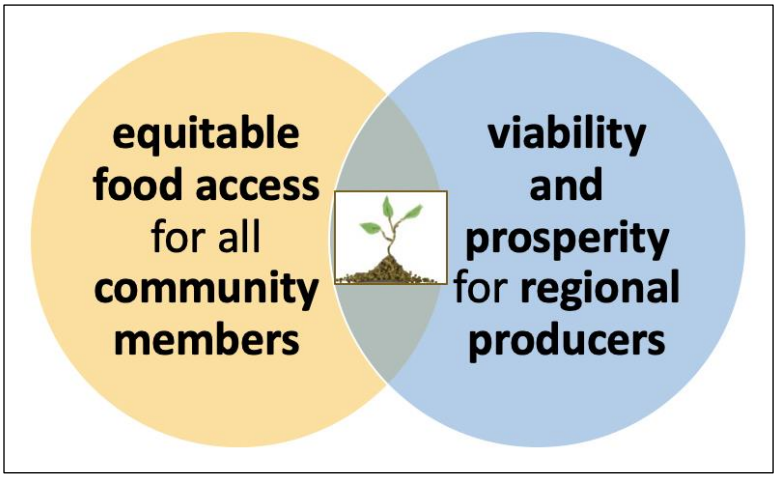
Instead, we need to be looking within our community for this funding. We need to be building diverse funding models that allow us the room to pivot. I believe the path to these models lies in how we are redistributing the other resources in our community such as food, compost, volunteers, and seeds.

We are currently operating in two different food systems: the "emergency food assistance" model and what I like to think of as the "foodie" model, where higher-earning residents are buying local food as a reflection of their values related to their community and environment. I see a real opportunity to bridge these models and create one food system where everyone has a seat at the same table by implementing sliding-scale models in our local food system, where profits are used to subsidize purchases for low-income consumers. So much of the work in alternative food systems right now focuses on either the farmer or the low-income consumer instead of looking at the "sweet spot" where these two issues intersect. See Figure 3.

Our Regional Food System Partnership sought to center this overlap, but after two years I see that the way to achieve this work cannot be done while being reliant on grant funding. It must be funded by the community. In hindsight, this should have been obvious all along: if a community does not support a project with its time, finances, and other resources, maybe that project is not what the community needs. Community buy-in is the path for alternative food systems success—for both the consumer and the farmer.

While we did not succeed in building the regional food system of our dreams for Eastern Connecticut in two short years, I am extremely proud of all the relationships built and lessons learned throughout this process. I believe we have truly begun to lay the foundation to achieving our original goals and see this experience as one that any food system organizer can learn from in their own work.

Figure 3. Windham Community Food Network's Regional Food System Partnership "Sweet Spot"



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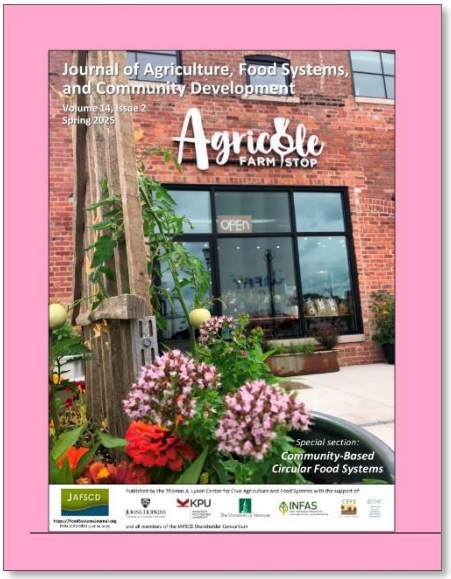
IN THIS ISSUE
DUNCAN HILCHEY

Community-based circular food systems



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Our spring 2025 issue features a special section of articles in response to our call for papers on **community-based circular food systems.** One example of an innovative C-B CFS, the farm stop, increases community resilience and adds to a circular economy. On our cover is Agricole Farm Stop, a farmers market that's open every day in historic downtown Chelsea, Michigan, USA. The store opened in July 2019 with the mission to grow the local food economy and cultivate community connection. Agricole is passionate about supporting nearby farmers, increasing local food access, and connecting its community members with fresh, sustainably grown food. Nearly 200 farmers sell their goods on consignment (with a 75/25 split between the farmer and Agricole). Since 2019, Agricole has returned US$5.8 million to local farmers and food businesses. (The cover photo is by Agricole and is used with permission.)

I extend a special thanks to the community-based circular food systems editorial team made up of **María Alonso Martínez, Jacob Park, Jim Worstell, Anna Davies, WarīNkwī Flores,** and **Sarah Rocker**. Please read their excellent thematic editorial to get the background and full scope of all the articles in the special section.

The issue begins with **John Ikerd's** The Economic Pamphleteer column, "Why not food-based communities?" in which he argues we should think about the opportunities for creating food-based communities "because it is right and good" and not necessarily politically or economically expedient.

Following Ikerd's column, we offer five non-peer-reviewed articles—three policy and practice briefs (on pork processing plant line speeds by **Kelsey Crawford** and **Patti Truant Anderson**, Oaxaca coffee by **Jesica Ariadna Jiménez-Mendoza, Norma Francenia Santos-Sánchez, Iván Antonio García-Montalvo, Marco Antonio Sánchez-Medina,** and **Alma Dolores Pérez-Santiago,** and improving the affordability of produce in Missouri by **Erica Williams, Participants of the 2024 Fruit and Vegetable Policy Convening, Lyndsey Ellis, Sagata Chatterjee, Thi Nguyen,** and **Sarah Anderson**), one commentary (on pesticide labeling in Spanish to accommodate farmworkers by **Catherine E. LePrevost, Joseph G. L. Lee,** and

Modjulie A. Moore), and one *Voices From the Grassroots* essay by **Gabriel T. Salah-Pfeiffer** (on communal gardening). We greatly value these non-academic contributions to JAFSCD and we hope they inform and inspire researchers, professionals, and practitioners in their work.

Next, we offer 12 open call papers.

In *Scaling up local food systems in context: Understanding and navigating constraints in the Palouse region*, **Soren Newman, Darin Saul, Steven Peterson, Colette DePhelps, Felix Haifeng Liao, Robert Heinse, Jodi Johnson-Maynard, Jane Kolodinsky,** and **Hannah Smith** explore the potential of small-scale local food production in a largely industrial agricultural region of the Pacific Northwest, U.S.

Catherine Horwitz and **Teresa Mares** examine the effectiveness of youth food justice programs in the Northeastern United States in *Empowering teens through food justice: An exploration of youth development programs*. And **Mecca E. Howe** and **Jennifer Meta Robinson** then explore the impacts of a "farm camp" for at-risk children in *Urban agriculture education for teens: A multidimensional study of positive psychosocial and metacognitive outcomes*.

In *How to address resource inequity in collaborative work: Reflections on partnerships between Vermont and Puerto Rico*, **David S. Conner** presents a reflective essay on the institutional barriers in building relationships with stakeholders outside the U.S. mainland.

Similarly, **William Schanbacher, Dhalia Bumbaca, Luciana Jones, Ana Vidal, Christiane Barros-Adwell, Anthony Olivieri,** and **Jennifer Kue** offer a reflection of the collaboration between a university and community partners utilizing community-based research methods in *Setting tables for community food sovereignty: Building a food sovereignty toolkit*. They find that flexibility, adaptability and openness to new ideas are essential to successful engagement.

Next, in *Assessing the existence of food deserts, food swamps, and supermarket redlining in Saginaw: A small, racially segregated Mid-Michigan City* **Dorceta E. Taylor, Ashley Bell, Abdeali Saherwala, Storm Lewis, Greg Rybarczyk,** and **Richard Wetzel** call for a more nuanced categorization of food-insecure communities and more significant efforts to ensure that residents can find places to purchase food when they want to.

In *Failure to launch: An analysis of an attempted central kitchen pilot program to serve childcare meals*, **J. Dara Bloom, David Yates, Gizem Templeton, Emma Brinkmeyer,** and **Caroline Hundley** identify the four key factors leading to the demise of a farm-to-childcare project, including the underlying power dynamic between the funder and recipient, reliance on a single project champion, lack of buy-in from community stakeholders, and failure to involve the county health department early in the planning process.

In *Crafting a grassroots introduction to food policy course*, **William Schanbacher, Joe Bon,** and **Erica Hall** present a reflective essay providing insights from a pilot, public-facing virtual course that they developed and delivered in collaboration with a statewide food policy council.

Next, in *Unpacking innovation demands for climate-resilient mixed farming systems in sub-Saharan Africa: A case of northern Ghana*, **Abena Ofosu, Thai Thi Minh,** and **Birhanu Zemadim Birhanu** find that climate-resilient innovations in sub-Saharan African contexts require multiple pathways, including innovation platforms, innovation bundling, multi-actor partnerships, inclusive finance, and multistakeholder dialogues.

Md Mahbubul Alam, Sharjana Akter Shaba, and **S. M. Ashik-Uz-Zaman** then identify the factors in selecting in *What does matter most for farmers' choice of marketing channels? Evidence from coastal Bangladesh,* concluding that direct marketing is favored by smaller limited-resource operators, especially women.

Next, in *Understanding smallholder dairy productivity and poverty reduction in Eritrea: An A-WEAI approach*, **Stephen Onakuse, Lilian Treasure, Okbasilassie Msghina,** and **Kahsay Negash** use the innovative Abbreviated Women Empowerment in Agriculture Index (A-WEAI) to inform strategies to simultaneously boost productivity and market access and reduce poverty among female farmers.

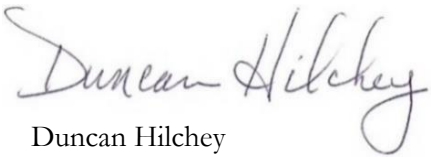
In our final open-call paper, entitled *Measuring community power: A scale to measure collective self-determination, Embodied Earth Care, and Ubuntu among urban farmers and gardeners,* **Ashley B. Gripper** and **Tori L. Cowger** report on the application of an innovative tool called Agriculture Community Power Scale (AgCPS), which breaks from more traditional methods of measuring well-being such as BMI and plant food consumption metrics.

We wrap up the issue with a review by **Christopher Shane Elliott** of the recent book *Handcrafted Careers: Working the Artisan Economy of Craft Beer* by Eli Revelle Yano Wilson.

Between the special issue focus on community-based circular food systems, the open-call articles, and the non–peer-reviewed articles, the spring 2025 issue is one of our biggest issues ever. I want to express my appreciation to all the volunteer reviewers, mentors, copyeditors (both volunteer and contract), and associate editors who contribute to the production of JAFSCD. It never ceases to amaze me how generous this group is, month after month.

We are aware that some of our volunteers may be deeply affected by the current political and economic climate. Managing Editor Amy Christian and I extend our best wishes in navigating these turbulent times. We stand with you, and if there is any way we can contribute to your professional development (such as writing a letter of support or serving as a reference), please do not hesitate to ask.

In solidarity,



Duncan Hilchey
Publisher and editor-in-chief

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THE ECONOMIC PAMPHLETEER
JOHN IKERD

Why not food-based communities?

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During the late 1990s, it appeared to some of us that by the 2020s the industrial food system might be largely replaced by a sustainable food system (Ikerd, 2008). By then it was clear that the industrial food system was not ecologically, socially, or even economically sustainable. The number of farmers markets was doubling every 10 years (Sauer et al., 2022), and organic food sales, growing even faster, doubling every three to four years (Greene, 2014). In less than 50 years, the local food systems of the 1940s had been replaced by the industrial food systems of the 1990s. It seemed logical that by the mid-2020s, the industrial food systems might be replaced by more sustainable systems of food production and distribution. That now seems highly unlikely, if not impossible.

Nevertheless, the sustainable agri-food movement has persisted despite minimal support from government programs and passive-aggressive opposition from the "industrial agricultural estab-

John Ikerd is professor emeritus of agricultural economics, University of Missouri, Columbia. He was raised on a small farm and received his B.S., M.S., and Ph.D. degrees from the University of Missouri. He worked in the private industry prior to his 30-year academic career at North Carolina State University, Oklahoma State University, the University of Georgia, and the University of Missouri. Since retiring in 2000, he spends most of his time writing and speaking on issues of sustainability. Ikerd is author of six books and numerous professional papers, which are available at https://ikerdj.mufaculty.umsystem.edu and http://johnikerd.com.

*Why an **Economic Pamphleteer**? In his historic pamphlet* Common Sense, *written in 1775–1776, Thomas Paine wrote of the necessity of people to form governments to moderate their individual self-interest. In our government today, the pursuit of economic self-interest reigns supreme. Rural America has been recolonized, economically, by corporate industrial agriculture. I hope my "pamphlets" will help awaken Americans to a new revolution—to create a sustainable agri-food economy, revitalize rural communities, and reclaim our democracy. The collected Economic Pamphleteer columns (2010–2017) are available at https://bit.ly/ikerd-collection*

lishment."[1] A special issue of this journal in 2016, entitled *Short Supply Chains*, featured articles focusing on potential alternatives to industrial food systems (Hilchey, 2016). However, the articles revealed more challenges than successes. In an Economic Pamphleteer column in 2020, I questioned whether the local food movement was just another food fad or the food system of the future (Ikerd, 2020). Large agri-food corporations had co-opted the organic food movement, and the growth in farmers markets, community supported agriculture operations (CSAs), and other local food options had seemingly slowed or leveled out.

The COVID-19 pandemic rekindled hope for the future of the local food movement by dramatically revealing the lack of resilience in the industrial agri-food system. In another special issue of this journal in 2021, *The Impact of COVID-19 on the Food System* (Hilchey, 2021), Catherine Campbell (2021) provides a comprehensive review of the literature on the evolution of the local food movement and its resurgence during the pandemic. However, her study revealed that the COVID-19 experience failed to significantly change local government stakeholders' attitudes regarding local foods.

Despite the increased sales of local foods during restaurant closures and emptied supermarket shelves, consumers have since returned to mainstream food retailers. Food corporations used the short-run supply disruptions to raise prices—and have continued to reap record profits (Perkins, 2024). Consumer concerns have shifted from food access to food prices. After near-average net farm incomes in 2020, U.S. farmers realized record-high incomes from 2021 to 2023 (U.S. Department of Agriculture, Economic Research Service [USDA ERS], 2024). The pandemic provided little economic incentive for change from industrial to more sustainable farming systems.

A collaboratively authored article in the special COVID-19 issue of this journal made the case for a complete dismantling and rebuilding of the food system based on the principles of food sovereignty (James et al., 2021). The dismantling principles according to the article were Decolonization, Decarbonization, Diversification, Democratization, and Decommodification. The rebuilding principles were Relationality, Respect, Reciprocity, Responsibility, and Rights. Indigenous communities are the leading advocates of food sovereignty in North America, perhaps because they have suffered culturally as well as physically from the industrial food system (Berardy et al., 2019). The principles of Indigenous food systems are also principles of agri-food sustainability.

However, dismantling and rebuilding the entire food system would require a fundamental change in farm and food policy at the national level. Barring a transformational change in public perceptions and attitudes, sustainable alternatives to the industrial food system seem destined to remain with farmers producing for niche markets that are limited to caring consumers with discretionary incomes.

Perhaps we should think about the opportunities for creating *food-based communities* — communities of interest that exist within larger communities of place.

In previous columns, I have advocated creating networks of sustainable community-based food systems as a sequential means of achieving local, regional, national, and ultimately, global agri-food sustainability (Ikerd, 2016). I have suggested community food utilities organized as vertical cooperatives to serve as sustainable alternatives to market competition and vertical integration (Ikerd, 2012). Food sovereignty provides a logical conceptual framework for such community-based food systems (Ikerd, 2015). In a 2022 column, I outlined a scenario for meeting the nutritional needs of low-income consumers receiving government food assistance by relying more on raw and minimally processed, locally produced

[1] I count among the "industrial agricultural establishment" the American Farm Bureau Federation, corporate agribusinesses, and agricultural commodity groups.

foods and significantly more meals prepared at home (Ikerd, 2022). This incremental approach to transformational change would not require major changes in state or federal farm or food policies, although policy changes could be helpful.

However, even community-based food systems have seemed too big a challenge for those involved in the sustainable agri-food movement. In today's divisive political and cultural environment, the task of bringing an entire community together to support an admittedly progressive cause seems daunting. Instead of thinking about the challenges in creating *community-based food systems*, perhaps we should think about the opportunities for creating *food-based communities*. A food-based community would be a *community of interest* that exists within a larger *community of place*. A food-based community would include only those who share a commitment to food sovereignty, meaning the right of everyone in the community to enough healthy, culturally appropriate, and sustainably produced food and the right of communities to choose their own food systems.

Unlike current ecovillages, agrihoods, and other intentional communities, members of food-based communities could reside anywhere in the larger community, and producers could operate in existing as well as new locations. Food-based communities must be small enough to reflect a common sense of commitment to ecological and social responsibility. They would not need to include the entire community to be economically viable. For example, assume the households in the food-based community can afford to spend an average of US$8,640 per year for food (US$9,000 per household for the 80% not receiving government assistance, and US$7,200 for the 20% receiving assistance) (Statista, 2025). If the farmers supplying products to the community were paid 50% of total expenditures, they would receive US$4,320 per community member.

If farmers producing food for the community can keep their costs low enough to retain 40% of their total sales for net farm income, US$200,000 in total sales would generate US$80,000 in net farm income. If community members received all their food from the community and the farmers received all their income from the community, each farm would provide enough food for 46 households. More realistically, if members received 50% of their food from the community and farmers provided 50% of their production to the community, the number of community households per farm would be the same: 46 per farm. The percentage commitments would need to reflect individual communities' food preferences and production potentials. However, both community members and producers would likely need to make significant adjustments in diets and production systems to move food-based communities toward food sovereignty.

While the number of community members and farmers needed for a viable food-based community may be challenging, it is not unreasonable or insurmountable.

With a 50% commitment to the community, farmers could still operate CSAs, sell at farmers markets or to restaurants, or continue other direct sales. A 50% procurement commitment by community members would leave 50% of their food budget for foods that cannot be produced or processed locally, particularly manufactured and convenience foods. Food communities could operate restaurants or other eating establishments to provide away-from-home meals and utilize products that might otherwise be wasted.

The percentage commitments and other specifics would need to be worked out cooperatively and be acceptable to both farmers and community members. The example just gives some indication of the potential size of a viable food-based community. For example, a 50% commitment by a community of 200 members would provide 50% of the income for four farm households. If the preferences of community members are comparable to those of the general population, a 200-member community could support two producers of animal products, one fruit and vegetable producer, and one producer of other products. If the community grows to 500 members, it would support 11 local

farm households: six for animal products, three for fresh produce, and two for other products. While the number of community members and farmers needed for a viable food-based community may be challenging, it is not unreasonable or insurmountable.

A 200-member food-based community would provide over US$430,000 to cover operating and administrative costs, based on a 50%-50% revenue split between the community organization and farmers. A 500-member community would provide over US$1,000,000 to cover the costs of preparing products for sale, operating the retailing or distribution facility, and carrying out the community's organizational and administrative functions.

Existing organizations could initiate food-based communities that could evolve into vertical cooperatives or community food utilities as the communities grow. Food hubs already have the assembly and distribution infrastructure to support food-based communities. Local food policy councils would be a logical source of organizational expertise and community leadership. Food hubs could continue to perform their current functions, and food policy councils could continue to serve the larger community. According to the Centers for Disease Control and Prevention (2018), 212 food hubs and 234 active local food policy councils were active in the U.S. in 2018.

Food stops are a more recent means of making sustainably produced foods accessible to consumers and returning a larger share of consumers' dollars to farmers (Hodder, 2024). The first national farm stop conference was held in 2023, and at least 16 farm stops are in operation in the east-central U.S. (Farm Stop Conference, n.d.). Food stops could provide the retailing or distribution function for food-based communities while continuing to provide a niche market for local farmers to serve the larger non-member community.

The new USDA Reinvestment Fund initiative is making US$60 million in loans, grants, and technical assistance available to support food retail and food retail supply chain projects that increase access to healthy food in communities underserved by grocery stores (USDA, 2024). A priority of the program is to establish grocery stores in rural and urban "food desert" communities to give low-income families affordable access to fresh, nutritious foods. However, there are legitimate concerns regarding the economic viability of grocery stores in areas that have been abandoned by mainstream food retailers.

A local food-based community with 200 or 500 members could provide a neighborhood grocery store with a stable economic foundation needed to provide everyone in the community with access to healthy, sustainably produced foods. Government food assistance funds for low-income community members could provide a stable economic foundation for the food-based community, keeping it economically viable and able to eventually expand to include the whole community. Food-based communities could also help restore the social fabric of both rural and urban communities.

Food-based communities will be economically viable only if their members, including their farmers, are motivated by the social values or benefits that result from being a part of a caring community and from doing something simply because it is right and good.

However, food-based communities will not succeed if they are motivated solely or primarily by the desire to increase farmers' incomes or reduce the consumers' food costs. The current industrial agri-food system is the inevitable consequence of farmers maximizing profits and consumers demanding cheap food. Food-based communities will be economically viable only if their members, including their farmers, are motivated by the social values or benefits that result from being a part of a caring community and the ethical values that arise from doing something simply because it is right and good—ensuring that everyone has access to good food. Food-based communities would need to be similar in concept

to the early CSAs, which were about creating caring communities as well as supporting farmers who cared for the land and produced good food (McFadden, 2004).

Sustainable food-based communities would need to be guided by the previously mentioned principles of the food sovereignty movement: Decolonization, Decarbonization, Diversification, Democratization, and Decommodification. They must insulate themselves from the colonization, carbonization, specialization, corporatization, and commodification of the industrial agri-food system. They must be fundamentally different from the existing system, rather than attempt to compete. Sustainable food-based communities must function by the principles of Relationality, Respect, Reciprocity, Responsibility, and Rights. Community members must build relationships, respect each other, help each other, be responsible to each other, and be committed to securing the basic human rights of all, including the right to good food.

Unfortunately, the consensus needed to establish food sovereignty does not exist at state, national, or global levels and is not likely to exist in the foreseeable future. However, community food sovereignty could be achieved at the local level by creating food-based communities. This may not be easy in today's divided society, but it is not illogical or unsurmountable. Regardless, we have seen limited success in trying to change the food system by creating community-based food systems. Why not try food-based communities?

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POLICY BRIEF

Policy and practice brief on the *2019 New Swine Inspection System*, line speeds, and workers

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Summary

The U.S. Department of Agriculture (USDA)'s Food Safety Inspection Service (FSIS) introduced the Modernization of Swine Slaughter Inspection Ruling and New Swine Inspection System in 2019 (USDA FSIS, 2019). This ruling eliminated the cap on the maximum swine-processing line speed, which had been regulated since 1981, instead allowing processing facilities to determine their own line speeds. Workers and worker advocacy groups immediately met the *New Swine Inspection System* with public criticism, citing concerns for worker safety under the new system. The *New Swine Inspection System* is currently being used in six time-limited trial facilities with an end date of May 2025, while data is collected to inform the future of the system (USDA, 2025). In this policy and practice brief, we discuss the effect of the *New Swine Inspection System*'s increased line speeds on workers in swine processing facilities, using a review of the literature. We found that there is strong evidence that line speed is associated with higher worker perceptions of injury risk, lower worker well-being, and higher risk of injuries from repetitive tasks. Additionally, line workers unanimously oppose increases to line speed and are advocating for reduced line speeds.

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Author Note

Kelsey Crawford's master's in public health (MPH) capstone project was the basis for this article.

Keywords
line speed, line worker, meatpacker, meatpacking, swine processing, swine production, worker safety, worker well-being, meatpacking injuries, *New Swine Inspection System*, Modernization of Swine Slaughter Inspection Ruling

Definitions

Line speed: The speed at which an animal is processed through a plant. This is regulated by the USDA. As of February 2025, the maximum line speed in most swine slaughter plants is capped at 1,106 heads per hour, although there is no maximum line speed limit in the six time-limited trial *New Swine Inspection System* facilities (USDA, 2019).

Line worker or meatpacker: The worker responsible for processing the animal as it moves along the automated moving "line," which is a conveyor belt with a set speed. We are discussing in particular the workers who do tasks of processing, cutting, deboning, shaving, grinding, and packaging the pork along the line as it is moving.

Abbreviations

National Institute for Occupational Safety and Health ..... NIOSH
Occupational Safety and Health Administration ..... OSHA
The United Food and Commercial Workers International Union ..... UFWC
U.S. Department of Agriculture ..... USDA
USDA Food Safety Inspection Service ..... FSIS
U.S. Department of Health and Human Services ..... HHS

Modernization of Swine Slaughter Inspection Ruling: Policy Review

In 2019, the FSIS under the Trump Administration introduced the Modernization of Swine Slaughter Inspection Ruling, revoking maximum line speeds and replacing them with an optional *New Swine Inspection System* (USDA, 2019).

Overview of the New Swine Inspection System

The *New Swine Inspection System* allowed swine slaughter facilities to run their line speed as fast as desired to increase productivity, asserting that "this increase in line speed is synonymous with an increase in industrial efficiency" (USDA, 2019, p. 52335). This decision was unanimously praised by the swine industry and unanimously criticized by worker organizations; both perspectives are cited in the ruling, but the USDA explicitly states that the ruling does not consider worker safety or well-being (USDA, 2019).

After releasing the *New Swine Inspection System*, the USDA stated it does not have "authority to regulate issues related to establishment worker safety" (USDA, 2019, p. 52305). The Occupational Safety and Health Administration (OSHA), the body regulating worker safety for meatpackers, has documents recommending that processing facilities decrease their lines speeds to lower worker injury rates (OSHA, 1993). These publicly available documents were cited in the Modernization of Swine Slaughter Inspection Ruling, but OSHA was not involved in developing the *New Swine Inspection System* and does not have jurisdiction over issues of line speed; the USDA is the single regulatory agency covering line speeds. The FSIS declares that the *New Swine Inspection System* "remove[s] unnecessary regulatory obstacles to industry innovation by revoking maximum line speeds and allowing establishments flexibility to reconfigure evisceration lines" (USDA, 2019, p. 52300).

Timeline of the New Swine Inspection System

The United Food and Commercial Workers International Union (UFWC) filed a lawsuit immediately following the Modernization of Swine Slaughter Inspection Ruling in an effort to halt the increase in line speeds

(UFCW, 2021). Seven states' attorneys general filed briefs supporting this lawsuit (UFCW, 2021). In June 2021, the Federal Court ordered the FSIS to remove the portion of the *New Swine Inspection System* that eliminated maximum line speed caps (UFCW, 2021). All processing facilities were ordered to cap their line speeds at 1,106 heads per hour (USDA, 2019). Thirty days later, the FSIS granted participation in a time-limited trial of the *New Swine Inspection System* to six processing facilities located in Illinois, Michigan, Minnesota, Nebraska, and Pennsylvania. According to the U.S. Senate Committee on Agriculture, Nutrition, and Forestry (2023), these six swine processing facilities are high-volume, in states that are responsible for processing 30% of the U.S. pork supply, and 40% of hogs in the U.S. are located within 100 miles of these six plants.

This *New Swine Inspection System* time-limited trial has been extended four times, with a current expiration date of May 15, 2025 (USDA, 2025). The National Pork Producers Council has stated, "We appreciate USDA and FSIS for listening to the pork industry and taking another step toward making permanent these increased line speeds" (National Pork Producers Council, 2024, para. 2). Meanwhile, as they have been for decades, workers and worker-led organizations are publicly fighting and protesting the increase in line speed.

Consideration of Workers in the New Swine Inspection System

The FSIS did not indicate in the Modernization of Swine Slaughter Inspection Ruling that it conducted or solicited a comprehensive risk assessment or literature review prior to the Ruling. There are indications that there are already serious worker-safety issues in the facilities in the time-limited trial (Barrett, 2019; Norfolk Daily News, 2024; Polansek & Huffstutter, 2021). One participating facility is operated by Tyson Fresh Meats, Inc. According to the Federal Good Food Purchasing Coalition's (2023) report, "Impact Analysis, Measuring and Modeling Climate, Environmental, and Social Impacts of Federal Food Procurement," Tyson has the highest number of serious OSHA violations and is also one of the largest recipients of USDA procurement contracts. While USDA procurement contracts are intended to be guided by the agency's Agriculture Acquisition Regulation labor standards, in some cases these contracts are still being awarded to companies with many labor violations (Federal Good Food Purchasing Coalition, 2023). These government contracts are lucrative. For example, Tyson was paid over US$248 million by the USDA for contracts in 2022 (Federal Good Food Purchasing Coalition, 2023). These high payouts are another motivation for meatpacking companies to increase line speeds and minimize injury reporting.

Context for the *New Swine Inspection System*

The *New Swine Inspection System* has an impact on workers that is influenced by other factors, including the work setting of the processing line, demographics of swine processing line workers, and evolution of line speed policies.

Work Setting of the Swine Processing Line

The swine-slaughter work environment is fast-paced and repetitive. After each hog is slaughtered and hung on the line, workers butcher, slice, and package the carcass based on various standards and cuts (Schweihofer, 2014). Each worker on the slaughter line is assigned to one task, which they do repeatedly at the speed of the line (Schweihofer, 2014). Cuts of the hog move along a conveyor belt, and the worker must perform their cut or packaging task quickly as the line is moving (Schweihofer, 2014). Based on the maximum line speed established by the USDA in 2019, the worker is completing this task within three seconds and repeating the same movement at least 8,848 times per day. This pace is increased limitlessly for the thousands of workers in the six time-limited trial *New Swine Inspection System* processing facilities that have unlimited line speeds.

In addition to these stressors, line workers are often stationed very close to one another in the slippery, cold environment using automated knives, saws, and other sharp tools (Culp et al., 2008; Ebner et al., 2016). According to workers in a 2015 Oxfam report, line workers are unable to take a break to use the restroom or hydrate since the line never stops moving. Of these workers, almost all reported being denied a restroom break, wearing diapers, or urinating on themselves while working (Oxfam, 2015). One line worker told

researchers, "I had to wear Pampers. Myself and many, many others had to wear Pampers. It made me feel ashamed" (Oxfam, 2015, "Pushed to the limit—and beyond," para. 2).

Swine Processing Workers

Meatpacking is one of the most dangerous industries for workers in the U.S., according to U.S. Bureau of Labor Statistics data (Smith, 2017). A study by Culp et al. (2008) found that there is at least a 33% chance of traumatic injury for swine processing line workers after just six months of employment, and data from OSHA show that each day, 27 U.S. line workers experience an amputation, loss of an eye, or injury requiring hospitalization (Rimmler-Cohen, 2023). In a survey conducted by Nebraska Appleseed in 2009, one anonymous meatpacking worker was quoted as saying, "They should recognize that we aren't machines" (Nebraska Appleseed, 2009, "Workers Comments from the Survey," para. 2).

A study conducted by Leibler and Perry (2017) found that line workers reported more than two times as many injuries to them than industry estimates show. A report by Human Rights Watch (2004) quoted a meatpacker who said, "They have us under threat all the time. They know most of us are undocumented—probably two-thirds. All they care about is getting bodies into the plant. My supervisor said they say they'll call the INS [Immigration and Naturalization Service] if we make trouble" (Compa et al., 2004, "Immigrant Workers in the Meat and Poultry Industry," para. 1). There are discrepancies in the meatpacking industry's injury data for many reasons, including immigration and language barriers, lack of federal protections, and the historical destabilization of food-chain labor in the U.S.

An estimated half of meatpackers are foreign-born, and most researchers estimate that at least one quarter of all meatpackers are undocumented, although these numbers are difficult to estimate and are thought to be higher (Bauer & Ramírez, 2010; Compa et al., 2004; Passel, 2005). Workers claim this results in underreporting due to fear of deportation if they were to interact with OSHA, and workers report experiencing threats to their immigration status from their employers if they do report injuries (Bauer & Ramírez, 2010; Compa et al., 2004; Constance et al., 2023; Passel, 2006). Line workers also report fearing retaliation from employers due to at-will employment laws and a lack of federal whistleblower protections (Fritzsche, 2013).

Line Speed

Line speeds have been regulated by the USDA in the swine industry since 1981 (Office of the Federal Register, 1981). Currently, the maximum line speeds in most swine slaughter plants are capped by the federal government at 1,106 heads per hour, meaning 18 per minute, or one per three seconds; there is currently no limit in the six time-limited trial *New Swine Inspection System* facilities (USDA, 2019). Line speeds have been continually increased over the years; some facilities have shown increased line speed by 50% within just a five-year window (Ken & León, 2022; McConnell, 2019). Facilities often increase line speed without increasing labor proportionately, forcing workers to repeat movements more often, more quickly, and under more strain (Ken & León, 2022; McConnell, 2019). Maximum line speed caps were established and upheld by the USDA to facilitate easier food safety inspections, and the USDA acknowledges that there has never been explicit consideration of worker well-being regarding line speed (USDA, 2019).

OSHA is responsible for the implementation of safety regulations and standards for this industry, but there are no specific OSHA regulations that protect workers from line speed, repetitive stress, or related musculoskeletal injuries, which are key risks faced by processing line workers, especially with increased line speed (U.S. Government Accountability Office [GAO], 2016). These issues fall under OSHA's General Duty Clause, which is the catch-all statute requiring "a place of employment which are free from recognized hazards" (OSHA, 2021, Sec. 5 "Duties," para. 1), and when OSHA does complete investigations, it rarely issues citations based on this clause (OSHA, 2024). According to OSHA itself in its 2021 COVID-19 Emergency Temporary Standard, the General Duty Clause "is not a good tool for requiring employers to adopt specific, overlapping, and complementary measures" (OSHA, 2021, p. 32418).

Review of the Literature

We reviewed available literature on the impacts of increased line speed on processing line worker injuries and well-being, and found that the associated increase in repetitive movements from increasing line speed will increase worker injuries, and that workers perceive unlimited line speed as a significant risk to their health and well-being.

Line Speed and Worker Injuries

There is evidence that line speed is positively correlated with line worker injury based on worker self-reports of perceptions of line speed and perceptions of injury rates. In a study of processing line workers in Arkansas, Choi and Constance (2019) found that all 198 participants reported increased difficulties at work when the line speed increased, and half reported feeling unsafe doing their job at the current line speed. Every worker who spoke with Human Rights Watch in a 2019 report cited speed of work as a major risk of injury and illness. In multiple studies, line workers have reported that supervisors control the line speed in their facilities and the workers feel that supervisors do not care about worker safety or safety procedures, leaving them without proper injury reporting channels (Choi & Constance, 2019; GAO, 2016; Lander et al., 2012).

The National Institute for Occupational Safety and Health (NIOSH) conducts Health Hazard Evaluations of workplaces, including meat-processing plants, in response to specific requests, but only in select cases where there is "reasonable cause to justify conducting an investigation" (HHS, Centers for Disease Control and Prevention, & National Institute for Occupational Safety and Health [NIOSH], 2009, Sec. 85.4 "Acting on requests," para. 1), and NIOSH states they may not have authority to conduct an investigation without the cooperation of the employer (HHS, 2009, Sec. 85.4). Notably, in one 2014 evaluation of a Maryland poultry plant, NIOSH researchers found that 81% of the jobs had hand activity levels above the American Conference of Governmental Industrial Hygienists' action limit, which is defined by the level at which there is moderate risk for musculoskeletal disorders (Ramsey et al., 2015). This same report concluded that 76% of participants tested abnormal on a nerve conduction test of one or more hands (Ramsey et al., 2015).

The literature shows that meat processing workers experience high rates of repetitive stress injuries, carpel tunnel syndrome, and nerve issues in the hand and arm, and these repetitive movement injuries are the most common injuries for line workers (Arcury et al., 2015; Choi & Constance, 2019; GAO, 2016; Lander et al., 2012; Ramsey et al., 2015). As line speed increases, repetitive movements for workers increase. A study by Rosenbaum et al., 2015) found distinct levels of risk based on the type of job being performed by the line worker (such as deboning versus cutting) raising considerations of differential risk for types of workers.

HHS and NIOSH have reportedly conducted minimal research on line speed, and these studies have often provided inconclusive results due to lapsed time (GAO, 2016). Even so, in a 2016 GAO report on workplace safety and health, NIOSH reported that line speed, in conjunction with other factors, "affects the risk of both musculoskeletal disorders and injuries among workers" (p. 30). NIOSH and OSHA have studied ergonomic risks and recommended that employers protect workers "by reducing the amount of time the employee performs repetitive motions, by reducing the speed at which the employee performs the tasks, or by eliminating certain repetitive tasks during recovery" (as quoted in Fritzsche, 2013, "Processing Line Speeds Blamed," para. 6). The literature recommends that future studies gather primary data to quantitatively determine the relationship between line speed and worker injury rates, but there are many barriers to conducting this research (GAO, 2016).

Line Speed and Worker Well-Being

The literature shows that line speed is negatively correlated with line worker well-being. The Southern Poverty Law Center (Fritzsche, 2013) reported that workers overwhelmingly report being unable to influence line speed and feeling desperate to slow down the line. Workers report struggling to keep up with the line speed and being threatened by supervisors when they were unable to perform at the speed, requested restroom or water breaks, experienced injury, or complained of pain (Ebner et al., 2016; McConnell, 2019).

Workers report that line speed is not the only threat to their well-being, but it is a major source of stress and worry (Choi & Constance, 2019; GAO, 2016; Lander et al., 2012). In a 2021 study, Ramos et al. found that line workers were aware of behaviors that may reduce their risk of injury, such as sharpening their knives or adjusting their posture,, but felt they were unable to engage in these behaviors due to the speed of work. A worker was quoted in this study saying,

> We don't speak English. We don't have another option. We don't have another form of work. Because that is where they pay us the best and we want to get ahead, but that way we are also killing ourselves because every day the line is faster. (Ramos et al., 2021, "Workers conform because they feel powerless," para. 2)

Limitations

There are limitations to the results of this review of the literature. Most of the primary data regarding line speed and worker injury or well-being is collected from the perspective of the worker, rather than using quantitative measures. While worker perspectives are valuable data, this limitation creates barriers to addressing the question of what an appropriate line-speed cap is and how much line speed must be reduced to decrease worker-injury rates. Line speed does not harm workers in a vacuum; rather, it is interacting with the many other dangerous factors that affect swine-processing line workers, making this a complicated issue to quantify. Other factors in this relationship include variable facility structures, work types, labor-to-livestock ratios, and workforce demographics.

Conclusion

There is sufficient evidence of the negative impacts of increased line speed on worker safety and well-being to end the current time-limited trial of the New Swine Inspective System in the six major pork producing facilities. Research is conclusive that the associated increase in repetitive movements from increasing line speed will increase worker injuries, and that workers perceive unlimited line speed as a significant risk to their health and well-being. Bills like the Protecting America's Meatpacking Workers Act are a means to limit line speed and halt the *New Swine Inspection System* time-limited trial until objective safety assessments can be conducted, and these provisions could also be incorporated into the next farm bill. We found gaps in the literature regarding the appropriate line speed, processes to limit work injuries and bolster well-being, the extent of unreported labor violations in the meatpacking industry, and how line speed interacts with other factors to influence workers. Line workers are sounding the alarm about the dangers of increased line speed under the *New Swine Inspection System* and its impact on their safety and well-being. As one line worker said to Nebraska Appleseed in 2009—15 years ago: "they fixed some things, but the line speed kills you" (Nebraska Appleseed, 2009, "Workers Comments from the Survey," para. 2).

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POLICY BRIEF

The Pluma designation of origin for coffee granted to the state of Oaxaca, Mexico

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Summary

Coffee production is an economically important crop in 13 of Mexico's 31 states. The states of Chiapas, Veracruz, Oaxaca, Puebla, and Nayarit account for 90% of all production. Twenty-five percent of the coffee crop production takes place in rural areas identified as socially and economically marginalized and food insecure. These marginalized areas transect four of the five states above (Chiapas, Veracruz, Oaxaca, and

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Puebla). The state of Oaxaca ranks third in terms of extreme marginalization (Secretaría de Agricultura y Desarrollo Rural [SADER], 2023).

Oaxaca has approximately 28,000 small coffee producers. The region has taken significant strides to elevate and distinguish its coffee. In 2020, the origin of Oaxacan coffee was officially recognized and granted the "Pluma" namesake. In 2022, Pluma met the Mexican Standard 255, a validation of quality and compliance.

The Pluma origin signifies and describes the geographical range, soil, and climate where that coffee is produced within the state of Oaxaca. The Mexican Standard 255 validates the homogenous sensory and physical attributes for the Pluma origin. Together, these brand the Pluma origin as a product worthy of a higher demand for production at a higher price point. Since the quality of Oaxacan coffee has already been recognized and is coveted in the international marketplace, this adds value to the region's specialty coffee.

Keywords
Coffea arabica L., Pluma, Oaxaca, Mexico, social development, economic development, designation of origin

How Did the Pluma Appellation of Origin Arise in Oaxaca, Mexico?

The Oro Verde Cluster, a group representing the coffee producers within a region of Oaxaca, requested assistance for an appellation of origin to distinguish their specialty coffee. Lic. Leticia Ruiz García provided this assistance, with additional goals to safeguard the production areas from soil degradation and the impact of climate change.

In coordination with the Mexican Institute of Industrial Property, a series of deliberations were conducted between coffee producers and a number of companies listed in Mexican Standard 255. Historian Francisco Zavaleta García provided the chronological account defending the rationale for the namesake "Pluma"; he established that (1) the municipality of Pluma Hidalgo did not exist at the time of the first coffee farm's establishment, and (2) the first farm, La Providencia, was named after the shape of a feather created by the clouds in the area. This information defended the relevance of the name "Pluma" for the region.

Following a defense of the name, the group defined the purpose of a Pluma designation of origin as inherently commercial in nature. The objective is to increase sales at a higher price point while maintaining and safeguarding quality standards.

It should be noted that the involvement of the three municipal, state, and federal governments was necessary to gain acceptance for the designation of origin.

To proceed, the Oro Verde Cluster requested samples of coffee beans from a subset of producers. Following this, a sensory evaluation was completed by a Q grader taster, an evaluator of the sensory quality of coffee. The state government of Oaxaca covered the costs associated with the evaluation and associated paperwork. On February 22, 2019, the application to obtain the denomination of origin of Pluma coffee was submitted.

The Acceptance for Designation of Origin Pluma

On February 4, 2020, approval for the origin Pluma was granted. The Declaration of Protection was published in the official gazette of the federation (Official Gazette of the Federation, 2020). The recognition extends to 30 municipalities of the Costa, Sierra Sur, and Lower Mixteca regions. Furthermore, on October

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Disclosure
The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

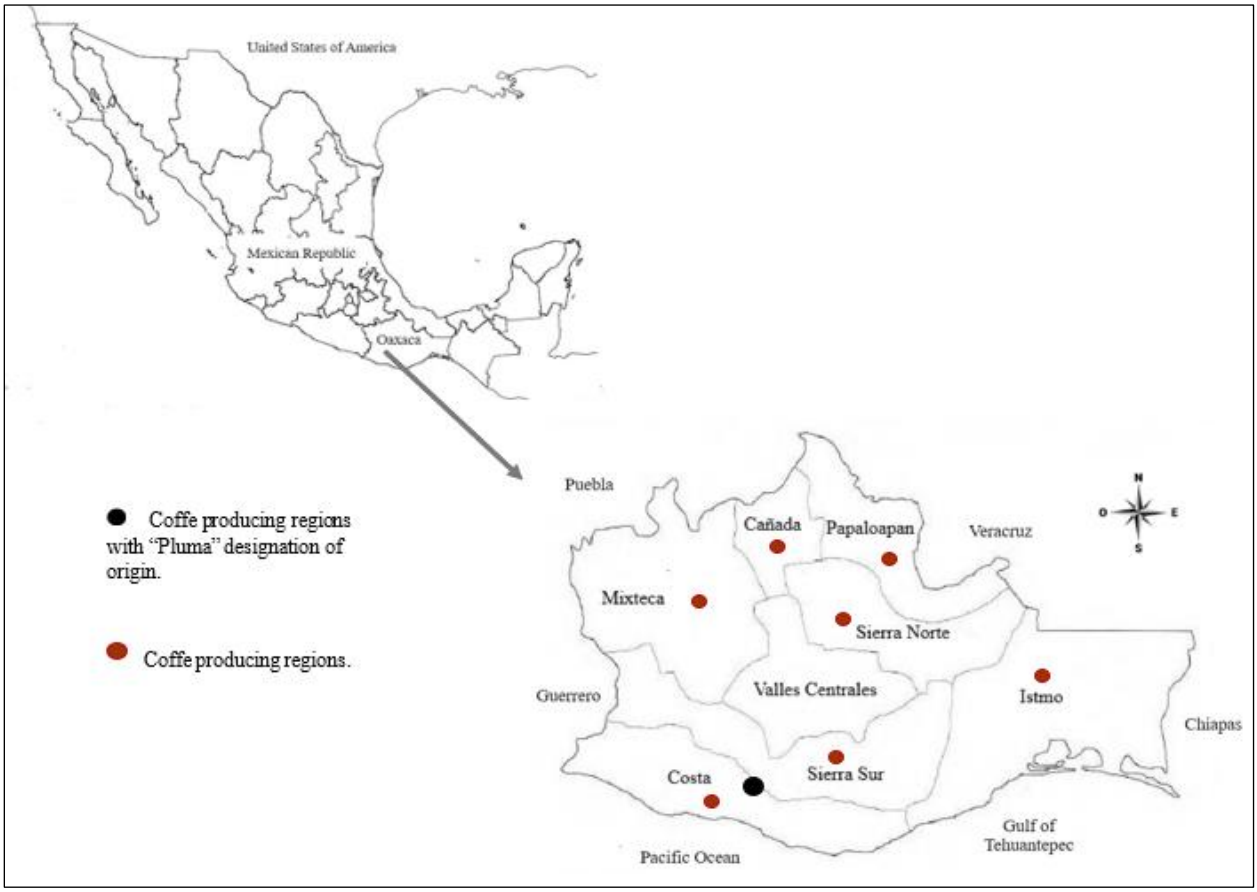
14, 2022, the Official Mexican Standard NOM-255-SE-2022, Café Pluma-Denomination-Specifications-Commercial Information and Test Methods, was published in the official gazette of the federation (Official Gazette of the Federation, 2022). In the margin is a stamp with the national coat of arms that reads United Mexican States.

The acceptance of these two recognitions has provided an important recognition for the economic development of coffee with a Pluma origin.

Pluma Geographical Range and Qualities

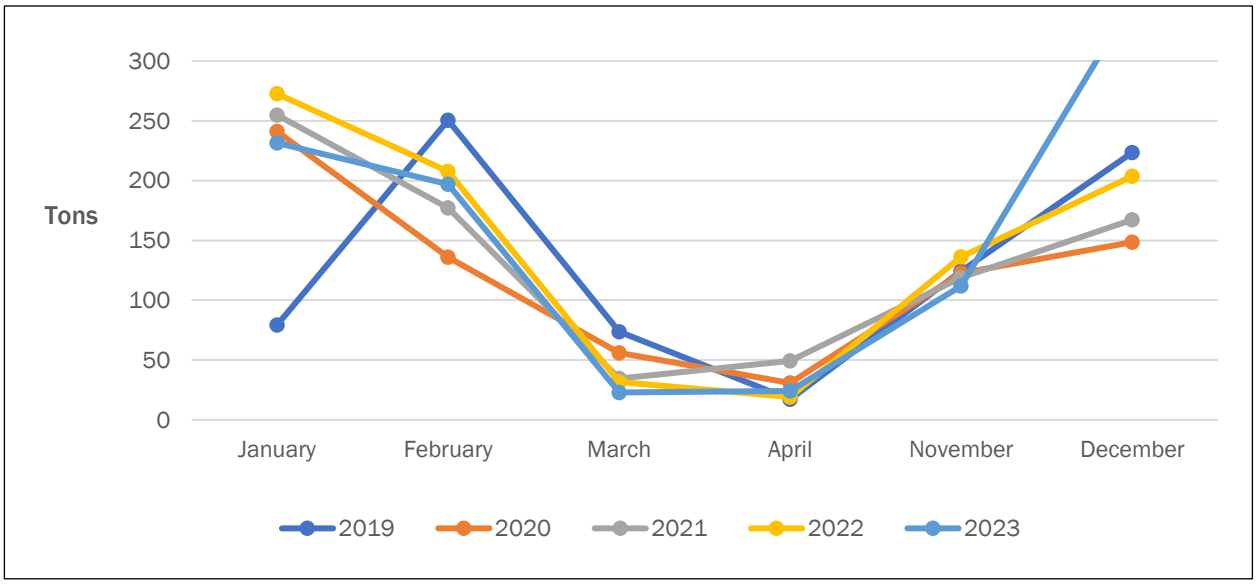
The coastal region of Oaxaca is situated in the southern portion of the state and adjacent to the Pacific Ocean and the Sierra Sur Region (Figure 1). It comprises three districts: Jamiltepec, Juquila, and Pochutla, which collectively encompass a total of 50 municipalities. The region has an area of 12,502 km², with the isthmus located to the east, the state of Guerrero to the west, and the sea to the south. The climate of this region is optimal for coffee cultivation, with warm, sub-humid conditions, an annual rainfall of 732–2,054 mm and temperatures ranging from 24°C to 26°C. The population is primarily engaged in agriculture and fishing. The production of both Arabica and Robusta coffee is increasingly common. It is the Arabica coffee produced in this region that has become classified as specialty coffee. Arabica coffee is cultivated in mountainous green or green forest areas, where the sea breeze has a beneficial effect on the quality of the beans. Robusta coffee is grown in low-lying areas that are predominantly exposed to sunlight, resulting in a different set of environmental conditions. Figure 2 shows that as of 2019, the production of Arabica coffee in Oaxaca was 75,724 tons, and in 2023, it reached 87,694 tons (Sistema de Información Agroalimentaria y Pesquera [SIAP], 2024,

Figure 1. Distribution of Coffee Producing Regions in the State of Oaxaca, Mexico



p. 48). This upward trend, despite adversities such as the COVID-19 pandemic, is indicative of the resilience of the coffee industry in Oaxaca. Robusta coffee is not designated as a specialty coffee.

Figure 2. Cherry Coffee Production in Oaxaca, Mexico, Since 2019



Conclusions

The recognition of the *Coffea arabica* L. grain, designated as Pluma, adds value that may increase demand for it in the national and international marketplace. This elevates the value of Mexico's cultural, gastronomic, and agro-industrial reputation on the global stage. This encourages grain production, thereby strengthening the economic position of coffee producers and generating new sources of employment in many of the marginalized areas of the state of Oaxaca. A continued examination of the remaining coffee-producing regions, to explore their future integration into the Pluma designation of origin, would greatly benefit the industry and enhance the national recognition of specialty coffee generated within various regions of Mexico.

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POLICY BRIEF

Food pricing and consumer choice: Recommendations for improving affordability for fresh produce in Missouri

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Summary

This policy and practice brief summarizes input from over 95 participants in the Fruit and Vegetable (Veggie) Policy Convening hosted by A Red Circle and University of Missouri Extension over two and a half days in February 2024. The purpose of the Convening was to discuss policy solutions that could keep fresh produce affordable while ensuring fair compensation for farmers. The goal for the community is to increase access and funding for fruits and vegetables, support community programs, and enhance education efforts that increase fruit and vegetable intake. Breakout room discussions included speakers from academic institutions, community-run nonprofits, and national organizations. Through the Fruit and Veggie Policy Convening, community members and stakeholders provided policy requests to improve food pricing

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and accessibility options that affect different parts of the food supply chain. Additional policy examples were also informed by searching published journal articles and reports.

Keywords
community programs, food pricing, food policy, food access, food insecurity, Supplemental Nutrition Assistance Program (SNAP), broad-based categorical eligibility (BBCE), local food systems, subsidies

Introduction

The Fruit and Veggie Policy Convening was held to address food pricing and policy challenges while also supporting the launch of a community grocery store. The development of this Convening began a year in advance, initiated by A Red Circle and in partnership with the American Heart Association and Missouri University Extension. The goal was to explore policy solutions that could keep fresh produce affordable while ensuring fair compensation for farmers. Over two and a half days, discussions focused on nutrition, farming, and policy. Funding from the Missouri Foundation for Health's Opportunity Fund covered meals, logistics, and stipends to make it possible for farmers to attend.

The Process and Invitations

The planning team identified key stakeholders, including farmers (especially farmers with farms of 50 acres or less), food advocates, policymakers, and community members engaged in food access efforts. The goal was to bring together individuals who could provide practical insights on ensuring fair prices as well as influence policy discussions and community education. Invitations were extended to people with experience in nutrition, farming, and policy, ensuring a well-rounded conversation. Experts from advocacy groups, local universities, and the Federal Reserve Bank served as guest speakers to provide economic and legislative perspectives.

Before the Convening, planning meetings were held virtually to organize logistics, select topics, and structure the event. Missouri University Extension facilitated the Convening and assisted with scheduling, data collection, and discussion frameworks. The Convening was held at St. Louis University, chosen for its accessibility to attendees from different parts of the city and county of St. Louis. Participants also drove in from the cities of Columbia and Springfield.

Challenges and Advice for Future Convenings

One major challenge during the discussions was maintaining focus on the core goal—affordable fresh food in grocery stores—while balancing the broad interests of attendees. Discussions often expanded into school meals, hospital meals, and institutional food policies. Establishing clear objectives helped to redirect participants and maintain focus on the primary topics of discussion.

Another significant challenge was ensuring farmer participation. Attending the Convening was an opportunity cost for local farmers and meant time away from their farms, so stipends of $400 (all currency is in US$) were provided to compensate for farmers' time. This approach was effective and would be a helpful consideration in future budgets for groups planning similar events.

Regarding funding conversations, we also hosted technical economic discussions, such as those led by the Federal Reserve Bank representative. These discussions were valuable but complex. We recorded these sessions and found that providing recorded material was helpful in giving accessibility to those needing to revisit the information later.

Lessons Learned and Recommendations

- **Clear Objectives:** Define and reiterate the core purpose to keep discussions on track.
- **Diverse Participation:** Invite a mix of community members, farmers, policymakers, and economic experts for a well-rounded discussion.
- **Farmer Compensation:** Offer stipends to ensure participation from those who would otherwise lose income by attending.
- **Strategic Location:** Choose an accessible venue to encourage attendance from all regions.
- **Technical Session Accessibility:** Record complex policy and economic discussions for later reference.

- **Partners:** Collaborate with university groups who can lend additional time and resources.

With these strategies, future convenings can more effectively help shape policy and provide actionable solutions for food affordability and accessibility.

Results: The Breakout Discussions

Access to nutrition is crucial for sustained health, often more so than access to healthcare alone. Between 700,000 and 860,000 Missourians are estimated not to have enough nutritious food to meet their daily needs (Missouri Foundation for Health, n.d.). Food insecurity in Missouri accounts for an estimated $1 billion in avoidable healthcare costs (Operation Food Search, 2021). This disproportionately impacts people in rural communities, older adults, people with disabilities, and people with low incomes due to barriers like availability, accessibility, affordability, and difficulties with government assistance programs.

This paper considers factors such as the drivers of food systems, the administration and availability of funding, sustainability, and socio-cultural contexts in a modified food supply chain. Food pricing is affected at each step of the supply chain, and the Convening was mostly centered around producers, retailers, and consumers. Recommendations arose on improving affordability at each of these three steps. It is important to note that implementing targeted subsidies, price controls, and discount programs for fresh fruit and vegetables have been successful policies in other states and can offer a feasible solution to strengthen food security for Missouri communities.

Producers

The Convening held breakout room discussions that highlighted the drivers of food pricing and how the current food production system disproportionately affects low-income communities. High production costs, corporate market control, and policy barriers favor large-scale farming, making fresh food less affordable. Policy suggestions that arose from the breakout room discussions included better support and funding for small-scale local farmers to implement sustainable agricultural practices and provide produce to a wider variety of retailers.

Solutions

Speakers at the Convening discussed how food that is locally produced is more cost-effective. Connecting local producers (e.g., farmers with 10-50 acres) directly with consumers and retailers can increase farmer profits, lower consumer prices, and enhance access to fresh produce. Moreover, programs like urban farms teach sustainable farming techniques, benefiting the local environment. For example, the Urban Farm Project and A Red Circle discussed the use of organic practices and minimizing chemical inputs and explained water conservation techniques employed on the farm, such as rainwater harvesting and drip irrigation.

Small-scale farms face market access barriers, limited infrastructure, and dominance by large-scale operations. To reduce these barriers, farmers require more comprehensive solutions that improve both market access and food pricing (according to Debi Kelly, a speaker at the Convening), such as:

- tax incentives for farmers growing specialty crops (e.g., organic produce, heritage grains);
- collective purchasing and distribution of food that involves local farmers, grocery stores, and community organizations; and
- investment in cooperative grocery stores, which are more likely to purchase produce from local farms.

Expanding Missouri's Resilient Food Systems Infrastructure Program with accessible grants could greatly benefit small farms. Missouri lawmakers already subsidize fruit and veggie farmers through budgetary processes. Currently, $50,000 grants are limited and reimbursement-based, creating barriers. The state received $7 million in funding for these grants, but only $2 million were allocated in the state budget (Rossi, 2024); 30 farmers were selected to receive a grant to sell their produce to local restaurants and stores, where there is high demand for local produce. However, only 16 of these

projects received funding and only partially. The funding limitations are a state budget issue. These efforts could be expanded. Allowing upfront payments and covering salaries could ease the burden. Participants at the Convening recommended $250,000 grants to support 10–50 acre farms (to, for example, expand capacity to contract for help or hire staff; buy tools; plan for future needs; or improve buildings), in turn bolstering independent grocery stores and access to local produce.

Redistribution of grant funding from the Missouri Department of Agriculture is necessary to effectively support food security and can help ensure that high-quality farmland is preserved and not lost to development. Farmers of small family farms must be included in policy conversations. The federal farm bill supports large, commodity farms, so more state-level subsidies for small, sustainable farms are essential to ensure food security and environmental sustainability. Bolstering support for 10–50 acre farms can help create a resilient, equitable food system that benefits both producers and consumers.

SUPPORTING SMALL-SCALE PRODUCERS

Short-term actions:

- Initiate discussions with farmers, grocery stores, and community organizations to collectively purchase and distribute food

Long-term actions:

- Increase disbursement of the Resilient Food Systems Infrastructure grant
- Offer tax incentives for specialty crops
- Offer subsidies to promote environmentally friendly, sustainable farming practices
- Invest in co-op grocery stores

Retailers

A session on the drivers of food pricing highlighted how retailer purchasing power affects food costs and supports local farmers who are reliant on both retailer and consumer sales. Another session, titled "The Value of the Card," highlighted how retailers could incentivize consumers to buy more fruits and vegetables. One solution focused on easing small retailers' participation in government programs that make healthy food more affordable. Specifically, one participant suggested "reducing barriers of small growers accepting Supplemental Nutrition Assistance Program (SNAP) benefits."

SNAP can provide a significant economic benefit. Every $1 in new SNAP benefits issued in Missouri can increase gross domestic product by $1.54 (U.S. Department of Agriculture, Food and Nutrition Service [USDA FNS], 2022). In Missouri, retailers who accept SNAP can also participate in Double Up Food Bucks (DUFB) and the Farmers Market Nutrition Program (FMNP), which provide coupons, discounts, and other benefits for buying fresh fruits, veggies, and grains (Missouri Department of Agriculture, n.d.-a). Participating retailers reported greater produce sales than nonparticipating stores (USDA FNS, 2023).

Solutions

Facilitating the growth of local food economies requires the creation of financial incentives for retail grocery stores that addresses regulatory compliance, marketing, and consumer demand. In addition to greater financial support, the Convening also proposed the following strategies to strengthen local food systems:

- **Stronger Supply Chains:** Building successful farmer-retailer relationships ensures a reliable local food supply.
- **Innovative Pricing Models:** Flexible pricing or price averaging can reduce the impact of price fluctuations.
- **Technical Assistance:** Helping retailers navigate regulations simplifies compliance and reduces their burden.
- **Bulk Buying Programs:** Independent stores can pool orders, lowering costs and providing farmers with a stable customer base.
- **Expand SNAP retailer participation** through the Healthy Food Financing Initiative (HFFI).

Bulk buying programs and cooperative efforts can benefit both farmers and retailers. Initiatives like the Rural Grocery Initiative, part of Kansas

State Research and Extension, offers technical support and grants to independently owned rural grocers, enhancing local food access (Kansas State University, 2024). State marketing campaigns such as Pick Tennessee Products, Fresh From Florida, and Certified South Carolina (Robbins, 2023) also connect consumers with local producers, providing models for the "Missouri Grown" program.

Healthy Food Financing Initiative (HFFI), a grant available to grocery retailers, could help expand the availability of locations that sell fresh fruits and vegetables. Retailers can also apply for funding to use on electronic benefit transfer (EBT) equipment if they demonstrate that having EBT equipment helps sell healthy, fresh, and affordable foods to underserved communities and markets (USDA FNS, 2024b). Additional funding for the SNAP Healthy Incentive program is also available for eligible government agencies and nonprofit organizations through the federal Gus Schumacher Nutrition Incentive Program (GusNIP).

SUPPORTING RETAILERS

Short-term actions:

- Innovative pricing models to mitigate the impact of price volatility
- Offer technical assistance on regulatory compliance to reduce burden

Long-term actions:

- Offer subsidies and incentives for equipment to serve as an EBT vendor
- Support bulk buying and food hub programs
- Support EBT at farmers markets

Consumers

SNAP accessibility, utilization, and stigmatization were key topics at the Convening. Awareness and adoption of federal food programs like SNAP and WIC are minimal among farmers market vendor and staff, and retailers. SNAP, which serves 11% of Missouri households, aims to reduce poverty and food insecurity while also boosting the economy (Center on Budget and Policy Priorities, 2025).

Many Missourians face a "benefits cliff," where increased income disqualifies them from aid and yet is not sufficient for fresh food. In 2023, Missouri passed legislation that created a transitional benefits program for Temporary Assistance for Needy Families (TANF) and SNAP (Revisor of Missouri, 2023). This program, however, is currently unfunded, leaving many without crucial support (Bates, 2024a). The Missouri legislature must allocate funding each year to ensure that people do not experience this benefits cliff.

Solutions

Participants advocated for shifting SNAP from a safety net to an empowerment tool, suggesting the removal of lifetime bans for nonviolent drug offenders and integrating SNAP eligibility screening into primary care, aligning with the "Food as Medicine" program (American Heart Association, n.d.). Strategies that increase SNAP participation also include expanding outreach about the program, increasing the availability of the program's managing office, and simplifying the application and recertification process (Nicoll, 2015; Pinard et al., 2017).

Policies that enable programs to offer discounts or vouchers for fresh produce can also provide additional immediate relief to low-income families. Prioritizing targeted subsidies, price controls, and discount programs can ensure that all Missouri residents have access to nutritious food and maintain a healthy diet. Notably, of these recommended policies, some do not require legislation:

- Broad-based categorical eligibility (BBCE) allows states to raise SNAP income limits from 130% to 200% of the federal poverty line, simplifies administration, and reduces frequent churn— when a household leaves and then reapplies and re-enters SNAP within four months (USDA FNS, 2024a). BBCE alleviates restrictive administrative rules for eligible low-income households because social services agencies can apply independently *without a legislative mandate*. BBCE simplifies eligibility, links SNAP to TANF, and increases deductions for expenses like rent and childcare. While 41

states have adopted BBCE, Missouri and eight others have not (Rios & Huelsman, 2024). Empower Missouri is collaborating with the Missouri Department of Social Services to implement BBCE without requiring new state funds (Bates, 2024b).

- The Food as Medicine initiative promotes nutrition to prevent chronic diseases and is supported by the federal government, health organizations, and universities. Programs include medically tailored meals, groceries, and produce prescriptions (American Heart Association, n.d.).
- The Farmers Market Nutrition Program (FMNP) offers annual benefits of $50 to low-income seniors and $30 in benefits annually to WIC individuals that can be exchanged for fresh produce at participating markets. Expanding this program, especially to southeast Missouri, could help alleviate food insecurity (Missouri Department of Agriculture, n.d.-b).
- Double Up Food Bucks (DUFB) matches SNAP dollars spent on produce. In 2023 in Missouri, $1 million was redeemed from fresh produce purchases. DUFB customers reported that having access to fresh produce positively impacted their health. The program boosted access to fresh produce for consumers, and retailers even increased their produce sales (Double Up Food Bucks Heartland, 2023). The DUFB grant was implemented in Missouri by the DUFB Heartland Collective. The collective did not secure federal funding in 2024, but was provided private funding for 2025 which will allow DUFB to be offered in Missouri (Alferman, 2024). The state could allocate funds through their legislative budgets and provide matching funds to supplement private donations, ensuring the program's sustainability and expansion.
- The Healthy Food Financing Initiative (HFFI) supports projects and provides grants that improve access to healthy food. Missouri's Rural Food Access Partnership, with the financial support of a three-year $1 million grant, was launched in 2024 and aims to expand healthy food to retailers in underserved areas (Empower Missouri, n.d.).

For consumers, requested policy changes include increasing their eligibility for food assistance programs and expanding the number of retailers that accept the benefits.

SUPPORTING CONSUMERS

Short-term actions:

- MO DHS could exercise the option to implement BBCE, which doesn't require legislative action
- Fund community food programs that provide healthy foods, and education to the community

Long-term actions:

- Expand Farmers Market Nutrition Program (FMNP) especially to southeast Missouri and other rural areas
- Support EBT at farmers markets

Community-based Considerations

Community initiatives also play a crucial role in addressing food accessibility issues. In St. Louis, events like the Good Food Summit focus on the economics of food distribution and the vital role of anchor institutions (e.g., grocery stores). These summits emphasize making fresh produce affordable while ensuring fair wages and investments for local farmers. These initiatives originally began with nutrition and cooking classes and later expanded to include growing food as well as a farmers' market to increase access to fresh produce (Jessica Donze Black, speaker).

Integrating agricultural practices with health and nutrition goals while supporting local food economies should be done through a holistic approach. Convening participants suggested implementing these multifaceted solutions that include both individual-level education and upstream systemic changes to improve nutrition security:

- Fund and implement sustainable community engagement projects.
- Consider diverse cultural preferences. Taste, price, and convenience influence food choices.
- Invest in food entrepreneurs and create infrastructure. Shared kitchens and manufacturing spaces bolster local food production and distribution.
- Build more community gardens. Educating and engaging residents through school and neighborhood gardens strengthens the workforce and local food systems. One example is the Carver Urban Farming Project (St. Louis American, 2024).
- Promote farm-to-school programs. Introducing the benefits of freshness and taste of locally grown produce early in childhood influences long-term dietary habits. Farm-to-school programs effectively introduce fresh produce to children despite barriers such as food service management policies and misconceptions about food safety.
- Community food prep education is key. Individuals who learn to cook and handle fresh ingredients in community-based programs and school-based interventions tend to purchase and consume more fresh fruits and vegetables (Ilić et al., 2022; Jeans et al., 2023; Metcalfe et al., 2021).
- More equitable funding practices. Historically, agricultural development funding often excluded minority farmers. Increasing efforts to fund organizations working with underserved farmers and ranchers, such as the 2501 program and the Socially Disadvantaged Groups Grant, which provides funding and technical assistance to socially disadvantaged groups in rural areas (USDA, n.d.).

Conclusions

Improving food access in Missouri requires supporting local producers, addressing retailer challenges, and improving customer access. Legislative tax incentives, subsidies, and technical assistance are key (see Table 1). Building robust local food systems support rural and urban farmers and improves local supply chains, advancing economic growth across Missouri.

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Table 1. Summary of Policy Recommendations for Missouri Legislators to Affect Different Categories of the Food Supply Chain

Support for local food systems could provide: CATEGORY	POLICY RECOMMENDATIONS
Small-Scale Producers	Expand funding through grant access and subsidies to make it more affordable to grow fruits and vegetables sustainably in the community, and minimize chemical inputs and use water conservation techniques.
Retailers	Increase incentives for grocers and farmers markets vendors to participate in food programs and accept Supplemental Nutrition Assistance Program (SNAP) while lowering the administrative burden.
Consumers	Create a wider eligibility net for individuals to participate in affordable, nutritious food programs through broad-based categorical eligibility (BBCE), while expanding SNAP income eligibility limits, removing lifetime bans for nonviolent drug offenders, and increasing cost incentives to buy fruits and vegetables through Double Up Food Bucks.

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COMMENTARY

Implementing Spanish-language pesticide labeling: The role of internet access for migrant and seasonal farmworkers

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Mitigating pesticide exposure among migrant and seasonal farmworkers (both referred to as "farmworkers" herein) is important for agricultural safety and health. Among farmworker patients served by the North Carolina (NC) Farmworker Health Program in 2021 (N = 11,518), 99% identified as Latine, 98% reported being nonfluent in English, 94% reported incomes below the federal poverty level, and 92% indicated they were uninsured. Prior community-led work in NC with farmworkers, advocates, and others working closely with farmworkers has highlighted demands for expanded employment benefits and improved living and working conditions, including pesticide

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protections, as well as expanded access to high-quality health care, improved visibility of farm work, and policy change for a better future (Cofie et al., 2023). Efforts to address pesticide exposure are critically important.

Worker protections related to pesticides are regulated by the U.S. Environmental Protection Agency (U.S. EPA). The Pesticide Registration Improvement Act (PRIA) was reauthorized in December 2022 as "PRIA 5," and it mandated new provisions for the protection of farmworkers, including requirements for Spanish-language pesticide labeling and farmworker training and education. These new provisions were informed by input from farmworker advocacy groups and environmental nongovernmental organizations. As information is an independent determinant of health that operates both directly and indirectly through other social determinants of health (Graham et al., 2024), requiring Spanish-language labels has the potential to prevent pesticide exposure and thus to promote farmworker health. The U.S. EPA has been working through the implementation of these new requirements (U.S. EPA, 2024), although we recognize that a change in administration may change the priorities of the EPA's implementation of PRIA 5. The intention of PRIA 5 implementation, however, remains important regardless of political changes. In this commentary, we provide considerations for implementation based on research and experience from NC.

PRIA 5 requires Spanish-language translation of health and safety sections of pesticide product labels (U.S. EPA, 2023). Translations must be available on the pesticide container or via a hyperlink or QR code, and farmworkers must have access to bilingual pesticide labeling starting in December 2025 (U.S. EPA, 2023). Previously, pesticide use instructions, warnings, and health information on containers had no specific requirements for languages beyond English. Spanish-language pesticide label information provided on the container or online should thus result in better access to important health and safety information.

However, Spanish-language label information will not be accessible to all farmworkers if only available in digital formats. A recent survey of NC farmworkers used time-venue sampling in partnership with eight health service sites that were simultaneously conducting outreach to farmworker housing (Lee et al., 2024). Collected across the 2023 growing season, the survey's 1,034 participants reported multiple barriers to internet access. Specifically, nearly one-quarter of participants did not have consistent, reliable internet access. Common reasons for inconsistent internet were weak cellular signal, too many people using an access point, and running out of data on cellular data plans. Importantly, the vast majority of participants used smart phones and cellular networks for their internet access.

In results from the NC survey, most participants paid for their own internet, with a small percentage reporting that internet was paid for by their employer (Lee et al., 2024). The average cost of internet to workers was just under US$45 a month. Currently, federal regulation places the onus on the employer to provide access to pesticide information through the Worker Protection Standard. These survey findings suggest, however, that the burden of securing internet access, which would be necessary to access digital pesticide labels, thus falls upon the farmworker. Additionally, stories from the field highlight the complexities associated with employer-provided internet access in employer-provided housing, including instances in which employers have cut off internet access as punishment for what was considered improper use of the internet.

Interviews with farmworkers and community health workers, who facilitate farmworkers' access to healthcare and social services, elucidate the problems associated with relying on cellular data to access critical information (Harwell et al., 2022; LePrevost et al., 2024). As shown in Box 1, from a research project by LePrevost et al. (2024), community health workers have reported losing contact with farmworkers who run out of cellular data. During these time periods of disconnection, farmworkers would not have the ability to access critical health and safety information, including the Spanish-language pesticide labels if only available digitally.

There are other considerations for regulators regarding online access to pesticide label information beyond connectivity to the internet. Anecdotal

Box 1. Community Health Worker Comments about Internet Access

"The first few days we were able to talk to [farmworkers in a housing unit] daily, and then we stopped hearing from some of them. And so then it was 'What's happening?,' and when we would go out there to do medication drop-offs or give them more food or something, they would tell us, 'Oh, well, my data plan ended,' or, 'I can't go to the store, so I can't add more minutes to my phone, and so there's no way for me to use my phone.'" (Community health worker, ID:2) (LePrevost et al., 2024, p. 4)

reports suggest that some farms restrict workers' bringing cell phones into the field as a safety measure (e.g., to reduce distracted driving while operating a tractor), but these restrictions may have unintended and deleterious consequences for access to digital pesticide information. Additionally, there is a need to consider digital literacy skills among farmworkers and optimization of the display of pesticide information for small screens and potential offline access after downloading. To maximize the benefits of digital pesticide information, it is crucial to follow best practices that make shared information both scientifically accurate as well as linguistically and culturally appropriate to the intended audience (Griffith et al., 2023).

In conclusion, increasing the accessibility of Spanish-language pesticide labeling is a critically important regulatory intervention for protecting health and encouraging safe practices. Availability of information by hyperlink or QR code will increase access compared to the status quo, but regulators must also recognize that use of these features will require internet access that may not be available to all farmworkers. Indeed, in NC, nearly one in four farmworkers might not have the consistent internet access needed to utilize a hyperlink or QR code. Further research is therefore needed to assess user accessibility of Spanish-language labeling in the locations where pesticide containers and labels are stored and used. Farmworkers with limited data plans should not have to choose between video calling their families or talking with their medical provider and accessing safety information at work.

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VOICES FROM THE GRASSROOTS COMMENTARY

Building community through communal gardening

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Introduction

Capitol View Communal Garden and Orchard (CVCGO) is a communal garden founded in 2022 in Saint Paul, Minnesota. The garden sits on a previously unutilized one-third acre (.13 hectare) city park accessed through a lease agreement with the Saint Paul Parks Department. CVCGO was conceived as a means of strengthening connection and cooperative capacity in our community by satisfying the tangible need for fresh food.

In response to the Uprising after George Floyd's murder, a small group of neighbors met to discuss strengthening the social fabric of our community. Personally, as a recently graduated engineer returning to the community I grew up in, I was seeking a way to connect with the neighborhood on new terms and live out my values through tangible action. We decided to explore a communal approach to community gardening.

After reaching out to the broader community, an informal core group developed and influenced the social norms by agreeing on a few foundational elements:

- *Unconditional Sharing:* CVCGO crops can be harvested whenever, by whomever, without limitations.
- *Non-Coerced Labor:* All human labor at CVCGO is voluntary, meaning there are no work requirements or minimums for participation. There are no paid staff in our organization.
- *Anti-Hierarchy:* There are no parent organizations or managerial roles at CVCGO. We strive to make every decision at the garden democratically–using a consent system at general meetings for major decisions. At the garden itself, decisions can be made if two people agree with an idea, such as deciding where to plant corn or a honeyberry bush.

CVCGO distills these three elements into the slogan inscribed on the garden's sign: *Take what you need; help if you want.* These concepts are likely antithetical to social practices in our home, workplaces,

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and community institutions, which may prompt some to dismiss this project as idealistic. On the contrary, these elements promote a practical way that all community institutions could operate. Furthermore, these principles create a space where many visions and ideas can coexist, so the assertions made here represent only one of these perspectives. By sharing my reflections on time spent at the garden, I hope to open up CVCGO to criticism and new ideas to continually learn, grow, and improve as a collective.

Simplified Administration

A typical community garden that rents out individual plots may require dues collection, an application process, a waitlist, formalized rules, and consequences for not maintaining plots. In the communal garden, there are no dues, no work requirements, no payroll, and no gatekeepers of participation such as applications and waitlists. The communal garden still requires administration, but CVCGO minimizes these tasks. Fundraising is only undertaken in response to the needs expressed by the community of gardeners. If cooking classes, specialized tools, or informational signage are requested by the community, the required materials are sourced through in-kind donations or fundraising.

We have received plants and seeds through the Minnesota Horticultural Society's MN Green program, the Youth Farm greenhouse, and the West Side Seed Library. Neighbors and local farmers have contributed beekeeping equipment, orchard tools, and plant starts. From the beginning, we did not want the garden's success to be dependent on funding or fundraising. We wanted any group of people to be able to launch a garden with only the financial resources that a few people might be able to contribute. So, we used bent fencing, tree-branch trellises, and rusty donated tools.

However, a number of neighbors were aware of some simple grants, and through these we received funding from the local government, the county public health agency, the Saint Paul Garden Club, and the USDA. Without paid staff, the majority of funds directly supports infrastructure that returns value year after year. In three years, the garden has raised US$23,000 for a shed, tools, cooking equipment, and informational signage, and to establish fruit and nut trees and bushes, native perennials, and permaculture plantings. Moving forward, our ongoing expenses are estimated to be around US$1,500 a year for water and supplies for community events.

Improving Food Access

A farm that harvests food for sale must wash, preserve, and transport food. Produce from a communal garden is simply harvested by those who will eat it. This requires a greater understanding of food production on the part of the consumer, and CVCGO seeks to build this understanding. This is achieved through Thursday work nights at the garden—a weekly gathering where one may arrive to find a cooking demonstration, a medicinal plant class, tomato pruning lessons, or just manual labor spreading mulch. Community members build knowledge and skills on Thursdays so that they can feel comfortable harvesting whenever they want (if they don't feel comfortable already).

Building Social Infrastructure

The goal of CVCGO is a more connected and organized community. When there is a defined need (e.g., a load of wood chips is delivered to be spread on paths) and labor available to meet it, we have developed the social relations to coordinate that labor. These social relations are part of the *social infrastructure* of our community. This social infrastructure reinforces connections in the community that improve our ability to react to changes and make decisions to meet our needs.

Workers at CVCGO have built a shed, tested soil, kept bees, obtained city permits, made medicinal remedies, cooked foods onsite, thrown parties, written grants, and grown an abundance of food. Each task has empowered community members to bring forward their unique skill sets. These challenges underscore how individuals are uniquely valuable to their community, and through their passion, they become leaders and community experts. Additionally, by facing challenges together, people build cooperative capacity. In putting together a tomato trellis, people learn how someone responds to frustration and how they like to communicate. These connections don't happen un-

less you are working side by side, and they increase the capacity of a community to face larger and more daunting challenges.

Cooperative capacity not only enables a community to undertake technical challenges, but also expands the ability to resolve conflict. It is inevitable that conflicts will arise due to the diverse needs and backgrounds of individuals. As disagreements arise, the care and high regard for one another that is built over time keep community members engaged in the conflict-resolution process, and experiences in making decisions collectively facilitate the resolution of the disagreement.

Gardens have the potential to meet a vast array of needs, and community issues such as commodified housing, institutional racism, and an opioid epidemic may be unresolvable within the confines of the garden. However, communal gardeners may be better equipped to address the root causes of these bigger crises and mitigate the impacts on the community because we have strengthened personal relationships at the garden.

Meeting Social Needs Through Increased Community Connection

In former Surgeon General Vivek Murthy's letter introducing the report *Our Epidemic of Loneliness and Isolation*, he states, "The mortality impact of being socially disconnected is similar to that caused by smoking up to 15 cigarettes a day" (Office of the U.S. Surgeon General, 2023, p. 4). The first of his six pillars to advance social connection is to *Strengthen Social Infrastructure in Local Communities*. Murthy says we must design the built environment to promote social connection, establish community connection programs, and invest in local institutions that bring people together. The workers of CVCGO are not agents of the surgeon general, but CVCGO is an example of this first pillar.

Someone may choose to connect at the garden by hosting cooking lessons, or they may choose to harvest alone; nevertheless, each person is engaging with the space on their own terms. Space and resources are communal regardless of how one wants to interact with the garden, and this builds connection to the physical space. This is a form of social connection that doesn't require you to enter into relationships. It instead builds an implicit understanding that this community's members trust and care for one another, as demonstrated by their collective care for the garden. Through experience, we know this understanding has led to deeply meaningful interpersonal relationships across our community, and individually meaningful relationships with the land.

The foundations of the communal garden provide fertile ground for social connections. Unconditional sharing creates the opportunity to connect by offering people free food. Anti-hierarchy fosters relationships built on trust and a genuine desire to engage rather than on power dynamics. Non-coerced labor creates an environment where every single person engages by choice, and where everyone can disengage by choice. These foundations are the roots of a project that effectively address loneliness, and that have developed an inviting and open social dynamic in the community. In addition, they inform the practical recommendations detailed in the appendix, which address the day-to-day operation of CVCGO.

Conclusion

Workers at CVCGO recognize that we must devote ourselves to radically changing food systems, social relations, and economic structures. Urban food production capacity must grow to meet the needs of communities in a changing climate, and communal gardening can both grow food and grow the base of people engaged in food production. Communal gardens can serve as incubators, connectors, and producers that are replicable but not necessarily "scalable." Communal gardening fits into the urban agricultural ecosystem without competing for large amounts of grant money or market share, and instead meets needs exactly where they exist. We hope that CVCGO's exploration into new social and productive relationships can lead to new ideas, and new connections across communities, all pushing toward a brighter future and a more secure, connected, and liberated world.

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Reference

Office of the U.S. Surgeon General. (2023). *Our epidemic of loneliness and isolation: The U.S. Surgeon General's advisory on the healing effects of social connection and community*. U.S. Department of Health and Human Services. https://www.hhs.gov/sites/default/files/surgeon-general-social-connection-advisory.pdf

Appendix. Practical Elements of Capitol View Communal Garden and Orchard

- Consistent community work night.
- Anyone can harvest, no limits.
- No coerced labor, including wage labor.
- No hierarchy, continued efforts to prevent establishment of hierarchy or power dynamics.
- Free food or music on days when a large labor force is needed.
- Welcome people into the space; talk to everyone.
- Start with a small group of committed people. Three friends can start a communal garden, but it is too much work to do alone.

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Scaling up local and regional food systems: Understanding and navigating opportunities and challenges in the Palouse region

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Abstract

Interest in local and regional food systems (LRFSs) as economic development and food resilience strategies has grown over several decades. Disruptions caused by climate change, the COVID-19 pandemic, and international conflicts have illuminated our vulnerabilities and increased motivation to build resilience by "scaling up" local and regional foods. Yet, scaling up LRFSs remains challenging and aspirational in many communities, suggesting a

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need to further explore their development as contextualized and hybrid systems. Drawing from a survey of landowners and interviews with producers, resource managers, and others, this study focused on the Palouse bioregion of the U.S. Northwest. This was done to illustrate the complexity and potential of scaling up LRFSs in the context of land and water constraints, diverse stakeholders, and multiple, potentially conflicting land-use goals. The results identify points of tension between small-scale produce and large-scale dryland commodity systems, but also identify points of complementarity. Conflict, dialectic, and hybridization can help each scale become more environmentally and economically sustainable. While land access is a barrier, our landowner survey identified over 1,000 acres (405 hectares) potentially available for growing produce for LRFSs. Landowners expressed a diverse set of values and orientations to agriculture, which shapes land access and provides opportunities for different approaches. Water supply constrains irrigated agricultural development rather than prevents it in this region; however, water-efficient irrigation practices and pond development hold promise for agricultural, hydrologic, and habitat improvement. Short food and values-based supply chains for artisan grains can leverage and support both types of production in the Palouse bioregion, highlighting an area for continued compatible development.

Keywords
values-based supply chains, short food supply chains, place-based food, rural development, community resilience, land access, water scarcity

Introduction

Climate change, geopolitical conflict, and other crises, such as pandemics, threaten food variety, affordability, and availability (Aminetzah & Denis, 2022; Johansen, 2023; Mead et al., 2020). Such supply chain disruptions reveal vulnerabilities and have increased the urgency of developing local and regional food systems (LRFSs) that can promote resilience through shortened supply chains, diversified production, increased profit and land access for producers, and employment of climate-smart agricultural practices (Béné, 2020; Hammon & Currie, 2021; Marusak et al., 2021; Richards & Vassalos, 2021; Saul et al., 2021; Seidel et al., 2021; U.S. Department of Agriculture [USDA], 2020, 2023; Worstell, 2020).[1] In this article, we explore opportunities and challenges for scaling up LRFSs using Latah County, Idaho, and adjoining Whitman County, Washington, in the U.S. Palouse bioregion as a case in point.

The Palouse bioregion spans much of southeast Washington and part of northwest Idaho. Over the last century, production in this region specialized in the export of dryland agricultural commodities. In 2024, 53% of land in Latah County and 58% in Whitman County was used for wheat, barley, lentil, and chickpea production (USDA, National Agricultural Statistical Service [USDA NASS], 2024a, 2024b). The study area is predominantly rural, and while dryland commodity

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Competing Interests
The authors have no relevant financial or nonfinancial interests to disclose.

Ethics Approval
This study was certified exempt by the University of Idaho Institutional Review Board (4/26/2018, No. 18-083) and performed in accordance with ethical standards.

Consent to Participate
Informed consent was obtained from all participants included in the study.

Authors' Contributions
Conceptualization: SN, DS, SP, CD, FL, JJ-M, and RH; Methodology: SN, DS, SP, CD, and FL; Formal analysis and investigation: SN, DS, SP, CD, and FL; Writing—original draft preparation: SN, DS, and SP; Writing—review and editing: SN, DS, CD, SP, FL, RH, JJ-M, JK, and HS; Funding acquisition: FL, DS, SN, CD, SP, JJ-M, and RH.

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[1] Resilience can be understood as "the capacity to deal with change and continue to develop" (Stockholm Resilience Center, n.d.).

production dominates the landscape, there is also momentum behind LRFS development focused on small-acreage diversified farms (Table 1).

As in many U.S. communities, multisectoral stakeholders in the area have worked to build LRFS capacity, such as by expanding market opportunities, providing technical assistance, and exploring value-added processing for produce and livestock (Bauman et al., 2019). Strong interest in diversified LRFS development is further evidenced by the existence of five farmers markets, a grocery store that spent US$802,521 on local products in 2019 alone (Moscow Food Co-op, 2020), roughly 30 restaurants that feature local ingredients (Palouse-Clearwater Food Coalition, 2017), and intermediated market demand throughout Idaho's 10 northern counties (Liao et al., 2019). The largest of the farmers markets, Moscow Farmers Market, boasts over 200 vendors and considerable economic impacts (DePhelps & Peterson, 2020). The main impetus for the current study was the observation that while there is a great deal of interest, small-acreage diversified farms, and market opportunities, the region lacks sufficient vegetable and fruit production to fully meet local demand. One study estimated the Palouse would need an additional 2,174 acres (880 ha) of vegetable and 326 acres (132 ha) of fruit production to meet local demand and identified access to land and labor as barriers (Manheim Solutions, 2013, p. 176). Furthermore, while the Palouse is not currently considered a water conflict area, surface water is limited, the long-term sustainability of the groundwater supply is uncertain, and there is tension between development interests and water conservation (Beall et al., 2011).

The Palouse illustrates the complexity of scaling up LRFSs in places with farmland access constraints, potentially conflicting land-use and agricultural goals, and water resource issues (Liao et al., 2023). The thesis of this paper is that scaling up LRFSs is desirable but remains challenging and aspirational in many communities, suggesting a need to further explore their development in the context of intersecting sociocultural, land, and water constraints. We investigated the research question: what are challenges and opportunities to scale up a more diversified fruit and vegetable agricultural landscape in the Palouse bioregion of the U.S. Northwest? First, we review the literature related to scaling up LRFSs to situate our study. We then describe our mixed-methods approach before presenting our findings. We conclude by discussing the feasibility and roles of developing a more diversified production landscape and the implications for policy, implementation, and future research.

Literature Review

Interest in LRFSs as economic development and food resilience strategies has grown over several

Table 1. Select Study Area Characteristics

	Latah County, Idaho	Whitman County, Washington
Population	41,301	48,012
Population per square mile	36.7	22.2
Number of farms	989	933
Total land (acres)	688,576	1,381,952
Land in farms (acres)	324,990	1,218,301
Average farm size (acres)	329	1,306
Number of farms by size		
1 to 9 acres	97	84
10 to 49 acres	368	162
50 to 179 acres	276	150
180 to 499 acres	120	142
500 to 999 acres	58	106
1,000 + acres	70	289

Data source: U.S. Department of Agriculture, National Agricultural Statistics Service, 2022a, 2022b.

decades (Feenstra, 2002; King et al., 2010; Renting et al., 2003; Sitaker et al., 2014). Although commonly depicted as superior and independent from conventional and larger-scale food systems, the extent to which LRFSs deliver improved, different, or separate outcomes is contextual (Born & Purcell, 2006; DuPuis & Goodman, 2005; Martinez et al., 2010). LRFSs are more accurately characterized as hybrids: they weave together alternative and conventional systems, including local to broader scales of production, and supporting relationships based not only on shared, but often compatible or conflicting values (Bloom & Hinrichs, 2011; Mount, 2011; Saul et al., 2022). In addition, all food systems are evolving in the context of increasing environmental uncertainty, raising questions of how a changing climate and future water availability will affect where, how, and what crops will grow (University of California Applied Climate Science Lab & University of Washington Hydro Group, 2022). Adding to these issues are questions about how to link supply chains and meet food security needs.

Small-acreage farms and research about them tend to be concentrated near population centers; however, the need to increase access to high-quality fresh produce in rural areas is paradoxically high (Coleman-Jensen et al., 2017; Food Research & Action Center, 2020). Small-acreage farms and their role in LRFSs present unique opportunities for economic development (Carlisle et al., 2019) and help diversify agricultural lands to improve adaptive capacity during climate change, as large-scale commodity agriculture dominates U.S. rural farmland (Petersen-Rockney et al., 2021; USDA NASS, 2024a). Midscale farms also can play an important role in building LRFSs (Lyson et al., 2008). However, midscale farms have greater need of labor, processing infrastructure, and profit-taking intermediaries, which are common constraints to scaling up (Mount, 2011; Richards & Vassalos, 2021).

Building production capacity may necessitate increasing the number of acres farmed, increasing the number of farms, reallocating land from the production of other crops, or using season extension or controlled environment production. These strategies require additional human and financial capital and risk as producers scale up or reorient their business (Mount & Smither, 2014). Land access and tenure are also critical for small-acreage and beginning producers, but rising farmland values, consolidation, and conversion to non-agricultural development can make buying or leasing land difficult (Calo & Master, 2016; Carlisle et al., 2019; Horst, 2019; Horst & Gwin, 2018). Many producers have trouble finding suitable land near their markets, or the land they can access requires considerable soil rehabilitation (Calo & Master, 2016; Horst & Gwin, 2018) or lacks infrastructure like on-farm housing or irrigation (Carlisle et al., 2019; Iles et al., 2023). Irrigation systems are expensive barriers for many, especially as water rights and access grow increasingly contentious and constrained (Carlisle et al., 2019; Mancosu et al., 2015). Permanently acquiring land or negotiating lease rates is expensive, time-consuming, and producers may be unfamiliar with zoning boundaries and land use policies (Carlisle et al., 2019; Iles et al., 2023).

The financing and profitability of small-acreage farms is also affected by time and labor demands, where many subsidize farm profits through off-farm incomes (Iles et al., 2023). Short-term lease financing is challenging to secure because institutions typically lend to those who can confidently pay back the loan in a set period, creating a barrier but also an opportunity for longer-term lease agreements (Adenuga et al., 2021; Carlisle et al., 2019). Other land access constraints include lack of capital, credit, or necessary relationships with farmland owners or the possibility of family succession (Calo & Master, 2016; Carlisle et al., 2019; Valliant et al., 2019). For large-scale farmland owners, the permanent transfer of land to small-acreage farms is rare due to zoning, legal fee, and capital tax barriers as well as family dynamics and complex emotions regarding inheritance, tradition, and legacy (Adenuga et al., 2021). Other constraints include the age of farmland owners and disinterest in selling (Iles et al., 2023; Valliant et al., 2019).

These complexities underscore the need to further explore development of LRFSs as place-based, contextualized, and hybrid systems. Furthermore, the similarities of the Palouse region to many other regions with large-scale production agriculture in

the U.S. West and Midwest make it an appropriate area for the study of challenges and opportunities for scaling up diversified production in LRFSs.

Methods

We used a mixed-methods approach that involved interviewing and surveying small-acreage producers; interviewing representatives of local and state governments and others involved in land use, water planning, and policy; and surveying agricultural landowners. We audio recorded and transcribed all interviews with permission. The purpose of our mixed-methods approach was to use "the results from the first method to inform" the second method (development), to examine "different overlapping aspects of [the] phenomenon" (complementarity), and to add "depth and scope" (expansion) (Onwuegbuzie & Collins, 2007, p. 284). Our interviews and surveys were also designed and sequenced to gather information needed to develop extension programming and to support modeling not included here. We describe the interview and survey methodologies in depth below.

Producer Interviews and Survey

In 2018-2019, we interviewed nine small-acreage producers in Whitman and Latah counties to gain their perspectives on opportunities, challenges, and technical assistance needs for scaling up fruit and vegetable production. Interviews averaged 75 minutes and were semi-structured with open-ended questions. Prior to the in-person interview, the participants completed a web-based survey with open- and closed-ended questions that gathered information on demographics, budget, irrigation, soil management, production, equipment use, and land access challenges.

Five of the operations represented were in Whitman County, and four were in Latah County. Two were orchards and seven grew a mix of fruits and vegetables. Five also raised animals. Their average farm size was 10 acres or 4 ha (range = 1–25 acres); however, the average number of acres dedicated to growing fruits, vegetables, or both was 5.9 acres (2.4 ha), ranging from half an acre (0.2 ha) to 18 acres (7 ha) (median = 4 acres). Three of the farms had at least one paid employee, not counting the farm owners. All sold to direct-to-consumer markets, and all but one sold to intermediated markets. Their average gross revenue in 2017 was US$30,419 (range = US$6,350–US$65,000). Participants had been growing produce for sale from 4 to 40 years (median = 10 years), and seven were first-generation growers.

Key Informant (Non-Producer) Interviews

In 2018–2019, we interviewed 10 key informants, including planners and representatives from state agencies, city governments, and the Palouse Basin Aquifer Committee (PBAC). PBAC cooperates to manage long-term water supply and comprises representatives from the cities of Pullman, Moscow, and Palouse; Whitman and Latah counties; Washington State University; University of Idaho; and ex officio committee members representing the Washington Department of Ecology and Idaho Department of Water Resources. These interviews were semi-structured, averaging 58 minutes, and covered participants' perspectives on the opportunities and barriers to scaling up fruit and vegetable production and the policy context for this type of development.

Landowner Survey

In 2020, we surveyed agricultural landowners in Latah and Whitman counties to assess how many acres could potentially be available for small-acreage producers to buy or lease, what types of agricultural practices landowners would want on their property if they leased to small-acreage growers, land use and succession plans, and landowners' perception of irrigation water availability. For the sampling frame, we started with a list of all agricultural landowners in the two counties obtained from CoreLogic (2016). We wanted to survey only landowners of parcels that could feasibly support fruit or vegetable production, so we narrowed the sampling frame based on a logistic regression probability analysis of soil characteristics; precipitation and temperature; and proximity to markets, highways, and existing fruit and vegetable farms following the methods described in Liao et al. (2019). Figure 1 shows the probability that parcels in Whitman and Latah counties are suitable for fruit or vegetable

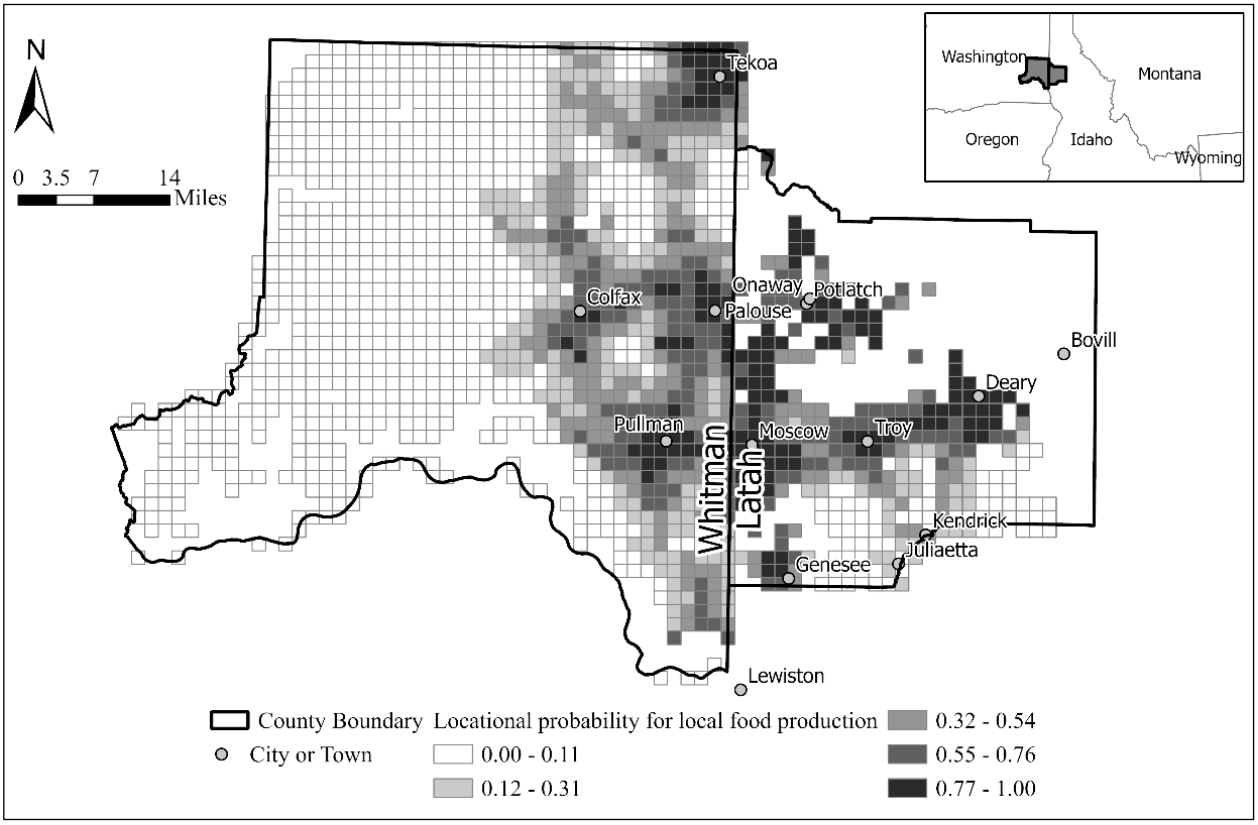
production. All landowners of a parcel with a 0.31 probability and higher received the survey.

We used a mixed-mode approach to implement the landowner survey, which included multiple mailings: (1) a cover letter with the paper survey, US$2 incentive, and a postage-paid return envelope; (2) a follow-up postcard with a link where they could participate online; (3) a replacement paper survey with a cover letter; and (4) a final postcard with the survey link (Dillman et al., 2014). Of the 511 landowners who received the survey, 327 participated, for a 64% response rate. Sixty-three percent owned land in Latah County and 43% in Whitman County (n = 318). Seventy-nine percent had dryland agriculture, 24% had livestock production, 11% had fruit production, 8% had vegetable production, and 16% had some other land use on their property (n = 318). Eighty-four percent lived on or next to the land they own (n = 312), 45% farmed or ranched their own land, and 56% leased land to a farmer or rancher (n = 319).

Analysis

We used Microsoft Excel to generate descriptive statistics and figures summarizing our quantitative data from the small-acreage producer and landowner surveys. We analyzed the qualitative data from the interview transcripts and open-ended survey responses with ATLAS.ti software using an inductive approach (Charmaz, 2006). Two researchers independently completed an initial coding phase that involved labeling and grouping segments of data into preliminary categories and subcategories based on a subset of the raw data (i.e., independent parallel coding) (Charmaz, 2006; Thomas, 2006). The coders then met to discuss, refine, and integrate the resulting codes into a single framework and to ensure intercoder reliability. Next, they coded the remaining data, continuing to refine and organize the categories, and meeting regularly to discuss the process and data interpretations (Charmaz, 2006). We then identified quotes to illustrate themes. Researchers' personal and professional backgrounds can influence data interpre-

Figure 1. Map of the Probable Suitability of Parcels in Whitman and Latah Counties for Growing Produce



tation. Therefore, the coauthors, who represent multiple backgrounds (e.g., sociologists, soil scientists, geographers, economists, and extension professionals) also met to discuss and refine data interpretations. A project advisory board provided stakeholder checks to further ensure the credibility of the findings (Thomas, 2006).

Findings and Discussion

Themes emerged related to social, economic, and environmental considerations that can shape the feasibility of scaling up fruit and vegetable production as a part of diversified LRFS development. Notably, most fruit and vegetable producers we interviewed were uninterested in substantially scaling up, owing to their challenges and lifestyle values. Two of the most salient factors that producer interviewees identified as affecting their interest and capacity to scale up were land ("We've looked at land … close to town and we wouldn't be able to afford it") and water ("Number one is going to be water. I mean just water, water, water"). The other most salient themes limiting their interest and capacity to scale up were labor ("Labor is real hard to get"), capital ("Access to capital to scale up whether it's to buy the land or to buy machinery to allow that"), and seasonality ("Our growing season can't really keep our community in fresh produce"). We synthesize the remaining findings from the producer interviews and survey, key informant interviews, and landowner survey organized by two interconnected, overarching topics: land and water.

Land

While all fruit and vegetable producer interviewees had secured land, they commonly identified challenges finding affordable land suitable for farming with adequate or predictable access to irrigation water, near where they already farm, or near their markets or social network. Responses to the open-ended questions on the landowner survey indicated that a large majority were uninterested in selling their land for any purpose. Specific themes included concern about the negative environmental, agricultural, and cultural impacts of breaking land into smaller parcels or integrating non-agricultural land uses ("Selling small parcels invites problems in various forms: non-farm-friendly neighbors, weed patches, sub-division"), incompatibility with family use—typically dryland farming—and succession plans ("This has been our family farm since 1887"), and water impacts ("I am concerned about the aquifer [and] the extended family currently [farming it] share an understanding of this fundamental concern"). However, 23 respondents (8%) said they would be willing to sell their land for fruit and vegetable production (n = 297), collectively representing a minimum of 238 to 317 acres. Even 238 acres offers potential for this type of small-acreage production (roughly 40 more farms at the scale of producer interviewees), if growers were able to access and afford it.

Considerably more landowners were interested in leasing their land: 104 (35%) said they would be willing to lease it for fruit or vegetable production (n = 301). Those interested in leasing collectively represented 778 acres to 1,173 acres: eight said they would be willing to lease "more than 0, but less than 1 acre," 44 said "1–5 acres," 13 said "6–10 acres," 15 said "11–20 acres," and 23 said "more than 20 acres." Themes in the open-ended responses explaining landowners' interest in leasing included general support ("Sounds interesting and would support"), lack of other use ("I'm doing nothing with it—I wish someone could use it"), support for LRFS ("Local production and availability of produce for local community"), and landowners with land currently in dryland production who were open-minded to other viable agricultural uses ("If anyone can prove there is a better option, will listen and support any good suggestions").

The primary themes of why some landowners are uninterested in leasing for fruit and vegetable production included that the property is for their personal use or too small; not wanting people on their property; water inaccessibility; soil, slope, or frost characteristics; leasing not fitting into their succession plans; and skepticism about the economic viability or capacity of small-acreage produce growers ("These enterprises have historically been undercapitalized. After an enthusiastic startup they fade away after a season or two. Structures and fences are poorly done and are a cleanup liability"). Finally, many respondents farm or are in lease agreements they are not interested in changing ("I already have 100% leased to farmers of

wheat/grain") or described dryland production as the best use of the land in general terms ("Dryland grain is best use").

Some landowners conveyed beliefs or concerns about the compatibility of fruit and vegetable production with conventional dryland agriculture ("Orchards, vineyards, vegetables, flowers not very compatible on the Palouse"), which could present complications for conventional dryland growers ("It would make it more difficult for producers growing commercial crops like wheat, barley, legumes, etc. when spraying those crops. I'm not against it, but not really for it"). Similar themes emerged from interviews with fruit and vegetable producers, centered on the practical and sometimes cultural complications of growing produce next to conventional dryland fields related to chemical drift:

> A limiting factor here in the Palouse is chemical drift. … In [YEAR] we had glyphosate drift onto … [many] trees, and they're all gone now. … Then in [YEAR] we got it big time … [and] had to pull out lots of trees. That set us back five to ten years. (Producer)

> We're an all-natural farm surrounded by conventional farming, and we get drifted on a lot. (Producer)

A related theme from the interviews with fruit and vegetable producers is that some dryland conventional producers do not view small-acreage operations as legitimate businesses, at least initially. The landowner open-ended survey data also supported this theme, as some respondents conveyed the belief that small-acreage farms are "hobby farms" or otherwise less than "real" businesses in contrast to dryland farms, or that smaller-scale fruit and vegetable production for LRFSs is less important than commodity production. Yet, several producer interviewees who had experienced chemical drift losses described working directly with their conventional neighbors to come to a shared understanding and commitment to resolving the problem:

> I have tried to take a neighborly approach. … And, for the most part, they're willing to talk to me. … They didn't realize that we were a business because, "we're so small, how could we be making money at what we were doing?" When I think profitability-wise acre for acre, we probably do better than them. … The next spring, when he had to spray, he came down my driveway and personally said, "hey, I'm doing this, but I'm watching the wind and if…[it] shifts, I promise you I'll stop." (Producer)

The survey also asked landowners how interested they would be in specific enterprises (Figure 2) and the extent to which they would support or oppose specific production practices and infrastructure (Figure 3). Some landowners were interested in leasing to all enterprises we asked about, and a greater portion expressed support or neutrality rather than opposition to specific practices and infrastructure. Many who were interested said they would consider leasing for any viable enterprise, but that the details would be important ("Permanent structures are less desirable but not out of the question. It is mostly about who and how they/we do it").

Of the landowners willing to lease, greater proportions expressed strong support for organic production, and chemical pesticide use stands out as a practice with comparably the most opposition (Figure 3). However, in the open-ended responses, many landowners explained they prefer organic production but view conventional inputs as appropriate or tolerable in some cases ("We like to minimize chemical pesticide use but acknowledge that it can sometimes be the best option"). Some landowners were strongly supportive of every practice, and most did not have strong preferences.

These findings reflect the numerous existing land management practices and uses in the study area that LRFSs must recognize and navigate. Although tension and conflict can occur between small-acreage fruit and vegetable production and conventional dryland practices and farming culture, data also suggested ways the two systems can be mutually supportive and compatible. For example, both types of farming benefit from landowners prioritizing farmland preservation or making land available to agricultural operations. Furthermore,

many of the same conditions that support export-oriented dryland agriculture also support LRFS-oriented production:

> In general, agriculture is the mainstay of the county, so we have codes and policies in place that protect agriculture. … It's not just wheat growing … vegetables and fruits are a part of ag, so it would come under the same protections. (Key informant)

Water

As fruit and vegetable producer interviewees highlighted, water access is critical to expand irrigated agriculture ("Water is the limiting factor"). Key informant interviewee perspectives coalesced around the expectation of a water-constrained future ("Any sort of major water-consuming endeavor on the Palouse is going to be met with water as a restraining factor"). Other salient themes from key informant interviews included uncertainty

Figure 2. Landowner Survey Respondents' Level of Interest in Leasing for Select Types of Production

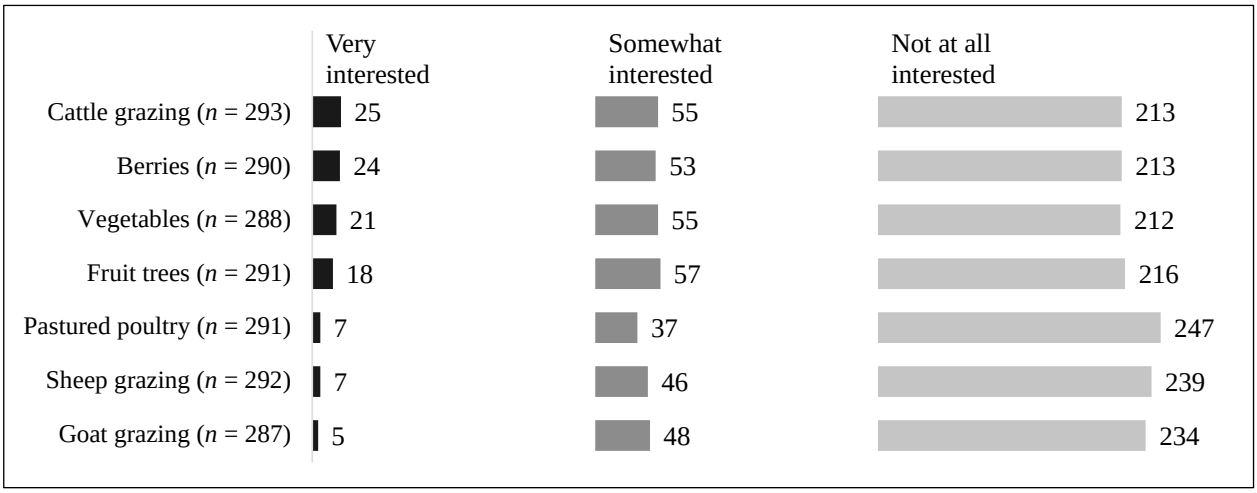
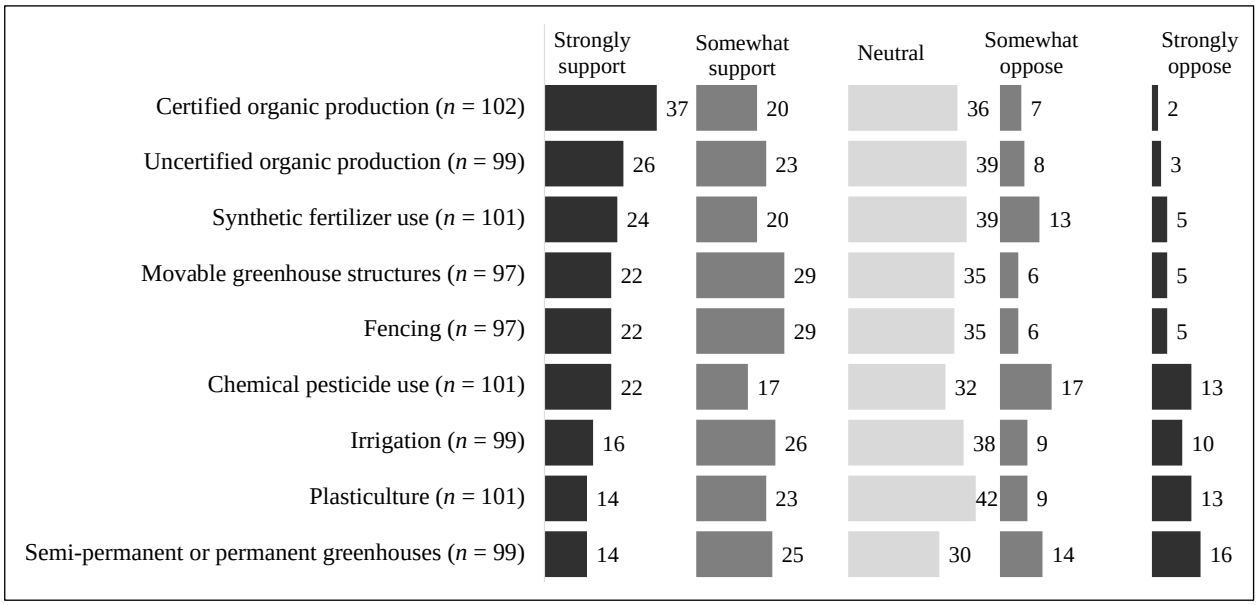


Figure 3. Landowner Survey Respondents' Support or Opposition for Production Types and Infrastructure on their Leased Land, by Number Interested in Leasing



regarding how climate change, population growth, public opinion, and conservation measures in the study area will affect water quantity and access over the long term. Water policy was also identified as a factor. As the Washington Department of Ecology (2025) explains, "Waters of the state belong to the public and can't be owned by any individual or group. Instead, a person or group may be granted a right to use a volume of water, for a defined purpose, in a specific place" (para. 1). In Washington, a water right is required for "any amount of surface water for any purpose" and for ground water for any purpose except for domestic or industrial uses of less than 5,000 gallons per day (gpd) or irrigation of a half-acre or less of lawn or non-commercial garden (Washington Department of Ecology, 2022, para 1). Although key informants described the potential, albeit extremely limited, to acquire an existing water right in Whitman County, the state is not issuing new ones.

In Idaho, new water rights are still granted in Latah County, where, without a permit, the daily limit for domestic water use (i.e., homes and livestock) is 13,000 gpd on up to a half-acre. While water may be more accessible in Latah County, water adjudication is in process in North Idaho, which will shape future use. Key informants expected permitting to be more restricted and water availability to decrease at some properties over the coming decades due to geology and nearby water use, an effect some producer interviewees described already experiencing. Local political entities recognize the problem of declining aquifers, and long-term planning is underway. Water development at the public works scale is fraught with difficulties and expensive, and will primarily support existing uses rather than an expanded agricultural industry (Anchor QEA, LLC, & HDR Engineering Inc., 2017). The long-term trajectory is toward more restrictive water management and availability, and political and ecological processes present risk and uncertainty to irrigated agriculture and other commercial development.

Despite constraints and caveats, key informants saw the potential for continued irrigated agricultural development:

> If they're smaller production and … using conservation techniques, I don't know that it would be a problem at all. … But most of [our aquifers] are not easy to recharge [and] making sure that people have drinking water before we're watering plants is the priority. (Key informant)

Key informants reflected a nuanced collective understanding of development potential and a widely shared desire to manage water resources to support multiple values. The cultural and political context for increasing irrigated agricultural production is as complex as the ecological and hydrological one, with compatible and conflicting factors to navigate:

> I think in general people appreciate … agriculture around here and … how influential [the Moscow Farmers Market] is on the community. People like to have locally produced things … but there also are a lot of people that are highly concerned and very plugged into the water issue, and so if they saw it as a real concern for water consumption, I think that there would be conversations about "is this the best place to do that?" (Key informant)

A theme from key informant interviews was the belief that agricultural water use is insignificant on the Palouse relative to other uses and more important than some, such as lawn and golf course irrigation. Some key informants expected that whatever development occurs will not use enough water to impact other users or the aquifer significantly:

> If it's 20 or 30 farms that are using a million gallons a year, that's 20 or 30 million gallons a year when the City of Moscow is using 900 million gallons a year. … It's when you [have] farms that are using 30, 40, 50 million gallons a year each [that] you start having a little bit more concern. (Key informant)

Landowner survey participants generally held similar views to key informants about water access. Many indicated that their properties do not have

adequate water to sustain fruit and vegetable farming. These respondents explained that their wells do not have capacity ("We have limited water: 1.5 gallons a minute"), described the constrained water environment more generally ("In this area you do not have enough groundwater to support irrigation") or pointed to economic constraints, such as the expense of drilling a well ("I'm not opposed to it; I just think it would be cost prohibitive at this time"). Some said water rights are a limiting factor ("Currently water rights (permits) are unattainable"). Another theme was opposition to irrigating with groundwater: "This [area] does not have capability for irrigation. We can't pump from lakes, reservoirs, or rivers. Irrigation would be detrimental to our groundwater."

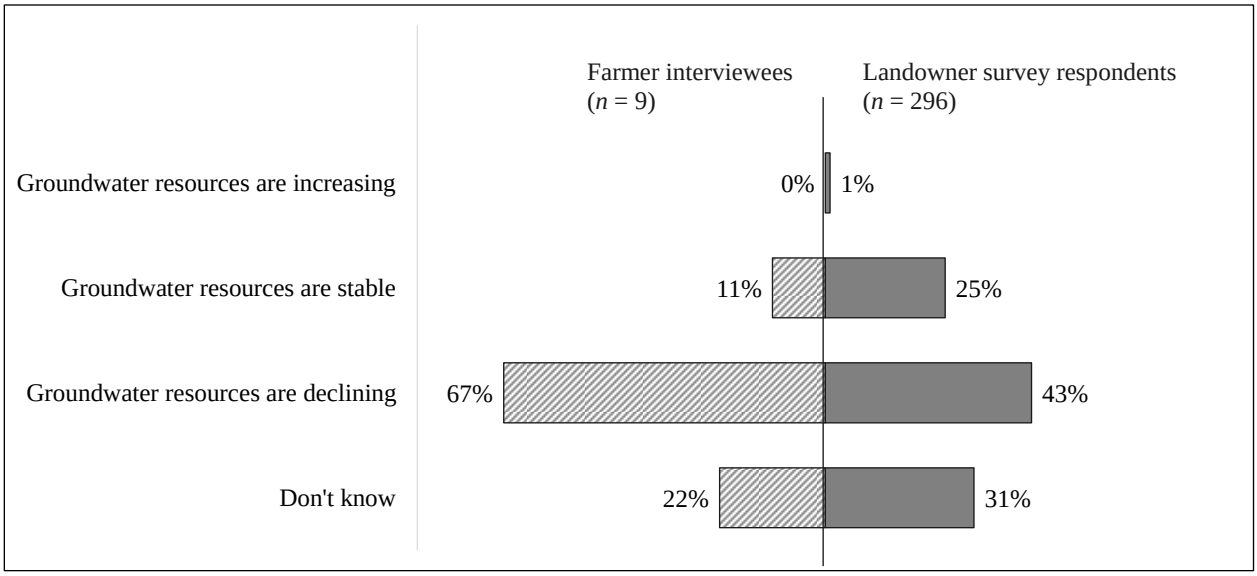
We asked fruit and vegetable producer interviewees and landowner survey respondents about the state of groundwater resources in the Palouse region (Figure 4). A greater proportion of landowner respondents believed the aquifers are stable in comparison to the proportion of producer interviewees. However, both groups relayed uncertainty, and the largest proportion of both groups believed groundwater resources are declining.

Even given constraints, several strategies emerged from the data to secure access to water for fruit and vegetable production. For example, some irrigated production may be supported within the limits for industrial or household use, depending upon jurisdiction. In Latah County, the 13,000 gpd exempt limit is enough by some estimates to support small-acreage, diversified production (Fuson, 2022). Another way to overcome water constraints is to use very little of it. Measures such as subsurface drip irrigation, mulching, and improving soil water storage by building soil health can help, and are practices that fruit and vegetable producer interviewees widely said they are implementing:

> We use a lot less water than a lot of the alfalfa or hay farms in the area because they're using overhead sprinkler irrigation … so I don't think the [water] quantity … is an issue for us because we're pretty efficient with our drip irrigation.

The current permit-exempt limits may be enough for water-efficient indoor operations in either state. Using water-efficient indoor systems could enable the startup of new farms with minimal impact on the local ecosystem and reduce conflict with conventional producers by protecting crops from chemical drift. This approach has higher startup costs and may be limited on leased land, given landowners' concern about permanent structures (Figure 3).

Figure 4. Perception of the Current State of Groundwater Resources in Palouse Region Aquifers



Another avenue to setting up a new farm is to buy one that already has water. Fifty-seven percent of landowner survey respondents said they own a water right (n = 296). Latah County had 424 irrigated acres (172 ha) and Whitman County had 4,583 acres (1,855 ha) in 2022 (USDA NASS, 2022a, 2022b). According to key informants, the only likely potential opportunity to start a midsized irrigated farm is to convert or diversify existing irrigated land, such as alfalfa production, from an existing operation as occurred nearby in Washington's Walla Walla Valley.

To increase water availability, some landowner survey respondents suggested irrigating out of ponds ("Building ponds and using the water for irrigation seems like a good idea to me"), a strategy some fruit and vegetable producer interviewees said they are already implementing ("We irrigate out of the pond, so we didn't have to … draw out of our well"). Local conservation districts and agencies are already providing funding and technical support to landowners to implement pond development for habitat and hydrologic values, such as improved water retention, surface flow, and aquifer recharge. Paired with high-efficiency irrigation systems, ponds could provide irrigation water and advance restoration priorities at local and watershed scales. Some landowner survey respondents and producer interviewees suggested future development suitable to Palouse environmental conditions might focus on livestock ("May not have enough water for irrigation but could pasture livestock"), dryland artisan, specialty grains for higher-profit markets, or developing vertically integrated grain operations that include milling or malting.

Conclusions

As our small-acreage producer interviewees articulated, accessing suitable farmland is challenging in the Palouse context, as it is in many places. Yet, our landowner survey found over 1,000 acres potentially available for growing produce for LRFSs, which is enough to substantially increase diversified production. Landowners expressed a diverse set of values and orientations to agriculture, which conditions access and provides opportunities for diverse approaches. Farms are for sale periodically, many landowners expressed interest in leasing, and new farms continue to start up. Increasing landowner and seeker awareness and use of connecting programs (e.g., Idaho Farm Link) is an important strategy for facilitating this type of LRFS production.

Water provides a hard limit for the foreseeable future to many types of agricultural development on the Palouse and beyond. For small farms, this constrains and conditions development rather than prevents it. As was frequently raised by participants, golf courses in Latah and Whitman counties alone use 204,400,000 gallons per year (U.S. Geological Survey, 2010), more than what is needed for expanding fruit and vegetable production at the scale considered in this study. Whether water goes to small farms or to other uses is a question of values. Building a new golf course would be challenged because of its water use; agricultural development should expect similar treatment. In many U.S. communities, small farm development is likely to occur in contested, constrained landscapes with competing visions for how to use limited resources.

The dialectic between small-scale produce and large-scale dryland commodity growers is a point of interaction and hybridization across systems, bringing different understandings and values not only to LRFS expansion but also to conventional supply chains. The issues we highlighted between these grower types are likely relevant where large-scale commodity production dominates the landscape as in much of the rural U.S. West and Midwest (USDA NASS, 2024a) and could be more broadly explored in future research. Despite barriers, it benefits society for all food systems to be as socially, environmentally, and economically sustainable as possible. Interaction, tension, and conflict between actors and systems can lead to positive adaptation that benefits all. For example, short food supply chains initially developed to support small-acreage diversified farms are now providing local and regional supply chain and market opportunities for grain products (Crossley, 2022). In addition, participants identified integrating produce, livestock, or value-added enterprises as strategies to diversify and integrate additional family members into existing grain farms.

If LRFSs are to have an important role in strengthening human resilience in a resource-constrained and uncertain world, development must be intentional to be complementary and compatible with existing land uses and community priorities. Both export and LRFS-oriented farms are embedded in culturally, politically, economically, and ecologically unique places. Many participants argued that the dominant dryland agriculture is well-suited to the Palouse, and that irrigated agriculture is questionably so. Using water efficiently and participating in watershed and habitat restoration are examples of how farms can implement sustainable practices with positive environmental impacts in water-constrained landscapes. In our study area, farms can help build hydrologic capacity, restore ecosystem function, and contribute to resilience in the watershed, for example, through pond development. Water resource challenges and solutions may be context-specific, but the need to address them is universal. The goal for this type of development is to realize the promise of local foods for supporting not only economic but environmental and social well-being. If small farms improve the many uses and values in a landscape, then they are truly contributing to socially, culturally, and ecologically embedded and resilient systems.

This study identified new constraints and opportunities for LRFSs to compatibly expand with existing agricultural production systems. It contributes to the literature by helping to "unpack" water and land access opportunities and constraints for LRFS development, exploring how these issues "are understood by those connected with them" and mapping a "range of positions" (Ritchie et al., 2013, p. 31). This study also has explanatory value as it examines "the factors [and] influences that underlie" (p. 32) decisions, attitudes, and behaviors affecting capacity to increase production and LRFS land and water access. Our mixed-methods, in-depth, and nuanced exploration of the issues provided diverse perspectives to inform future policy and outreach. Our interview results are not statistically generalizable, and our broader results are bound by place. However, the literature points to the importance of place and context of agricultural production when examining LRFSs, and we uncovered dynamics that can be explored in future research (Feenstra, 2002; Saul et al., 2022).

As the Palouse illustrates, scaling up LRFSs can be an aggregation of small, scalable activities rather than a single development to reach regionally significant economic impacts. Research is needed to better understand both community and regional impacts of this type of development in the context of larger-scale systems. Research is also needed that supports regional-scale planning that integrates local development as an important goal. In many areas, this will be a new type of planning that builds on and supports other more narrowly or generally focused efforts. There are large grant-funded projects in the United States focused on regional-scale planning for more specific goals, such as business development, or broad implementation of new producer practices. Understanding the differences in approaches and outcomes among these projects is one example of a fertile research opportunity. Our ongoing research builds on this study to explore integration of small- and midscale farms into regional supply chains, and the role of LRFSs in addressing broader community development goals.

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Empowering teens through food justice: An exploration of youth development programs

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Abstract

Youth food justice programs hire teenagers to engage in food justice projects in their neighborhoods. These community-oriented programs encourage youth to discover and develop their natural strengths by farming, taking advantage of leadership opportunities, and working on relationship-building. This exploratory research compares the development outcomes of five youth food justice programs in the Northeastern U.S. through data collected from interviews with youth and adult staff. Four main themes emerged: food justice, community building, providing a safe space, and personal development. Results suggest that program participation supported youth feeling greater connection to their food system, their communities, and themselves. Participants reported gains in systems thinking, a deeper sense of community, positive relationships with adult mentors and peers, and feelings of self-efficacy. Youth food justice programs are crucial tools for building resilient food systems, community well-being, and youth empowerment.

Keywords

youth empowerment, food justice, positive youth development, community development, resiliency

Introduction

Research has shown that connecting youth to community, meaningful relationships, activities of authentic care, and positive roles can help them develop and discover their natural talents, attributes, assets, and social skills (Butts et al., 2010; Catalano et al., 2004; Delia & Krasny, 2018). Provided with the right environment, adolescents can

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Author Note

This paper was adapted from Catherine's graduate project for her master of science degree in food systems at the University of Vermont.

enter adulthood with a deep sense of self, strong leadership skills, and self-efficacy (Scales et al., 2001). Originating with a research project by the U.S. Department of Health and Human Services, Positive Youth Development (PYD) is a strength-based and resilience-oriented model that consistent with the research on connectivity asserts that all youth have the capacity for meaningful self-discovery (Catalano et al., 2004).

Scholars argue that one of the most effective ways to use the PYD model is through meaningful employment, because work is intrinsically based in learning, contribution, and relationship building (Butts et al., 2010). Youth Food Justice (YFJ) programs hire teenage youth to do food justice work in their community, garden and farm, and cook and feed their neighbors, all while developing personal development skills. YFJ programs use the PYD framework by creating community-based spaces where youth can learn about their strengths. This paper analyzes the PYD outcomes of five different YFJ programs in the Northeastern U.S. through data collected from interviews with youth and adult staff. Overall outcomes include youth feeling stronger connection to their food systems, their broad and immediate communities, and themselves.

Food Justice and Positive Youth Development

The current global food system is a corporate food regime, which concentrates wealth and exploits land, labor, and the individual. Wealth is increasingly controlled by powerful monopolies (Howard, 2016), leaving individuals feeling disconnected and abandoned by their food systems (Clendenning, et al., 2016). Low-income communities and communities of color have been subjected to discriminatory laws and policies that make it difficult for them to own their own land, access fresh food, and work under fair labor conditions (Alkon & Agyeman, 2011). Advocates address these discriminatory policies with systems-based, social justice approaches. Through a lens of anti-oppression, advocates from all sectors of food systems work together to create the food justice movement (Gottlieb & Anupama, 2010). Food justice aims to fight social inequalities, racism, classism, and labor issues in the food system, with the ultimate goal that each person has the right to access healthy, affordable, and culturally appropriate food (Holt-Giménez and Wang, 2011; Sbicca, 2012). Food justice is radical: it addresses injustices at every step of the food system (Gottlieb and Anupama 2010). Food is ingrained in every aspect of society, making it an important tool for empowerment and anti-oppression (Sbicca, 2018).

A means for promoting empowerment as well, Positive Youth Development (PYD) is a comprehensive way of facilitating adolescent transition to adulthood (Shek et al., 2019). In the early 1970s, youth leaders and educators turned to PYD as a strength-based and resilience-oriented model that views all youth as capable of healthy development if connected to meaningful relationships, communities, and positive roles (Butts et al., 2010). The goal of PYD is to assist youth in developing and discovering their natural talents, attributes, assets, and social skills. PYD is strength-based, which means youth should never be evaluated for a *lack* of assets (Mannes et al., 2005).

Nevertheless, it has been claimed that PYD has historically lacked appreciation for the developmental differences of low-income youth and youth of color (Ginwright & Cammarota, 2002). Other frameworks, such as Social Justice Youth Development and Positive Youth Justice, have been called on to address the complex consequences that racism and poverty have for youth (Butts et al., 2010; Ginwright & Cammarota, 2002). Considering youth within their social contexts, and recognizing the adverse effects of oppressive systems on youth development, these frameworks can be seen under the umbrella of PYD, particularly when used in programs that "encourage youth to address the larger oppressive forces affecting them and their communities" (Ginwright & Cammarota, 2002, p. 87). Thus, PYD can empower youth to be active problem solvers and change agents who play active roles in their communities.

Youth Food Justice Work Programs: Past Research

While PYD programming can be done through schools, after-school programs, and community development programming, Butts et al. (2010)

argue that the most effective way of using PYD is through work programs because youth can be introduced to new roles, skills, and relationships. For youth who may not feel supported or bound for success in their school lives, home lives, or relationships, PYD programs can offer youth spaces set up intentionally for them to succeed (Sonti et al., 2016). The belief that youth have a future worth investing in can be life changing: Penniman (2017) states that "all of our young people deserve to enjoy a sense of purpose, the acquisition of real skills, and the opportunity to contribute to the betterment of the community" (p. 252).

Many U.S. programs hire teenagers into work programs to do food justice work in their communities. These programs may have youth work on farms, at farmers markets, or in community gardens. Most of these programs are doing PYD, whether recognized or not, because their programs are assisting youth in asset-building during an important stage of their adolescence; youth are at a fundamental period of forming their identities, considering their futures, taking on adult roles, and seeing themselves as powerful individuals (Allen, et al., 2008; Cochran & Ferrari, 2009). Past research on these programs has shown that youth food justice work programs are effective in creating a positive sense of self (Fifolt et al., 2018; Hughes, 2016), relationship building (Allen et al., 2008; Delia & Krasny, 2016), and community capital building[1] (Allen, et al, 2016; Gutierrez-Montes et al., 2009; Vitiello & Wolf-Powers, 2014).

For youth who feel unsuccessful at school, having a space in which they are trusted with responsibilities and can succeed will significantly increase their sense of self-worth (Hughes, 2016). Fifolt et al. (2018) found that through doing difficult farm activities, youth reported feeling more responsible. Sonti et al (2016) interviewed youth who graduated from these programs and reported that they "often [felt] proud, confident, motivated, and purposeful, and attributed these attitudes to their internship experience" (p. 283). In work programs, youth create meaningful relationships with their peers, adult staff, and adults in the community (Allen et al., 2008; Delia & Krasny, 2016; Fifolt et al., 2018). Delia and Krasny (2016) argue that leaders of these programs trust youth, set high expectations for them, and give them complex and fulfilling tasks. These caring relationships created feelings of belonging and safety for youth (Delia & Krasny, 2016). Fifolt et al. (2018) found that youth held deep trust and respect for their adult mentors, which created a sense of comfort and security in their program.

Vitiello and Wolf-Powers (2014) assert that youth work programs create community resiliency and revitalization as well. Youth work on projects that revive their neighborhoods, such as community gardens, urban farms, food access programs, and farmers markets, showing communities that youth care about their neighborhoods and that these neighborhoods are worthy of food justice; the programs: "challenge dominant narratives about distressed communities… young people are given the chance to see their community as a place of which they are proud and to which they are committed" (Sonti et al., 2016, p. 272.). This cyclical community development leads to community capital building, which can help individuals enter a "self-reinforcing cycle of increased opportunity and community well being" (Emery & Flora, 2006, p. 23), creating a process of assets that build upon assets (Gutierrez-Montes et al., 2009).

Work programs can increase youth economic capital by building skills useful in future employment, such as teamwork, leadership, reliability, and independence. Some programs include workforce development training, featuring resume building, mock interviews, or field trips to workplaces (Hughes, 2016). Providing youth with these skills not only leverages youth for future employment opportunities, but helps give them a sense of future economic security (Hughes, 2016; Vitiello & Wolf-

[1] Capital is defined as the "resources people and/or communities possess." These resources can be tangible, like money or land, or they can be intangible, like relationships or personal assets (Gutierrez-Montes et al., 2009). These resources build upon each other to create further resources, creating a cycle where the more capital one has, the more they are able to build. Community capital building is a systems approach to addressing which resources promote sustainable livelihoods through community change efforts (Gutierrez-Montes et al., 2009).

Powers, 2014). Importantly, youth are gaining economic capital by being paid for their work (Allen, et al, 2016).

Researchers have noted that these programs struggle with sustained funding: most programs are run through nonprofit organizations, which rely on charitable donations and grant money. These programs are innately insecure because this money is not guaranteed each year. Fulford and Thomas (2013) found that running the Youth for Eco-Action program cost US$100,000 per year, an amount difficult for the program to sustain. Maïga et al. (2021, p. 615) argues that the lack of robust research that clearly supports the benefits of the programs has a direct influence on policymakers' will to implement them. Past research has focused on producing case studies that demonstrate outcomes of individual programs, which may be too narrow for policymakers to extrapolate from in order to justify supportive policy. This paper adds to the research by exploring the commonalities of five programs with diverse settings, histories, and intentions. This ascertains a holistic conceptualization of youth food justice programs—a key step in encouraging policymakers to engage with these programs.

Methods

This is a comparative case study of five nonprofit organizations in the Northeastern U.S. that host youth food justice (YFJ) programs (Table 1). They hire high school-age youth from their communities to engage in farming, relationship building, personal development, and community programming. After gaining approval from the Institutional Review Board of University of Vermont, I identified cases by word of mouth, internet searches, and my knowledge of organizations engaged in this work. I recruited organizations via direct outreach by phone and email. Youth were invited by staff members at their organizations to participate in interviews. While this recruitment process may have encouraged participants who were particularly enthusiastic about discussing their experience, the nature of this study simply aims to explore the general outcomes of these programs, not to make

Table 1. Outline of Practices of Youth Food Justice (YFJ) Program

Organization/Practice	Details of Practice
Project Youth	
Food Justice Work	Farming on urban community farm; running an affordable community farmers market; food justice workshops; community outreach
Other Activities	Journaling; group bonding games; field trips; events with community partners; leading farm tours; cooking workshops; cooking demonstrations
Development Goals of Program	Self-reflection and healing; motivation; trust in oneself; teamwork; public speaking; sense of community; sense of responsibility; growing food; making connections with peers and adults
Leadership	Instilled into the program weekly: each week there are Crew Leaders who take charge
Timeframe	Summer only, 25 hours a week
Payment	Hourly
Urban Growing Corps	
Food Justice Work	Farming on urban youth farm; helping immigrant/refugee farmers on farms; working in community gardens; cooking lunch together
Other Activities	Field trips; workforce development; crafts; herbalism; self-worth sessions
Development Goals of Program	Growing food; tangible work skills; fulfilling relationships; sense of respect for those who are different; sense of responsibility; communication skills; sense of community; connection to the land/nature; self-worth
Leadership	Hires Food Systems Interns each summer as supports for youth programming
Timeframe	3 seasons: spring, fall, summer. 20 hours/week in summer, less intensive in spring and fall
Payment	Hourly

continued

Table 1 continued

Sprout	
Food Justice Work	Farming on urban community farm; bringing food shares to neighbors in public housing; cooking lunch together; cooking and delivering food to community members
Other Activities	Group challenges; group games; workshops on nutrition, food justice, and self-improvement; crafts
Development Goals of Program	Self-reflection; friendship; learning their own attributes; confidence; healthy relationship to food; caring for own well-being; mindfulness; independence; connection to peers
Leadership	Youth are given more responsibilities as they continue on in program: spring session is Youth Leadership intensive
Timeframe	3 seasons: spring, fall, and summer. 15-20 hours in summer, 6 hours in the spring and fall
Payment	Stipend
Farming Justice	
Food Justice Work	Farming on urban youth farm; food justice workshops/discussions; working at and supplying food for organization's food pantry; running affordable community farmers market
Other Activities	Civic engagement; hosting community workshops/discussions; conversations on mental health/relational health; events around culture and food; potlucks
Development Goals of Program	Intergenerational relationships; advocating for social change; communication skills; critical thinking; understanding of colonialism, capitalism, oppression; sense of community; self-worth
Leadership	Hires Junior Staff as support for youth programming and leading community events
Timeframe	Year round. 15-20 hours/week in summer, less intensive in fall, winter, spring
Payment	Hourly; Gift card for winter session
Fresh Harvest	
Food Justice Work	Farming on urban and rural farms; working at farmers markets; workshops on food justice
Other Activities	Community projects and working groups; event planning; personal development; professional development; spending time in nature
Development Goals of Program	Leadership skills; self-advocacy; social justice advocacy; dialogue about differences; connection to the land/nature; professional development skills; self-worth
Leadership	Formalized leadership program. Youth incrementally advance during their time in the program, with highest positions as Peer Leaders or a fellowship.
Timeframe	Year-round. 32 hours/week in summer, less intensive during the academic year
Payment	Hourly

Note. It is important to note that these simple overviews do not fully encompass all aspects and goals of the programs: these programs are complex, dynamic, and ever changing, based on youth input, grant funding, and general improvements each year. A few organizations noted that their programs have changed since the COVID pandemic and are currently in transition phases.

conclusions about them as a whole. Youth and staff gave their written consent, when applicable giving written assent alongside their guardian's verbal consent. Youth and staff participated in open-ended interviews about youth experience with growing food, and their thoughts on food justice, and what they got out of the program. These interviews were audio-recorded and transcribed. All participants were paid for their participation with a US$20 gift card.

Youth participant ages ranged from 15 to 20. Youth self-identified as Hispanic, Black/African American, Black/Caribbean, White, Cape Verdean, African, and Puerto Rican. Adult staff self-identified as White/Native American, Mixed/Puerto Rican, African American/Indigenous, White/Arab, Vietnamese American, and Hispanic. All participant and organization names in this paper are pseudonyms.

Data were collected through 17 interviews with youth (11) and adult staff (6) who work with these organizations. Using NVivo, a qualitative coding software package, I placed coded data from interview transcripts into categories that emerged dur-

ing coding, then axial coded and condensed codes into broader categories. During this stage of coding, four main themes emerged. Within these main themes, seven sub-themes emerged. These themes were used as a structure to analyze data (Table 2).

Results and Discussion

This research seeks to understand with what assets, feelings, perspectives, and relationships youth leave their youth food justice (YFJ) programs. Using Positive Youth Development (PYD) as a framework, I examined how through food justice these dynamic programs gave youth opportunities for connection, relationship building, and self-discovery. Four central themes emerged: Food Justice, Community Building, Having a Safe Space, and Personal Development.

Food Justice

Systems Thinking

All YFJ programs teach food justice by combining workshops and experiential learning. Learning about food justice helped youth understand the larger systems that impact their lives, specifically systems of oppression that target low-income neighborhoods. Learning about these systems was eye-opening for youth. CJ explains how learning about food justice made her realize how her community is impacted by food injustice:

> Before I started working here I didn't really think of the food system much. When I started working with Project Youth, I realized how big of an issue food waste is, food insecurity, climate change … like those things started to stick out to me more. And I just started to develop more of a passion for advocating for these things. I didn't even know what food apartheid[1] was, and I didn't realize that if you go into Black and Brown communities, you can find like five fast food restaurants on one block. I never paid attention to that much. But now that I understand what that is, every time I pass a street with a McDonald's and a Wendy's and all that stuff, I just remember what this program is teaching me. They are doing this stuff on purpose because they know that certain communities can't afford good food. So they make easy money off of us. And that's part of the reason I've stuck around. I want to help my community with these issues.

Table 2. Outline and Description of Themes and Subthemes

Theme	Subtheme	Summary
Food Justice	Systems thinking	Through learning about food justice, youth gain understanding of systemic oppression in their communities and gain passion for social justice, and learn they can be change agents.
	Sense of belonging in nature	Through farming, youth gain access to the mental health benefits of nature
	Empowerment through food literacy	Through growing food and cooking, youth gain food literacy skills
Community Building	Being a part of their community	Youth learn that they care about their community and their community cares about them
Having a Safe Place	A safe place to go	Youth, particularly refugee youth and speakers of other languages, feel they have a safe place to go to
	Reliable mentors	Adult staff are people that youth can bond with, trust, and learn from
Personal Development	Self-efficacy and Leadership	Youth gain leadership skills and a sense of self-efficacy

[1] Food apartheid is a "human-created system of segregation that regulates certain groups to food opulence and prevents others from accessing life-giving nourishment" (Penniman, 2019, p. 4).

Garett expressed a feeling similar to that of CJ, that they now understand that there is a reason why their community lacks access to fresh vegetables:

> I think before this job I was ignorant on a lot of things … but then when I came here I began to be aware of the flaws in our food system, like clear examples of purposeful things in our food system that are made to keep some people down and other people up. I feel like before I came here, I didn't really think about it often. But now when I shop or when I eat, I try not to shop at gas stations and stuff. Even though they do have produce, it's not the best. So I try to shop locally or try to get vegetables at Farming Justice.

Garett adds that they have changed the way they approach food because of the knowledge they have gained about food justice. Jack was surprised to learn about issues he had never heard of before, suggesting that perhaps these issues should be taught in school: "Some people don't even know about these things. I feel like it should be more accessible so people can know more about it. It's like we're living in the dark before someone tells us! I feel like, when you have a certain knowledge, you can see like 'this is not good, they're doing it on purpose.'"

CJ, Garett, and Jack all spoke to the effect that "they are doing this on purpose." Whether youth have an idea of who "they" are does not matter: these insights show that youth are thinking about larger systems at play. While they may have learned about systems of oppression in school, seeing tangible examples can help ground these concepts in their own lives. For example, CJ saw concrete examples of systemic racism and classism manifest through food apartheid in her neighborhood. As Garett and CJ noted, having knowledge about systems of oppression enables them to have more autonomy about the decisions they make and to realize they have the ability to fight back. These examples show that learning about food justice increased youth political efficacy and desire to make social change.

Levkoe (2005) argues that food justice may be an ideal opportunity for youth to "develop the knowledge and skills necessary to actively participate in society and to have an impact on different political levels" (p. 92). Food justice can be a useful groundwork for youth to get involved in social justice causes that they care about. This was true for CJ, who discussed how learning about food justice helped her realize her deep passion for advocacy work and that she plans to pursue a path in social justice. She said of her time at Project Youth:

> [It] uplifted me, making me see my full potential. And opening up my mindsets, learning about new things that I could pursue in my future. I gained a lot of knowledge on these different issues, and how they are impacting my community around me. It helped me to realize how much I care about my community. And just how much I like helping people. If I didn't have this job … I wouldn't have found out that there's different ways I can help my community and that I would actually really enjoy doing those things.

This program helped CJ realize that she can be an active change maker in her community. This connection, from learning about social justice issues to becoming an agent of social change, reflects the PYD literature. Ginwright and Cammarota (2002) argue that gaining critical consciousness is an important step in youth development. Learning about systems of oppression gives youth the opportunity to "change the social and community conditions that prevent a positive healthy process of development" (p. 93). Youth can see the world as a place where they can make change (Ginwright & Cammarota, 2002). From the perspective of critical consciousness, youth choices can become more intentional. Once youths recognize their power to make social or political change, they can see the power they have to make change in their own lives. By learning about food justice, youth leave these programs knowing that they have the power to make change in their personal lives, relationships, communities, and larger systems.

Sense of Belonging in Nature

Not all youths loved farming. While no youths said they disliked farming, only three seemed particularly excited about it. Five said they either did not like being in the heat, lacked motivation to do farming work, or did not like bugs. Data about this is likely skewed towards favorability toward farming because all youths had decided to return to their program. Presumably, those who really disliked farming would not have returned. Regardless, most youths said they gleaned something important from farming: they felt empowered by connecting to nature.

Most youths had never been on a farm or in a garden before. Many said they felt excited about learning about farming, something with which they never thought they would have experience. Ariana said that she entered the program knowing nothing about growing food, but left feeling "like a professional farmer." Steven said, "I never thought that I would actually be a farmer when I grew up. I never knew farming was actually this fun to do." It was empowering, as well, for youth to see themselves take up space in a profession that in the U.S. is dominated by older white people: 95% of farmers are white[2] and 92% are over 35 (Horst & Marion, 2018). In addition to doing farm work at their own programs, all the programs included visits to other farms often run by BIPOC, immigrant, and refugee farmers. Meeting these farmers challenged the dominant narrative of what a farmer looks like and allowed youth to see that farming could be a viable option for their futures. Theo argued that it was important for youth to see themselves in this work: "There are some times when we bring inner city youth to the bigger farms, they get to see how much land there is out there. … I think the most profound thing really is knowing that this work exists, like farming actually exists. And the impact it has on the community." Seeing themselves in this work can have implications for youth's sense of belonging. While it is apparent that most youth will not pursue a career in farming, experience in farming gives them a larger sense of connection to their communities and to their food systems.

In a broader sense than the experience of farming, youth appreciated how much time they were able to spend in nature, which they felt they had historically not been able to do. Eco-racism systemically prevents some youth from encountering green space in their lives, blocking access to the benefits of nature. Communities of color are often pushed into neighborhoods that do not have parks or natural areas for youth to spend their free time (Fisher, 2017). Research has shown that "spending time in nature reduces stress, social anxiety, depression, disease, and impulsivity, and increases concentration, creativity, conflict management skills, agility, balance, academic performance, eyesight, and life satisfaction" (Penniman 2018, p. 246). YFJ programs are an important way for youth to routinely access green space and reap its mental health benefits. Six youths said they enjoyed their job because of the time they got to spend in nature. CJ, Hana, and Jade talked about the therapeutic benefits they got from being on the farm, particularly through weeding and harvesting. Randy said he felt relaxed and comfortable in the garden, and Edwin said this program strengthened his love of nature. Steven shared that being in the garden gave him a space to reflect more than usual: "In the garden I feel calm, I feel like I can really think about what I want to think about." Without farming, youths perhaps would not have learned that nature can help them feel good. Even with discomfort from heat, bugs, and the physical demands of farming, there is still reason to believe that farming is an important part of YFJ programs.

A question that emerged from the interviews was whether farming is necessary to YFJ programs. While there are benefits to farming, as discussed, lack of excitement about farming may suggest that the programs do not need farming to be successful. Perhaps youth are better off spending their time in other program sectors, such as food justice projects, cooking, exploring nature, and personal development. Nevertheless, some scholars argue that farming can be empowering for youth.

[2] This statistic reflects "owner-operator" farmers, farmers who both own their land and work it. The majority of farm laborers who work on farms they do not own are people of color. This statistic demonstrates the history of slavery and racism that has led to extremely low rates of U.S. farmland ownership for people of color (Horst & Marion, 2018).

According to Penniman (2018), BIPOC youth often find connection with the land empowering because it is a counternarrative to the "messages that [their] only place of belonging on land is as slaves, performing dangerous and backbreaking menial labor" (p. 3). A sense of belonging on the land can offer youth dignity and empowerment (Penniman, 2018). More research is necessary to explore whether farming is integral to YFJ programs.

Empowerment Through Food Literacy

Three major components of food literacy are learning what one wants to eat, where one can access food, and how to cook food. YFJ programs help youth with the first component by developing appreciation for fruits and vegetables through farming. Ariana said that trying new foods encouraged her to think about what she eats day to day: "When I was at the farm, I was up to try stuff that I probably never thought of trying, or I didn't think it was edible, since I was uneducated on that type of stuff. … I definitely see myself being more conscious of what I'm putting in my body and what's healthy." Ariana demonstrates how gaining food literacy can give youth the agency to make decisions about what foods they want.

For the second component, YFJ programs also increase food access for families, generally encouraging youths to take home fruits and vegetables. Through the Urban Growing Corps youth CSA,[3] youths were given produce each week to take home. In particular, programs focus on growing crops that reflect the multicultural backgrounds of their communities, like collards, hot peppers, and chayote, demonstrating to youth and their families that they can, and should, have sustained access to the foods that they want. As for the third component, teaching youth how to cook is a major way through which programs promote youth food literacy. Edwin, Jack, and Jade were youth staff at Sprout, where youth participants cook and eat lunch together every day. They said that cooking was one of the highlights of their program because they became confident in their ability to cook for themselves. Food literacy forms resilience: for the rest of their lives, youth can make informed choices about what they want to eat, where to get their food, what foods are important to them, and how to cook. It is radical for youth to learn food literacy because it reclaims the power youth have within their food system.

Community Building

Being a Part of their Community

A central feature of YFJ programs is community food justice work. For all programs in this study, the main focus was for youth to maintain community-facing farms and gardens. The farms and gardens were important pillars in their communities; neighbors could see flourishing plants, familiar produce, active wildlife, and engaged youth. Youth also worked on other community food justice projects (Table 1). Project Youth, Farming Justice, and Fresh Harvest sold or gave away at community farmers markets and food pantries food they grew. Urban Growing Corps and Sprout delivered fresh produce and/or prepared foods to their neighbors. Not only does this work give space for youth to contribute to and engage with their communities, but it allows youth to realize that they are valuable and indispensable members of their communities. Frank reflected that YFJ programs are "giving youth the ability to see that they're important to their community."

Ariana shared how she found her work in the community meaningful. Her program, Project Youth, had a community farm adjacent to public housing, a welcoming green space that the community otherwise lacked: "We have a lot of people coming in and out who are low income. I see this farm as a community farm for a reason: it's for the community!" Other youth stated that doing this work made them feel appreciated by neighbors. Hana reflected on the food distribution part of Sprout, youths knocking on doors in public housing and delivering fresh produce and prepared meals; this gave youth an opportunity for connection and community building:

[3] CSA is community supported agriculture, a marketing approach for farms in which consumers typically commit to farmers upfront for sustained access to produce throughout a season (Gottlieb & Anupama, 2010).

> You could see that people were so excited to see the youth and they were so excited for fresh produce. … I could tell they really appreciated it. A lot of the youth were from Angola, so a lot of them spoke Angolese with the neighbors. I think they really liked bonding with the neighborhood.

Meeting neighbors was an important point of connection for youth. Scales et al. (2001) notes that to hear praise from community is an important part of positive youth development. A community's support of youth work can create powerful cycles. In YFJ work, community can see that their youth care about the well-being of their neighborhoods by projects like cultivating community gardens or providing fresh food to neighbors. This leads to community members praising and appreciating youth, which supports youth feeling cared for, valued, and empowered. This cycle can increase youths' feelings of self-worth, deepen their interest in community development projects, and feel closeness to their neighbors (Scales et al., 2001).

Having a Safe Place

A Safe Place to Go

At a basic level, YFJ programs are simply somewhere for youth to go. Programs are not only places of refuge for youth who have nowhere else to go, but also spaces where they can flourish apart from the manifest agenda of the program. The reality of these programs is that some youth are not interested in learning about the complex systemic issues of food justice. They certainly may not be issues that all youth are passionate about or have the capacity to care about in their free time. Four youth seemed to be in this camp—nevertheless, they had all returned to the program. This suggests that PYD is a central aspect to YFJ programs: in times of development, youth seek stability, support, and connection. Carmen discusses the consequences of not having teen programs in their city: "There's not many after school programs here. … The schools themselves and the towns themselves do not put a whole lot of money into young people. And then we get surprised when there's gun violence and murdering of young children, because there's nothing for them to do! It's not a problem of crime, it's a problem of nurturing and loving." Carmen argues that the programs can play an important role in countering larger systemic issues that youth encounter, like violence or the school-to-prison pipeline.[4] Not having options like these programs demonstrates a disregard for youth livelihoods. Youth, particularly youth of color, may end up in spaces where they are stigmatized, criminalized, and surveilled by law enforcement (Nocella II et al., 2017). YFJ programs can certainly offer spaces for youth to escape these oppressive systems.

YFJ programs also offer safe spaces to youth who may not typically have access to such things. They are safe havens for refugee youth and speakers of other languages. Sprout hires youth regardless of their citizenship status or language. Brooke says Sprout is an important place for refugee youth in her city, who are often placed in shelters and motels: "These applicants this past year, when I asked 'why do you want to do this program?' A lot of them replied with 'I'm living in XYZ shelter or motel, and there's nothing to do and I want somewhere to go during the day.'" Brooke said Sprout was a good fit because "if you are a kid who does not have work permits and does not speak English well and may not be doing well in school. … I do not look at that [when hiring]." She says that youth who are new to the city can feel empowered by joining this program because there are so few options for non-English speakers in her city. Hana said that Sprout was also an important point of relationship building for refugee youth. She and another staff member, Lila, were able to connect well with youth who were new to the U.S.: "A lot of them were asylum seekers or refugees who were

[4] The school-to-prison pipeline is defined as the "ways that social institutions track and narrow the freedoms, options, and life chances of youth of color who are frequently pushed from the highly segregated and underfunded public school system into the criminal 'justice' system" (Pellow, 2017, p. xix). While this definition focuses only on school, it is a holistic concept meant to encompass all the systems through which youth of color and low income youth interact with the prison industrial complex.

coming here, so they connected with me and Lila. We kinda knew what they were going through, so we could share our stories and what our journey living in [our city] was like." Hana was able to make Sprout feel like a comfortable space for youth because of her shared lived experiences.

Importantly, youth at these programs are paid for their work. Research has shown that an important outcome of YFJ programs is youth gaining economic capital (Vitiello & Wolf-Powers, 2014). For this reason, I only selected programs who paid youths for their time. Every program paid youths at least minimum wage; for most youths, this was the first time they were able to make money. Particularly for youth without work permits, a source of income can be life-changing. Not only do YFJ programs provide a place to go during the day and space for social connections, but they give youth a sustainable source of income.

Reliable Mentors

One of the most important aspects of the programs is providing youth with meaningful relationships, which create a sense of belonging and safety (Delia & Krasny, 2016). This connection seems to be less of a boss-employee model; rather, one of mentors who hold their mentees accountable. Jazmyn discussed how this was an intentional framework that she used in Project Youth, that she treated youth as peers, rather than kids, because it helped create mutual feelings of trust and respect:

> It just comes down to treating youth as people! Just because they're younger than us does not mean that they're below us. A lot of the youth say that we feel like an older brother or sister, because we treat them with respect. … We give them a lot of trust, a lot of respect, and a lot of grace. Which [is something that] a lot of times the youth don't see from adults.

Ariana and CJ of Project Youth reflected on how much they got from their trusting relationships with Jazmyn, that they gained self-efficacy and leadership skills because Jazmyn made them trust in their abilities. Youth learn that there are adults who they can trust, depend on, and look up to. Butts et al. (2010) claim that youth who have at least one close relationship with an adult feel more confident in themselves in social settings. This confidence can lead to being more honest and vulnerable in all of their relationships. Youth's comfort around adult staff was abundantly clear during my interviews. I saw youth and adult staff laugh with each other, eat food together, and talk about their personal lives. When asking about their relationships with each other, it was clear that all youth and adult staff had deep respect, care, and appreciation for each other. Carmen said that the program has high retention rates because youth not only feel safe in the physical place, but feel safe being surrounded by people who care about them. YFJ programs are spaces where youth are empowered through growing not only food, but through developing positive relationships with adult mentors.

Personal Development

Self-Efficacy and Leadership

YFJ programs aim to help youths feel confident in their abilities by believing in their innate capabilities (Butts et al., 2010). Part of the strengths-based approach of YFJ programs is creating positive work environments where youth are able to try out new roles and engage in new experiences without anxiety about being disciplined. Ariana and Jack said that feedback from the adult staff helped them learn about their best attributes. In particular, they learned about their self-efficacy. Ariana came into the program often feeling anxious about doing a good job. She talked about giving a tour of the farm to a group of visitors:

> I learned about trusting myself. Because when I first started I was very nervous and unsure … I was like "oh my god I can't do this, what if I mess up?!"… but I would have someone come up to me and be like "Oh my god, you did so good! I've seen you and you really made it look like you were at ease, and you look like a natural." And I was like, Really?! And they were like "yeah you have to trust yourself!" So I definitely gained that, I try to trust myself and not worry too much.

From this program, Ariana learned to trust her own abilities. CJ talked about how her time at Project youth not only gave her a sense of self-efficacy, but also her first experience being a leader among her peers:

> Every week during the program we would vote for a different leader and they would pick the games we would play in the morning and the pairs that we do for different activities and things like that. So we had a lot of responsibilities. But when it was my turn to become the leader, I was a little scared because, you know, I was still shy, I didn't like being out there much. But they pushed me, and I think I did a very good job the week I was a leader! They were very supportive of me.

This is an important example of how PYD encourages youth to discover what attributes they already have. Through leadership roles, YFJ programs can help youth see how they can be leaders. Garett and Jack discussed how leadership positions gave them an opportunity to learn what leadership qualities they already have, and ones that they hope to gain. Garett described how they learned that being a good leader is letting people have space to do their own work:

> One of my best qualities is that I'm more observing than being too hands on. Like I'm not suffocating you, like I'm watching what you're doing to check with you. I feel like by being a Crew Leader, I can get to know everybody individually and see how they work so then I can put them in the groups I feel like they would more fit in for their skill level or just like something that they would more enjoy, things like that.

Jack had very similar reflection on his leadership style. He said that being a leader is "more of a role that I'm playing, because I cannot just order them to do something … that would be bad. I just have to let go and back up, and let them work and see who is playing what role. And then I can't really go and interrupt, I just have to see." Garett and Jack have strong understandings of their leadership qualities and what they desire in a leader. While I only spoke to each of them for about an hour, they emanated a deep sense of self and a high level of self-worth. Their YFJ programs built a strong foundation of leadership skills and self-confidence. These are advanced skills for youth in high school—ones that set them up to feel confident in future endeavors.

Conclusion

These findings suggest that YFJ programs are crucial spaces for youth empowerment. YFJ programs help youth find a sense of self, build community, develop relationships, and discover their strengths. A goal of this research was to highlight youth voices. Due to time constraints and logistics, I interviewed fewer youth than anticipated, and therefore I had more input from adult staff than anticipated. Youth were self-selected, so I only spoke to youth who felt inclined to talk about their experience in their personal time. Youth who did not enjoy their programs likely would not have agreed to participate in an interview. Naturally, some youths were more talkative than others. As I did not spend much time at the organizations or with youths, I was seen as an outsider, and perhaps as a person of authority. Youth may have had thoughts and feelings about their programs that they did not feel comfortable sharing with me. This all may have skewed the data more favorably towards depicting a positive youth experience in YFJ programs.

More research needs to be done that highlights youth voices: what youth get out of these programs, what they want out of these programs, and how they think these programs can improve. Researchers who spend more time with youth may be able to gather unspoken information about their critiques of these programs. Additionally, hearing from youth well after they have graduated from their programs could provide important insight into the long-lasting benefits of these programs that youth may not recognize while participating. Finally, future research should question whether farming is a necessary component of YFJ programs, or whether other aspects of the programs are more foundational.

Barriers to the success of YFJ programs

included funding and staffing. These programs were operated through donations and grants, an innately unstable structure. Programs reported lack of funds for critical resources or to hire enough staff to run programming. One program has had to lay off their adult staff members and temporarily halt their program due to funding issues. This is deplorable, as these programs have immeasurable impact on our youth: we must empower our youth by giving them competency, agency, and resilience. Policymakers must recognize the long-lasting benefits these programs have on resilient food systems, community well-being, and youth empowerment.

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Urban agriculture education for teens: A multidimensional study of positive psychosocial and metacognitive outcomes

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Abstract

Research shows that youth participating in engaged agricultural learning gain important practical skills and knowledge. The physicality, setting, and social aspects of agricultural and horticultural projects are opportune for improving mental, emotional, and social well-being—yet the psychosocial and metacognitive impacts of agricultural learning are still unclear. This study examines psychosocial impacts among youth participants, ages 13–17, in the Felege Hiywot Center's 2023 STEAM (science, technology, engineering, agriculture, and math) Farm Camp. The Farm Camp combines hands-on urban agriculture with employable skills training while addressing food insecurity in an urban neighborhood with limited access to affordable and nutritious foods. During the camp, students design and maintain garden plots where they grow food, prepare shared meals, and participate in integrative science projects. Using a mix of quantitative and

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qualitative data collected from surveys and facilitated journaling, we explored the positive psychosocial and metacognitive impacts of camp participation. We found gardening instilled positive feelings and was perceived as a source of stress relief and accomplishment among participants. Teens also gained social support through the development of friendships and mentorships. Furthermore, their participation in the program was associated with metacognitive skills development, including self-awareness and reflection. This case study provides a compelling example of how to engage youth from an underserved area in sustainable urban agriculture while fostering metacognitive skills development and positive psychosocial experiences. We conclude that urban youth agricultural learning programs have valuable impacts on participants that go beyond agricultural education and the achievement of practical skills. These findings—which highlight the potential to contribute to psychosocial well-being, social support, and metacognitive abilities associated with maturation and personal development—may be particularly useful for other programs addressing at-risk and vulnerable youth.

Keywords
youth agriculture, urban agriculture, psychosocial, metacognition, agricultural education, STEM education, journaling, reflection, farm, camp

Introduction and Literature Review

Youth-participatory agricultural programs offer fertile ground for fostering knowledge, life skills, and community ties—benefits that are especially valuable for disadvantaged populations such as urban youth from low-income backgrounds and communities. Since the early 1900s, enthusiasts have endorsed participatory learning programs for youth to learn about and connect with food and sustainable agriculture (Rogers, 2018). More recent initiatives benefit youth through community gardening, agricultural projects, and urban school gardens (Rogers, 2018). Youth programs in urban spaces aim to address food insecurity in historically underinvested and discriminated areas with limited access to affordable nutritious food (Walker, 2023). These projects often also teach job skills and foster community engagement. The scholarly literature is saturated with evidence showing that youth in such programs gain various hard (e.g., engineering, agriculture) and soft (e.g., leadership, teamwork, problem-solving) skills along with knowledge of growing practices, nutrition, and sustainability (Layton, 2022; Nzaranyimana, 2020; Russ & Gaus, 2021). However, few studies focus on the psychosocial impacts of youth participation in engaged gardening or agricultural learning programs, and even fewer have assessed metacognitive skills development among youth participants in these programs.

We focus on "psychosocial" interrelations between the social environment and psychological factors because this interconnection plays an important role in mental and physical well-being (Woodward, 2015). Some social-environmental contributions to psychosocial outcomes include socioeconomic circumstances, adverse experiences, (in)access to safe and nutritious foods, and neighborhood context. For example, living in low-income neighborhoods is associated with negative psychosocial conditions, such as discrimination, segregation, crime, and low access to healthy food, healthcare, and social services (Raposa et al., 2019).

While little documentation exists on the psychosocial impacts of participation in urban youth agricultural programs, assessments of school garden initiatives, a related phenomenon, commonly find feelings of enjoyment and satisfaction (Ohly et al., 2016). Youth farm and gardening programs have also been associated with feelings of confidence and reward and improvements in self-esteem and self-worth (Bahamonde, 2019; Cruz-Piedrahita et al., 2020; Holloway et al., 2023; Ohly et al., 2016; Swank & Shin, 2015). Furthermore, a recent review shows that youth garden and agriculture programs can foster positive social relationships and community engagement (Rogers, 2018).

Based on such findings that urban youth agriculture is associated with increased access to nutritious foods and green spaces, positive feelings and self-esteem, social interactions, and community building, we expect that participation also fosters positive psychosocial experiences. A logical conclusion, therefore, is that implementing urban agrifood initiatives and their positive associations in

low-resource neighborhoods may mitigate negative psychosocial outcomes for vulnerable individuals and communities.

Hands-on gardening and agricultural initiatives can also encourage metacognition and the growth of metacognitive skills among participants, although this has yet to be investigated among youth. Metacognition, "a critical awareness of one's thinking and learning and oneself as a thinker and learner" (Chick, 2013, para. 1 rests on such skills as self-reflection, self-awareness, and intention. Programs that incorporate reflective exercises and team challenges can provide substantial opportunities for participants to build their metacognitive capacity. Practiced in an outdoor setting with access to nature-based feedback loops and challenging physical work, agri-food programs can effectively motivate mindfulness and support metacognitive development.

In this paper, we assess the psychosocial and metacognitive impacts of participation in a summer youth urban agricultural education program. The STEAM Farm Camp is organized by the Felege Hiywot Center (FHC), a youth-oriented and faith-based program co-founded and directed by Aster Bekele and located in an inner-city neighborhood of Indianapolis, Indiana (see Figure 1.) The FHC STEAM Farm Camp combines hands-on urban agriculture with employable skills training while addressing food insecurity in a particular urban setting of constrained food supply. The Farm Camp includes an intensive summer camp where youth learn to cultivate and manage their personal urban gardens and obtain practical life and business skills (Felege Hiywot Center, n.d.) (Figure 2). More specifically, the camp teaches science, technology, engineering, agriculture, and math while youth develop interpersonal abilities such as teamwork, leadership, and perseverance (Felege Hiywot Center, n.d.). The STEAM Farm Camp is just one initiative within FHC's larger RISE Initiative. The RISE Initiative (which stands for Resilience and drive; Inquiry and ingenuity; Social impact, and Economic security) supplements conventional education with a suite of programs that help people in middle school, high school, "college, and beyond" to acquire advanced skills through workshops, internships, and mentorships (Felege Hiywot Center, n.d.).

FHC is a particularly apt site for the study of these issues due to its location in the Martindale-Brightwood neighborhood on the near northeast side of the city of Indianapolis, Indiana. The city identifies this area as a "neighborhood" for targeted information dissemination and development planning. Historically, the area is demarcated by 30th Street, Massachusetts Avenue, 21st Street, Sherman Drive, and the Norfolk Southern Railroad tracks (The Polis Center, n.d.).[1] Founded in the late 19th century, Martindale-Brightwood was originally two independent neighborhoods whose mostly blue-collar residents were African American and Western European immigrants working in industries such as railroads, machining, and manufacturing. Like other urban areas, industry declined during the 20th century and white residents migrated out. The remaining, largely Black, citizens were challenged not only by lack of employment opportunities but also by interstate highway incursions, school busing, school consolidation, and additional institutionalized disempowerment. Today, Martindale-Brightwood continues to be a largely residential neighborhood flecked with vacant lots, small manufacturers, and industrial brownfields (City of Indianapolis, 2021), although gentrification is also visible. According to the 2020 U.S. Census, 63% of residents are Black and 15% describe themselves as other minorities. More than 40% of residents live in poverty (median income US$24,000), making this the poorest area in the county (Indianapolis Business Journal, 2018; Statistical Atlas, n.d.). In 2024, Martindale-Brightwood did not have a full-scale grocery store within its official boundaries.

Previous assessments of the FHC farm camp have documented the benefits of participation including the promotion of "life skills, entrepreneurship, and healthy eating intentions for minority youth participants" (Nzaranyimana, 2020, p. 11; Hernandez & Robinson, 2022). Here, we provide

[1] This brief history of the Martindale Brightwood neighborhood is drawn largely from a more detailed one by the Polis Center at Indiana University Indianapolis.

new insights by exploring the psychosocial and metacognitive impacts among youth participating in the camp using data collected from surveys and facilitated journaling. The research contributes a valuable evaluation of the positive outcomes of participatory agricultural learning programs beyond practical skills and knowledge obtainment, providing support for similar initiatives for disadvantaged youth and low-resource areas.

Research Methods

Indiana University researchers were contracted as external investigators by the Felege Hiywot Center to design and conduct research on the social impacts of the camp. Our involvement began with designing the original research proposal in collaboration with FHC, which was submitted to and funded by the Lilly Foundation. At that time, Indiana University Anthropology graduate student

Figure 1. The FHC Logo is Printed on a Small Shed on the Main FHC Grounds
The painting features the letters "FHC" with two children of color and a community icon. It sits next to a black rain barrel.

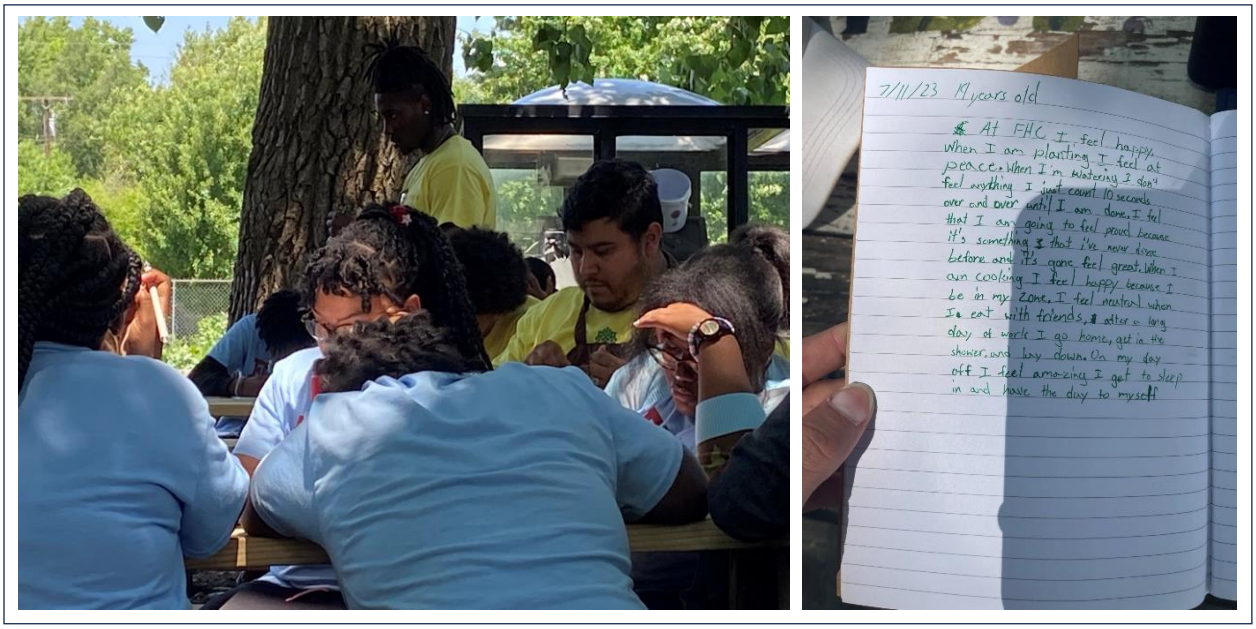
June Guo, under the advice of faculty members Shellye Suttles and Jennifer Meta Robinson, developed the initial idea to use student journals to explore the program's impact using creative qualitative data. That plan was revised, operationalized, and piloted in 2022 by Robinson and graduate student Gerardo Hernandez. In 2023, we refined the journaling protocol and collected significant qualitative and quantitative data (from journals, surveys, and participant observation) on the impact of the RISE Initiative's STEAM Camp on student participants. This analysis, particularly, focuses on the psychosocial and metacognitive impacts among youth participants. The program evaluation, data analysis, and report writing were led and completed by the authors who were external researchers (not part of the FHC organization). The authors declare no conflicts of interest.

This study was approved by the Indiana University Institutional Review Board (protocol #11718) for research integrity and compliance. Parental consent and youth assent were received and housed by FHC staff members. Before camp and participation began, parents and youth attended an orientation where they were informed of the research including the objectives and methodologies (both the surveys and the journaling sessions). All camp participants and their parents agreed to participate in the research as part of their camp experience and employment hours; all submitted signed parental consent and assent prior to the survey administration and journaling sessions. Therefore, all participants were recruited for this analysis.

The 2023 summer STEAM Farm Camp took place between June 5 and July 22, 2023. Two online surveys were administered using After-School HQ, a youth program management software. Students took one survey (named pre-survey) during the second week of camp and a second survey (post-survey) during the last week of camp.

Figure 2. Campers' Garden Plots at the Felege Hiywot Center, Main Grounds
The raised garden beds are made of concrete blocks and feature an array of vegetables and fruits. Two counselors and one camper are shown watering the gardens.

Figure 3. Left: Campers (in Blue) and Counselors (in Yellow) Write in their Journals During a Facilitated Journaling Session. Right: A Journal Entry Written by a Camper in Response to Various Prompts Beginning with "Let me tell you how I feel…" (i.e., at FHC, when planting in the garden)



The surveys collected demographic information (age, gender, race) and included questions about students' perceptions and experiences of the summer Farm Camp.

Solicited journaling was used to collect qualitative data on youths' experiences and relationships with food, identity, and people (Figure 3). Journaling is a valuable qualitative method that can provide data that would be otherwise difficult to obtain. Journaling allows researchers to gather real-time data to understand experiences during the study period and information about individuals' pasts, future goals, and experiences outside the study site. It is a method that allows the researchers to "get close to participants but leaves them enough space for personal reflections" (Kaun, 2010, p. 139). This is especially important when studying vulnerable groups like teens, where building trust and rapport to alleviate hesitancy are invaluable for collecting rich and truthful data. In addition, journaling is a metacognitive act as it motivates mindfulness and requires self-reflection. For example, one must be focused and both physically and mentally present to write, and journal prompts related to one's experiences, self (e.g., personality, likes/dislikes), perceptions/opinions, and goals require self-reflection. Finally, by using data recorded by the participants themselves, the method mitigates recall bias.

The journaling sessions (Figure 3) took place at FHC and were facilitated twice a week for five weeks. All students who were present participated in these sessions. Sessions lasted around 90 minutes, on average. Journal prompts were provided to participants to facilitate directed writing. The writing topics included food preferences, food culture, lived experiences, opinions, feelings, personalities, sense of self, knowledge and skills gained at camp, camp gardening and farming activities, and perceptions of FHC and the STEAM farm camp throughout their time participating in the summer program. Students also participated in a group listing activity where they were asked to list things to be happy about using the book *14,000 Things to be Happy About* by Barbara Ann Kipfer as a model. The group exercise was conducted four times: once during the first week, once during the third week, and twice during the fifth (last) week of camp. While not initially an activity for research purposes, we observed that the lists and conversations were connected to students' positive experiences at camp, particularly related to social support

and positive relationships. Thus, we decided to include the qualitative data from these lists in our analysis.

All student participants had access to and were prompted to participate in pre- and post-surveys. The demographic and open-ended survey data were analyzed, and summary statistics were collected using Excel (version 2310). Qualitative data came from journal entries associated with feelings and experiences while participating in the summer farm camp and the final "things to be happy about" list. Qualitative data from journaling and group lists were analyzed separately from survey data using inductive coding in NVivo 14 (Bernard, 2011). Codes were quantified into themes and conceptualized by the research question. For example, we coded for positive experiences and then created child codes to classify the positive experiences such as stress relief, mentorship, and gratitude, among others. Similarly, we coded for metacognitive experiences with subcodes such as reflection and self-awareness.

Findings

Thirty-six campers participated in the camp and journaling. A smaller number, 25, completed both the pre-and post-surveys (all those who submitted the surveys also participated in journaling). These participation numbers differ because some individuals left or were removed from the summer farm camp before the program ended. For this analysis, surveys were used only if participants completed both the pre- and post-surveys. In addition, journal entries were used when they applied to this paper's research questions and objectives.

Based on the survey data, 48% of participants identified as female, 44% as male, and 4% as non-binary at the time of the post-survey.[2] Ages ranged from 13 years to 17 years, with a mean age of 15 years. Seventy-two percent of youth identified as Black or African American, 16% as white, and 8% as American Indian or Alaska Native.[3]

To make novel contributions to the literature on understanding the effects and potential of such a program, we focus here on the psychosocial and metacognitive experiences indicated by the data. In total, we coded 62 positive psychosocial and metacognitive experiences (out of 99 cases coded) expressed by participants in the journals or open-ended survey responses. Core themes related to psychosocial impacts included positive feelings, stress reduction, and positive social interactions, including social support and community. Metacognitive skills development encompassed self-awareness, reflection, and gratitude.

Psychosocial Impacts

Psychosocial impacts encompassed subthemes of positive feelings, stress reduction, social support, and community.

Positive Feelings

Several psychosocial impacts were detected in the data. First, positive feelings were found in entries related to how teens felt at FHC, in the garden, while watering plants, and while cooking at FHC. We also documented positive feelings in letters students wrote to staff and future selves in their journals. Twenty students mentioned they felt happy or joy in some capacity while at FHC. For example, one wrote, "When I'm watering, I'm also happy. Watering is actually like my favorite part. Once again, I love watching my plants grow healthy. So, while watering I feel happy & relaxed."

Fifteen participants described feelings of pride or accomplishment as the result of gardening, harvesting, and/or cooking at the center. These tended to be connected to feeling "good," "great," or "amazing," as shown in this entry: "When I harvest food from the garden, I feel accomplished knowing I did everything right to get the food. So, it feels good."

Relatedly, seven students mentioned improved self-esteem or confidence during their time in the program, particularly in their abilities related to growing and cooking food. For example: "When I'm cooking [at FHC], I feel confident and excited for other people to try my food and ready to eat it myself."

Less common but still notable, a few partici-

[2] One participant did not provide an answer for gender.
[3] One participant did not provide an answer for racial identity.

pants mentioned they felt comfortable and/or "safe" at FHC. One explained that FHC is a place where "I can fully be myself and say anything." When students were asked to write about what they see and how they feel while sitting near the gardens, one participant wrote:

> What I see is blooming trees that look like golden in the sun. I see bushes and flowers looking beautiful as mountains in the snow. I feel cooled and regulated when the wind blows on my skin, and I feel safe and beautiful. The leaves move in a unique way, back, and forth, back and forth which is nice, I also see and hear the leaves rustling around and the lovely birds.

Similarly, the survey data showed more students felt comfortable in the FHC gardens at the end of camp compared to the start (48% vs 60%).

Stress Reduction

Many participants described stress-reducing impacts, including therapeutic aspects of gardening, particularly planting and watering. Some also noted positive feelings and mindfulness from simply being in the garden space. Specifically, 11 students wrote they felt relaxed while working in the garden, and nine referred to feelings of peace. One participant stated they felt "at peace and a little dirty" when planting in the garden. Another noted, "I don't have to care about anything but the plants in the ground, which is relaxing."

A few mentioned feeling "clear-minded" and "focused" while working—characteristics of relaxation and stress reduction.

Social Support

We found substantial social benefits of camp participation, including the formation of positive peer relationships (i.e., friendships), mentorships between participants and staff, team bonding experiences (i.e., social cohesion), and community building.

There were 15 references to friendships made during camp, not only among peers but also between campers and camp counselors. Counselors and staff also served an important mentor role for teens, of which 18 journal entries spoke positively. For example,

> Now I know it sounds crazy or out of the ordinary to be good friends with a counselor, but tbh [i.e., to be honest] we [are] just cool like that. See me and [counselor] have that brother bond, with professional boundaries of course. I feel like [counselor] is really the main person I can go to when I have something on my mind and need guidance. He gives me his input from a big brother standpoint, but also a counselor.

The theme of social support and community emerged in relation to team experiences and peers. There were 23 positive references to participants' teams, often connected to fun, joy, "good people," teamwork, collaboration, support, and respect. By the end of the program, 60% of participants stated in the post-survey that they felt like a member of a team after their experience at FHC.

In writing to a camp team member, one student described the support they received:

> I'm glad that I get to work with you sometimes. You will talk to me about something that I have going on and them talks help me out. So, thank you for being there for me even when you don't have to be. You are one of the best people I have ever met and I'm thankful for so much you have done for me. You have this fun playful side and when you're in that mood you light up the room and a lot of people need that. Everyone can agree you are a great person. Thank you for coming into my life and helping me out with a lot of things.

This quote is just one example of the positive social interactions and cohesion that participants experienced while working at the summer farm camp. It highlights the value of social interaction as a key part of the program and the pro-social behaviors that took place.

Social support was also found in relationships between participants and staff. For example, one journal entry expressed:

> Dear [staff member], I'm very grateful that you welcomed me into FHC. I was new so I didn't know anyone. I feel like you observed that I was shy & you came to talk to me. I really love that you took the time to chat with me. You were very nice and open it was like we were friends. You have impacted me by uplifting me, asking about my life, talking to me about your life a bit. … I really thank you for talking to me and welcoming me to FHC. I hope we'll both be here next summer as well. I really enjoyed your company. You've made me feel like I have someone here for me. So, I thank you a lot a lot.

Another explained:

> [Staff member] makes a safe welcoming space for all campers and he notices when I don't feel myself. Sometimes when I get in my head and start to overthink, I feel down, and at those times [staff member] notices and makes sure to let me know that I can talk to him. When I'm around him I feel in a good mood, and he always tries to lift spirits.

These positive social bonding experiences were also evident in the group's final "things to be happy about" list. Sixty-four percent of the last list consisted of names of camp counselors, staff members, teams, and campers, highlighting the profound impact that social interactions, including peer relationships and formal mentorships, had on participants. Furthermore, the centralization of others in this final list of gratitude exemplifies bidirectional prosocial behaviors—on the one hand, students were recipients of positive behaviors like altruism, caring, supporting, and comforting, and on the other, they exhibited these behaviors through naming peers, staff, and teams in their list of things to be happy about.

Community

Lastly, students also gained a sense of community and civic responsibility within and beyond the center. While more students indicated they felt like a member of the community in the post-survey compared to the pre-survey, the changes were not substantial (64% vs 68%). However, the theme was apparent in journal entries and open-ended survey questions in which participants emphasized the importance of community in building a more sustainable and better world, and the benefits of contributing to the community by growing and sharing food. Some noted positive feelings they felt by helping their community and feeding others. Additionally, more students felt comfortable eating food grown where they live at the end of camp compared to the beginning, which could represent changes in perceptions of community (20% vs 40%).

Negative feelings, experiences, or perceptions were presented in 37 cases, but primarily in entries by the same handful (6) of participants. Journal entries that relayed negative emotional responses were associated with feeling annoyed, irritated, or frustrated by the weather or labor, feelings of being watched or at school, and dislike of the program activities (e.g., watering).

Metacognitive Development

Metacognitive development encompassed the subthemes of self-awareness, reflection, inspiration and motivation, and gratitude.

Self-Awareness

During the last two journaling sessions, participants were asked to write a series of letters that indirectly prompted them to speak on the skills they learned and/or used throughout the program. Following knowledge assessment, the second most common topic youth wrote about was self-awareness. Fifteen participants noted that their experience at the farm camp helped them recognize their interests and passions mostly concerning gardening, agriculture, and/or business. For example, one journal entry expressed:

> What I have learned this summer can help me going forward by showing myself that if I try new things, I can actually learn more of who I am and what I like to do in life. Before FHC I had no interest in farming or planting. But now that I have tried it, I actually love planting and watching my plants grow.

Reflection

Teens engaged in personal reflection, becoming more aware of their strengths, qualities, opportunities, and goals. The strengths and positive qualities most mentioned were related to work ethic, passion, and kindness. But beyond specific characteristics or skills, the camp helped youth reflect and learn about themselves more generally. For example, one student wrote:

> This center has taught me so much more than a school ever can. This center helped me find my voice, myself, my friends, my mind, my leadership, and so much more. Without the center and its multiple teachers, I would've ended up an entirely different person. This center has been filling my mind with unforgettable experiences, and I hope many, many, many more people's hearts, minds, and souls are influenced by this incredible event that is FHC.

Some teens also described how their time working at the Farm Camp allowed them to reflect on their behaviors, and this self-awareness fostered a motivation to make self-improvements. Most self-improvements were in regard to respect, work ethic, and school. Here is an example of these themes:

> This summer, I've learned I speak my mind and getting better with controlling my feelings and handle them better and I love that for myself. How this can help me in the future is not doing crazy things off of how I'm feeling and learning sometimes to walk away, and I feel like that can help me a lot in the long run when I get older, so I stay out trouble and staying on track with my life.

Inspiration and Motivation

According to seven journal entries from the last session, the camp experience invoked inspiration and motivation in the participants—sometimes concerning the program and gardening, but often beyond. Some camp attendees wrote that they wanted to return to the STEAM Farm Camp next summer. A few were inspired to start a farm or business, while others shared broader newfound goals such as improving their performance at school, focusing harder on extracurricular activities, and finding a job more generally.

> Dear future self[:] I changed a lil [i.e. little] bit throughout this summer. I changed a lil because I became respectful this summer and [learned] self-control this summer. I learned how to plant and how to take care of plants. [What] I hope to accomplish the remainder of the summer is to buy me school clothes[,] and for the next school year[,] I want to have passing grades.

Gratitude

Students became grateful for their experience and social interactions as the camp went on. By the end of the camp, a sense of gratitude was a concrete topic in 16 journal entries and, as formerly mentioned, the final "things to be happy about" list. More specifically, students were thankful for the opportunity to work and learn new skills, the friendships and mentorships they made, the support and kindness they felt, and the food they grew and cooked. As an example, one participant wrote in their letter to the FHC director:

> I want to thank you for giving me a chance. I love working here. I am grateful for all the opportunities and experiences you have let me experience working here. You have made a positive impact on my life. Before working here, I would stay in the house all day doing nothing. Working here I have made lots of friends. Thank you.

Discussion

In this analysis, we evaluated survey responses and qualitative data from solicited journaling to explore the psychosocial and metacognitive impacts of youth participation in the 2023 Felege Hiywot Center (FHC) STEAM Farm Camp. We found support for positive experiences and outcomes distinct from the well-established benefits associated with knowledge achievement and practical skills development. Participants experienced positive feelings (e.g., enjoyment and happiness), and many

recognized the actions and spaces associated with gardening and agriculture as therapeutic. Teens formed valuable social relationships including friendships and mentorships and gained a sense of social support and community from these interactions. In addition to these positive psychosocial aspects, participants gained and utilized metacognitive skills associated with self-awareness and reflection. As such, we provide evidence that the benefits of youth participation in urban agricultural programs stretch beyond the project site and participation period. Rather, participation can provide youth with long-lasting emotional and social benefits and metacognitive skills that may mitigate negative experiences and risks among vulnerable youth. Below we outline our findings in connection with previous investigations.

Positive Feelings

Youth participants of the FHC Farm Camp retrieved positive feelings during their participation. While there are no studies, to our knowledge, focusing on feelings among urban youth participating in agricultural programs, our results align with studies among adults and youth participating in an urban greening initiative (e.g., Soga et al., 2017; Rauk et al., 2023; Wadumestrige Dona et al., 2021). The positive feelings that participants experience in relation to gardening and agriculture likely contribute to emotional and mental health benefits. For example, a study among adolescents participating in home gardening found that gardening is significantly associated with better mental and emotional well-being, including lower levels of depressive symptoms and better social relationships (Lier et al., 2016).

Gardening prompted feelings of pride, reward, and confidence among participants. These feelings have been documented among other youth farm and gardening programs (e.g., Bahamonde, 2019; Ohly et al., 2016; Russ & Gaus, 2021). These benefits may stem from the physicality and difficulty of the work, learning and applying new skills, overcoming challenges and solving problems, finding social support through teamwork and mentorship, and/or the concreteness of their accomplishments when participants witness a product they created and nurtured (Ohly et al., 2016). These positive self-evaluations may be further strengthened when participants share their products with others such as those in their communities (Ohly et al., 2016; Russ & Gaus, 2021), suggesting a promising area of development for the FHC program.

Stress Reduction

Students indicated through their journaling that they felt relaxed, at peace, and clear-minded at the center's farm and orchard, especially when working with their gardens. Our findings are consistent with others that have documented the contributions of gardening and agriculture in stress reduction and even improved mental health among individuals of all ages, including urban samples (Bahamonde, 2019; Cruz-Piedrahita et al., 2020; Nicholas et al., 2023; Wadumestrige Dona et al., 2021). A comprehensive review of urban garden projects also posits that gardens reduce stress and have positive impacts on youth attitudes (Rogers, 2018). While not specifically a youth agricultural program, a study among youth participating in an urban greening initiative found that working in nature "allowed them (i.e., the participants) to relax and enjoy themselves" (Rauk et al., 2023, p. 193). Thus, our study corroborates findings that the mental relaxation and mindfulness experienced through gardening and agriculture can contribute to mental and emotional well-being.

Positive Social Interactions, Support, and Community

The social aspect of the camp was of significant value to participants. They formed positive peer and mentor relationships, social support, and community—all of which played a substantial role in the enjoyment and reward of youths' participation in the program. Furthermore, the center's provision of an environment where youth were free to be themselves enriched participants' feelings of social support and community. Other studies have also documented community-building and personal connections with peers and leaders as positive outcomes of urban youth agriculture programs (Russ & Gaus, 2021; Wadumestrige Dona et al., 2021), school gardening initiatives (Davis et al., 2015; Ohly et al., 2016), and participation in FHC's former farm camp, specifically (Nzaranyimana, 2020).

In their review, Rogers (2018) stresses that youth-led urban gardens improve peer relations and motivate prosocial behaviors. Similarly, we found prosocial behaviors among our participants, in which youth became kinder, more respectful, and more grateful throughout the camp.

Indeed, "social relationships" may be among the most potent outcomes of the FHC program. In a recent review of urban agriculture programs, Wadumestrige Dona and colleagues (2021) noted that "social relationships" were the most documented benefit, arising in 43 different publications related to urban agriculture. Despite this, social interactions are undervalued in investigations of urban youth agricultural programs. One study looking at youth participation in an urban greening program found that mentorships and peer support were factors underpinning youths' enjoyment and engagement in the program (Rauk et al., 2023). These studies suggest the social benefits identified from the FHC program are likely to have further emotional and mental health advantages among these vulnerable and at-risk youth.

Participants also felt that FHC was a space where they could contribute to a community. Some noted in their journal entries the positive feelings of helping their community and feeding others. A recent review shows that community engagement and a sense of civic responsibility are common outcomes of urban youth agriculture programs, and students gain positive feelings related to helping their peers, families, and community at large by producing and sharing nutritious and safe food (Russ & Gaus, 2021).

Positive peer interactions, social support, and healthy mentorships are associated with lower odds of depression and risk behaviors such as violence and delinquency (Pardini et al., 2012; Raposa et al., 2019; van Harmelen et al., 2016). Additionally, feelings of connectedness promote healthy youth development (Lerner, 2021) and are protective against risk factors, including depression, anxiety, and sexual activity among vulnerable youth (Foster et al., 2017).

Metacognitive Skills Development

Both the type of experiences youths encountered at the camp and the solicited journaling activities fostered metacognitive skills development. These skills included self-awareness and reflection, which motivated behavioral changes, inspired plans, and engendered a sense of gratitude among the participants. These findings are aligned with a previous assessment of participants in the FHC Farm Camp (Nzaranyimana, 2020). Among adults associated with the Ground-Up agricultural initiative in Singapore, researchers found that involvement encouraged self-awareness and reflection and, among some participants, motivated behavioral changes (Nicholas et al., 2023). However, metacognitive impacts are not a central theme within investigations of youth agricultural programs. Despite the lack of previous research, the ecological and social environments combined with the physical and mental work associated with gardening and agriculture create an ideal space for mindfulness and reflection. Furthermore, a setting where youth are supported and encouraged to reflect on who they are and their actions, goals, and opportunities can fuel self-awareness and behavioral changes. Metacognitive skills, therefore, are likely outcomes of youth agricultural learning programs as well as general youth initiatives for at-risk youth.

Limitations

Limitations include possible social desirability bias in surveys and self-reported data, potentially distorting the accuracy of the data. This possibility persists even though the researchers did not personally supervise the anonymized surveys and teens appeared more deeply attuned to their peers' approval than that of our researchers. A limitation is the lack of direct evaluation of social desirability factors. In addition, the sample size is small, and this is a cross-sectional survey. Future research could explore longer-term impacts on participants' lives and careers, a more comprehensive program evaluation, and mechanisms acting on participants' affective responses. Longitudinal investigations across multiple years would provide stronger evidence for the impacts, including the long-term advantages of improved metacognitive skills.

Implications

The positive psychosocial and metacognitive impacts of participation in the FHC urban youth

agricultural learning program suggest that similar programs designed for disadvantaged youth may mitigate risks and disparities. Psychosocial impacts—positive feelings, therapeutic indicators, social support, and community engagement—and metacognitive impacts—self-awareness, reflective capacity, inspiration, motivation, and gratitude—highlight the importance of continuing such initiatives among vulnerable populations along with assessments of their psychosocial and metacognitive impacts. While most urban garden programs have been established for high-resource elementary and middle schools (Rogers, 2018), the effectiveness of the FHC STEAM Farm Camp suggests that agricultural educational initiatives aimed at urban and low-income youth are likely to be impactful investments for psychosocial health. Such critical interventions during adolescence can help establish long-standing behaviors, academic and career-related opportunities, and mental health (Bluth et al., 2016; Eisman et al., 2015). Moreover, intervention during this age may mitigate the negative effects of mental health disorders, risky behaviors, and poor academic performance (Bluth et al., 2016; Eisman et al., 2015). The implication is that the most vulnerable young people, based on their socioeconomic status, race, and ethnicity (Alegría et al., 2015) and the resultant social-ecological inequities (Alegría et al., 2015; Eisman et al., 2015), may make important gains from equivalent investments. Moreover, the impacts on disadvantaged high school students suggest that agricultural learning opportunities can have profound positive and protective effects on youths' well-being, mental and social health, and futures beyond the program, through the provision of positive environments, social support, and positive peer interactions (Alegría et al., 2015). In short, urban youth agri-food education programs make a good investment toward a healthier and more equitable society. Expressed in the voices of children, we can hear how kids themselves connect what they learned in camp with their hopes for the future: "I became respectful this summer and [learned] self-control this summer. … For the next school year I want to have passing grades."

The Farm Camp environment and activities at FHC encouraged positive feelings, including competence and confidence, as well as therapeutic feelings associated with relaxation and peace. The provision of stress-reducing experiences and a safe, supportive space may be similarly replicated in other agri-food initiatives. Furthermore, our evaluation shows that programs that incorporate positive social interactions and foster the development of valuable peer and mentor relationships can fuel positive experiences and have long-term impacts on youth participants. The extension of FHC's successful programming may lead to a similar sense of connection, support, and community among participants at other urban agri-food initiatives.

Lastly, youth agricultural programs such as the FHC STEAM Farm Camp can promote valuable metacognitive awareness and skills, including self-awareness, reflection, motivation, and inspiration, that also serve as long-term advantages. Metacognitive knowledge, skills, and awareness may improve academic performance, increase learning and self-motivation, and assist in the development of a growth mindset among socioeconomically disadvantaged youth (Smith et al., 2017; Wang et al., 2021; Zepeda et al., 2015). Thus, youth agricultural education programs that target under-resourced areas, provide an environment conducive to metacognition, and involve activities that require metacognitive skills can provide both immediate and long-term benefits. The development of these valuable skills provides youths with tools they can utilize beyond the centers and programs and that may mitigate disadvantages associated with low-resource areas or institutions and, relatedly, a lack of support. As such, we encourage similar programs to incorporate activities that utilize reflection and self-awareness, and we encourage future assessments to incorporate measures of metacognitive skills development and benefits.

Conclusion

> *I can actually learn more of who I am and what I like to do in life.*

This study examines the psychosocial and metacognitive impacts of youth participation in the Felege Hiywot Center's 2023 STEAM (science, technology, engineering, agriculture, and math) Farm

Camp. STEAM is a summer program for urban youth in Indianapolis that blends practical agricultural learning with personal-growth activities and community engagement. Utilizing surveys and facilitated journaling, we found the program had positive psychosocial impacts—positive feelings, therapeutic indicators, social support, and community engagement—and fostered metacognitive impacts—self-awareness, reflective capacity, inspiration, motivation, and gratitude. Participants in the 2023 summer STEAM Farm Camp gained positive and therapeutic experiences and forged personal connections with the community, staff, and peers. Lastly, they learned more about themselves in just a few short weeks. Students also gained a sense of gratitude and appreciated the opportunities provided by the center and the farm camp.

In conclusion, the FHC STEAM Farm Camp provides a compelling example of how to engage young people in not just environmental sustainability and urban agriculture but also metacognitive skills development, while at the same time fueling positive psychosocial outcomes in an area and population vulnerable to negative psychosocial circumstances. Such findings communicate the value of this and potentially other youth gardening programs to funders, prospective participants, parents, and other stakeholders. Our evaluation shows support for the role of youth-centered agricultural learning programs in provisioning positive youth experiences, especially for at-risk and vulnerable teens, beyond knowledge acquisition and life skills achievement. Moreover, it provides new support for examining improved psychosocial dimensions as outcomes of such learning opportunities so that more children in the future may experience a program that they can say "helped me find my voice, myself, my friends, my mind, my leadership, and so much more."

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How to address resource inequity in collaborative work: Reflections on partnerships between Vermont and Puerto Rico

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Abstract

This reflective essay details my experiences as a professor in a small land-grant university working with counterparts in Puerto Rico. Our work aimed at enhancing food resilience of both regions. While we forged lifelong friendships and learning partnerships, the structural legacies of colonialism and resource inequality created barriers and ultimately prevented further collaboration. I also discuss how compliance culture in my home institution is not only a nuisance but creates incentives in direct opposition to the goals of our work. I conclude with implications for future partnerships between scholars in regions with different capacities and procedures.

Keywords

food resilience, partnerships, colonialism, land-grant university

Abstract

This reflective essay details my experiences as a professor in a small land-grant university working with counterparts in Puerto Rico. Our work aimed at enhancing the food resilience of both regions. While we forged lifelong friendships and learning partnerships, the structural legacies of colonialism and resource inequality created barriers and ultimately prevented further collaboration. I also discuss how compliance culture in my home institution is not only a nuisance but creates incentives in direct opposition to the goals of our work. I conclude with implications for future partnerships between scholars in regions with different capacities and procedures.

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Introduction

> "If you have a chance to accomplish something that will make things better for people coming behind you, and you don't do that, you are wasting your time on this earth."
> —*Roberto Clemente (National Portrait Gallery, n.d.)*

Puerto Rico (PR) is called the Island of Enchantment (in Spanish, *Isla del Encanto*). This place and its people enchanted me from the start. Working there has been perhaps the most rewarding part of a very rewarding career. Yet the challenges I faced were also among the most frustrating. I want to share my story in this reflective essay because I believe there are broader lessons to be learned for food systems scholars and others wishing to work in places scarred by colonial legacies, who wish to overcome lingering structural inequities in resources and wealth.

Literature Review

As outlined by Hernández-Acosta (2015), PR became a U.S. territory in 1898 as a condition of the end of the Spanish American War. Its people became American citizens to provide additional soldiers as part of World War 1 efforts in 1917; Rodríguez Vargas (2023) argues that U.S. federal money has been disbursed using norms and methods that are designed for the U.S. but fail to account for cultural differences in PR and thus and are highly ineffective.

There is a large body of literature (e.g., Carro-Figueroa, 2002; Diaz & Hunsberger, 2018; Marrero et al., 2022; Hernández-Acosta, 2015) detailing the current and historical challenges of PR's food system and its lack of resilience. Key themes are the prevalence of food insecurity and lack of healthful food access; the lack of production for local consumption and reliance on imported foods; the role of policy in creating these conditions; and proposed solutions. This review is far from comprehensive but provides background that underpins the work I detail below.

Carro-Figueroa (2002) provides an overview of the history of U.S.-Puerto Rico relations as it relates to food systems. It begins with the island's aforementioned acquisition by the U.S. in the Spanish-American War in 1898. It then discusses the industrialization policy which expanded food imports in the 1950s, the introduction of food stamps in 1974, a shift in 1978 to a tourism and high-tech industries and the steady decline of staple crop production in the 1980s and 1990s. Hernández-Acosta (2015) discusses the role of large mainland investments in sugar plantations in the 1930s, which led to decreased local food consumption and increased prices for the poor. The effects of these events are briefly summarized below.

One recent estimate measures PR's food insecurity at 40% of the whole population and 56% of children (PR51st, 2022), this figure is far higher than the U.S. as a whole, recently estimated at 13.5% (U.S. Department of Agriculture, Economic Research Service, 2023). There is also a historical and current the lack of healthful foods, and poor diets overall (Diaz & Hunsberger, 2018; Marrero et al., 2022) as highly processed foods (sugar-sweetened beverages and foods, salty snacks, canned meats) are more available and widely consumed, leading to chronic diseases and poor health outcomes (Lane et al., 2024). The introduction of the supplemental nutrition (food stamps) program in 1974 led to greater consumption of processed foods purchased from supermarkets (Carro-Figueroa, 2002; Félix & Holt-Giménez, 2017).

A related issue is the high reliance on imported food. It has been cited that 85% of PR's food is imported (e.g., Diaz & Hunsberger, 2018; Lerman Ginzburg, 2022), a percentage similar to Vermont's (Conner et al., 2020) despite the vast difference in climate and growing season. Much of the imported food is less healthful, leading to the aforementioned nutrition and diet problems. Similarly, there is a lack of production for local markets, and history of policies encouraging agricultural production of commodity monoculture of crops with high monetary value and reliance on agrichemicals (Diaz & Hunsberger, 2018; Carro-Figueroa, 2002). The overall policy emphasis on industrialization on the island delinked local production and consumption; these policies accelerated farmland loss and food imports, made subsistence farming unviable, and encouraged urbanization and migration to the mainland (Carro-Figueroa, 2002).

As discussed above, several policies have led to

the current situation of reliance on this decoupling: production for export and reliance on cheap and unhealthful imported foods. One particularly pernicious policy is the Jones Act (U.S. Department of Transportation, Maritime Administration, n.d.), which requires cargo entering PR to be on ships built, owned and crewed by the United States. This law keeps food prices high overall and greatly delayed hurricane relief efforts (Félix & Holt-Giménez, 2017; Marrero et al., 2022). The policies, together with the colonial history and its enduring institutions and norms, contribute to PR's lack of food resilience.

Other scholars have highlighted the impacts colonial practices and legacies on education in PR. Rodríguez Vargas (2023) argues that U.S. mainland norms and values are too often imposed on PR's education system. The individualistic and profit-driven cultural norms of the U.S. often conflict with PR's more community-centric values. These differences are exacerbated by neoliberal governance structures and practices (Santiago-Ortiz, 2020). Research and community development projects are often imposed from the outside with little dialogue with or input from local stakeholders. Rodríguez Vargas (2023) further argues that the U.S. favors and forces on the University of Puerto Rico (UPR) system a hierarchical model based on complex relationships and bureaucracy, in conflict with PR cultural values and norms which favor horizontal relationships.

As discussed by Santiago-Ortiz (2020), these conflicts came to a head in 2016-2017, when it was declared that PR's debt was unpayable. The island's governance and thus autonomy was transferred to a Fiscal Oversight Management Board (known colloquially as *La Junta*). One effect was large (approximately $500 million) budgets cuts to the UPR system (Santiago-Ortiz, 2020). These events further imposed neoliberal logics such as transactional relationships and emphasis on return on investments on the UPR system. (Santiago-Ortiz, 2020; Rodríguez Vargas, 2023). While UPR faculty's strong community outreach ethic and participatory approaches to research and engagement attempt to mitigate these issues, the budgets cuts and complex bureaucratic regulations (particularly around purchasing) create a profound lack of resources for project completion and community engagement. This in turn creates extreme vulnerability for UPR and the people of PR as a whole (Rodríguez Vargas, 2023; Santiago-Ortiz, 2020)

The literature proposes a suite of solutions to improve the resilience of PR's food system (Carro-Figueroa, 2002; Diaz & Hunsberger 2018; Marrero et al, 2022; Rodríguez-Cruz et al., 2022; Stokes-Ramos, 2023). The central themes are fostering local production for local consumption, elevating local knowledge, and incorporating agroecological principles, all with the goal of increasing food security and food sovereignty. Santiago-Ortiz (2020) highlights the need for participatory research to address complex issues. These principles underpinned the work in PR which I discuss below.

My Work in Puerto Rico

I first traveled to PR in February 2019 as part of my first faculty sabbatical from the University of Vermont (UVM). To be honest, many of my reasons for traveling there were personal. The appeal of leaving Vermont (VT) in mid-winter and spending a week or so on a tropical island speaks for itself. I had long wanted to visit PR, as it was the birthplace and home of my childhood hero, Hall of Fame baseball player, humanitarian and civil rights activist Roberto Clemente. Even though Clemente died when I was a young child, his courage and commitment to improving the lives of those around him are ideals that I continue to embrace as an adult.

To prepare for my trip, I began to assemble a list of food systems scholars and practitioners working in PR. I had the great fortune that a rising star of PR food systems scholarship and practice, Luis, was a PhD student at UVM and had taken one of my classes the year before. I asked Luis for recommendations, and he provided me with several. At the top of the list were his advisors when he earned his MS degree at the land grant university (LGU) of PR, The University of Puerto Rico at Mayagüez (UPRM): Robinson and Maria, a married couple, both professors at UPRM.

I reached out to Robinson and Maria and they graciously invited me to visit them at UPRM, meet other colleagues, and present a research talk on local and regional food systems, community

development and food resilience. After the talk, Robinson and Maria then invited me to their home for the afternoon, for lunch, and a swim at the beach.

After knowing Robinson and Maria for only a couple of hours, I knew that we would be friends for life. First, they are among the kindest, smartest, and most dedicated people I have ever met, people of the utmost ethical integrity. But what drew me to them was twofold. First, we had very similar approaches to education, scholarship, and practice: we both embrace community-based research and stakeholder engagement - "listen to the street" is how Robinson phrases it. Second, I was struck by despite the differences between PR and VT in language, culture, history, latitude, climate, and other factors, the community development challenges each of our home regions face —lack of access to services in rural mountainous areas, lack of opportunity for young people and the resulting brain drain, farm viability challenges due in part to competition with cheaper imported foods, and many others—are strikingly similar. We both realized as well that our regions share the greatest assets as well: the people and communities. I saw a great opportunity to engage and learn beside people in another region, hopefully to the benefit of all sides.

The Work

Later that spring, we saw a USDA grant opportunity calling for proposals addressing disaster preparedness. Given the horrific effect extreme weather effects (e.g., Hurricanes, such as Maria in PR and Tropical Storm Irene in VT) on agriculture, food, and communities in general, we responded and were funded. Thus began a four-year collaboration covering two grants, two visits to VT, and three visits to PR. While I believe the work we did was incredibly personally rewarding and hopefully had long lasting benefits to our communities, it also exposed deep systemic challenges that are important for all scholars and practitioners to note. I am relating this story from my personal standpoint. A list of UVM and UPRM scholars who collaborated on this work can be found in the author list in this article: Conner at al., (2023).

The Projects

I was the lead on two funded projects. Each worked to investigate and enhance the role of anchor institutions in fostering food resilience, seeing this as an entry point to the issues discussed in the literature review above. Each primarily used qualitative data collection methods, specifically focus groups: the subjects were farmers and other food systems stakeholders impacted by PR hurricanes and farm to institution (FTI) experts in Vermont. The first project was a partnership between UVM and UPRM resulting in a Food Resilience Toolkit in both English (Serrano-Cortés et al., 2022) and Spanish (Serrano-Cortés et al., 2023). This toolkit has four main sections. The first section defines food resilience and introduces the Community Capitals model (Flora et al., n.d.); the second section outlines various methods to engage stakeholders and guide decision-making; the third outlines action steps; and the fourth provides lessons learned from the two regions. Its purpose is to help community leaders and technical support professionals assess and build food system resilience in their regions.

The second project was a seed project, a partnership between UVM, UPRM and Clark University to collect more data on farm to institution (FTI) programs in the two regions and position us for future funding. While these data contributed to two Master of Science theses (Whitehouse, 2022; Desravins, 2024), one at each university, as will be discussed below, they did not result in another grant proposal as we originally intended.

What Went Well

The following sections will highlight successes, including funding, scholarship and information exchange.

Successful Funding

Given the difficult current grant funding environment, two successful grant proposals must be seen as a win. The topic, partnerships, and approach were seen favorably by the grant reviewers. Both UVM and UPRM were (and remain) Established Program to Stimulate Competitive Research (EPSCoR) jurisdictions, which may have also been points in our favor. Our development of bilingual

(English and Spanish) outreach materials advanced USDA's commitment to underserved farmers.

The Scholarship

The teams had faculty with expertise and experience conducting research and advising graduate students. We shared a commitment to mixed methods research and community engagement, so our research approaches were well aligned. Three graduate students used this work as part of their master of science theses, one each at UVM and one at UPRM (Cunningham, 2022; Desravins, 2024; Whitehouse, 2022). We created the toolkits and one peer-viewed journal article on its application. Elements of the toolkit were utilized in symposia in VT and PR by our team. Recently, stakeholders in Vermont requested information on the asset mapping elements of the toolkit. Besides this, no other organizations specifically have employed the toolkit to my knowledge.

Exchange of Expertise

The grants funded a total of five trips for exchange of knowledge and expertise. Two of them were mainly for grant planning and management, but three were expert stakeholder exchanges, where a team of food systems stakeholders traveled with the university affiliates to teach and learn about food systems issues.

In March 2020, the UVM team brought three experts in FTI (institutional food service and local food procurement) to PR: a nutrition services director from a K-12 school and hospital, respectively, both known for success and innovation in FTI; and the executive director of a regional FTI advocacy and technical assistance organization. The UVM arrived in PR on March 11, 2020. After a tour of a regional hospital and university food service operation, and a day-long symposium at UPRM, the team made a hasty return to VT on March 14 as the Covid-19 pandemic was closing down schools and universities. The nutrition service director's phones were blowing up all day with urgent calls from home: how will we feed kids with schools closed? How do we feed patients if hospitals are overrun with Covid patients? Despite the looming pandemic threat, the VT and PR food service professionals were able to meet and brainstorm ideas on how to increase local food procurement.

Due in part to travel restrictions associated with Covid-19, the next exchange did not take place until March 2022. While the purpose of this trip was mainly seed grant and toolkit composition planning, the UVM team (three faculty including me, a research associate, and a graduate student) visited two organizations, Fundación Bucarabón (FB) and Asociación Pro-Bienestar Barrio Marías de Aguadas Inc. (APBMA), the first focusing on rural economic development through agricultural entrepreneurship (especially for women), the second focusing on food access and food insecurity in western Puerto Rico. The morning of our departure, we had a tearful goodbye with Robinson where he expressed his deep gratitude that we were both the last collaborators before Covid and the first ones after.

The next exchange was in July 2022, when the UPRM team (three faculty and two graduate students) along with a livestock farmer and fisheries expert visited Vermont. In addition to a symposium at UVM, the teams visited a farm incubator and food hub, an artisan cheese maker, maple syrup maker and agritourism operation, specialty food manufacturer, food gleaning center, and UVM Dining. At each stop, the PR and UVM teams met with the VT stakeholders and learned and discussed goals, operations, and strategies for food resilience and community development. The most rewarding and impactful meeting, in my view, was at the UVM Medical Center (VMMC, our regional hospital) with their Executive Chef Manager and co-founder of the Culinary Medicine program, Leah. The meeting took place on a lovely sunny summer morning at UVMMC's rooftop garden. As has been documented in other articles (e.g., Becot et al., 2016), UVMMC is a role model for an anchor institution's contributions to food resilience and community development. Leah spoke of UVMMC's work in purchasing from and investing in local farms and food vendors, healthful menu options, and empowering patients and community members to prepare and consume healthful foods.

For the final visit, before grant funds expired, I traveled to PR with Leah to meet with stakeholders from local hospitals, as well as UPUM faculty, and

School of Hotel and Restaurant Administration faculty from another UPR campus, UPR-Carolina.

Each Side Thinks They Benefitted and Learned More

As the author Anne Lamott says, "A good marriage is where both people feel like they're getting the better end of the deal." Conversations between our teams suggest that each feels they learned and benefitted more. Each region has a strength that complements the other. Vermont has strength in formal institutions: it has a statewide strategic food systems plan and network, supporting state policies, well-connected and coordinated technical assistance providers, and FTI stakeholders, including UVM Extension. The UVM team is deeply engaged and connected with these formal institutions. PR, in contrast, lacks the well-organized and connected formal institutions. But PR has deep community ties, and the strength, relevance, and credibility of their organizations like ABPMA and FB. An interesting anecdote demonstrating the community ties is this: during the 2022 visit to PR, the two teams were traveling in two cars in western PR on winding mountainous roads with few street signs. On two occasions, Robinson stopped in small towns for directions to FB, the agricultural development organization. In each case, the people were very familiar with FB and their work and were able to provide directions. The UVM team observed that it would be unlikely that people in rural Vermont would be as familiar with the work of the local UVM Extension office or know where it is located. Seeing how similar work with similar goals can be accomplished under very different methods was a valuable learning experience for both teams. For each to use the strength of the other to complement one's own would certainly accelerate efforts to improve food resilience.

Lending Legitimacy

Another benefit was the spotlight that visits and collaboration from the other region put in our own work. While I have no direct evidence to document it, I believe that these projects with partners from far away put a spotlight and legitimacy to the work in ways that projects from our own or adjacent regions may not. The visits and symposia drew large crowds of interested stakeholders and were featured public relations articles from the universities. Local business owners and stakeholders were proud to showcase their work to visitors.

The legitimacy requires some reflection, however, on colonial legacies and wealth and resource imbalances. Was the URPM team able to showcase their work because a team of university researchers from the mainland came to visit? Did the events in VT draw big crowds because of exotic visitors from the south? While the net result, fostering conversations and new perspectives on food resilience, was overall positive, the underlying wealth and resource imbalances are troubling and reflect deeper issues that will be discussed below.

The Friendships

The greatest success, both for its own sake and its importance of the success of the work, was the friendships forged among the teams. The kind of deep community-based work that both teams do requires immense trust and commitment in and between teams and with the people and communities we engage. Issues like food resilience are immensely complex social issues with many stakeholders and interconnected parts. There are few, if any, "one size fits all" solutions. Rather, efforts to address these problems are highly context-specific, "one size fits one." This requires profound trust with and understanding of our communities and its stakeholders, their assets and priorities. These relationships are the backbone of our work. Similarly, it takes time and effort for each team to learn about the others' work, the overlaps and the differences, and discern how our experiences apply in the other context. The friendships we forged were also essential to learning how to work together.

While the formal activities like the research debriefs, the symposia, the grant planning and writing were essential components, some of the best insights and ideas came in the informal moments like driving in the car, sharing a meal, and walking around campus. I cannot overstate how important it was to simply spend time together, to laugh and joke, to share success and failures, to be vulnerable, to be human. The friendships created not only deep trust but deep commitment to each other and

the work. They were essential to the work but also brought great personal joy and satisfaction.

What Was Challenging

If I had to sum up all the frustrations with the project and why the work ended when the grant funding ended, it would be bureaucracy. There were struggles navigating each university's procedures and regulations that created frustration and eventually, in many ways, inhibited future collaboration.

The first barrier, or at least frustration, from the VT and UVM side was the bane of academics - compliance culture. This played out in several distinct ways on the various trips when teams from one region visited another.

To be clear, compliance regulations have a purpose. They exist to prevent fraud and embezzlement, for example, and to ensure that taxpayer-funded grant money is spent responsibly. There are places, however, where "one-size-fits-all" rules can at best cost a great deal of time and effort and, worse, disincentivize actions which advance the implicit goals of the collaboration. I will detail the issues below and then discuss a few lessons learned.

The examples below came to my attention when my UVM purchase (credit) card was set to expire. On the first day of the expiration month on my card (May 2024), I got an email listing expenses that were out of compliance, which arose from my work in PR. The infractions were largely of three types: lack of itemized receipt; food expenses exceeding daily maxima; paying for meals with stakeholders with grant funds. I had to correct these before a new card would be issued. I had numerous research travel and other expenses (mainly for my graduate assistants to travel to collect data, meet with stakeholders or present their work at conferences) in June 2024. I was faced with the options of addressing these infractions in short order, paying for all expenses up front myself, or asking my graduate assistants (many of whom came from the Majority World and who struggle to pay for daily expenses on a graduate assistant income) to pay for expenses up front. As I discuss below, with a great deal of help from staff from my college, these issues were resolved and I was issued a new card at the very end of the month, in time to use for June 2024.

During the visits to PR, we generally ate at restaurants chosen by our hosts Robinson and Maria. We shared meals because friendship and camaraderie are essential to forging relationship and doing the hard work of engaging with communities with different cultures. The restaurants were part of their small farm to table movement, ones that buy from local sustainable fisher people and farmers and support their communities. During the meals we often talked to the owners about their support of local vendors; the owners were rightfully extremely proud of these efforts (difficult as they are in a place like PR with decades of exploitative, colonial-style institutions and regulations that make PR dependent on the mainland, still in place as discussed above). As I state above, I believe that the attention of scholars and experts from the mainland legitimized and motivated these efforts to support their communities.

Meals at farm to table restaurants cost a bit more. Food in PR overall is very expensive because of the Jones Act and other colonial policies and practices that have created vulnerability for the people of PR. UVM auditors cited these expenses in violation of policy going over the daily limit for meals even though they were all paid for with grants I had written and were line items in the project budget.

These rules undermine the very food resilience efforts we were trying to promote and support the cheap food paradigm: the rules encourage eating at chain restaurants who keep food prices down by exploiting employees and buying the cheap imported food that prices out Puerto Rican farmers. There are plenty of Dunkin and other cheap fast-food chains there; I doubt they contribute to their communities and local farmers and fisher people like the places we ate do. (As an aside, I have no empirical evidence to measure the differences in community development impacts of chain versus farm to table restaurants, but it would be interesting to use this as a lens for a deeper dive comparing the VT and PR food systems). To be clear, the cost to me was time and convenience. I think, however, that incentives matter and regulations that work in opposition to stated project goals and university values must be examined.

I booked lodging for myself and the guests with a local entrepreneur who helps neighbors rent their apartments. The auditors similarly cited me for not having a perfectly itemized receipt. Compliance culture incentivizes me to stay in mainstream chain hotel owned by outsiders, one that is perfectly able to make a receipt to fit their standards, but where the profits leave the island and do not support the community.

Finally, despite writing funds into the grant budget for shared business meals among the teams in both locations for each visit, the UVM auditors objected to grant funds paying for the meals of the UVM team when in VT or the UPRM team when in PR. These meals were essential for discussing the day's events and lessons, planning the next day, reflecting and putting them into deeper context, and most critically, forging the friendships and mutual trust that underpin the work. Apparently, the preferred practice under compliance culture is to say, "so long suckers, go pay for your own meals." Such a sentiment is not only shockingly rude, in my view, and casts UVM in a terrible light, but also would rob us of countless team building and learning opportunities.

To their credit, my college's Dean's office staff helped me navigate these difficulties and request exceptions for the daily meal overruns and lack of itemized lodging receipts. I was able to use other funds to pay for business meals, but only after hours of poring over receipts trying to recall who ate what and allocating each to the grant versus other funds.

I frame and qualify the critique of compliance culture with the understanding that the cost was inconvenience and the opportunity cost of my time. I am incredibly grateful for the grant funds, experiences, and assistance. I also wish to express great gratitude for the staff that helped me navigate this issue and emphasize that those who enforce compliance culture rules are usually underpaid staff just doing their jobs, and I have no personal animosity. But I also believe it is important to point out how procedures disincentivize the goals of our work and reinforce colonial norms and structures.

In retrospect, here are actions I could have taken to prevent or mitigate some of these inconveniences. First, when working in places like PR, it may have been helpful to negotiate with the funders and university grant administration the daily meal cost overruns. Second, writing more working business meals into budget line items may have allowed for time to debrief the day's events and build camaraderie. Third, sharing a sample compliant itemized lodging receipt (ideally translated into Spanish) maybe have helped the lodging agent create a compliant receipt for my stays.

The lack of administrative support and rigid structures were even more apparent at UPRM. Before I came to UVM, I worked at Michigan State University and before that was a PhD student at Cornell University. I noticed early on that UVM, a relatively small LGU, had many fewer resources to support research grants compared to the behemoth LGUs where I had previously worked. After working on and submitting the first grant application with UPRM, I realized how good I had it: the gap between UVM and URPM was at least as large as that between UVM and the larger LGUs. In the spirit of the Roberto Clemente quotation to open this essay, I committed to using the relative wealth of expertise and resources at UVM to collaborate with UPRM.

As an outsider, I hesitate to criticize or even compare, but I will share a few observations on the differences as I saw them. First, UVM faculty are very much encouraged to seek external funding and granted a good bit of flexibility in time commitment as needed. At UPRM, there are more restrictions. UPRM faculty could not provide any in-kind match of effort and have been very cautious to commit to formal effort on grants. My sense is also that, while faculty at UVM certainly work long hours and in reality have workloads adding to much more than 1.0 Full-time equivalent by any measure, UPRM faculty are even more overloaded, have less time and opportunity to seek out new projects, and their time commitment is much more closely guarded.

Grant application approval through the chains of command at UVM tends to be fairly quick and efficient with faculty playing a small role once the process begins. Getting signatures and approvals of subawards at UPRM was much more time consuming and required faculty persistence and many reminders to move the process along. In at least

one, it required walking a written document to an administrator at the last minute to get approval.

The tasks of subaward management at UVM are handled mainly our Sponsored Program Administration (SPA). Faculty approve invoices and write reports but have little hands-on processing. At UPRM, these tasks fall more to faculty.

With every grant applied for and received, I reminded our SPA pre- and post-award specialists of the differences and possible difficulties of working with UPRM. I emphasized my view of the importance of the work and of our using the resources we have to work with those with fewer. It is, as I stated, the cost of working there and one we would bear.

UVM's greater management capacity has had a very perverse effect, however. The two grants we received were both based at UVM. That means the majority of the money and the majority of indirect costs went to UVM. The travel funds all came from the UVM budgets. UPRM has very restrictive rules on travel that made it easier to put these costs in the UVM budget. UPRM had no subaward at all on the first grant; they only had a line item as consultants for translation services. On the second grant, the UPR subaward paid for a small amount of summer salary and graduate student assistant funds. It totaled only about 20% of the budget and UPRM's indirect (F&A) rate was only 10%. The vast amount of the money and F&A costs went to the wealthier university (UVM) with more resources to manage grants.

The Conundrum

All this leads us to a present-day conundrum. I want desperately to continue the work. It is the most rewarding work, with some of the dearest friends and best people, I have ever done. As the seed grant expired, we discussed next steps. The UVM team noted the inequitable flow of funds and strongly desired that the next grant be based at UPRM, with the vast majority of money going to them, with only a small subaward to UVM. This seemed like the most equitable outcome. Yet discussions with the UPRM colleagues revealed they simply lacked the capacity to submit and manage the grant, even if the UVM team took the lead in writing the narrative, creating the budget and other tasks. Given the choice of an inequitable grant with money flowing to UVM or no grant, we chose the latter. In the intervening time, Robinson took on a more administrative role, further limiting his ability to collaborate. Efforts to work with other UPRM faculty exposed the same barriers: lack of time, bandwidth, and institutional support to collaborate on external grants.

It is also troubling that the Toolkit has been used minimally in VT and not at all in PR once grant funds expired. It was clearly not relevant enough to be employed by others or in the absence of further funding. While one can critique the reliance on short-term competitive funding in the current environment, most of the blame clearly falls on me.

Implications and Conclusions

My experiences have led me to ponder the broader implications of this collaboration and how an institution with greater assets should engage with those with less. As I discuss above, neoliberal governance regimes across universities and the world exacerbate resource inequality and make food systems development work acutely needed but difficult to sustain. I am left with many questions but few answers. Most painful to ponder, did these partnerships really help Puerto Rico? To what extent and how did our collaboration just reinforce colonial structures and norms? How can we overcome them? How can scholars from wealthier universities, even those who enter with the best of intentions, as I believe we did, overcome this? How can we empower our partners in the face of and without recreating inequitable institutional norms and structures? In our home institutions, how can we overcome the petty and demoralizing specter of compliance culture, especially when its rules work directly against the goals of equity, inclusion and engagement that we seek? I hope that this reflective essay will help foster more equitable partnerships.

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Setting tables for community food sovereignty: Building a food sovereignty toolkit

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Abstract

This reflective essay outlines the collaboration between a university and community partners to develop a community-based food sovereignty assessment (CFSA) and toolkit, and the challenges and key insights that were gained. Our core research question was to explore how we could develop and deploy the concept of food sovereignty in an industrialized, urban environment. Using community-based research (CBR) methods that included photo elicitation, field observation, community meals, focus groups, and GIS mapping workshops, we worked with two underserved, food-insecure communities in Tampa, Florida, to develop an understanding of their assets and needs. All partners in the research team have worked with

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Competing Interests

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the two communities for over four years, and reflect on the successes and challenges of community-based research on food sovereignty. Community insights helped identify gaps in urban agriculture education, which helped craft a community-centered curriculum around urban agriculture that ultimately resulted in the creation of a food sovereignty toolkit.

Keywords
food sovereignty, community-based research, partnership, empowerment, food security, photo elicitation

Introduction

Officially coined in 1996 by La Via Campesina, an international peasant movement that began in the Global South, the concept and the social movement of food sovereignty took the global stage in 2007 at the Conference of Nyéléni, in Mali (Desmarais, 2007; Desmarais et al., 2010; Holt-Giménez, 2018). Composed of small-scale farmers, landless and Indigenous peoples, fisherfolk and pastoralists, the Conference asserted that food sovereignty is the "right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems" (Forum for Food Sovereignty, 2007, p. 1). In the Global North, food sovereignty movements are enacting projects that are "appropriate to the diverse social and ecological contexts" (Weiler et al. 2015, p. 1080) of urban and rural environments (García-Sempere et al., 2018; Resler & Hagolani-Albov, 2021), and that focus on enriching agro-ecological knowledge and building context-specific local action. Based on principles of local food production, knowledge sharing, respect for the natural environment, and the sacred value of the land and its agricultural gifts, food sovereignty presents a vision and a practice for creating a more healthy and equitable food system (Desmarais, 2015). Food sovereignty recognizes the systemic and pervasive influences of corporate, political, and gendered power dynamics that negatively affect food systems. Food sovereignty thus frequently incorporates food justice ideals that inspire innovative research into better understanding where food comes from, under what labor conditions it is produced, and whether healthy, environmentally sustainable, and culturally meaningful food is accessible to all (García-Sempere et al., 2019; Schanbacher, 2019).

Food sovereignty research provides an alternative way to think about the problem of food insecurity (Schanbacher & Fung Uy, 2023). Food security is defined by the Food and Agriculture Organization of the United Nations (FAO) as "when all people at all times have physical, social and economic access to food,. which is safe and consumed in sufficient quantity and quality to meet their dietary needs and food preferences…allowing for a healthy and active life" (2012, p. 9). Although food security has been well researched nationally and globally (Carney, 2012; Clapp, 2014; FAO, 2023; Hopma & Woods, 2014; Rabbitt et al., 2023; Weiler et al., 2015), the food sovereignty concept challenges top-down solutions to food security that do not adequately take into account local and Indigenous knowledges (Schanbacher, 2010). In particular, food sovereignty provides a path for local communities to challenge the pervasive influence of corporate agriculture and food production and engage in action-oriented projects in local food systems. These initiatives are not only influencing national and state agricultural and food production policies, such as Florida Senate Bill 82 (Florida Senate Community Affairs Committee, 2019), which prohibits local government from regulating vegetable gardens on residential properties, but are also encouraging community-centered solutions. Communities with the capacity and vested interest in changing their food system are better equipped to share knowledge and experience about food related activities, such as regional gardening techniques, regenerative agricultural practices, favorite recipes, as well as local physical and individual resources.

In the U.S., small-scale farms, urban farms, and community and home gardens are joining together to implement food sovereignty practices (Méndez et al., 2013). Food sovereignty initiatives have only recently taken root in organizations such as the US Food Sovereignty Alliance, which aims to promote the original, international mission of food sovereignty in the U.S. The alliance brings together

"food justice, anti-hunger, labor, environmental, faith-based, and food producer groups" to promote the human right to food (U.S. Food Sovereignty Alliance, n.d.). As the Alliance rightly notes, building food sovereignty in the U.S. must take into account its unique historical forms of marginalization of Black, Indigenous, and People of Color (BIPOC) groups, as well as the relationship between those urban and rural populations that face the highest rates of food insecurity.

This reflective essay provides an overview of the processes of implementing a community-based research (CBR) project to investigate food sovereignty in underserved communities in Tampa, Florida, U.S., and the lessons learned.[1] In order to build an urban food sovereignty initiative in our community, we developed a systems-thinking approach that examined existing federal, state, and local nutritional programming, such as the Supplemental Nutrition Assistance Program (SNAP) and the Women, Infants and Children program (WIC), as well as grassroots organizations. These programs address food insecurity—specifically, gaps in food access—to improve health outcomes in low-income populations. SNAP and WIC coverage rates vary by state; in Florida, an estimated 418,000 individuals were covered by WIC in 2023. Federal interventions, such as the pairing of Fresh Access Bucks (FAB), a statewide nutrition incentive program in Florida that increases the purchasing power of SNAP recipients to buy fresh fruits and vegetables (feedingflorida.org, 2024), presented an opportunity to explore ways in which local programming could promote these goals. Furthermore, federal interventions largely supported urban agriculture and other food initiatives that contributed to mitigating food insecurity and improving healthy food access based on the pillars of food sovereignty.

The Project: WellFed Community—A Culture-Centered Approach to Incorporating Food Sovereignty in Food Security Solutions

Systemic problems contributing to food insecurity motivated two organizations in the greater Tampa Bay area to develop a partnership to analyze current food sovereignty work and identify creative solutions for addressing food insecurity. The University of South Florida's Food Sovereignty Initiative (FSI), and WellFed Community, a not-for-profit organization, came together to strategize ways to build community food sovereignty, improve the food security of individuals and households, and bolster health equity through a CBR approach. The project aimed to a) assess the gaps and strengths in urban agriculture education; b) develop a toolkit for assessing a community's understanding of food sovereignty, and c) create a strategic plan for successful and sustainable implementation of food sovereignty programming that could drive conversation in public policy related to food access and health equity.

Our project focused on four zip codes (33604, 33605, 33612, and 33613) outside the urban core of Tampa. The 33604 and 33605 zip codes are referred to as the East Tampa Area Community (ETAC) and the 33612 and 33613 codes are referred to as the University Area Community (UAC). These zip codes represent a diverse community across racial, ethnic, and economic dimensions, offering a rich opportunity to learn from varied perspectives. The U.S. Census Bureau in 2022 reported that these zip codes had a total population of 144,545 in 2022 (2023b). The median household incomes in the zip codes—33604 ($73,739); 33605 ($48,829); 33612 ($54,952); and 33613 ($66,882)—are on average 31% lower than the Florida median household income of $96,992 (U.S. Census Bureau, 2023a). While these incomes are a community average, those with slightly higher incomes would generally be considered more among the ALICE (Asset Limited, Income Constrained, Employed) population. The ALICE population, more commonly known as those who live paycheck to paycheck, are constantly balancing the high cost of living, including housing, childcare, and transportation costs, with other needs to subsist in a precarious balance that can easily turn unstable by unforeseen deleterious employment, health, or other events, including natural disasters or other unforeseen disasters such as the COVID-19 pandemic. As of 2022, 46% of Florida households were below

[1] The University of South Florida Institutional Review Board (IRB 005039) approved this study.

the ALICE threshold (United for ALICE, 2023). However, in Hillsborough County, where Tampa is located, there are major economic differences within neighborhoods that might not be completely captured by the ALICE figures. Our target zip code, 33605, includes a larger percentage of African Americans (52%) than the national average (12.5%), and the 33612 and 33613 zip codes have diverse racial compositions, with larger Hispanic or Latino populations of 41.2% and 33.8%, respectively (U.S. Census Bureau, 2023b).

Community Partners

This project was made possible by a grant from the U. S. Department of Agriculture. The design and implementation of the project was led by WellFed Community, a program of a local nonprofit with support from the University of South Florida's FSI, FHEED LLC, and community stakeholders.

The Well Incorporated. This partnership was intentionally composed of community organizations and academic institutions to ensure commitment to values of dignity and reciprocal relationships while also ensuring project outcomes. The Well Incorporated (the Well), a nonprofit organization and the project lead community organization, was established in 2014 with the mission to address questions and solutions related to health inequity, food insecurity and improved nutrition. The organization operates weekly food distributions through their mobile food pantry that collaborates with local community gardens, food banks and other food distribution agencies to provide free food to underserved communities. It conducts food education programs and cooking classes that incorporate recipes from community suggestions as process to build direct relationships with the people they serve. It's model for the mobile pantry is grounded in the food sovereignty notion of bringing a more dignified experience to food distribution programs (De Souza, 2019; Martin, 2021).

The FSI was established in 2019 as a transdisciplinary research group that draws on different disciplinary perspectives to build creative solutions to food insecurity. Rooted in the core principles of food sovereignty and agroecology, the FSI includes three focus areas: research, community engagement, and curriculum development. The FSI includes faculty from across the three University of South Florida (USF) campuses (Tampa, St. Petersburg, and Sarasota) and from the departments of Sociology, Religious Studies, Anthropology, History, the College of Public Health, the College of Nursing, the School of Public Affairs, and the Patel College of Global Sustainability. Having an academic arm of this partnership enabled due process and credibility of findings.

FHEED LLC and Anthony Olivieri, MURP. Founded in 2011 by Anthony Olivieri, FHEED LLC (Food Health Environment Economic Development) is a consultancy dedicated to promoting food sovereignty and health justice through innovative community food systems planning, geographic information system (GIS) analysis, and policy advocacy (FHEED LLC, n.d.). FHEED champions the right of communities to govern their food systems democratically, working with local government agencies and community organizations to develop policies that foster sustainable, equitable food systems and enhance health equity. Their efforts focus on creating systemic changes that support environmental sustainability and community well-being.

Community Stakeholders. The success of the project is a testament to the collaboration of diverse organizations and communities, each playing a vital role in its realization. In addition to The Well and the FSI, this project was made possible through collaboration by the University Area Community Development Corporation Inc. (UACDC), Cornerstone Family Ministries, the Coalition of Community Gardens, The Dream Center, Hillsborough County Extension Office, Uptown Eagles, and other departments of USF. These partners bring a wealth of knowledge, resources, and community connections to the table, amplifying our collective efforts towards achieving food security and fostering sustainable community development in Hillsborough County.

Methods

The FSI and WellFed Community's commitment to the food sovereignty principal of local knowledge sharing, and their plan to develop a food sovereignty toolkit that would be applicable for our communities, made community-based

research the most appropriate research model to employ. The following section outlines our process and context specific application of community-engaged research.

Community-Based Research

We implemented a CBR framework, which offers a more inclusive learning environment and the potential for sustained community engagement that is necessary for building social capital and empowering citizens to have a voice in decisions that affect their livelihoods (Carney et al., 2011; Pine & de Souza, 2013). With its emphasis on community engagement, CBR was the ideal framework for this project as it allowed us to explore and develop food sovereignty values and pillars in our community (Sánchez et al., 2021). Moreover, CBR would help us better understand the locally specific knowledge necessary for including agroecology in food sovereignty research (Méndez et al., 2013). Agroecology is a holistic approach to agriculture that incorporates ecological and social concepts and principles in the design and management of agriculture and food systems. It "seeks to optimize the interactions between plants, animals, humans and the environment while also addressing the need for socially equitable food systems within which people can exercise choice over what they eat and how and where it is produced" (FAO, n.d., par. 1). CBR emphasizes balancing power dynamics between researchers and participants, reducing skepticism towards researchers and encouraging more reflexive, respectful, and culturally sensitive research practices, consistent with the core principles of agroecology. The ability to share context-specific knowledge, particularly with respect to food-related activities such as community gardening and cooking demonstrations, served as another method to integrate community voices and perspectives (Flicker et al., 2007). Our commitment to CBR led to an evolving project plan as we incorporated community input. For example, as more community members engaged in our programming activities, they offered insights that provided a nuanced understanding of community dynamics that, in turn, proved helpful for developing an adaptive program design. Our previous research experience highlights the importance of engaging community members in project planning in order to recognize local wisdom, knowledge, and points of view that may be different from those of the research team (Sabir et al., 2009). Acknowledging community needs and preferences is critical for tailoring a project to a specific community and fostering collaborative partnerships to produce locally rooted solutions (Wallerstein et al., 2019). From this process, we produced our food sovereignty toolkit (www.foodsovereigntytoolkit.com).

Focus Groups

Initially, the intention was to host four focus groups with community stakeholders in each of the two identified zip codes, for a total of eight meetings. The focus groups design included: (a) a Local Community Champions Focus Group to engage participants from organizations who lived in the community (Posner, 2015; Worthy et al., 2016), such as the football coach, employees of the community center, and engaged parents; (b) an Art Based Focus Group, utilizing an Arts Based Research (ABR) approach, which would help participants to convey truths or bring about awareness of everyday experiences with food, and help them to express their ideas related to community food programming (Gerber et al., 2018); (c) an Asset Mapping Focus Group which would utilize community input to develop a deeper and more comprehensive understanding of food, nutrition, and health-related community resources; (d) a Cultural Foods Focus Group that would provide a hands-on exercise that would aid participants in identifying the cultural nuances of their relationship with food by sharing their understanding of different foods that are grown and used across cultures.

While these focus groups were great in theory, low attendance required our team to pivot and think of new ways to utilize the principles of CBR more inclusively and engagingly. Conducting focus groups in underserved areas presented several persistent challenges. Logistics such as transportation, time constraints, and competing responsibilities were reasons we heard from community members for barriers to participation. People often expressed distrust of formal research processes due to past experiences of being excluded from decision making or research efforts. Cultural and lin-

guistic differences, along with varying levels of health and research literacy, further complicated engagement, leading participants to feel uncomfortable or disconnected from the research process (Aldridge, 2019; Bonevski et al., 2014).

As a result, the research team decided to host community meals that would create intentional conversation around food. To prepare, WellFed Community hired two members of the University Area neighborhood, one of whom was Spanish-speaking, to design flyers and help promote the event to neighbors. Hiring community representatives also helped us better align our project with the food sovereignty themes of giving voice to local knowledge and uplifting culturally relevant foods. The community representatives more accurately reflected the ethnic, racial, and linguistic backgrounds of the community. Under the guidance of the onboarded representatives, we arrived at the innovative model of hosting, in each neighborhood, three community meals (expanded on below in the Lessons Learned section), followed by an intensive asset mapping workshop, and simultaneously conducting program evaluations of existing food sovereignty interventions.

Community Meals

In part, our community meals were designed by community feedback in which people expressed how they enjoyed sharing recipes from their cultural background, appreciated home-cooked meals, and felt a sense of dignity when they could share food over a common table with their neighbors. Drawing from these community insights, the project team planned and facilitated further meals to foster relationships with and between our community members and the organizations working in our research zip codes.

Our team hosted a total of four meals in our target community over the project period of 18 months. Depending on the neighborhood where the meal was hosted, the dishes were home-cooked and included seasonal local produce, health-conscious options, and culturally inspired dishes. We hosted our first community meal at the Harvest Hope Community Garden located centrally in the University Area Community (UAC). More than a dozen neighbors attended the event with a proportional representation of the African American and Latino/a communities. Families also brought their children, which proved both informative and challenging, in a positive way. Children's perspectives offered new insights with which to think about how our program was received in the community; they also produced chatter, laughter, and loud voices that made it challenging to record conversations and take detailed field notes. At our subsequent community meals, we planned for onsite childcare that encouraged participation for those with families, while also engaging youth. Furthermore, the project team was dispersed throughout the group to better observe and engage in intimate conversations.

During meals we used various data collection methods, including notetaking and facilitator feedback forms (WellFed Community, 2024a), photo and video elicitation (Shannon et al., 2020; Wang & Burris, 1997), and focus group discussion questions to acquire quantitative and qualitative data to supplement the valuable input of the participants (see the Appendix). In alignment with the innate values of CBR methods, our facilitator feedback form not only focused on the demographics and outputs of the event, but concluded with a reflective exercise with questions inspired by the cookbook *Cooking with Five Senses* by Rita Bumbaca (1990).

To conceptualize food sovereignty in specific local terms, our team decided to utilize story telling through photographs as a way to convey food sovereignty themes of respecting human dignity, sharing diverse local knowledges of our community members, and identifying culturally significant stories about food. In our design, we elicited photographs by asking participants upon arrival to take one or two pictures of something they saw at an event that reminded them of a personal story about food, or an experience with food (WellFed Community, 2024a). We then recorded short audio segments asking participants to explain why they chose the pictures. After the event, we asked the same participants to reflect on their original statements and how their involvement at the community meal had impacted their relationship with food. We also utilized video elicitation by showing a bilingual video we created, *What is Food Sover-*

eignty? (WellFed Community, 2024b), that used footage from the community and represented its cultural groups. Neighbors who attended the community meal watched the video as a group and then were asked about their understanding of food sovereignty and the emotions and thoughts the video provoked. The project team took notes of participant responses and completed a facilitator feedback form immediately following the event that standardized the data collected. In this way, we made the participant experience enjoyable and natural while placing the onus on the project team to collect the data that would gauge the effectiveness of the community meal. Team leaders coached our graduate assistants to ensure that notetaking was inconspicuous and did not interrupt the meals. Our emphasis on centering the food sovereignty ideals of culturally appropriate foods and human dignity was recognized by the community. Furthermore, these meals served as a recruitment method for the subsequent asset mapping workshop that was part of our original research plan.

Food Sovereignty GIS Mapping Workshop

Having strengthened relationships with the target communities, we carried out our original plan to conduct an asset mapping workshop. Asset mapping provides a baseline for determining how to design food delivery and nutrition education, and provide overall well-being (Villanueva et al., 2016). Researchers across various disciplines use asset mapping as a useful tool for building community capacity and community development (Lightfoot et al., 2014; Sharpe et al., 2000). Food asset mapping has been identified by the American Planning Association in the *Policy Guide on Community and Regional Food Planning* (American Planning Association, 2007), and has been utilized to bolster the representation of Black and Indigenous populations (Soma et al., 2022). In partnership with a national consultant with Food for Health, the Environment, Economy, and Democracy (FHEED), we created a Food Sovereignty Mapping Workshop with the goal of geo-visualizing the principles of food sovereignty, integrating community assets, and addressing the social determinants of health (SDOH) that shape community agency (National Institute on Minority Health and Health Disparities, 2024). Recognizing the impact of SDOH, such as economic stability, education access and quality, and health access, we aimed to visualize how these factors influence ability to make healthy food choices and actively participate in local food systems. This approach aligns with findings that food systems profoundly impact community health outcomes, including diabetes—a condition intricately linked to diet and affected by access to healthy, affordable, and culturally appropriate food (Neff et al., 2009).

Ultimately, food insecurity is not a result of a lack of supply but rather how social and economic conditions (SDOH) constrain a person's ability to make food choices and participate in their local food system. The relationship between diet, and SDOH factors such as economic insecurity, and chronic disease has been well documented, with early research establishing that inequitable food access contributes to rising rates of obesity and type 2 diabetes, particularly among low-income populations (Drewnowski, 2009). For this reason, we specifically chose to focus on diabetes because it has a well-established relationship with social and economic drivers of health. Diabetes, a metabolic disorder, is one of the clearest health outcomes linked to the condition that shape dietary choices and community economic conditions (Hill-Briggs et al., 2021). Because of its strong association with food access and the availability of public health data from sources such as the CDC, diabetes was selected as a representative outcome to map disparities in food-related health across areas with high social vulnerability.

To ensure our approach aligned with state health priorities, we consulted the health equity advisor at our Department of Health (DOH) to confirm that including diabetes as a geographic health outcome of food insecurity would be consistent with the DOH's community health needs assessment framework. This allowed us to link our food sovereignty interventions to an official population health measure. For example, Hillsborough County's 2019 Community Health Assessment identified diabetes as one of the top five health issues facing the community, alongside exercise, nutrition, and weight. In its analysis, it situates diabetes at the intersection of food insecurity and

poverty (Florida Department of Health in Hillsborough County, 2020).

We conducted two- to three-hour mapping workshops with 10 to 20 participants at the ETAC and UAC zip code locations. These workshops were held during community meals, and the relationships formed through these gatherings played a crucial role in their success. Participants were provided with strategy worksheets and handouts from the *WellFed Community Food Sovereignty Toolkit* (2024a) to guide discussion around approximately twenty land-based community assets that could be repurposed for food growing, storing, distribution, marketing, consumption, or recycling. Examples of assets included houses of worship (for gardens or food pantries), public libraries (for seed storage), community centers (for cooking classes), vacant land, greenways, food pantries, and farmers markets.

In addition to identifying community assets, the paper maps used by participants in the workshops showed areas of "high need," defined as census tracts with both (1) an above-county-average diabetes rate and (2) an above-county-average Social Vulnerability Index (SVI) score, based on datasets from the CDC PLACES and CDC SVI. The SVI served as a composite measure for SDOH, since it includes factors such as socioeconomic status, race, and household composition among others. These two indicators, diabetes and SVI, were chosen to visualize and target areas with overlapping social and health vulnerabilities. This pairing is supported by national research showing that higher social vulnerability, especially the socioeconomic and household factors, is significantly associated with increased incidence of diagnosed diabetes (Varghese et al., 2024). The asset mapping workshops contributed to the development of an ArcGIS map that was later integrated into the *Food Sovereignty Explorer*, an online tool created for both organizational planning and community use.[2]

Program Evaluations

To complement the collecting of forward-aiming data, we simultaneously captured a baseline of existing food security programs by employing a new tool aimed at measuring their relation to food sovereignty. This evaluation form was created by the project team and used to analyze WellFed Community's existing programs (WellFed Community, 2024a). This assessment tool incorporated the pillars of food sovereignty and definitions provided by international food sovereignty leaders (García-Sempere et. al., 2019; Levkoe & Blay-Palmer, 2018).

Discussion and Results

The aim of this project was to work with our two communities to develop a food sovereignty toolkit that could be adapted by other community organizations to fit a broad range of needs and programs (WellFed Community, 2024a). At the start of the project, we knew that knowledge of the concept of food sovereignty was limited, but we did not realize to the full extent how limited community members' understanding of the dynamics of the food system were. In fact, we realized early in our conversations that the term "food system" itself was academic jargon. At our first community meal, we observed people expressing occasional bewilderment when asked questions that included reference to the "food system." We realized that people were equating "food system" to a government or bureaucratic system, rather than thinking in terms of different areas of the food cycle such as production, processing, distribution, marketing, consumption, and resource management. Therefore, defining community food and agriculture systems or promoting one's right to healthy and culturally appropriate food did not have as much meaning for our participants as it does in communities such as those of small-scale, landless and peasant farmers who are more intimately connected to the production system. To address this challenge, we created and refined a short video that defined and illustrated food sovereignty within the context of the food cycle, or food supply chain—from growing food, to harvesting and transporting food to stores, and ultimately consuming it. Replacing "food system" with examples from the food cycle or food supply chain proved to be a more effective way of communicating our lived experiences with

[2] This map can be viewed at https://www.foodsovereigntytoolkit.com

food. A participant remarked on the video and community meal: "I got a better understanding of food sovereignty, and it was nice to come together with other members of the community and answer prompt questions about the food supply and how food affects my health."

Part of the co-education, or the knowledge-sharing pillar of food sovereignty, that both the project team and community members experienced during our planning and execution of the community meals illuminated a different perspective on food sovereignty. The video and subsequent conversations prompted people to talk more about their food consumption choices as well as make connections to how conventional grocery stores and fast-food outlets contribute to limited access to healthy fruits and vegetables and eventually unhealthy eating behaviors. As one participant commented after a community meal event: "[I] learned about the different foods and how they prepared without meat and everything was very delicious and some of it was homegrown and it tasted so healthy, much better than what you buy from the restaurants and grocery stores."

The community meals provided an opportunity for people to share knowledge and engage in co-education as they shared stories about family meals, special holiday celebrations, and different recipes. A participant remarked: "I've learned that I'm not as much of a picky eater as I thought, and vegetables are actually delicious. I can't wait to learn new recipes and establish and build on some of the ones I have now with what I've learned today." At the community meals, we also integrated nutrition education in an informal, commenting sort of way as we described the types of food Well-Fed cooked. By integrating casual conversations with healthy food knowledge, we were further able to learn about how the community felt about their local food environment. As another community member commented with respect to a conversation she had during the community meal: "It really gave me an insight, especially with the cereal thing. It's like things that I thought was healthy or a lil healthy were not because the reason why they could stay on the shelf was because they are unhealthy." These meals provided opportune moments for gaining insight about how community members thought about their health in relation to food access, the built environment, and the industrial food system.

In practicing CBR in marginalized communities, the most important takeaway lesson was the importance of creating a dignified experience for neighbors and promoting reciprocal relationships in order to engage individuals around concepts of food sovereignty and subsequently to identify best practices. This was done in the smallest of details, yet was clearly visible to participants. First, and foremost, placing the responsibility for providing data on the project team rather than the participants, through note taking and facilitator feedback forms, removed the awkward and academic nature of most research practices that survey participants. By completing the feedback form after each event, the facilitators were able to enjoy their time engaging with the community, which yielded more substantive field notes. However, this practice is somewhat cumbersome for facilitators, and future research could explore how to streamline this process and still obtain data. Employing techniques like photo elicitation and video elicitation in the areas of programming where participant input is essential can be equally as effective in gauging community attitudes, beliefs, and impact. Second, by literally setting a table with real dishware, glassware, and silverware, we created a welcoming, dignified and hospitable environment in which community members felt truly cared for. One said: "You really put in a lot of work for this for us. … I don't know the last time I ate off a real plate." Finally, in investigating a field like food sovereignty, it is pivotal that the research team embodies the values and practices elements of cultural knowledge, sharing food, and leveraging local food resources.

The reality of the current state of food sovereignty in urban areas is that conversations around food are not happening at the level that they are in the academic community. Thus the first step in assessing and building community food sovereignty is creating spaces and opportunities for people to intentionally convene around the pillars of food sovereignty. By hosting community meals and onboarding community members to the team, this project was able to embody the pillars. We focused

on "food for the people" by ensuring a nutritious and culturally appropriate meal was provided, in a dignified experience that emphasized a tangible connection with food. We built knowledge and skills by blending academic literature with community knowledge, through guided questions about food experiences, behaviors, and more. We "worked with nature" by hosting events outdoors in places like community gardens. We "valued food providers" by incorporating local food organizations and resources. We practiced "localizing food systems" by incorporating food from local food banks and preparing the food ourselves. We "put control locally" by holding events in the community we were serving and promoting community members to places of leadership. Finally, we honored "food as sacred" by dignifying the research experience and focusing on food as a gift that bonds communities, and that through building relationships conversations and concrete practices can begin to address injustice in the food system.

Strengths and Limitations

Our research and programming contained limitations that are worth noting. It took us a couple months to realize that our original strategy of traditional focus groups would not work in our community, so our shift to community meals prevented us from spending as much time engaged with the community as we would have had if we arranged these meals from the beginning. Time constraints also surfaced for community members. In our study zip codes, many people work multiple jobs and are responsible for childcare work, limiting the participation to those with more available time.

The successes of our project—the community meals and the asset mapping exercises—can be attributed, in part, to our existing work and established relationships in the community. This was a strength of our team and project, but it should also be noted as a reminder that building trust, friendships, and overall social capital within communities is essential for implementing a food sovereignty initiative. Our bilingual video explained food sovereignty in a more relatable and jargon-free way, making it an effective method for communicating the concept to people unfamiliar with it. By showing it at the community dinner and holding discussions after the video we were able to make additional edits to the video as well as gauge whether people gained a deeper understanding of food sovereignty.

Our community meals were unique due to their inherent incorporation of food sovereignty. The idea of human dignity and the human right to food is a core feature of food sovereignty. From the set-up of the physical tables, with physical plates, silverware, cloth napkins, glassware, and table decorations such as flowers, fruits and gourds, we tried to establish a sense of dignity for all guests. In addition, project members served the food to the guests, explained where the food came from and, when possible, used home-grown ingredients or ingredients that could be grown in our climate. By creating a comfortable and inclusive space where participants share meals and experiences, these gatherings allow community members to express their challenges and aspirations regarding food access, production, and cultural practices. This approach provides richer, more authentic qualitative data that captures the lived realities and nuanced understandings of food sovereignty.

The food sovereignty notions of agroecological growing methods and the localization of food production and distribution were reinforced through these activities. Communities hoping to replicate this framework can collaborate with community partners and members to determine how the pillars of food sovereignty can best be incorporated into community meals and the discussions that ensue. By adapting our methods to fit the community culture, we have been able to represent better their needs and perspectives.

Conclusion

In this reflective essay, we hope that readers can gain some insight for future community-engaged food sovereignty projects. Specifically, the CBR approach proved to be an effective method for conducting research and collecting data in a dignified, respectful, and mutually beneficial manner for both researchers and the community. At the same time, the CBR approach presented us with unforeseen challenges inherent to dedicated community-based work. We learned that flexibility, adaptability and openness to new ideas are essential to the pro-

cess. The collaboration between the FSI faculty members provided a helpful approach that leveraged different skill sets from the College of Public Health, the Departments of Communication, and Religious Studies. By applying different research methods ranging from public health to the humanities, we were able to gather and analyze data from different perspectives from recent Latin American immigrants (largely from the Chiapas region of Mexico, Guatemala, Puerto Rico, and the Dominican Republic), Black and Caribbean Americans, and organizational representatives that serve these communities, thus enriching our final analysis and the food sovereignty toolkit. Another successful tool was our bilingual video on food sovereignty. The community meals proved to be an extremely illuminating and special time for building social capital, friendships, and connections with other organizations in the community. We felt that this success was due in large part because we are committed to the food sovereignty ideal of the human right to food and centering human dignity in all our events.

For organizations wishing to build a food sovereignty initiative in their community, our open access online toolkit includes activities and research and evaluation templates for universities, nongovernmental organizations, religious institutions, and food aid organizations seeking to implement food sovereignty principles in their programs and activities. The toolkit includes a Food Sovereignty Index based on the core pillars of food sovereignty that quantitatively measure the degree to which food sovereignty is incorporated into programs and outreach,. These metrics include locality, food production, access, working with nature, knowledge sharing, and the sacred quality of food.

Our community meals were held at a nondenominational religious site that provided a venue for participation from members of the religious communities in one of our neighborhoods. Exploring how food sovereignty's notion of the sacred, as developed by groups such as the First Nations Development Institute, might provide new avenues for research and community engagement that incorporate religious and spiritual dimensions in our (and other) food sovereignty toolkit. (First Nations Development Institute, 2014; Kimmerer, 2013).

We also recommend using the food sovereignty toolkit to build educational programs at colleges and universities that can engage faculty, graduate and undergraduate students, and courses with the wider community. The toolkit includes a template for hiring a food sovereignty fellow (i.e., an undergraduate or graduate student). We modified this hiring template to build fellowship descriptions for our Honors College, College of Arts and Sciences, and School of Geosciences to solicit assistance from those specific areas of expertise. Other universities utilizing the toolkit can use the hiring template based on their assessment of what types of programs their school offers and what would best fit with their community's strengths and weaknesses.

We did hire two graduate students, but realized that building stronger ties to the community best occurred when we hired two members of the community as well, one of which was bilingual. This hiring marked a decisive moment of shifting to a more community-based participatory (CBRP) model of research. Looking back, we found this to be an enriching and important decision, and communities might consider incorporating a mixed-methods CBR and CBPR approach in their research design from the beginning.

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Appendix. Focus Group Discussion Questions

If you were a food, what food would you be and why?
Si fueras un alimento, ¿qué alimento serías y por qué?

What foods do you like that are NOT available in your community?
¿Hay alimentos que ha escuchado que las personas de su comunidad quieren, y a los que no pueden acceder?

Who do you think decides what foods are available in your community (at the grocery, delivered by food programs, etc.)?
¿Quién crees que decide qué alimentos están disponibles en su comunidad (los supermercados, lo entregado por programas alimentos, etc.)?

What is your understanding of a community food system?
¿Cuál es su comprensión de un sistema alimentario comunitario?

Do you know what the term "food system" means?
¿Conoce el término "food system" si es así descríbalo?

What does "food security" mean?
¿Sabe qué significa "food security", si es así descríbalo?

What does "food sovereignty" mean?
¿Sabes qué significa "food sovereignty"?

Who in your community provides food for others?
¿Quién en su comunidad proporciona alimentos para otros?

What do people in your community like to eat?
¿Qué le gusta comer a la gente de su comunidad?

Do you think that community gardening programming in the community is necessary/effective? Explain.
¿Cree que la programación actual de huertos comunitarios en la comunidad es efectiva? Explicar.

Do you think that community cooking programming in the community is necessary/effective? Explain.
¿Cree que la programación actual de clases de cocina en la comunidad es efectiva? Explicar.

Do you think that nutrition programming in the community is necessary/effective?
¿Cree que la programación actual de programas de nutrición en la comunidad es efectiva? Explicar.

Do you think eating healthy foods is important in your community?
¿Crees que comer alimentos saludables es importante en tu comunidad?

What stops people from eating healthy?
¿Qué detiene a la gente?

What encourages people to eat healthy?
¿Qué anima a la gente?

Name a health benefit of a food at the table?
¿Cuáles son los beneficios para la salud de estos alimentos, sí los conoces?

If you were a food, what food would you be and why?
Si fueras un alimento, ¿qué alimento serías y por qué?

What was your favorite food growing up?
¿Cuál era tu comida favorita mientras crecías?

What are your favorite foods now?
¿Cuáles son tus comidas favoritas ahora?

Do you like gardening? If so, what do you like to grow?
¿Te gusta la jardinería? Si es así, ¿qué te gusta cultivar?

Do you participate in community gardening?
¿Participa en la jardinería comunitaria?

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Assessing the existence of food deserts, food swamps, and supermarket redlining in Saginaw: A small, racially segregated mid-Michigan city

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Abstract

Food insecurity is an issue that is commonplace in American cities but that impacts Blacks disproportionately. Unfortunately, most food access studies focus on large cities, leaving us with little knowledge of food access in small cities. This paper focuses on Saginaw, a small, racially segregated Michigan city. We examined the following questions: (1) How has the distribution of Saginaw's food outlets changed between 2013 and 2023? (2) Does Saginaw fit the definition of a food desert in 2013 or 2023? (3) Does Saginaw fit the definition of a food swamp in 2013 or 2023? (4) Has supermarket redlining occurred in Saginaw in 2013 or 2023? (5) How is population decline related to food outlet distribution? (6) How do food store closures impact food store distribution?

Food store data were collected and verified in 2013 and 2023 from Data Axle and other sources. We used ArcGIS 10.8.1 for spatial mapping and

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SPSS 28 for statistical analyses. We conducted regression analyses to determine how the distribution of food outlets changed over a decade, comparing the 577 food outlets identified in 2013 with the 452 found in 2023, a decline of 21.7%. There were 85 fewer food outlets in Saginaw in 2023 than in 2013. The study found evidence of a vanishing food infrastructure. Eighty-nine food outlets were shuttered in 2023; 43 were in Saginaw.

Restaurants dominated the food landscape in both study periods. Though many food access studies focus on supermarkets and large grocery stores, these venues composed only 4.9% of the food outlets in 2013 and 3.8% in 2023. Though portions of Saginaw had limited access to supermarkets and large grocery stores, describing the whole city as a food desert is inaccurate, nor did the findings support the food swamp or supermarket redlining theses.

Keywords
food insecurity, food access, supermarkets, grocery stores, food outlets, Whites, Blacks

Introduction

Food insecurity is a persistent worldwide phenomenon: about 258 million people in 58 countries were acutely food insecure in 2022 (Food Security Information Network and Global Network Against Food Crises, 2023). Food insecurity is also prevalent in the U.S.; in 2021, an estimated 33.8 million people lived in food-insecure households. The highest rate of food insecurity was found among Blacks and Hispanics/Latinx (Coleman-Jensen et al., 2017, 2021; Odoms-Young & Bruce, 2019).

Though Michigan is a significant agricultural producer, food insecurity and food accessibility, particularly among Blacks, are growing concerns (Taylor, Bell, et al., 2022). Numerous food access studies have been conducted in the state, but generally in Michigan's largest or more famous cities like Detroit, Grand Rapids, and Flint (Bell & Taylor, 2022; Budzynska et al., 2013; LeDoux & Vojnovic, 2021; Mayfield et al., 2017; Murthy, 2016; Pothukuchi, 2005; Reppond et al., 2018; Rybarczyk et al., 2020; Sadler et al., 2011, 2013a, 2013b, 2019, 2021a, 2021b; Saxe-Custack et al., 2019; Shaver et al., 2018; Taylor & Ard, 2015; Taylor, Farias, et al., 2022; Veldman, 2012; Westphal et al., 2012; Zenk et al., 2005, 2006, 2009, 2013, 2020). This study does something different. Defining food outlets as places where food is grown, produced, prepared, processed, sold, or distributed for free, it examines the small, racially segregated mid-Michigan city of Saginaw to find how food outlets are distributed and whether racial, income, and educational inequities are evident, in first-of-a-kind research on Saginaw's changing food landscape. The study examines the following questions: 1) How has the distribution of Saginaw's food outlets changed between 2013 and 2023? (2) Does Saginaw fit the definition of a food desert in 2013 or 2023? (3) Does Saginaw fit the definition of a food swamp in 2013 or 2023? (4) Has supermarket redlining occurred in Saginaw in 2013 or 2023? (5) How does population decline relate to food outlet distribution? (6) How do food store closures impact food store distribution?

The paper examines three common concepts from food access discussion: food deserts, food swamps, and supermarket redlining. This study assesses whether any of these terms describe Saginaw accurately or help us understand the city's food landscape. We argue that population decline, extensive food store closures, and the intermingling of different types of food outlets help explain the contemporary distribution of food outlets in Saginaw. This research is important because it is among the first to accomplish several milestones. It is one of the first studies to analyze an extensive array of food venues in a city in two different periods. It is also one of the earlier studies to examine the relationship between long-term population decline and a city's food infrastructure, and one of the first to analyze Saginaw's widespread closure of food venues and the impact on food access.

The paper will first summarize Saginaw's history and the demographic changes the city has undergone. The literature review focuses on the relevant theoretical concepts and the state of food access in Saginaw. Results from the two time periods follow an accounting of the methodology used and an analysis of the findings. The study's strengths and limitations are discussed and future directions are identified.

Saginaw: Historical Context

European explorers first visited the mid-Michigan region in 1790. The Chippewa were forced to cede the territory of which Saginaw is part in the 1819 Treaty of Saginaw (Cooper, 1933; Darling, 1950; Fierst, 2019; Manning, 2014; Mills, 1918;). Louis Campau established a trading post on the western side of the Saginaw River in 1816 and one on its east side in 1820. The two settlements, Saginaw and East Saginaw, developed simultaneously, but by 1860 East Saginaw outgrew Saginaw, and the cities merged in 1890 (Castle Museum of Saginaw County History, 2022; Cooper, 1933; Mills, 1918; Romig, 1973). Despite over a century of functioning as a municipality, the divide between the east and west sides of town influences contemporary food access.

Saginaw grew rapidly because of the timber boom, from 900 residents in 1850 to 29,500 in 1880. Settlers called the timber "green gold" and the Saginaw Valley the "lumber capital of the world." At its peak, in 1882 area mills produced over a billion board feet of timber. Saginaw also produced and exported salt (Cooper, 1933; Mills, 1918; Warner, 2006). By 1899, Saginaw expanded its economic activities to include agricultural production (sugar beet and beans) and coal mining. Automobile manufacturers also operated in Saginaw; the first car was produced in 1905 and by 1919 several automobile and truck companies, including General Motors, called the city home (City of Saginaw, 2020). Today, Saginaw County continues to have fertile soils: over 60% of the land is used for agricultural production and food preparation (Saginaw County Community Health Assessment, 2020; Saginaw County Roadmap to Health, 2017). However, access to food is a significant challenge for the city.

The Changing Racial Climate of the City

Saginaw's contemporary residential patterns are rooted in the nineteenth-century slavery and Reconstruction era when Black migrants from the South began settling on the city's Eastside in the 1860s, from 37 in 1860 to 276 in 1870 (Ross & Jezierski, 1982; Warner, 2006). Though the city's population reached its zenith in 1960, its White population peaked a decade earlier at 84,247. In 1950, there were only 8,608 Blacks in the city, but fueled by the Great Northern Migration and the promise of industrial jobs, the Black population soared. The rising Black population triggered White flight that began in the 1950s and has not ceased. The city's Black population peaked in 1990 at 28,040 (McKether et al., 2011; Warner, 2006). Saginaw is also home to Latinx/Hispanic residents. Drawn by agricultural and manufacturing jobs, 2,066 Mexican migrants from Texas and Mexico were settled in the city by 1930 (Cooper, 1933; Rosales, 2014). Saginaw is now a racially divided city: most Blacks reside on the east side of the Saginaw River, and most Whites reside west of the river or in the suburbs. Latinx/Hispanic residents are concentrated in the southwest corner (U.S. Census Bureau, 2010, 2020a, 2020b).

Today, Saginaw is a poor city dotted with vacant and abandoned properties (Mallach, 2012). About 21.8% of the city's residents live below the poverty level, compared to 13.1% of Michigan (U.S. Census Bureau, 2021). So, despite Saginaw County's agricultural productivity, food insecurity in the city is high.

Literature Review

Conceptualizing Saginaw's Food Landscape

The Food Desert Framing

Saginaw is frequently described by the media, civic leaders, and policymakers as a food desert (Bleu & Mose, 2024; Dent, 2023; Hunton, 2014). The concept of a food desert originated in the U.K. in the 1990s to describe suburban developments that lacked food stores and other community amenities (Beaumont et al., 1995; Cummins & Macintyre, 2002). The term is now commonly used to describe communities where residents lack ready access to fresh, healthy, and affordable foods. In the U.S., poor urban neighborhoods with high percentages of People of Color are often described as food deserts. However, some researchers argue that the food desert frame is misleading as it conjures images of empty landscapes lacking places to buy healthy foods. Such framing underestimates food availability and often ignores independent grocers, ethnic groceries, and small food stores that stock

healthy and culturally desired food (Alkon et al., 2013; Bell & Taylor, 2022; Bodor et al., 2007; Hale, 2004; Hill, 2017; Hubley, 2011; McKinnon et al., 2009; Raja et al., 2008; Sharkey et al., 2009; Short et al., 2007; Taylor & Ard, 2015; Taylor et al., 2023; Taylor, Farias et al., 2022; Taylor, Lusuegro et al., 2022). Moreover, the food desert framing ignores residents' initiatives to grow, produce, and sell healthy and affordable foods (Taylor & Ard, 2015; White, 2010, 2011a, 2011b).

Food Swamp

The food swamp concept has been used, including by U.S. Department of Agriculture researchers (Ver Ploeg, 2010a, 2010b; Ver Ploeg et al., 2009), to describe low-income urban communities like Saginaw that are saturated with fast-food restaurants, convenience stores, mini-marts, gas stations, and liquor stores selling highly processed foods. The argument claims that stores selling energy-dense foods overwhelm and displace those selling healthy food options, thereby forming food swamps. As a result, few or no supermarkets and large grocery stores are found in them (Bodor et al., 2010; Hager et al., 2017; Robitaille & Paquette, 2020; Rose et al., 2009; Schuck, 2022; Sushil et al., 2017).

Supermarket Redlining

A related term with increasing usage, supermarket redlining, describes the distribution of supermarkets and large grocery stores in urban areas (Wang, 2022; Joyner et al., 2022). Those supporting the concept contend that supermarkets and large grocery stores abandon low-income, inner-city neighborhoods and reopen in high-income or suburban areas, and that such economic decisions are racialized and facilitate the inequitable distribution of these food outlets (Crowe et al., 2018; Eisenhauer, 2001; Joyner et al., 2022; Shannon, 2016, 2018, 2021; Shannon et al., 2016, 2018, 2021; Zhang & Ghosh, 2016).

Food advocates argue that supermarket redlining is an outgrowth of the residential segregation and neighborhood redlining initiatives promoted by the Home Owners' Loan Corporation (HOLC) in 239 cities in the 1930s and 1940s (Eisenhauer, 2001; Joyner et al., 2022; LeDoux & Vojnovic, 2021; Sadler et al., 2021). Taylor (2014) discusses redlining, restrictive covenants, government-endorsed residential segregation, and White flight extensively. The HOLC 1937 map of Saginaw redlined neighborhoods with Black renters; neighborhoods were yellow-lined because of the "threat of negro invasion" and "possible negro encroachment." Yellow-lined neighborhoods typically had recent European immigrants, working-class Whites, and a small number of Black residents and were adjacent to Black neighborhoods. Blue-lined neighborhoods contained native-born Whites in white-collar jobs and high incomes, while the wealthiest, most prestigious neighborhoods were green-lined; they contained native-born White executives in white-collar jobs. Furthermore, homes in green-lined neighborhoods were bound by racially restrictive covenants and deeds or zoning laws to prevent Black "infiltration" (Nelson et al., 2017). Zhang and Ghosh (2016) studied the relationship between redlining and the location of supermarkets. They constructed a supermarket redlining index and impact model that determined that when supermarkets closed in low-income Communities of Color, residents found it difficult to obtain healthy foods. Shannon (2018) found few supermarkets and superstores in Atlanta in once-redlined neighborhoods. Shannon (2021) also argues that supermarket redlining is connected to the spread of dollar stores in Communities of Color. Other researchers have supported the supermarket redlining concept (Cameron et al., 2010; Cantor et al., 2020; Chan-Tack, 2014; Li & Yuan, 2022; Miller et al., 2021; Russell & Heidkamp, 2011; Sbicca, 2012; Shannon et al., 2021; Widener & Shannon, 2014).

New Conceptualizations of Saginaw's Food Environment

Population Size, Decline, and Demographic Shifts

The protracted exodus of people from Saginaw is associated with the number of food outlets and their location in the city and suburbs. The city has lost many food stores, and we argue that population decline plays a major role in the loss because supermarkets and large grocery stores tend to operate where there are enough people to make the businesses viable. Hence, communities with few

residents or dwindling numbers have difficulty attracting or keeping food outlets.

Saginaw had a population of 98,265 in 1960, but less than half that number in the latest census. Table A1 (Appendix) shows how the population changed from 2010 to 2020 (U.S. Census Bureau 2010a, 2010b; 2020a, 2020b). While Michigan's population grew by 2% over the decade, Saginaw's population shrank as both Whites and Blacks fled the city. In 2010, there were 51,508 residents; by 2020, the population had plummeted 14.2% to 44,202. As the table shows, the city is composed mainly of Blacks, Whites, and Hispanics/Latinx. The largest racial group, Blacks (not Latinx/Hispanic), constituted 44.9% of the population in 2010 and 43.4% in 2020. From 2010 to 2020, Saginaw lost 17.1% of its Black population. The outmigration of Whites was even more pronounced, 21.1% moving from the city during the intercensal period. Thus, Whites composed 37.5% of Saginaw's population in 2010 and 34.4% in 2020. The Latinx/Hispanic population declined more gradually, falling 4.8% during the decade. Latinx/Hispanic residents made up 14.3% of the city's population in 2010 and 15.8% in 2020 (U.S. Census Bureau, 2010a, 2010b, 2020a, 2020b).

Vanishing Food Infrastructure and Store Closures

Researchers are addressing food store closures and have identified a vanishing food infrastructure in some Michigan cities, such as Flint (Bell & Taylor, 2022), Lansing and East Lansing (Taylor et al., 2023), and Detroit (Taylor et al., 2024), that have widespread food store closures. The studies found many closed grocery stores, restaurants, dollar and variety stores, urban farms and community gardens, and emergency food assistance organizations. Scholars have also found extensive grocery store closures in rural communities (Gillespie et al., 2022; Yeager & Gatrell, 2014). Food store closures accelerated during the COVID-19 pandemic and continued in the post-pandemic era.

The Intermingling of Food Outlet Types

To date, the food access literature has not identified configurations of food outlets that reflect what is commonplace in Saginaw. The city and surrounding suburbs present examples of neighborhoods where supermarkets and large grocery stores are *intermingled* with dollar stores, variety stores, corner and convenience stores, and other food outlets. The findings are similar in Detroit: rather than being driven out of neighborhoods and commercial strips by small grocery stores, dollar stores, variety stores, and fast-food restaurants, there is ample evidence that many of Detroit's supermarkets and large grocery stores co-mingle with smaller food stores or outlets selling unhealthy food. An analysis of the distribution of food outlets in Detroit found intermingled food outlets, rather than supermarkets and large grocery stores occupying exclusive zones (Taylor et al., 2024).

Food Access in Saginaw

Food insecurity and lack of access to food are common problems in Michigan and particularly in communities with large numbers of Black residents. According to Feeding America, 11.5% of Michigan residents are food insecure (2023b), as are 13.6% of Saginaw County residents (Feeding America, 2023a), compelling reasons to examine food access in Saginaw. The city is relevant to food access discussion as 59.2% of the residents are Black and Latinx/Hispanic. This is significant because Black and Latinx/Hispanic households nationwide are about twice as likely as White households to be food insecure; about 21.7% of Black and 17.2% of Latinx/Hispanic households are food insecure (Coleman-Jensen et al., 2017, 2021; Odoms-Young & Bruce, 2019). About 28.0% of Saginaw County Black residents, about 19% of Latinx/Hispanic residents, and 10.0% of non-Hispanic Whites experience food insecurity (Feeding America, n.d.). (Although Saginaw residents can obtain food from subsistence activities, they must be cautious about obtaining it; they live close to fishing and hunting areas, but fish from the Tittabawassee and Saginaw Rivers are contaminated with polychlorinated dibenzo-*p*-dioxins (PCDDs), dibenzofurans (DBFs), and polychlorinated biphenyls (PCBs) (Jude et al., 2010; Wan et al., 2010).

Despite the many food access studies conducted in Michigan, few assessments have been done in Saginaw. In 2014, Saginaw Valley State University students canvassed the city to find out

what was sold in 33 food stores (Hunton, 2014). Another indicator of food access in the city comes from a 2019 health assessment, that found that one in eight Saginaw County residents had difficulty traveling to food stores, and that Black residents earning less than US$30,000 were most likely to say they had difficulty accessing food (Saginaw County Community Health Assessment/Community Health Improvement Committee, 2020).

Saginaw conducted a city-wide feasibility study to assess food access and the likelihood of converting a publicly owned vacant building into a grocery store in 2023. When asked what the most significant barrier was to acquiring food (N = 493), 78% of the respondents who drove to buy food and 69% of those who took the bus said that the high cost of food was the biggest obstacle to obtaining the food they wanted and needed. It was found that 55% of 637 responses indicated that attracting a new grocery store to the city is the most likely way to expand food access. To improve access, 43% of the respondents suggested more food pantries, 30% suggested more significant support for urban farms and locally grown food, and 19% suggested greater opportunities to grow food in community gardens would. There was an income divide in resident preferences. Most very low-income respondents (56%) wanted to see more food pantries, and 42% wanted a new grocery store. In contrast, 60% of the low-income respondents and 71% of those who were not low-income desired a new grocery store. Food pantries were the top priority to expand food access for 39% of those classified as low-income and for a third of respondents who were classified as not low-income (Colby et al., 2024).

Ninety-eight percent of the respondents said they got their groceries at Kroger, Walmart, or other supermarkets. However, very low-income respondents obtained groceries from dollar stores, convenience stores, gas stations, and food pantries. Eastside respondents were more likely to say they got groceries from dollar stores and food pantries than Westside residents. In the end, most residents selected the new grocery store option as the strategy the city should use to enhance food access, with 70% of Blacks wanting a new store (Colby et al., 2024). Residents preferred a non-profit grocery store or food club to a member-owned food cooperative or a for-profit grocery store (Colby et al., 2023; Dent, 2023).

Superstores built on the outskirts of town try to attract customers. For instance, Walmart has operated a free bus program since 2012 to facilitate Saginaw residents' trips to and from the store (Hunton, 2014). Nonetheless, 22% of survey respondents said that making it easier to get groceries by bus would enhance food access (Colby et al., 2024).

The USDA's Classification of Food Access in Saginaw's Census Tracts

The USDA Economic Research Service (ERS) classifies most Saginaw census tracts as low-income and low-access (2023). In 2009, the ERS began mapping food access to identify communities with low availability of and access to affordable, nutritious food, and found that food deserts were ubiquitous (Karpyn et al., 2019). Since 2013, the USDA has reduced its reliance on the term food desert, the ERS replacing it with low-income, low-access terminology for census tracts with limited access to healthy food. However, even with the new terminology, access is still measured as the presence of supercenters, supermarkets, and large grocery stores in each census tract. The ERS excludes drug, dollar, and convenience stores from its calculations because it claims to lack information on these types of food outlets (USDA Economic Research Service, 2023). However, the ERS identifies the locations of full-service and fast-food restaurants, convenience stores, and specialty food stores in its Food Environment Atlas (USDA Economic Research Service, 2019; 2024).

Methodology

Defining the Study Area

We undertook a comprehensive study of food outlets in Saginaw and surrounding townships in 2013 and 2023. Data were collected in 2013, when scholars were beginning to challenge the dominant food desert narrative by studying a broader range of food outlets and expanding understanding of the food environments in low-income communities of color. The second round of data was collected

because we were interested in determining how the distribution of food outlets had changed in the decade since we first collected data.

We included the surrounding townships to account for the "edge effect." Research has demonstrated that urban dwellers do not stop at a city's boundary when shopping for food; they frequently buy food in adjacent suburbs (Devries & Linn, 2011; LeDoux & Vojnovic, 2013; Rose, 2011). Data from Saginaw indicate that most residents shop for groceries outside the city (Colby et al., 2024). Therefore, it is judicious to create a buffer around the city and gather and analyze data within the buffer, which offers a more realistic assessment of food access than analyzing only the food outlets within city limits. Scholars have used buffers ranging from four to sixteen kilometers in food studies, depending on the size of the city or metropolitan area and shopping patterns (Rybarczyk et al., 2020; Sadler et al., 2011). We used an eight-kilometer buffer around Saginaw to define the study area. Eight kilometers is appropriate because the number of food outlets declined precipitously beyond this distance. The buffer captured food venues with food delivery services and those that provide bus service to their stores.

Data Collection and Sources

Data were collected on the food outlets of Saginaw and its surrounding townships in 2012–2013 and 2022–2023. We developed a typology of 13 major categories and 57 subcategories of food outlets (Bell & Taylor, 2022; Taylor, Bell et al., 2022) to determine how many food venues of what type were present. Each outlet is defined in Supplement Table S1, which also lists the sources of definition when they were derived from elsewhere.

Taylor, Bell et al. (2022) developed a comprehensive typology of food venues used in this study. The typology incorporates numerous types of food establishments overlooked in earlier studies. Data Axle (formerly ReferenceUSA), our primary data source, stores information on U.S. and Canadian businesses and is the foremost source of information on establishments that sell food, providing information to scholars such as Liese et al. (2010), Lisabeth et al. (2010), Raja et al. (2008), Rybarczyk et al. (2020), Taylor & Ard (2015), and Taylor, Bell, et al. (2022). To search for food venues, we used the Standard Industrial Classification (SIC) division code, the federal government's primary classification system for commercial enterprises, which groups businesses into divisions, major groups, and industry groups. We used 153 SIC codes to identify food establishments to study, also using the major group, industry group, and industry codes as filters to help identify more food establishments. This multi-stage search technique is the most effective way of identifying outlets and finding significant numbers of them. Consequently, other food access researchers have used SIC codes to identify food outlets (Lisabeth et al., 2010; Moore & Diez Roux, 2006; Raja et al., 2008; Rybarczyk et al., 2020; Taylor & Ard, 2015; Taylor, Bell et al., 2022).

As not all food outlets can be found through Data Axle searches, we found additional food vendors using directories of urban farms, community gardens, local emergency food assistance programs, stores that accept electronic benefits transfer (EBT) cards and that participate in Women, Infants, and Children (WIC) programs, and Google and Bing search engines.

Spatial Mapping

After identifying food outlets, we mapped and displayed them visually and analyzed them statistically. The latitude and longitude coordinates were plotted on maps using ArcGIS Pro 10.8.1. We acquired jurisdictional boundaries from the U.S. Census Bureau Open Data mapping tool (2020d), then extracted the shape files for Saginaw and its suburbs.[1] We also combined 2020 census tract data and neighborhood characteristics with the spatial data. The food vendor data were inserted as a comma-separated value file. We used the NAD 1983 Michigan GeoRef to project the shapefiles onto the map.

Census tract data on Saginaw's population size,

[1] These are Carrollton Township, Buena Vista Charter Township, Zilwaukee Township, Kochville Township, Tittabawassee Township, Saginaw Charter Township, Thomas Township, James Township, Spaulding Township, and Bridgeport Charter Township (U.S. Census Bureau, 2020c).

median household income, racial characteristics, and the percentage of residents with high school education were obtained from the 2010 and 2020 census. We computed the demographic information for census tracts partly contained in city, township, and county boundaries by clipping the tracts and using proportional allocation to estimate demographic characteristics (see also Taylor & Bell, 2022). See the complete data in Supplement Table S2.

Statistical Analyses

This study sought to understand how the distribution of food outlets in Saginaw and surrounding townships is related to racial and socio-economic factors and how these have changed over time. To this end, we examined census tract characteristics in each study period and their association with the number and type of food outlets present.

We used census tract data from 2010 and 2020, as these two data-gathering years were closest to our study periods. In 2010, the study area had 48 census tracts with about 132,021 residents; it had 51 census tracts and about 123,185 residents in 2020. We examined the demographic attributes of the census tracts for 2010 and 2020. We created a categorical variable for the year the data was collected, and we analyzed the racial characteristics of census tracts by creating another categorical variable to describe the percentage of Black residents in each tract. Two groups of census tracts were studied: census tracts with 0%–40% Blacks were categorized as low Black (LB) tracts. Tracts with more than 40% Blacks were classified as high Black (HB) tracts.

Because the data is not normally distributed, we used a Mann-Whitney U Test to determine whether there were significant differences in the number and types of food vendors in the two categories of census tracts and years of data collection (Figures B1a and B1b in Appendix B).

We created two models: the direct model analyzed the census tracts' racial attributes, population density (pop/km^2), median household income per US$1,000, and residents' education (Supplement Table S3), while the interaction model added and examined the relationship between the census tract racial composition and median household income per US$1,000 (Supplement Table S4). However, we omitted some types of food outlets from the regression analysis if there were not enough observations in particular food categories.

Results

The Food Landscape of Saginaw and the Surrounding Area

The paper involves hundreds of food outlets from Saginaw and its suburbs. Only the categories and types of food stores we collected data on in *both* study periods are analyzed in this portion of the article. We compared 577 food outlets in the 2013 study area with the 452 found in 2023. Tables A2a and A2b in the Appendix show that the number of food venues declined by 125 (21.7%) during the study period, and the decline was evident in both the city and suburbs. More food outlets were built outside the city than inside it; in 2013, 228 were in Saginaw and 349 were in the surrounding townships. However, the number and percentage of food outlets in Saginaw dropped precipitously by 2023; 143 were within the city limits, and the remaining 309 were in the suburban area. In other words, there were 85 fewer food outlets in Saginaw in 2023 than in 2013. Figures B2a and B2b in Appendix B show the distribution of these outlets in and around Saginaw. Figure B2c visually compares the number of each type of food outlet in Saginaw and the suburbs in each study period.

The Grocery Sector

The study area's grocery sector had two major categories of food venues: supermarkets and large grocery stores, and small grocery and convenience stores. There were 28 supermarkets and large grocery stores in the study area in 2013 but only 17 in 2023. Almost 90% of the supermarkets in both study periods were in the surrounding townships. However, it should be noted that supermarkets and large grocery stores compose only a tiny portion of the study area's food landscape in each period—4.9% in 2013 and 3.8% in 2023 (Figures B3a and B3b in Appendix B).

In 2013, Saginaw had two traditional supermarkets and one limited-assortment store. The city lost one of the Eastside supermarkets, leaving the

city with only one supermarket/large grocery store on each side of the river in 2023. The suburbs had a much richer array of supermarket and large grocery store options than Saginaw in both study periods.

Small grocery and convenience stores were the second most common food outlet type in the study area. These stores declined during the study period. The city lost 12 small groceries, convenience, corner stores, and mini marts between 2013 and 2023, 57.1% of its small grocery/convenience/corner stores. In comparison, the suburbs also lost 19 (38.7%) of these food venues in the study period (Figures B4a and B4b in Appendix B).

Pharmacies and Variety Stores

We studied pharmacies, drug stores, dollar stores, and variety stores because food is often sold in them. Such food establishments proliferated in the study area, forming an increasing percentage of the food outlets. However, most of the growth occurred in the suburbs. The suburbs had 20 pharmacies, dollar stores, and variety stores in 2013 and 34 in 2023. The city of Saginaw had fewer of these food outlets in the second study period than in the first, 21 pharmacies, dollar stores, and variety stores in 2013 and 15 in 2023 (Figures B5a and B5b in Appendix B).

Bakeries and Other Specialty Vendors

The specialty food stores and vendors remained remarkably stable during the decade. There were 38 such venues in 2013 and 39 in 2023. However, the number of bakeries increased by 60%. Saginaw gained four new bakeries and five opened in the suburbs. There were fewer health food stores and meat markets/delicatessens, Saginaw losing two health food stores and three meat markets/delicatessens. Saginaw had no ice cream parlors or confectionary shops during either study period (Figures B6a and B6b in Appendix B).

Restaurants and Food Services

Restaurants and other food service operations were the most common food venues in the study area in both periods. During the study period, however, the area lost 66, or a fourth of its restaurants and food service establishments. The decline was more evident in Saginaw, which lost 46 (54.8%) of its 2013 84 restaurants and food services (Figures B7a and B7b in Appendix B).

It should be noted that the study area had more full-service restaurants (109) than fast-food restaurants (100) in 2013, but by 2023, there were fewer of both types of restaurants, and fast-food restaurants outnumbered full-service ones. In 2023, there were 82 fast-food and 60 full-service restaurants. The shift occurred because many more full-service restaurants closed than fast-food ones. The study area lost 49 of its full-service restaurants. Saginaw lost 21 (60%) of its full-service restaurants, while the suburbs lost 28 (37.8%) of theirs. In comparison, the study area lost 18 of its fast-food restaurants. Saginaw had 21 fast-food restaurants in 2013 and 16 in 2023.

Agricultural Sector

The urban agriculture sector is important for growing and producing food for personal consumption, sale, or donation. The number of urban farms, community gardens, farmers markets, and produce markets in the study area dropped from 15 in 2013 to six in 2023—a 60% decline. Most of these food venues were in Saginaw, so the decline was steepest in the city. During the study period, Saginaw lost seven of 10 (70%) of these food venues. In 2023, Saginaw contained the study area's sole farmers market/produce market and two of the three urban and community gardens. However, Saginaw had no community-supported agriculture (CSA) or dairy outlets (Figures B8a and B8b in Appendix B).

Distributors and Other Supply Chain Vendors

This study identified 11 distributors and supply chain establishments in 2013 and eight in 2023. In 2013, 63.6% of the distributors and supply chain venues were in Saginaw; half of them were in the city in 2023. Saginaw had five wholesalers in 2013, but none in 2023 (Figures B9a and B9b in Appendix B).

Food Assistance Organizations

Food assistance organizations are critical to the food landscape as they distribute free or nominally priced food. the sole or primary food source for many low-income people. During the study period,

the area lost 24 (38.1%) food pantries, soup kitchens, and food banks. The area had 63 emergency food outlets in 2013, which dropped to 39 by 2023. Saginaw had most of the emergency food venues in both study periods. Over the decade, Saginaw lost 14 food pantries and soup kitchens, while the suburbs lost 12. They accounted for 15.7% of the food outlets in 2013 and 16.1% in 2023 (Figures B10a and B10b in Appendix B). Despite the drop in emergency food outlets, these venues remain essential to the city's food infrastructure.

Additional Food Retailers Studied in 2023

Thus far, we have compared 577 food outlets identified in 2013 with 452 identified in 2023. The 2023 data collection efforts, however, expanded the categories and types of food outlets that were searched for, in order to include food sources such as mobile vendors and take-out food operations that were not included in our 2013 data collection efforts. The COVID-19 pandemic highlighted the significance of these food outlets as places where people obtained food, so we incorporated them into our study in 2023.

The expanded search yielded an additional 146 food outlets, recorded in Table A2b in Appendix A and shown in Figure B11 in Appendix B. Table A2b shows that the expanded search yielded 27 take-out restaurants, 21 farmers markets and produce vendors, and 13 mobile food vendors. The new search also found 69 social, educational, religious, and community service establishments.

Changing Distribution of Food Outlets: Population Density and Census Tract Racial Characteristics

The 2013 Distribution

Analyzing the percentage of food outlets alone is insufficient to help understand their distribution fully, so we also examined the density of food outlets. We found 4.26 outlets per thousand residents in 2013 (Supplement, Table S4a), with 3.73 outlets per thousand in Saginaw and 4.37 per thousand in the surrounding townships. However, the rate of occurrence of small grocery stores/convenience stores/corner stores and pharmacies/dollar stores/variety stores was higher in Saginaw than in the suburbs. Emergency food assistance was also more concentrated in Saginaw than the surrounding townships. There were 1.15 emergency food assistance operations per thousand residents in Saginaw and 0.59 per thousand in the suburbs. The reverse was true for restaurants and other food service: there was a greater concentration in the surrounding townships than in Saginaw.

The racial composition of census tracts was related to the distribution of food outlets. LB census tracts had more food outlets per thousand than HB tracts, 4.30 food outlets per thousand in LB tracts and 4.13 per thousand in HB tracts. Saginaw's HB census tracts had higher concentrations of small grocery stores/convenience stores/corner stores and emergency food outlets than LB tracts. The reverse was true for pharmacies/dollar stores/variety stores and restaurants/food service. Except for specialty food stores and vendors, all the categories of food outlets studied were located at higher rates in LB census tracts than in HB tracts in the surrounding townships.

The 2023 Distribution

There was a decline in the density of food outlets between 2013 and 2023. In 2023, the study area had 3.61 food venues per thousand residents (Supplement, Table S4b). As was the case in 2013, the density of food outlets was much lower in Saginaw than in the surrounding townships, 2.70 food outlets per thousand in Saginaw and 3.93 per thousand in the suburbs. The density of restaurants was higher in the suburbs than in Saginaw, but the reverse was true for the density of small grocery stores/convenience stores/corner stores and pharmacies/dollar stores/variety stores.

Multivariate Analyses of Temporal Changes in the City's Food Environment

Regression Analysis and Tests for Significance

Thus far, we have examined six bivariate relationships. We probed deeper by examining how food outlet distribution changed when several variables were analyzed simultaneously. We conducted a Mann-Whitney U Test to ascertain statistically significant differences in the number of food outlets in each major food category studied in 2013 and

2023 (Supplement, Table S5). Only one significant difference was identified: the total number of food outlets identified in Saginaw in 2013 significantly differed from the number found in 2023 (U = 112.00, p = 0.045).

Poisson and negative binomial regressions were conducted to determine the likelihood of having an additional food outlet in a census tract. We assessed whether the year of data collection was related to the likelihood of having an additional food outlet. Then we investigated whether the census tract's racial composition, median household income, percentage of the population with at least a high school education, and population density per square kilometer contributed to an increase or decrease in likelihood of having a food venue (Supplement, Table S6). The results of regression analysis reveal that in most major food categories, there was an increase in the likelihood of having an additional food outlet in 2013 compared to 2023, but that none of the increases were statistically significant. For example, the results indicate that for the entire study area and suburban area, an additional supermarket or large grocery store is about 2.6 and 2.5 times more likely to be present in 2013 than in 2023.

Supermarkets and large grocery stores were not analyzed in Saginaw because there were too few in the city. Nonetheless, the findings for Saginaw reveal that an additional restaurant or other food service was about 1.4 times more likely to be present in 2013 than in 2023. Moreover, an additional emergency assistance outlet was about 1.2 times more likely to be present in Saginaw in 2013 than in 2023. It should be noted that two major food categories, small groceries and convenience stores, and pharmacies/dollar/variety stores, were less likely to be found in the study area in 2013 than in 2023.

Census Tract Racial Composition

Regression results for the study area showed a 52.8% decrease in the likelihood of having an additional small grocery or convenience store in tracts that are more than 40% Black compared to those that are 0–40% Black. In Saginaw, HB tracts are less likely to have an additional food outlet regardless of type than LB tracts. Statistically significant results were observed for most food categories analyzed in the city.

Median Household Income and Educational Attainment

Several statistically significant relationships were observed between median household income and major food categories. Generally speaking, the likelihood of having an additional food outlet decreased for every US$1,000 increase in median household income.

For every percentage increase in the population having at least a high school education in the study area, the likelihood of having an additional supermarket or large grocery store increased by 15%, and the likelihood of having an additional pharmacy, dollar, or variety store increased by 6.1%. In Saginaw, the likelihood of having an additional food outlet dropped as the percentage of the population having at least a high school education increased. In the suburbs, for every percentage point increase in the population having at least a high school education, there was an increased likelihood of having an additional supermarket or large grocery store, pharmacy/dollar store/variety store, or specialty food store or vendor.

Supermarket Redlining

The analysis led us to examine popular theses used to explain food access and how food outlets are distributed. We first investigate if the supermarket redlining thesis accurately described what we found in Saginaw and its suburbs. We examined how supermarkets, large grocery stores, dollar stores, and variety stores were distributed in relation to the HOLC 1937 redlining map. Figures B12a and B12b in Appendix B show the location of supermarkets/large grocery stores and dollar stores/variety stores superimposed on the redlining map. Most of Saginaw was yellow-lined; only tiny slivers were green-lined. There were no supermarkets, large grocery stores, or dollar stores/variety stores in formerly green-lined neighborhoods in either study period. In both study periods, the maps and Table A3 in the Appendix show that the supermarkets and large grocery stores were in formerly yellow-lined and uncolored areas. In 2013, there was one dollar/variety store in a formerly blue-

lined neighborhood and seven in formerly yellow-lined areas (Figure 12a). The 2023 map shows that nine dollar/variety stores are in formerly yellow-lined neighborhoods, and 15 are in neighborhoods not color-coded (Figure 12b).

Food Swamp or Intermingling of Food Outlets

We also examined whether the food swamp thesis accurately described the study area's food landscape by analyzing the distribution of supermarkets and large grocery stores, small grocery/convenience/corner stores, liquor stores, gas stations, and fast-food restaurants. We found no evidence that supermarkets/large grocery stores were displaced from locations by the other types of food establishments studied (Figures B13a and B13b in Appendix B). Rather, we found that supermarkets and large grocery stores were intermingled with other food outlets. The supermarkets and large grocery stores were neither isolated nor in stand-alone locations; they operated beside or close to the other food venues. The intermingling of supermarkets/large grocery stores occurred in Saginaw and the surrounding townships.

Store Closures and Vanishing Infrastructure

Many cities have seen food store closures, especially since the COVID-19 pandemic. Thus, in 2023 we identified the closed food outlets in the study area (Figure B14 in Appendix B). The study found 89 closed food outlets: 43 in Saginaw and 48 in the surrounding townships. The many food store closures signal a vanishing infrastructure that significantly impacts the study area.

Most of the closed food venues were in LB census tracts: 56 in LB census tracts, and 35 in HB tracts. Most of the suburban closed food venues were also in LB census tracts: 39 closed food establishments in the surrounding townships were in LB tracts, and nine in HB census tracts. However, the reverse was true for Saginaw; 26 of Saginaw's closed food venues were in HB tracts, and 17 in LB census tracts.

Discussion, Implications, and Actions

Despite the many food access and food insecurity studies conducted in Michigan, because none as comprehensive as this has been conducted in Saginaw our study provides needed information on a city with limited food access assessments (Colby et al., 2024; Hunton, 2014). A highly relevant and timely contribution, our study fills a gap by comprehensively examining food access in the city and surrounding townships. The study is also important because most Saginaw census tracts have been designated as low-income and low-access tracts by the ERS (2023). The study provides a detailed analysis of food outlets in such a community during two periods by showing how food access changed with time.

We included the surrounding townships and extended the study area beyond the city of Saginaw boundary because research shows that people do not limit their food shopping activities to the confines of their cities or always shop at the food retailers closest to their residences. Studies show that shoppers routinely travel three or more miles to obtain food (Reed, 2011; Rose et al., 2011; Rybarczyk et al., 2020; Sadler et al., 2013; Zenk et al., 2005). Thus, incorporating the surrounding townships in the study provided a more accurate depiction of residents' food environments. The expanded study area also allowed us to compare the city and suburbs, examine inequities in the two locales, and learn about access to different food retailers and how it changed over time. This work also builds on earlier food access studies by examining a comprehensive list of food retailers and mapping their locations to produce a more detailed view of the local food environment.

Distribution of Food Retailers

Racial Characteristics and Population Decline

We studied eight major categories of food stores and compared the 577 food stores found in 2013 with the 452 found in 2023. The food outlets are not distributed equitably across census tracts; most were in LB tracts in both study periods.

The Saginaw results mirror the findings of similar studies conducted in other Michigan cities. In Flint, census tracts where 40% or more of the residents were Black had lower access to traditional full-line supermarkets and large grocery stores than residents of census tracts with 40% or fewer Blacks (Taylor, Bell et al., 2022). The same was seen in

Lansing and East Lansing, where census tracts composed of more than 60% Blacks had less access to these outlets than those in census tracts with 60% or fewer Blacks (Taylor et al., 2023).

Supermarkets and Large Grocery Stores

Food access scholarship has focused heavily on the presence of and access to supermarkets and large grocery stores when characterizing and analyzing food environments. However, our study found that supermarkets and large grocery stores accounted for less than 5% of the area's food outlets in 2013 and 2023. Similar findings have been reported in other cities. Traditional full-line supermarkets and large grocery stores composed 3.3% of Lansing food outlets, 1.4% for East Lansing, 0.7% for Flint, and 1.8% for Detroit (Taylor et al., 2023; Taylor & Ard, 2015; Taylor, Bell, et al., 2022).

In 2023, only 17 supermarkets and large grocery stores operated in the study area. Saginaw had three supermarkets in 2013 but only two in 2023. Not only are most of the supermarkets and large grocery stores in the surrounding townships, but the bulk of them are in the northwestern portion of the suburban area. This indicates a racialization and disproportionate impact not identified in earlier food access studies. The clustering of supermarkets/large grocery stores and other food venues in the northwestern quadrant means that Saginaw Westside residents can travel more readily to suburban food outlets than Eastside residents. Colby et al. (2024) found that residents of Eastside had greater difficulty accessing food stores than Westside residents. Westside residents are mostly White and Latinx/Hispanic and Eastside residents are primarily Black. Any efforts to remediate inequitable access to supermarkets and large grocery stores must consider the distribution and focus foremost on improving access on the Eastside.

Saginaw lost many of its supermarkets long ago as the city deindustrialized and lost much of its population. The number of grocery stores in the Saginaw urbanized area peaked at 41 in 1934, when the city had 15 A&P grocery stores and 10 Kroger supermarkets. The rapid growth in supermarkets and grocery stores corresponded to brisk population growth. Saginaw's population grew by 22.6% from 1920 to 1930 and 30.4% between 1930 and 1940. However, since 1970, the city's population has declined rapidly, dropping by 6.5 to 15.6% during each intercensal period. From 1970 onwards, there have been fluctuations in the number of supermarkets and grocery stores in the study area, but generally they have declined (Gwynn, n.d.; U.S. Census Bureau 2010a, 2010b; 2020a, 2020b, 2020d).

A declining population makes it challenging to keep supermarkets in a city or town (Colby et al., 2023). Since 1925, 42 supermarket and grocery chains have operated in the Saginaw Urbanized Area, including national and regional brands such as Kroger, A&P, Kmart, Meijer, IGA, Farmer Jack, and Save-A-Lot. Most operated for a few years before abandoning the area. Between 1934 and 1965, nine to eleven supermarket/grocery chains operated in the area. Since 2000, between four and seven chains do. Not only is the total number of supermarkets and large grocery stores shrinking, but the variety that customers can choose from has also shrunk.

Small Grocery and Convenience Stores

Our study supports the claim that small grocery stores, convenience stores, corner stores, and mini marts abound in cities. We found that small grocery and convenience stores composed a significant portion of the food landscape, about a fifth of Saginaw's food landscape in 2013 and nearly a fourth in 2023. Studies find that these food establishments are also plentiful in Lansing, East Lansing, Flint, and Detroit (Taylor et al., 2023, 2024; Taylor & Ard, 2015; Taylor, Bell et al., 2022).

Small grocery and convenience stores were unevenly distributed in the study area. Overall, HB tracts had a higher rate of small grocery stores or convenience stores per 1000 in 2013 and 2023 than LB census tracts. This finding supports claims made by other researchers that poor communities and People of Color communities host a greater density of small grocery and convenience stores than high-income communities or ones with low percentages of People of Color (Dawkins et al., 1979; Gordon et al., 2011; LaVeist & Wallace, 2000; Lee et al., 2010; Morland et al., 2002; Sharkey & Horel, 2008). We make a more nuanced

argument, however, because it matters where the food outlets are being examined, city or suburb. Our study found that small grocery and convenience stores were located at a higher rate per 1000 residents in HB tracts than in LB census tracts in Saginaw, but not in the surrounding townships. In the suburban ring, the LB census tracts had a higher density of small grocery and convenience stores than the HB census tracts. In Saginaw and the surrounding townships, HB census tracts had a substantially higher poverty rate, lower household income, and lower educational attainment than LB census tracts.

Powell et al. (2007) also add nuance to the argument that low-income communities and Communities of Color have more small grocery and convenience stores than high-income neighborhoods with a low percentage of People of Color. Their research found that the mean number of supermarkets, grocery stores, and convenience stores peaks in middle-income neighborhoods and is lowest in upper-income communities.

Though Saginaw's civic leaders and food advocates focus on increasing supermarket access (Saginaw Community Food Club & Kitchen, 2024; Saginaw County Community Health Assessment/ Community Health Improvement Committee, 2020; Mose, 2022), our findings suggest an urgent need to pay attention to small grocery stores, convenience stores, and corner stores as well. Although these stores are often maligned for selling high-priced, unhealthy foods (Bodor et al., 2010; Caspi et al., 2017; Cavanaugh et al., 2013; Gebauer & Laska, 2011; Gittelsohn & Kumar, 2007; Laska et al., 2010; Sadler et al., 2013a; Sharkey et al., 2012; Shaver et al., 2018), they occupy an important niche in the food landscape of urban, low-income neighborhoods and rural communities. In Saginaw, 85% of the food stores that accept Supplemental Nutrition Assistance Program (SNAP) cards are convenience stores, corner stores, and dollar stores (Colby et al., 2024; USDA Food and Nutrition Service, 2023). The study shows that Saginaw lost 57.1% of its small grocery, convenience, and corner stores over a decade. The significant loss of these stores in Saginaw could mean that some residents will have difficulty finding places to purchase food and other essentials.

While there are healthy corner store initiatives in cities like Detroit, Philadelphia (The Food Trust, 2022; Pothukuchi, 2005), and many others, Saginaw has no such program. There is great need for an initiative like this in the city, and Saginaw should implement one soon. Civic leaders should provide funds and other resources to help convert existing corner stores into venues that sell fresh, healthy, and affordable food. Existing vacant stores like the Walgreens and Rite Aid pharmacies can be converted into grocery stores. These types of brick-and-mortar stores already have infrastructure for equipment like refrigerators and freezers that are necessary in food stores. A healthy corner store initiative could also create new small grocery stores where none exist.

Experimenting With Small-Format Grocery Stores

Cities like Saginaw can also try to attract downsized grocery stores. Recent assessments of the grocery retail industry have found that small-format grocery stores are revolutionizing the industry. The pandemic helped to push retailers in this direction (Ghai, 2023). Some grocery chains have gone from building 50,000+ square-foot stores to 10,000-square-foot outlets. For instance, Detroit's Whole Foods Supermarket is smaller than the usual 40,000+ square-foot store the chain usually builds. The chain is building small-format, "daily shop" Whole Foods stores in New York City and other urban areas that are 7,000–14,000 square feet. Trader Joe's opened a 2,800-square-foot grab-and-go store in Manhattan in 2024 (Bigora, 2024; Kang, 2024). Other retailers like Big Y are introducing 10,000-square-foot small-format stores. Meijer, Publix, Wegmans, Hy-Vee, and Target are also experimenting with small-format stores (Ghai, 2023).

Restaurants Dominate the Food Environment

Restaurants are the most common food outlet type identified in our study, representing 45.6% of the study area's food landscape in 2013 and 43.6% in 2023. These data align with findings from other Michigan cities where restaurants compose over a fourth of the food environment (Taylor et al., 2023, 2024; Taylor & Ard, 2015; Taylor, Bell et al., 2022). In both study periods, the LB census tracts

had more restaurants and food services per 1000 persons than the HB tracts; this was true for the entire study area and Saginaw. Fast-food restaurants surpassed full-service restaurants in number and, by 2023, composed the most significant component of the restaurant sector.

Michigan has a Restaurant Meal Program that allows residents on food assistance programs to use their Michigan Bridge or SNAP card to purchase prepared food. To be eligible, one must receive food assistance benefits, or be 60 years or older, or be disabled, or be homeless, or be the spouse of a food assistance recipient. Only three Saginaw restaurants participate in the program. All are Subway Restaurants, and all are on the Westside (Michigan Department of Health and Human Services, 2024). Not only should there be oversight of the extent to which participating restaurants sell fresh and healthy foods, but the city should also make the program more accessible and equitable by having participating food outlets on the Saginaw Eastside.

Urban Farms, Farmers Markets, Community Gardens, and Produce Vendors

Our analysis of Saginaw's urban farms, farmers markets, community gardens, and produce vendors revealed another unique finding that contributes to the food access literature. The study found that two-thirds of the food outlets in this category were in Saginaw in 2013, and half were in the city in 2023. Of those in Saginaw, only two were in the HB census tracts in 2013, and all were in the HB tracts in 2023. This finding corroborates earlier studies that show that farmers markets can reduce food insecurity and provide access to healthy foods in low-income areas (Becot et al., 2020; Karpyn et al., 2012; Taylor, Farias et al., 2022; Widener et al., 2012). National studies also show that the number of low-income people in government food assistance programs shopping at farmer's markets has increased significantly since 2013 (Farmers Market Coalition, 2020; USDA, 2020). Past studies have also shown that community gardens are vital for food production and practicing food justice and sovereignty in poor Communities of Color. Community gardens also enhance access to free food in such communities (Taylor, Lusuegro et al., 2022). Saginaw could increase food access by supporting mobile food trucks, or "veggie vans," that could travel through city neighborhoods on specified days and routes. The trucks can sell or give away local urban farm and community garden produce.

The USDA collects information on farmers markets and maintains the *National Farmers Market Directory*, but the information from the Agricultural Marketing Service is not connected to the information that the ERS provides on their Food Access Research Atlas or Food Environment Atlas (USDA Agricultural Marketing Service, 2024; USDA Economic Research Service, 2023, 2024). These databases should be connected in order to enhance efforts to understand and assess food access.

Emergency Food Assistance Venues

In 2013, most of the study area's emergency food assistance venues (58.7%) were in LB census tracts. There was a difference between Saginaw and the suburbs; 69.4% of Saginaw's emergency food outlets are in the HB census tracts. In contrast, in the suburbs 96.3% of the emergency food outlets are in the LB tracts. In 2023, emergency food outlets were found to have shrunk considerably and are almost equally divided between the LB and HB census tracts. The distinction between the city and suburbs remains, as 73.9% of Saginaw's emergency food assistance venues are in the HB tracts. Conversely, 87.5% of the suburban emergency food assistance venues are in the LB census tracts.

The concentration of food assistance organizations in Saginaw HB census tracts can be attributed to the high poverty rate, low household income, and low educational attainment that characterize these tracts. The presence of so many emergency food assistance venues indicates that food outlets that distribute free food are a vital part of the urban food landscape that should not be overlooked in assessments of food access. There is no question that these food outlets are vital food sources for Saginaw residents. As Colby et al. (2024) found, most of the very low-income respondents in their survey thought that food assistance organizations would be the most effective means to enhance food access in the city.

Earlier studies found a robust emergency food assistance infrastructure in other cities (Taylor et al., 2023; Taylor & Ard, 2015; Taylor, Bell et al., 2022; Taylor, Wright et al., 2022). Scholars also point to the expanded role that emergency food assistance programs played in enhancing food access during the COVID-19 pandemic and continue to play in the post-pandemic era (Taylor, Wright, et al., 2022).

This study points to the need to assess the emergency food infrastructure of communities where food access studies are being conducted. In cities like Saginaw, where many people rely heavily on emergency food assistance organizations (Colby et al., 2024), care must be taken that such food outlets are serving and distributing healthy foods. Researchers have found that emergency food outlets sometimes serve and give away unhealthy, highly processed, energy-dense foods (Oldroyd et al., 2022; Short et al., 2022; Sisson & Lown, 2011). Moreover, assessments of the impact on food access of the closure of emergency food assistance venues are urgently needed in a city like Saginaw, with persistently high poverty rates.

Lack of Evidence for Food Deserts, Food Swamps, and Supermarket Redlining

Saginaw has neighborhoods with limited access to supermarkets and large grocery stores, but it would be inaccurate to claim that the entire city is a food desert. As Taylor et al. (2023) contend, the assumption that census tracts lacking traditional full-line supermarkets or large grocery stores are food deserts is faulty. Though supermarkets and grocery stores stock large volumes of food and are vital parts of a city's food landscape, this study and similar work have shown that a city's food environment is much larger and more complex than the landscape of its supermarkets and large grocery stores. Research shows that urban residents purchase food from vendors other than supermarkets or large grocery stores (Bodor et al., 2007; Cannuscio et al., 2010, 2013; Caspi et al., 2017; Fish et al., 2013; Lucan et al., 2011, 2015). Therefore, the time has come for scholars to abandon the practice of studying only supermarkets and large grocery stores and to examine a broader range of outlets in their food access and food insecurity studies. Investigators such as Powell et al. (2007) have pioneered this perspective.

Though the food swamp thesis is widely used (Rose et al., 2009; Bodor et al., 2010; Sushil et al., 2017; Hager et al., 2017; Robitaille & Paquette, 2020; Schuck, 2022; Ver Ploeg, 2010a, 2010b; Ver Ploeg, 2009), it does not accurately describe Saginaw or the surrounding townships. If food swamps were present, we would find isolated supermarkets and large grocery stores in the study area. Instead, we find supermarkets and large grocery stores in saturated commercial strips, adjacent to, across the street from, or within the same malls, with dollar stores, variety stores, and fast-food restaurants in both study periods.

The study did not provide support for the supermarket redlining thesis either. Although many scholars and activists espouse this thesis (Crowe et al., 2018; Eisenhauer, 2001; Joyner et al., 2022; LeDoux & Vojnovic, 2021; Sadler et al., 2021; Shannon, 2016, 2018, 2021; Shannon et al., 2016, 2018, 2021; Zhang & Ghosh, 2016), our study did not find evidence to suggest that supermarkets were closed in formerly redlined neighborhoods and relocated to formerly greenlined neighborhoods. The redlining thesis suggests that dollar and variety stores replace supermarkets in formerly redlined neighborhoods, and ignores formerly yellow-lined and blue-lined neighborhoods as well as neighborhoods that were not color-coded. Our results show why researchers exploring this thesis should consider all five neighborhood types. In our study area, most supermarkets/large grocery stores and dollar and variety stores were in formerly yellow-lined neighborhoods in both study periods. A similar finding has been made in the study of supermarket redlining in Detroit (Taylor et al., 2024). To date, no research has investigated the movement of stores from formerly redlined to formerly yellow-lined neighborhoods or to neighborhoods that were not color-coded. More research should be done to identify how the movement of food stores may or may not be related to the racial and class categorization of the HOLC system that was superimposed on hundreds of American cities decades ago.

Hollowed Out: The Disappearing Food Infrastructure

The number of food outlets declined noticeably between 2013 and 2023 in both the city and the surrounding townships, as the number of outlets fell by 21.7%. However, the decline was steeper in Saginaw than in the neighboring townships. During the decade, Saginaw lost 37.3% of its food outlets, while the neighboring townships lost 11.5%. The loss of food outlets is even more severe than these numbers suggest. In 2023, we documented 89 closed or non-operational food establishments in the study area; 43 were in Saginaw. We argue that the number of food venues that had already disappeared from the foodscape, in addition to those found shuttered, represent a formidable vanishing food infrastructure that requires urgent attention. Though food outlets had vanished from the surrounding townships, the phenomenon was more alarming in Saginaw and could potentially imperil the lives of residents. Few researchers have studied this problem (Bell & Taylor, 2022; Gillespie et al., 2022; Taylor et al., 2023, 2024; Yeager & Gatrell, 2014).

Vanishing food infrastructures can limit food access and disproportionately impact Communities of Color and low-income urban areas. Our study found that HB census tracts lost a higher percentage of their food stores over the decade and had more closed food stores in 2023 than LB tracts; 60.5% of the city's closed food outlets were in HB tracts.

The large number of closed food outlets in Saginaw and other cities is concerning. The closures raise questions about urban residents' continued access to food. Despite ample evidence of vanishing food infrastructures elsewhere (Bell & Taylor, 2023; Engler-Stringer et al., 2016; Gillespie et al., 2022; Guy, 1996; Jia, 2008; Lowery et al., 2022; Morland, 2010; Sadler et al., 2013a; Taylor et al., 2023; Taylor et al., 2024; Yi et al., 2021), the USDA does not track or incorporate food store closures in its food access measures. With the severe extent of store closures around the country, it behooves the USDA to begin tracking this phenomenon and incorporating it into their measures of reduced or low access to food.

Developing Food Policies

Food policy oversight is important and part of many cities' governance structure. Though most jurisdictions in Michigan have a local food council (Gensler, 2024), Saginaw and Saginaw County do not, meaning that the city and county have little oversight of food policies. No individual, office, committee, or group is responsible for developing and overseeing consistent and equitable food policies. The city and county need to form a local food council so that all aspects of food insecurity and food access can be understood more coherently and strategically. A food council would allow the city to be proactive about food-related matters. The city also needs to identify and track the distribution of food outlets, so that leaders and residents can better understand food access and how to enhance it for everyone.

Expanding Opportunities for Low-Income Residents to Purchase Healthy Foods

Jurisdictions can enhance food access by participating in federal, state, and local food initiatives that help low-income people purchase healthy foods. Saginaw participates in one such program, Double-Up Food Bucks (DUFB), but the city should expand it to include more food outlets. Only two outlets, both on the Eastside—the Downtown Saginaw Farmers Market and Great Giant Market (a grocery store)—participate in the program. Program participants get double the fruits and vegetables when they use their Bridge card to purchase fruit and vegetables up to US$20 per day (Fair Food Network, 2021).

New Initiatives

The Saginaw Community Food Club and Kitchen

Food activists in Saginaw have worked to develop the Saginaw Community Food Club and Kitchen. The Saginaw Food Club (as the entity is called) is modeled after the Community Food Club in Grand Rapids. The leaders spearheading the Saginaw project raised US$4 million of the US$5 million in startup costs needed. The Food Club will operate a grocery store and commercial kitchen on Saginaw's Eastside in an HB census tract; construction begins in 2024 (Mose, 2022; Saginaw Community Food

Club & Kitchen, 2024). The Saginaw Food Club will operate the grocery store as a nonprofit membership organization, with annual operating costs of US$500,000–$600,000. It will source its products from donated food, low-cost food from the USDA and other vendors, and local gardens. The club will also rely on grants, foundations, and membership fees. Member households will pay fees of US$12–$16, based on household size and income, for a 30-day membership. Members receive and shop with points; the club also accepts cash, credit, and debit cards. To encourage purchase and consumption of healthy foods, fruits and vegetables are assigned the lowest points and snacks and processed foods are assigned higher points (Saginaw Community Food Club & Kitchen, 2024).

Grocery Busses

The city has also focused on enhancing transportation options to and from grocery stores. The Saginaw Transit Authority Regional Services (STARS) and the Saginaw City Council are collaborating to use a US$100,000 American Rescue Plan Act (ARPA) grant to build bus shelters at the East Side Soup Kitchen, senior citizens apartment buildings, and income-based housing developments. The goal is to make it easier for residents to take the "grocery buses" to acquire food. Each bus accommodates 10–15 people at a time (Bleu & Mose, 2024).

Strengths, Limitations, and Recommendations

Our study has several strengths. We conducted the first comprehensive food access study of Saginaw's food landscape over two periods. By analyzing an extensive list of food outlets, we added complexity to the understanding of food access in the city. Utilizing an eight-kilometer buffer around the city was helpful because city residents, especially of a city as compact as Saginaw, are not bounded by city limits when they shop. Saginaw is like other cities where large food retailers place their stores on the urban fringe, where they can build sprawling facilities and ample parking lots that attract customers. If such venues are ignored in the study of food access, then it is likely that food access will be underestimated.

This study contributes to food access scholarship because small cities like Saginaw are often overlooked. As this paper has shown, small and mid-sized cities have much to add to the discussion of food access and the impact of racial composition on the kinds of food outlets residents have access to. The paper outlines detailed methodologies for identifying, mapping, and analyzing food outlets, including an appendix that defines each type of food outlet studied. It presents the most extensive categorization of food outlet types so far in this genre of research, which will help researchers replicate or add new dimensions to this sort of food access study.

The study, however, has limitations. Data were collected in 2013 and 2023. The 2023 data collection might have been influenced by the COVID-19 pandemic, which resulted in the closure of several food outlets that may have impacted the results. The study adds depth to our understanding of the distribution of food outlets by studying two time periods; however, if data were collected and analyzed for each year, much more information could be gained about changing food access. We urge cities and researchers to collect and track such data annually.

The study used proportional allocation to estimate the population of census tract fragments. This approach may cause either an over- or underestimation that can introduce bias into the analysis. Although it is helpful to describe local food landscapes, considering the increasing burden of adverse health outcomes, such as diabetes and obesity, on residents of small U.S. cities, future studies should document the types of food sold to determine their nutritional value. Researchers have analyzed this for a small number of food outlet types; most food outlet types have been ignored in this genre of research.

Food access studies like ours typically do not study how subsistence activities like hunting, fishing, foraging, and gathering impact food access. Food gifting and sharing are also activities that influence food access. Future food access studies should examine these activities to expand our understanding of how and where people obtain food.

The study also highlights the need to examine

the impacts of race and income on food store access in more nuanced ways. Such factors can be explored further in studies that examine the types of food sold in a broad range of food stores. Our study examined the Black and White composition of census tracts. However, further studies can be conducted to examine how the Latinx/Hispanic composition of census tracts is related to the distribution of food outlets. Further research should also be conducted to see in more detail how food store closures impact food access.

Conclusions

This study described the food landscape of Saginaw, a small Michigan city that has not received much attention from food access scholars. Because the city has a long history of segregation, the study examined the relationship between the racial composition of census tracts and the number and types of food outlets present. Our study addresses a critical gap in food access research by calling attention to smaller cities. The study also examined racial, income, and educational dynamics in a city where Blacks and Whites made up most of the population. As a result, the study added nuance to common arguments scholars make about food access, race, educational attainment, and poverty.

Though Saginaw is described as a food desert, the label is misleading. Our study found a diverse food landscape in the city. Though the city has a limited number of supermarkets and large grocery stores, there are other food outlets, such as farmers markets, where residents can purchase food or obtain it for free. Nevertheless, we acknowledge that Saginaw faces challenges in ensuring that all city residents consistently have access to healthy and affordable foods. The declining population base will make attracting new supermarkets or midsized and large grocery stores difficult. Building new stores or rehabilitating old ones can be cost-prohibitive in the cash-strapped city. However, the city is taking steps to enhance food access among the most vulnerable populations.

The USDA has abandoned its use of terms like food desert and now relies on "low access" to describe the ease or difficulty of acquiring food in a community. Our study suggests that the USDA should further refine the definition of low access to more accurately describe food landscapes. When food access is focused on a few components of the food environment (supermarkets, large grocery stores, wholesale clubs or supercenters, and convenience stores), crucial indicators are overlooked and not analyzed or incorporated into assessments.

This Saginaw paper identifies one such conundrum. Though city residents had a wide variety of places to obtain food, the many emergency food assistance organizations—especially soup kitchens—indicate that high poverty rates hinder residents' ability to purchase food. Thus, we should not focus solely on where the supermarkets and large grocery stores are located and how far away people live from them; more significant efforts should be put into making sure that residents can find places to purchase food when they want to.

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Appendix A

Table A1. Racial Characteristics of Michigan and the City of Saginaw, 2010 and 2020

	Michigan					City of Saginaw				
	2010		2020		Percent	2010		2020		Percent
Population Characteristics	Population	Percent	Population	Percent	Change	Population	Percent	Population	Percent	Change
Total population	9,883,640	100.0	10,077,331	100.0	2.0	51,508	100.0	44,202	100.0	-14.2
White alone (Hispanic or Latinx)	7,569,939	76.6	7,295,651	72.4	-3.6	19,310	37.5	15,227	34.4	-21.1
Black alone (not Hispnic or Latinx)	1,383,756	14.0	1,358,458	13.5	-1.8	23,127	44.9	19,176	43.4	-17.1
Hispanic or Latinx	436,358	4.4	564,422	5.6	29.3	7,344	14.3	6,988	15.8	-4.8
Native American or Alaska Native	54,665	0.6	47,406	0.5	-13.3	180	0.3	120	0.3	-33.3
Asian	236,490	2.4	332,288	3.3	40.5	145	0.3	184	0.4	26.9
Native Hawaiian or Pacific Islander	2,170	0.0	2,603	0.0	20.0	10	0.0	17	0.0	70.0
Other	9,866	0.1	37,183	0.4	276.9	72	0.1	271	0.6	276.4
Two or more races	190,396	1.9	439,320	4.4	130.7	1,320	2.6	2,219	5.0	68.1

Compiled from: U.S. Census Bureau (2020a). Hispanic or Latin, or Not Hispanic or Latino by Race. Table P9. DEC Demographic and Housing Characteristics. https://data.census.gov/table/DECENNIALDHC2020.P9?q=michigan%20race%20and%20ethnicity; U.S. Census Bureau (2020b). Hispanic or Latin, or Not Hispanic or Latino by Race. Table P9. DEC Demographic and Housing Characteristics. https://data.census.gov/table/DECENNIALDHC2020.P9?q=race%20and%20ethnicity%20saginaw%20city%20michigan (2010a). Hispanic or Latin, or Not Hispanic or Latino by Race. Table P9. DEC Summary File 1. https://data.census.gov/table/DECENNIALSF12010.P9?q=michigan%20race%20and%20ethnicity; U.S. Census Bureau (2010b). Hispanic or Latin, or Not Hispanic or Latino by Race. Table P9. DEC Summary File 1. https://data.census.gov/table/DECENNIALSF12010.P9?q=race%20and%20ethnicity%20saginaw%20city%20michigan

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Table A2a. Comparing 2013 and 2023 Food Outlets for Saginaw City and the Surrounding Townships

	2013 Food Outlets						2023 Food Outlets						Percentage Change					
	Entire Study Area		Saginaw City		Surrounding Townships		Entire Study Area		Saginaw City		Surrounding Townships		Entire Study Area		Saginaw City		Surrounding Townships	
Food Outlet Type	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
All food venues	**577**	**100.0**	**228**	**100.0**	**349**	**100.0**	**452**	**100.0**	**143**	**100.0**	**309**	**100.0**	**−125**	**−21.7**	**−85**	**−37.3**	**−40**	**−11.5**
Supermarkets and large grocery stores	**28**	**4.9**	**3**	**1.3**	**25**	**7.2**	**17**	**3.8**	**2**	**1.4**	**15**	**4.9**	**−11**	**−39.3**	**−1**	**−33.3**	**−10**	**−40.0**
Traditional supermarkets	14	2.4	2	0.9	12	3.4	5	1.1	1	0.7	4	1.3	−9	−64.3	−1	−50.0	−8	−66.7
Limited-assortment stores	7	1.2	1	0.4	6	1.7	6	1.3	1	0.7	5	1.6	−1	−14.3	0	0.0	−1	−16.7
Fresh format supermarket	1	0.2	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0	−1	∞	0	∞	−1	∞
Supercenters	3	0.5	0	0.0	3	0.9	5	1.1	0	0.0	5	1.6	2	66.7	0	∞	2	66.7
Mass merchandiser	1	0.2	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0	−1	∞	0	∞	−1	∞
Wholesale clubs	2	0.3	0	0.0	2	0.6	1	0.2	0	0.0	1	0.3	−1	−50.0	0	∞	−1	−50.0
Small groceries and convenience stores	**109**	**18.9**	**45**	**19.7**	**64**	**18.3**	**96**	**21.2**	**35**	**24.5**	**61**	**19.7**	**−13**	**−11.9**	**−10**	**−22.2**	**−3**	**−4.7**
Gas stations with food	21	3.6	9	3.9	12	3.4	37	8.2	10	7.0	27	8.7	16	76.2	1	11.1	15	125.0
Liquor stores and party stores	36	6.2	15	6.6	21	6.0	38	8.4	16	11.2	22	7.1	2	5.6	1	6.7	1	4.8
Small groceries, convenience, and corner stores	52	9.0	21	9.2	31	8.9	21	4.6	9	6.3	12	3.9	−31	−59.6	−12	−57.1	−19	−61.3
Pharmacies, dollar, and variety stores	**41**	**7.1**	**21**	**9.2**	**20**	**5.7**	**49**	**10.8**	**15**	**10.5**	**34**	**11.0**	**8**	**19.5**	**−6**	**−28.6**	**14**	**70.0**
Pharmacies or drug stores	26	4.5	14	6.1	12	3.4	24	5.3	6	4.2	18	5.8	−2	−7.7	−8	−57.1	6	50.0
Dollar stores and variety stores	15	2.6	7	3.1	8	2.3	25	5.5	9	6.3	16	5.2	10	66.7	2	28.6	8	100.0
Specialty food stores and vendors	**38**	**6.6**	**15**	**6.6**	**23**	**6.6**	**39**	**8.6**	**14**	**9.8**	**25**	**8.1**	**1**	**2.6**	**−1**	**−6.7**	**2**	**8.7**
Bakeries	15	2.6	7	3.1	8	2.3	24	5.3	11	7.7	13	4.2	9	60.0	4	57.1	5	62.5
Ice cream parlors	0	0.0	0	0.0	0	0.0	3	0.7	0	0.0	3	1.0	3	∞	0	∞	3	∞
Health foods	7	1.2	3	1.3	4	1.1	5	1.1	1	0.7	4	1.3	−2	−28.6	−2	−66.7	0	0.0
Meat markets and delicatessens	11	1.9	5	2.2	6	1.7	6	1.3	2	1.4	4	1.3	−5	−45.5	−3	−60.0	−2	−33.3
Confectionaries	5	0.9	0	0.0	5	1.4	1	0.2	0	0.0	1	0.3	−4	−80.0	0	∞	−4	−80.0
Restaurants and other food service	**263**	**45.6**	**84**	**36.8**	**179**	**51.3**	**197**	**43.6**	**46**	**32.2**	**151**	**48.9**	**−66**	**−25.1**	**−38**	**−45.2**	**−28**	**−15.6**
Full-service restaurants	109	18.9	35	15.4	74	21.2	60	13.3	14	9.8	46	14.9	−49	−45.0	−21	−60.0	−28	−37.8
Fast-food restaurants	100	17.3	21	9.2	79	22.6	82	18.1	16	11.2	66	21.4	−18	−18.0	−5	−23.8	−13	−16.5
Coffee, tea, and juice shops	6	1.0	2	0.9	4	1.1	13	2.9	2	1.4	11	3.6	7	116.7	0	0.0	7	175.0
Banquet halls and hotels	2	0.3	1	0.4	1	0.3	18	4.0	2	1.4	16	5.2	16	800.0	1	100.0	15	1500.0
Bars and clubs	37	6.4	22	9.6	15	4.3	22	4.9	11	7.7	11	3.6	−15	−40.5	−11	−50.0	−4	−26.7
Caterers	9	1.6	3	1.3	6	1.7	2	0.4	1	0.7	1	0.3	−7	−77.8	−2	−66.7	−5	−83.3
Urban farms, community gardens, farmers markets, and produce vendors	**15**	**2.6**	**10**	**4.4**	**5**	**1.4**	**6**	**1.3**	**3**	**2.1**	**3**	**1.0**	**−9**	**−60.0**	**−7**	**−70.0**	**−2**	**−40.0**
Urban farms and community gardens	8	1.4	7	3.1	1	0.3	3	0.7	2	1.4	1	0.3	−5	−62.5	−5	−71.4	0	0.0
Farmers market and produce market	5	0.9	3	1.3	2	0.6	1	0.2	1	0.7	0	0.0	−4	−80.0	−2	−66.7	−2	∞
Community supported agriculture (CSA)	2	0.3	0	0.0	2	0.6	1	0.2	0	0.0	1	0.3	−1	−50.0	0	∞	−1	−50.0
Dairy	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	1	0.3	1	∞	0	∞	1	∞

Supply chain	**11**	**1.9**	**7**	**3.1**	**4**	**1.1**	**8**	**1.8**	**4**	**2.8**	**4**	**1.3**	**–3**	**–27.3**	**–3**	**–42.9**	**0**	**0.0**
Manufacturers, processors	2	0.3	1	0.4	1	0.3	2	0.4	2	1.4	0	0.0	0	0.0	1	100.0	–1	∞
Food hub (aggregator)	0	0.0	0	0.0	0	0.0	1	0.2	1	0.7	0	0.0	1	∞	1	∞	0	∞
Distributors	1	0.2	1	0.4	0	0.0	5	1.1	1	0.7	4	1.3	4	400.0	0	0.0	4	∞
Wholesalers	8	1.4	5	2.2	3	0.9	0	0.0	0	0.0	0	0.0	–8	∞	–5	∞	–3	∞
Emergency food assistance	**63**	**10.9**	**36**	**15.8**	**27**	**7.7**	**39**	**8.6**	**23**	**16.1**	**16**	**5.2**	**–24**	**–38.1**	**–13**	**–36.1**	**–11**	**–40.7**
Food pantries or soup kitchens	62	10.7	35	15.4	27	7.7	36	8.0	21	14.7	15	4.9	–26	–41.9	–14	–40.0	–12	–44.4
Food banks/distribution	1	0.2	1	0.4	0	0.0	3	0.7	2	1.4	1	0.3	2	200.0	1	100.0	1	∞
Social, religious, educational, and community services	**9**	**1.6**	**7**	**3.1**	**2**	**0.6**	**1**	**0.2**	**1**	**0.7**	**0**	**0.0**	**–8**	**–88.9**	**–6**	**–85.7**	**–2**	∞
Service organization	5	0.9	4	1.8	1	0.3	1	0.2	1	0.7	0	0.0	–4	–80.0	–3	–75.0	–1	∞
Shelter	4	0.7	3	1.3	1	0.3	0	0.0	0	0.0	0	0.0	–4	∞	–3	∞	–1	∞

f = frequency; ∞ represents a rate of increase from 0. A percent change can not be calculated when starting value is 0.

Table A2b. Food Outlets Studied Only in 2023

	Entire Study Area		Saginaw City		Surrounding Townships	
	f	%	*f*	%	*f*	%
Additional food outlets	**146**	**100.0**	**79**	**100.0**	**67**	**100.0**
Restaurants and other food service	**27**	**18.5**	**10**	**12.7**	**17**	**25.4**
Takeout establishments	27	18.5	10	12.7	17	25.4
Urban farms, community gardens, farmers markets, and produce vendors	**21**	**14.4**	**21**	**26.6**	**0**	**0.0**
Market produce vendors	7	4.8	7	**8.9**	0	**0.0**
Market prepared food vendors	12	8.2	12	**15.2**	0	**0.0**
Market stores	2	1.4	2	**2.5**	0	**0.0**
Mobile food sources	**13**	**8.9**	**11**	**13.9**	**2**	**3.0**
Food trucks	10	6.8	9	**11.4**	1	**1.5**
Mobile food distributions	3	2.1	2	**2.5**	1	**1.5**
Attractions and amusement parks	**5**	**3.4**	**3**	**3.8**	**2**	**3.0**
Attractions	5	3.4	3	**3.8**	2	**3.0**
Social, religious, educational, and community services	**69**	**47.3**	**30**	**38.0**	**39**	**58.2**
School cafeterias	33	22.6	15	**19.0**	18	**26.9**
Retirement communities and homes	13	8.9	2	**2.5**	11	**16.4**
Childcare	20	13.7	10	**12.7**	10	**14.9**
Youth organizations and centers	3	15.0	3	**30.0**	0	**0.0**
Gyms and heath centers	**10**	**6.8**	**4**	**5.1**	**6**	**9.0**
Fitness centers and health centers	2	1.4	0	**0.0**	2	**3.0**
Hospitals and medical centers	8	5.5	4	**5.1**	4	**6.0**
Internet, online purchase, and delivery	**1**	**0.7**	**0**	**0.0**	**1**	**1.5**
E-commerce, online	1	0.7	0	0.0	1	1.5

Note: *f* = frequency

Table A3. Home Owners' Loan Corporation (HOLC)'s Neighborhood Codes and the Distribution of Supermarkets, Large Grocery Stores, Dollar and Variety Stores in 2013 and 2023

			Supermarkets and Large Grocery Stores				Dollar Stores and Variety Stores			
HOLC's Codes	HOLC's Color	HOLC's Description	2013	Percent	2023	Percent	2013	Percent	2023	Percent
Entire Study Area										
A	Green	Best	0	0.0	0	0.0	0	0.0	0	0.0
B	Blue	Still desirable	0	0.0	0	0.0	1	6.7	1	4.0
C	Yellow	Definitely declining	4	19.0	2	18.2	7	46.7	9	36.0
D	Red	Hazardous	0	0.0	0	0.0	0	0.0	0	0.0
Uncoded	No Color		17	81.0	9	81.8	7	46.7	15	60.0
Total			21	100.0	11	100.0	15	100.0	25	100.0
Saginaw City										
A	Green	Best	0	0.0	0	0.0	0	0.0	0	0.0
B	Blue	Still desirable	0	0.0	0	0.0	1	14.3	1	11.1
C	Yellow	Definitely declining	2	66.7	2	100.0	6	85.7	6	66.7
D	Red	Hazardous	0	0.0	0	0.0	0	0.0	0	0.0
Uncoded	No Color		1	33.3	0	0.0	0	0.0	2	22.2
Total			3	100.0	2	100.0	7	100.0	9	100.0
Surrouding Townships										
A	Green	Best	0	0.0	0	0.0	0	0.0	0	0.0
B	Blue	Still desirable	0	0.0	0	0.0	0	0.0	0	0.0
C	Yellow	Definitely declining	2	11.1	0	0.0	1	12.5	3	18.8
D	Red	Hazardous	0	0.0	0	0.0	0	0.0	0	0.0
Uncoded	No Color		16	88.9	9	100.0	7	87.5	13	81.3
Total			**18**	**100.0**	**9**	**100.0**	**8**	**100.0**	**16**	**100.0**

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Appendix B.

Figure B1a. Map Showing the Census Tracts and the Percentage of Non-Hispanic Blacks in 2010

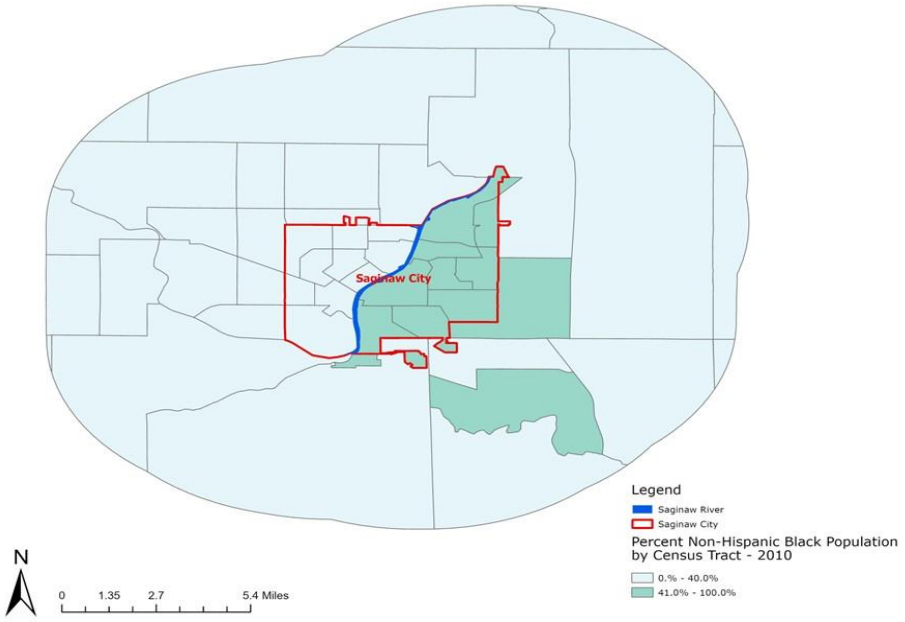


Figure B1b. Map Showing the Census Tracts and the Percentage of Non-Hispanic Blacks in 2020

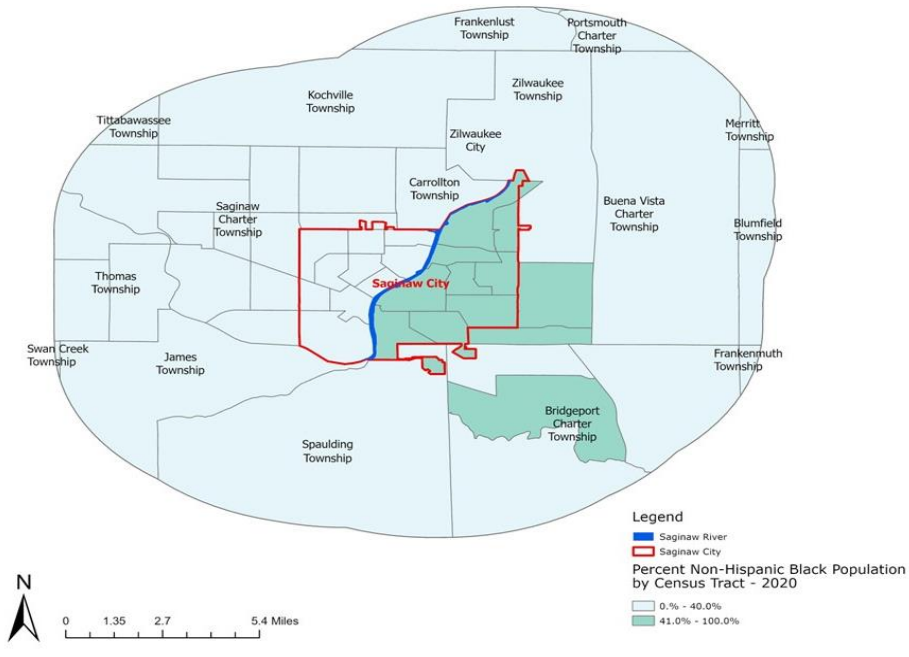


Figure B2a. Map Showing the Location of Food Outlets Studied in 2013

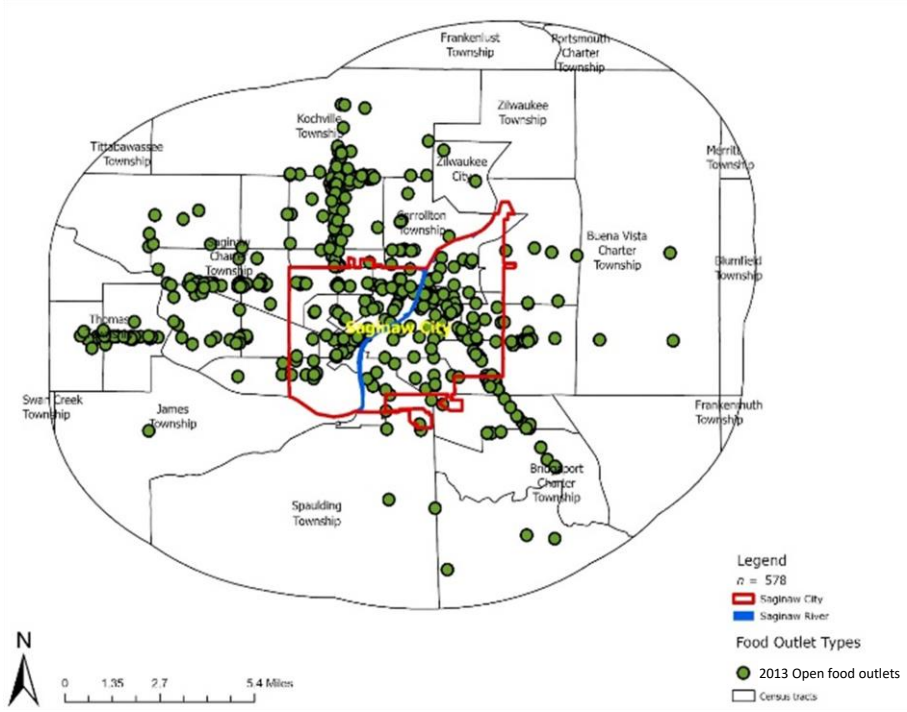
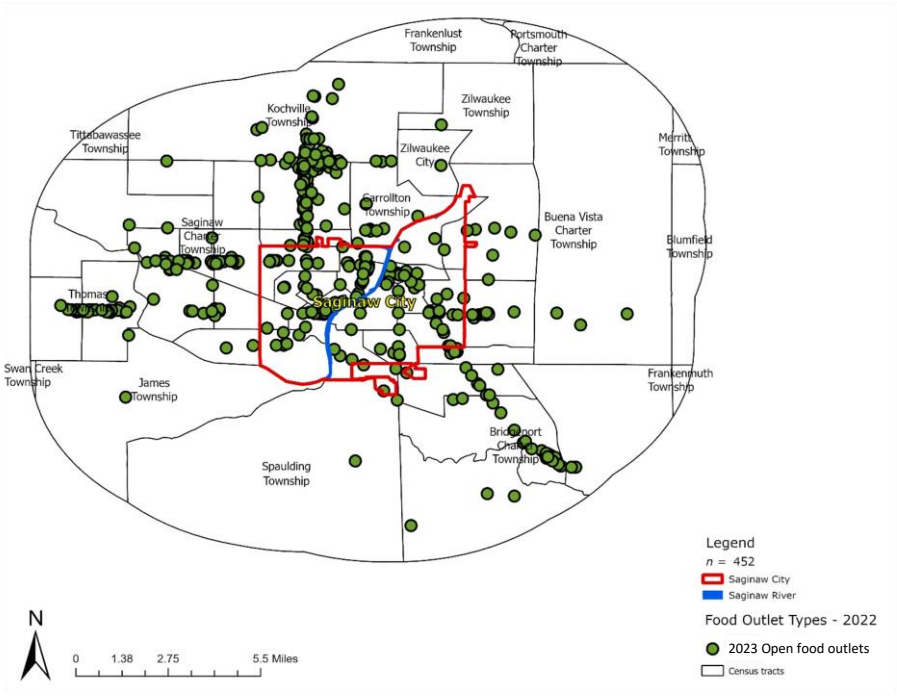


Figure B2b. Map Showing the Location of Food Outlets Compared to 2023



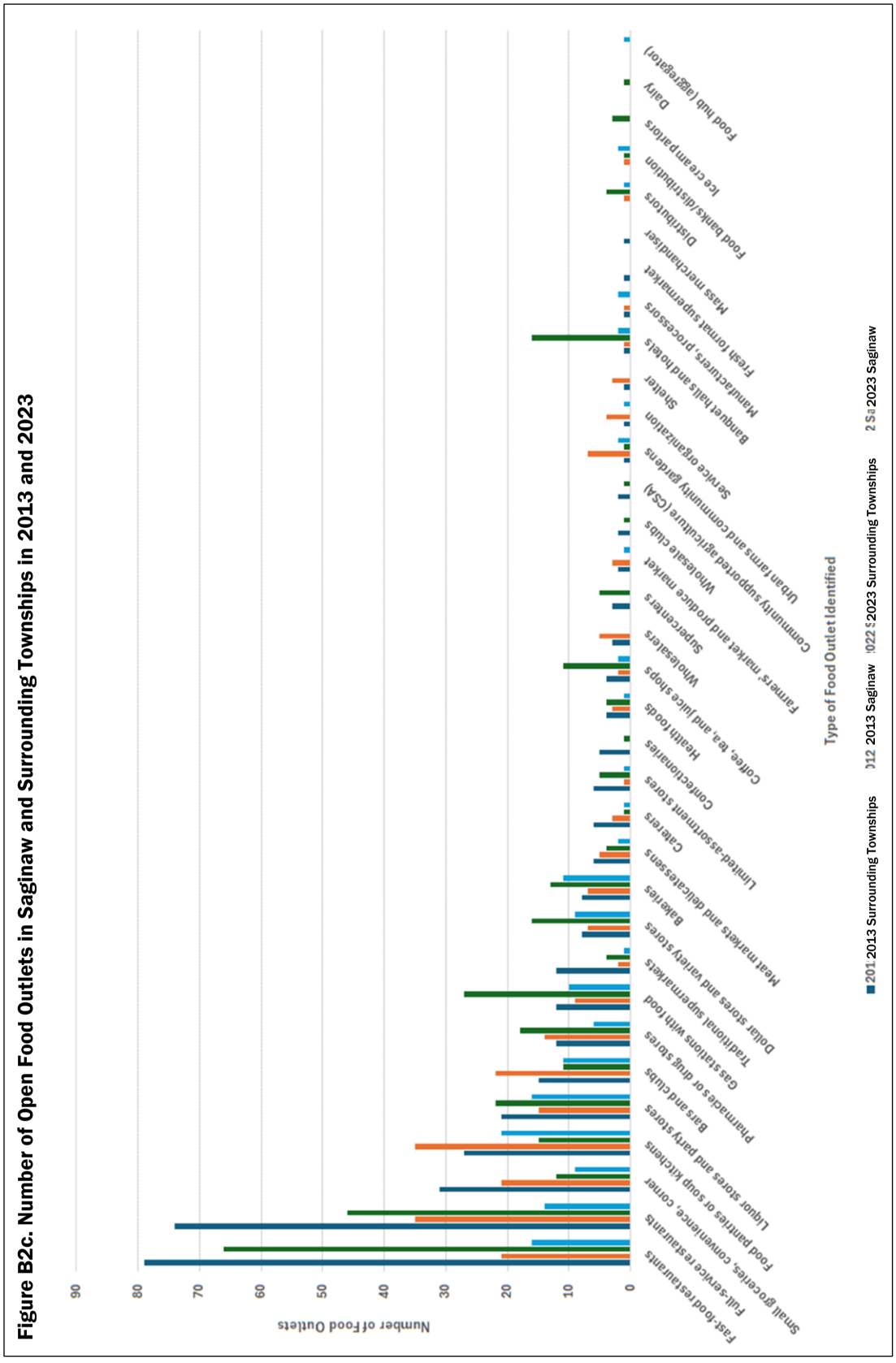


Figure B2c. Number of Open Food Outlets in Saginaw and Surrounding Townships in 2013 and 2023
Number of Food Outlets
0
10
20
30
40
50
60
70
80
90
Fast-food restaurants
Full-service restaurants
Small groceries, convenience, corner
Food pantries or soup kitchens
Liquor stores and party stores
Bars and clubs
Pharmacies or drug stores
Gas stations with food
Traditional supermarkets
Dollar stores and variety stores
Meat markets and delicatessens
Bakeries
Caterers
Limited-assortment stores
Confectionaries
Health foods
Coffee, tea, and juice shops
Wholesalers
Superstores
Farmers, market and produce market
Wholesale clubs
Community supported agriculture (CSA)
Urban farms and community gardens
Service organization
Shelter
Banquet halls and hotels
Manufacturers, processors
Fresh format supermarket
Mass merchandiser
Distributors
Food banks/distribution
Ice cream parlors
Dairy
Food hub (aggregator)
Type of Food Outlet Identified
2013 Surrounding Townships
2013 Saginaw
2023 Surrounding Townships
2023 Saginaw

Figure B3a. Map Showing the Location of Supermarkets and Large Grocery Stores in 2013

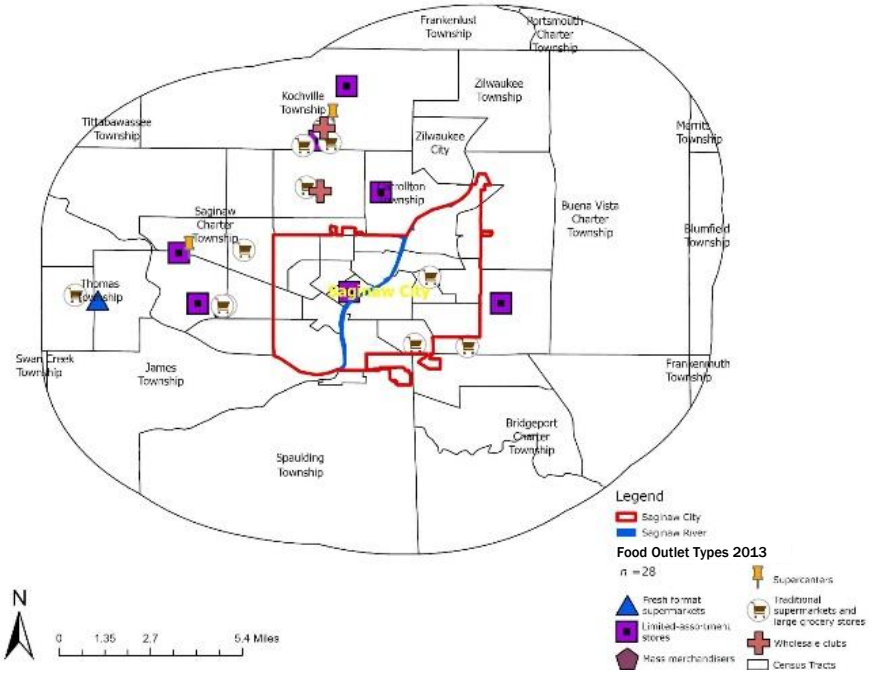


Figure B3b. Map Showing the Location of Supermarkets and Large Grocery Stores in 2023

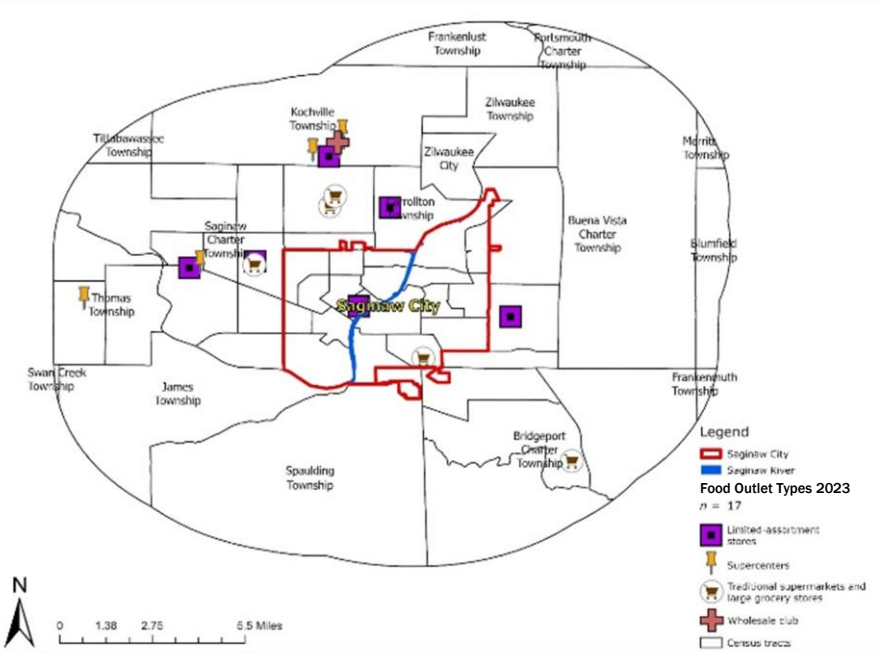


Figure B4a. Map Showing the Location of Small Grocery and Convenience Stores in 2013

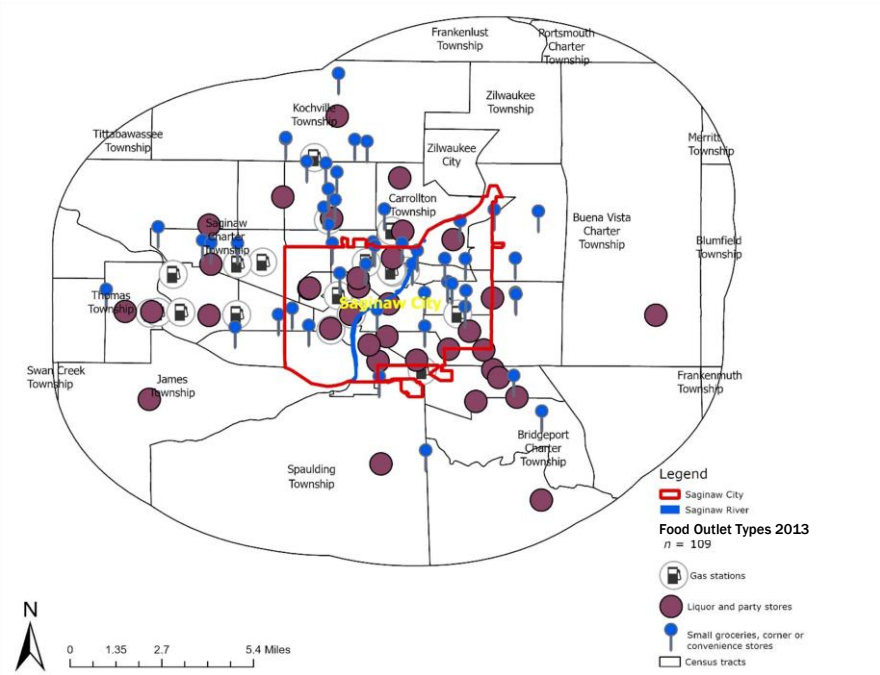


Figure B4b. Map Showing the Location of Small Grocery and Convenience Stores in 2023

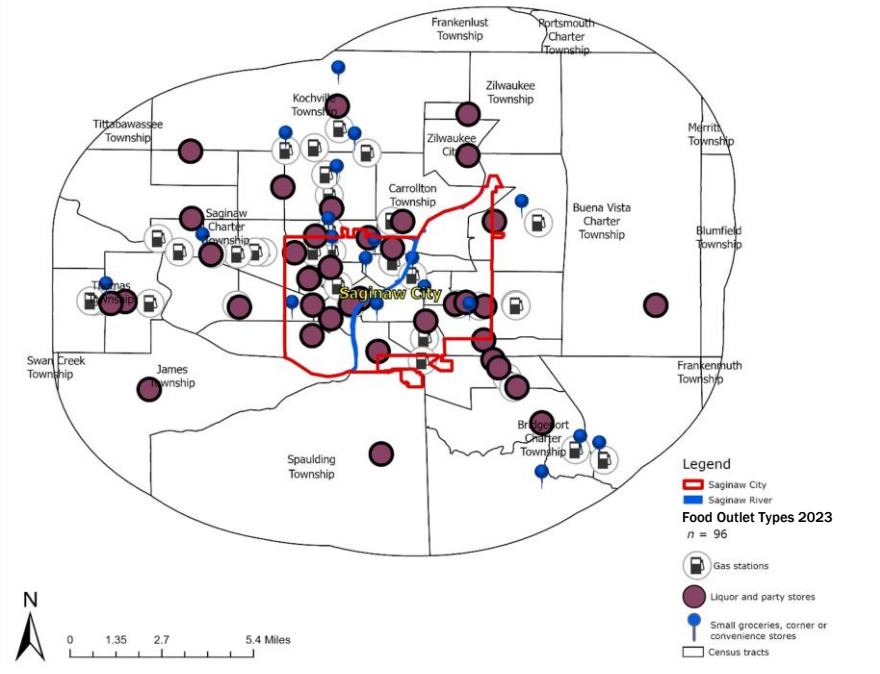


Figure B5a. Map Showing the Location of Pharmacies, Dollar, and Variety Stores in 2013

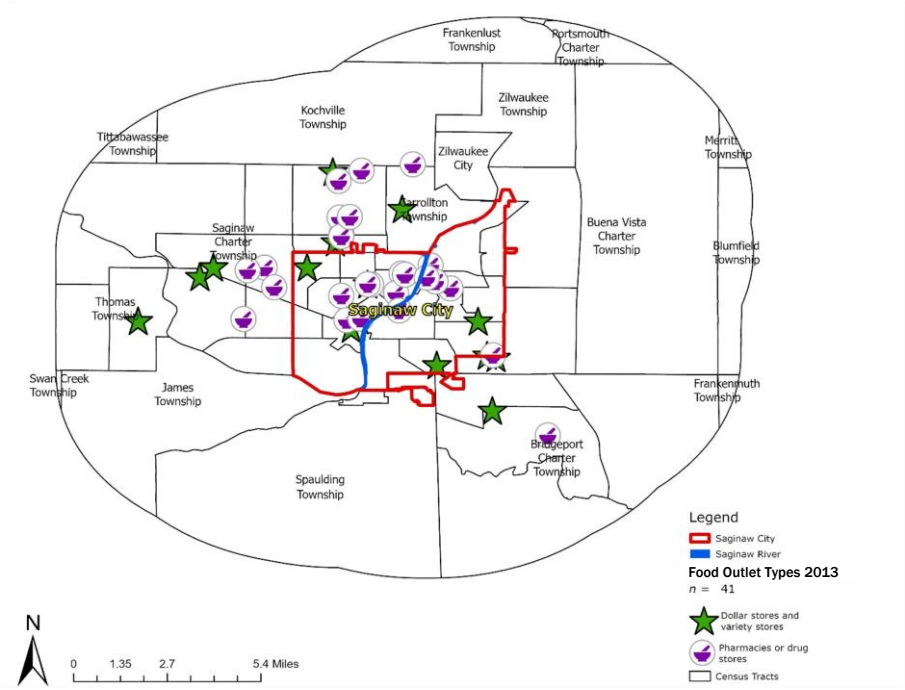


Figure B5b. Map Showing the Location of Pharmacies, Dollar, and Variety Stores in 2023

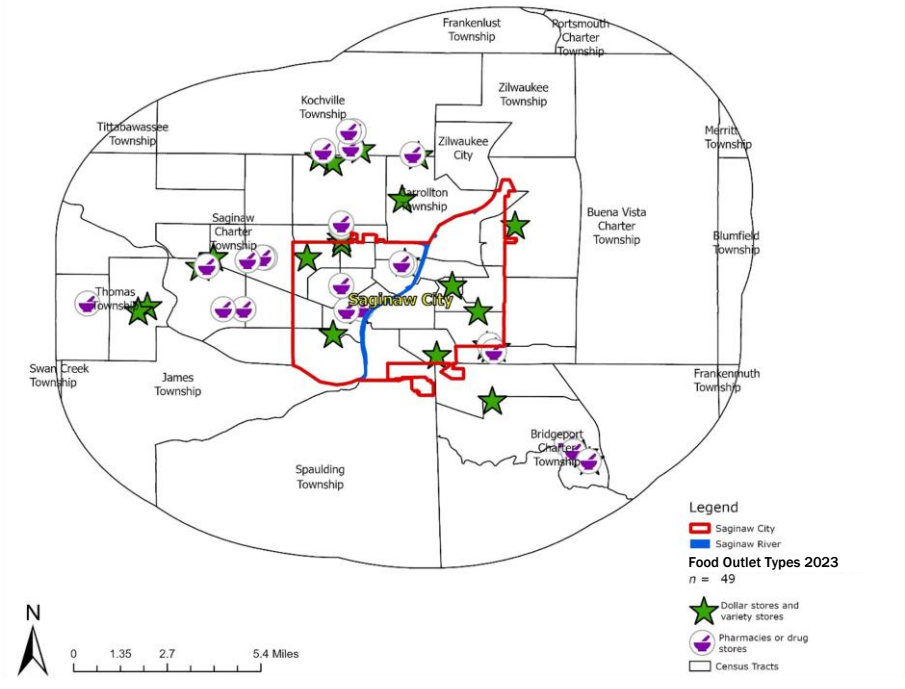


Figure B6a. Map Showing the Location of Specialty Food Stores and Vendors in 2013

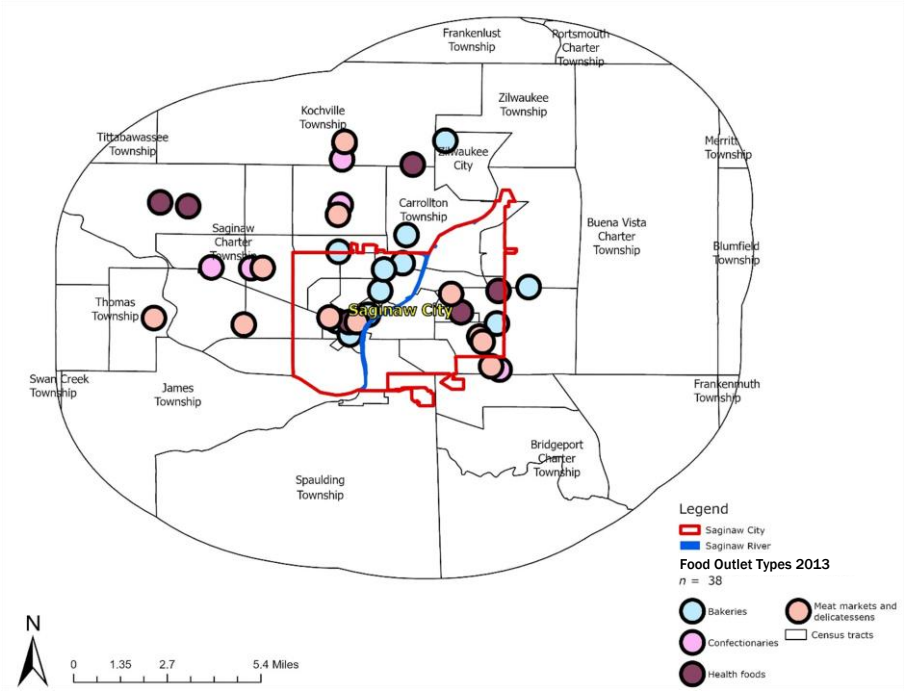


Figure B6b. Map Showing the Location of Specialty Food Stores and Vendors in 2023

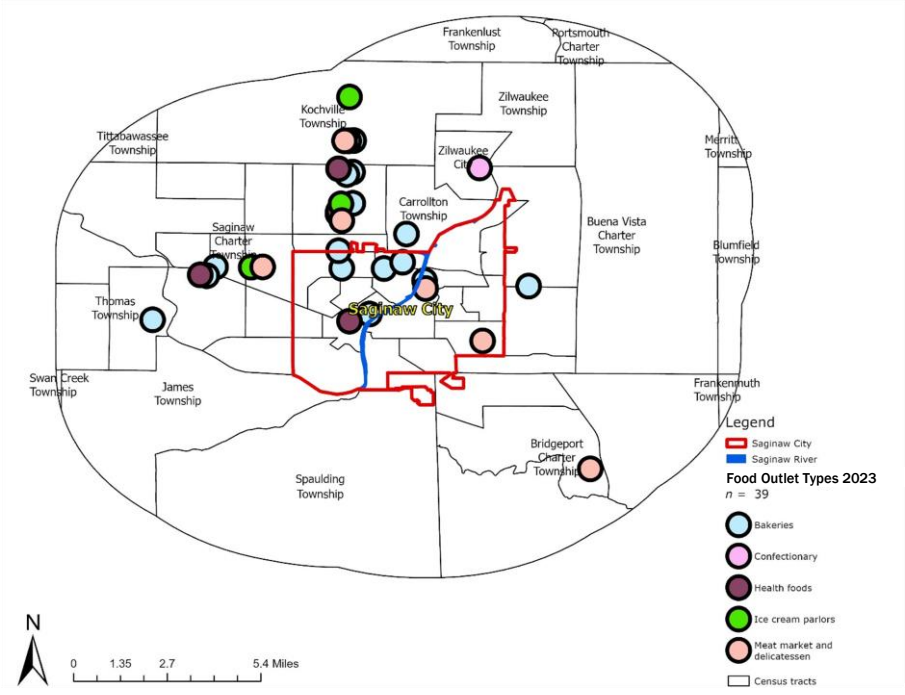


Figure B7a. Map Showing the Location of Restaurants and Food Services in 2013

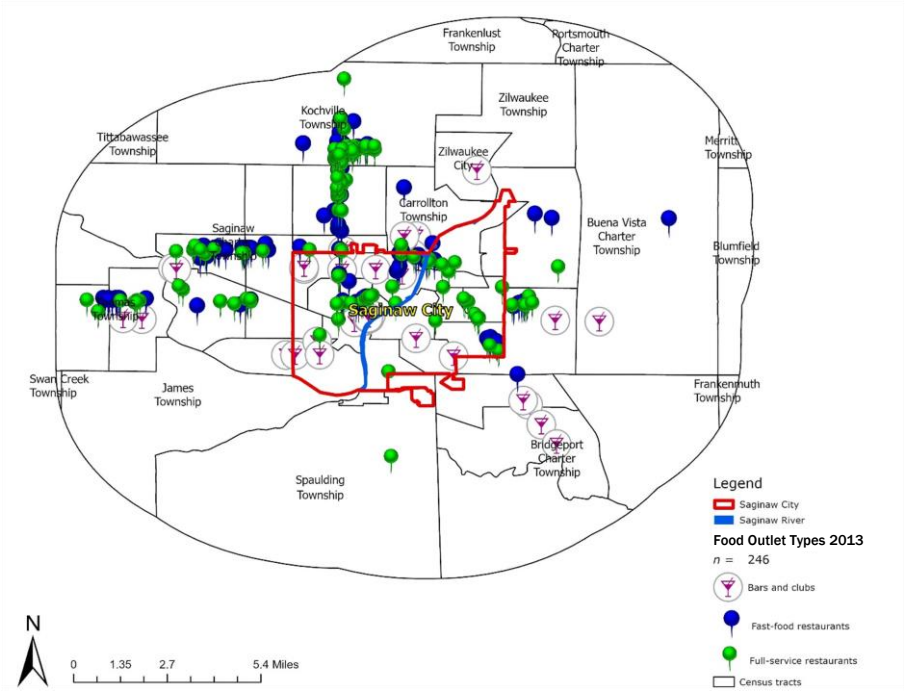


Figure B7b. Map Showing the Location of Restaurants and Food Services in 2023

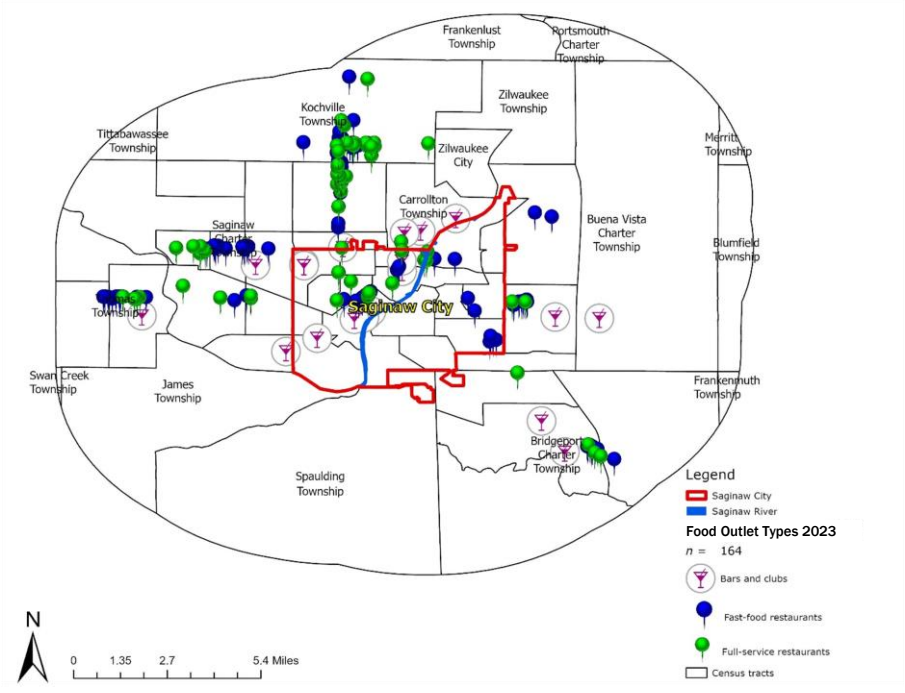


Figure B8a. Map Showing the Location of Urban Farms, Community Gardens, Farmers Markets, and Produce Vendors in 2013

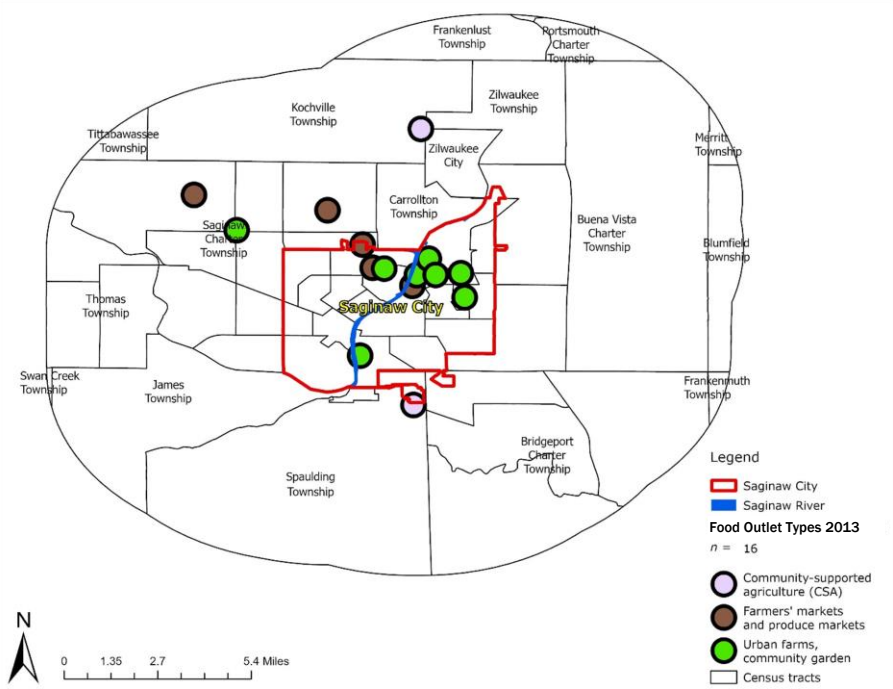


Figure B8b. Map Showing the Location of Urban Farms, Community Gardens, Farmers Markets, and Produce Vendors in 2023

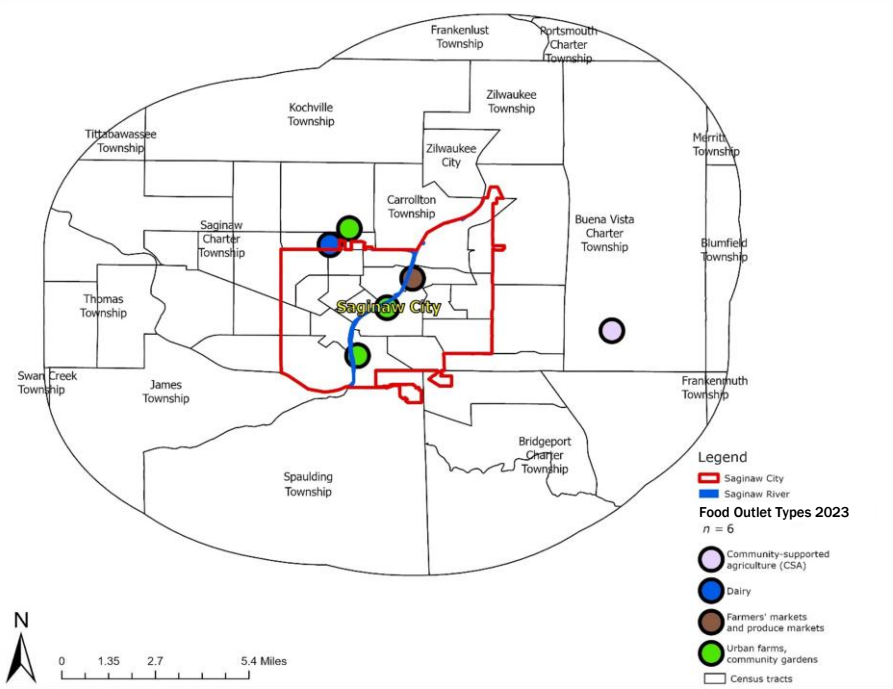


Figure B9a. Map Showing the Location of Distributors and Supply Chain Vendors in 2013

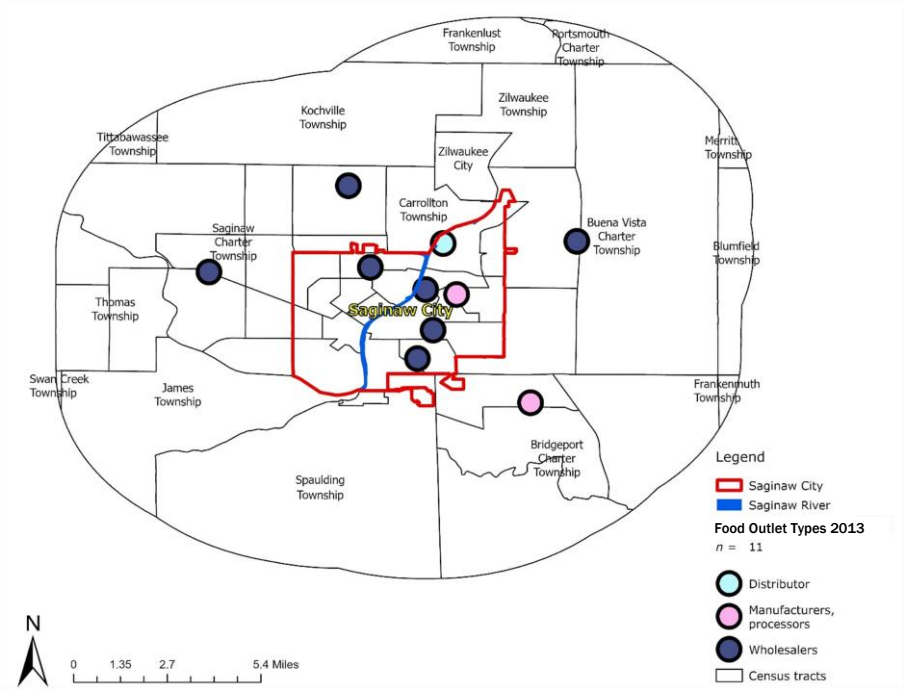


Figure B9b. Map Showing the Location of Distributors and Supply Chain Vendors in 2023

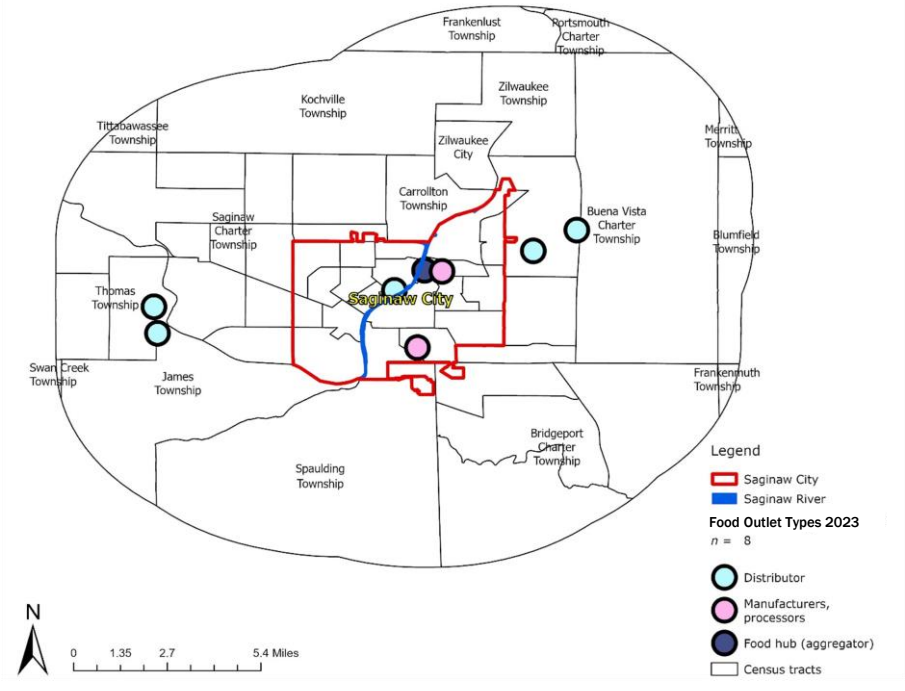


Figure B10a. Map Showing the Location of Food Assistance Organizations in 2013

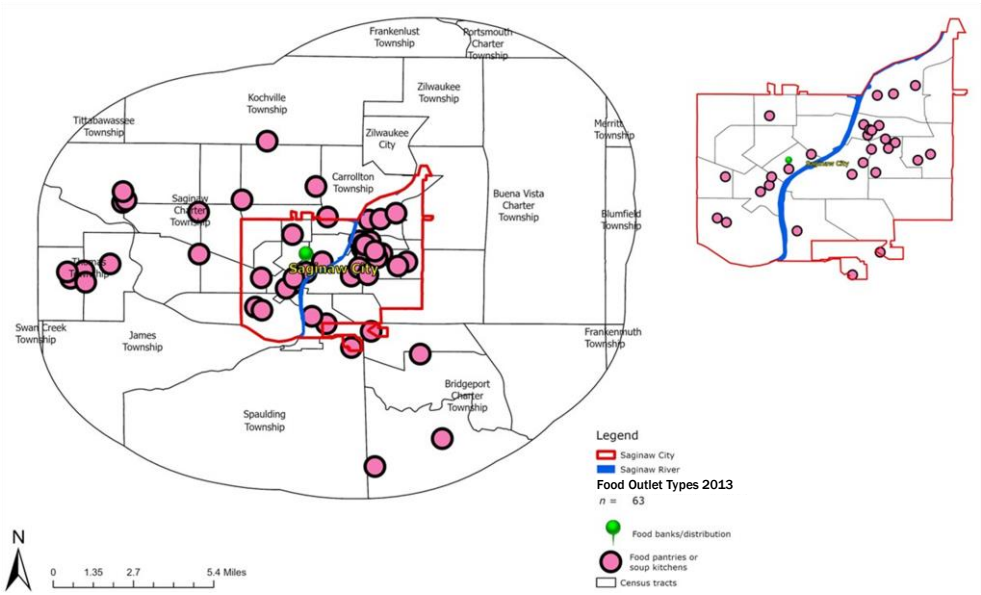


Figure B10b. Map Showing the Location of Food Assistance Organizations in 2023

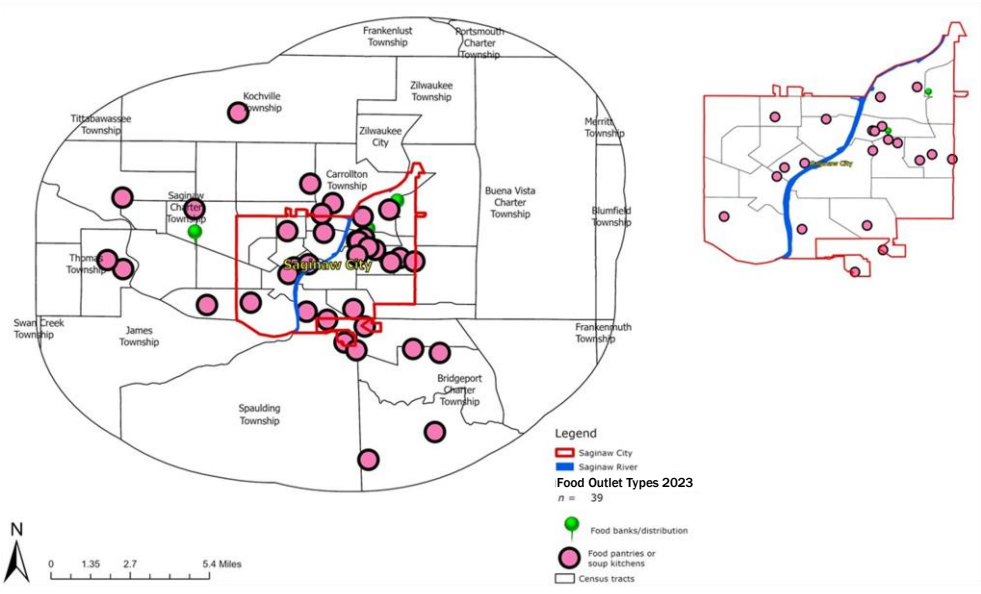


Figure B11. Map Showing the Location of All Food Outlets Studied in 2023

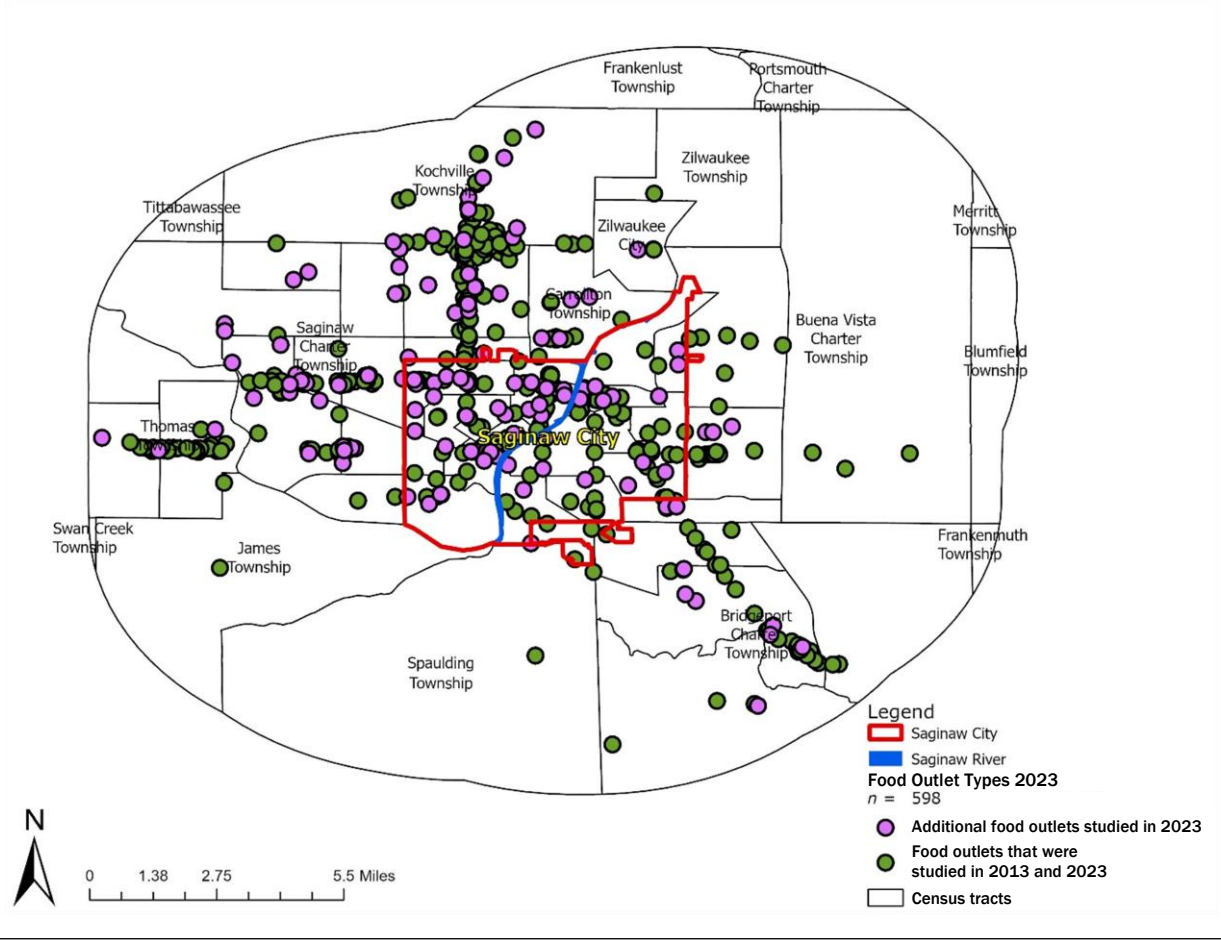


Figure B12a. Map Examining the Supermarket Redlining Thesis for 2013

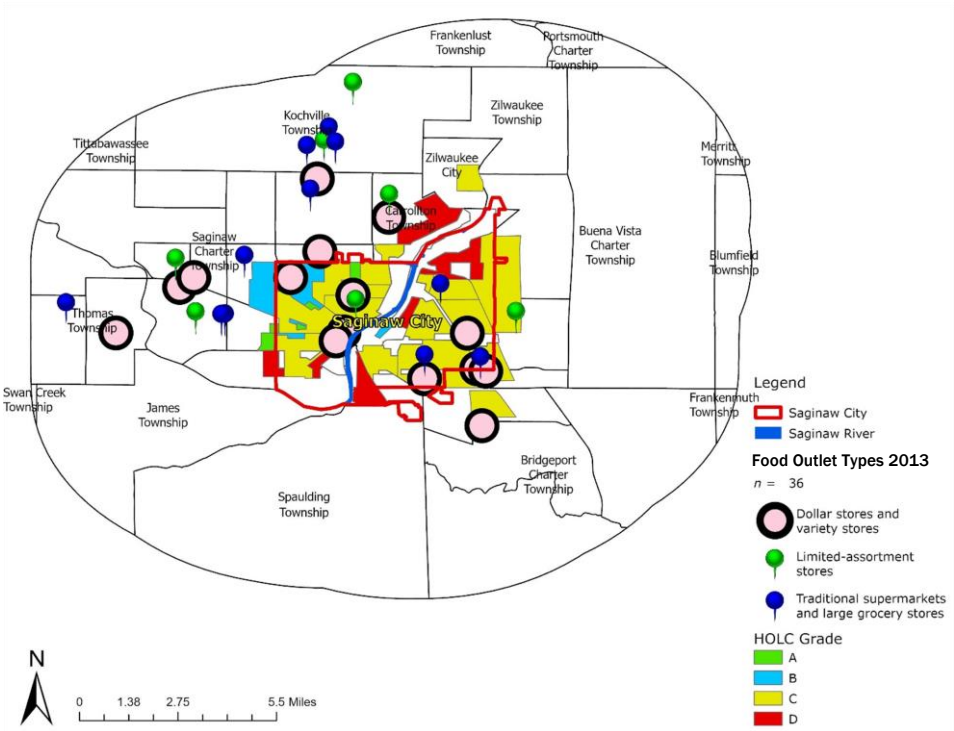


Figure B12b. Map Examining the Supermarket Redlining Thesis for 2023

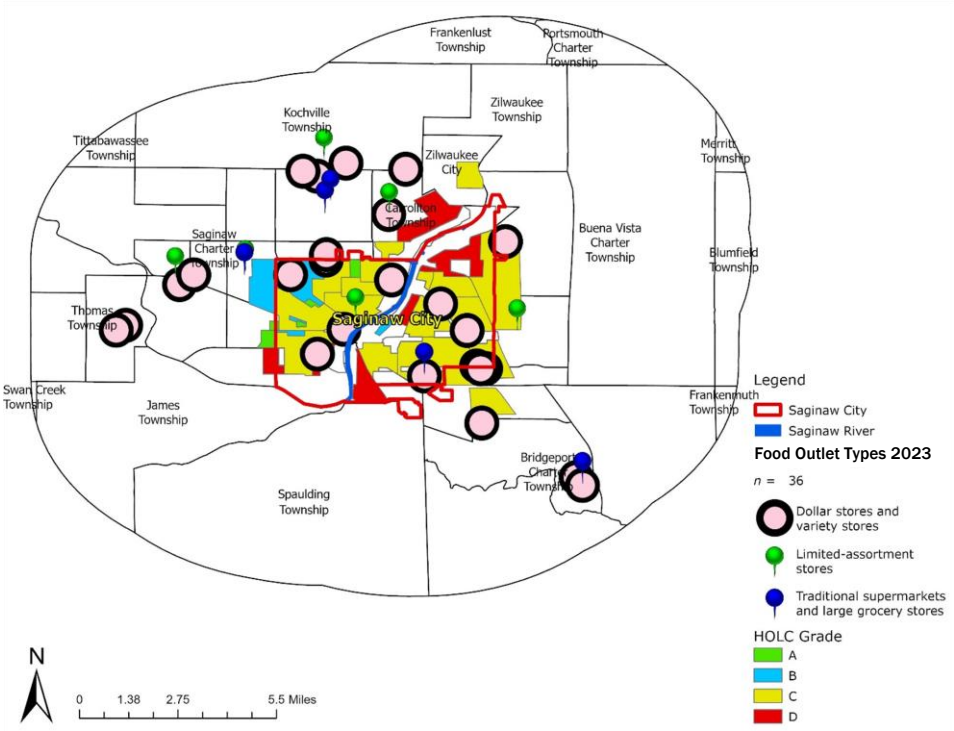


Figure B13a. Map Examining the Food Swamp Thesis for 2013

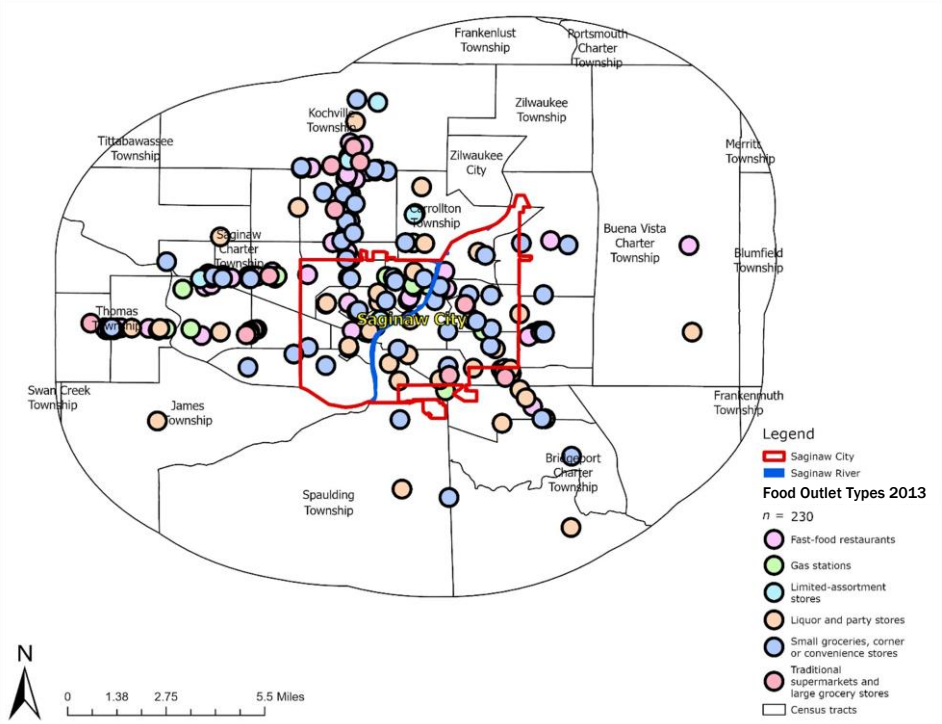


Figure B13b. Map Examining the Food Swamp Thesis for 2023

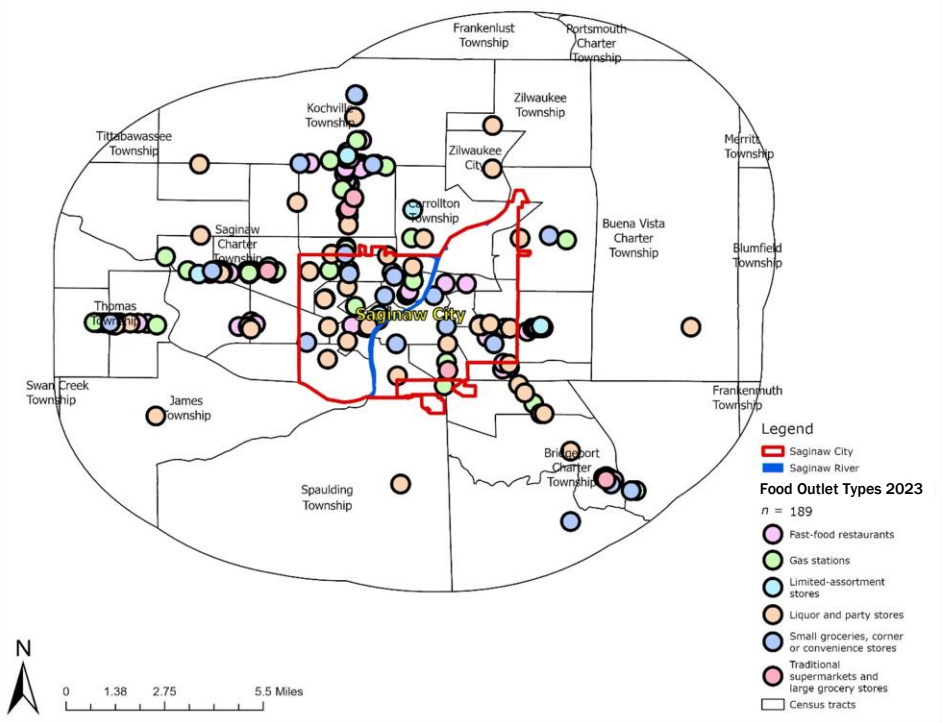
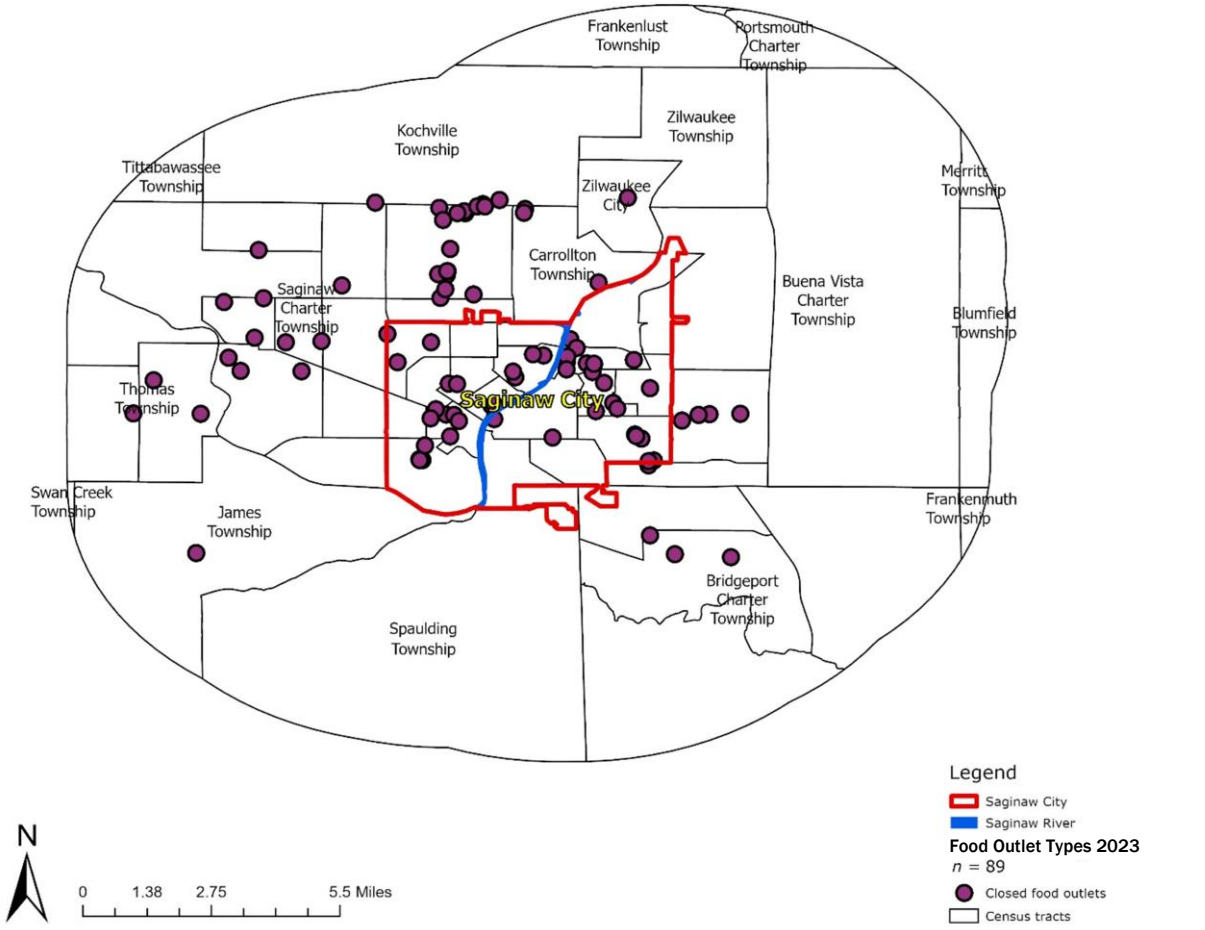


Figure B14. Map Showing the Location of Food Outlets that were Closed in 2023



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Failure to launch: An analysis of an attempted central kitchen pilot program to serve childcare meals

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Abstract

The majority of children ages 0–5 consume most of their meals in early care and education (ECE) settings, prompting interest in the nutritional quality of childcare meals and snacks as a vehicle for improving dietary-related health outcomes for this vulnerable population.[1] Our team has identified central kitchens that serve prepared meals to childcare centers as a potential model to improve meal quality for children, while also relieving childcare providers of the burdens of meal preparation and paperwork associated with federal meal reimbursements, and aggregating local food purchases to create a larger market for farmers than purchases by individual centers. Our team partnered with a

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[1] We define children as vulnerable based on the fact that they are completely dependent on adults for decision-making that affects their health and well-being, which is especially true for children in the 0–5 age group (Bagattini, 2019).

funder, a church, and community organizations to attempt a pilot that would replicate this central kitchen model in a rural area. Unfortunately, the pilot project was never fully realized, leading us to conduct a process evaluation to identify the generalizable factors that impeded its success. We identified four key factors, including the underlying power dynamic between the funder and recipient, reliance on a single project champion, lack of buy-in from community stakeholders, and failure to involve the county health department early in the planning process. In this paper, we construct a timeline of the project to help identify key factors that led to the project's failure to launch, explain our four key findings, and provide a set of recommendations that funders and other communities can take into consideration as they consider the viability of this timely intervention.

Keywords
central kitchen, caterer, farm to early care and education, child and adult care feeding program (CACFP), rural food access

Introduction and Literature Review

This reflective essay provides a detailed analysis of a pilot central kitchen that was designed to serve prepared meals to children ages 0–5 in rural early care and education (ECE) sites, but which failed to progress beyond the initial stages of the project. We begin with a review of research surrounding the emergence of local food infrastructure as a contributor to building regional food systems and supporting both farmer profitability and consumer health. We contextualize the growth of interest and investment in local food infrastructure in the mainstream food system and explore the challenges that are specific to social enterprises, rural local food projects, and the ECE sector more generally, before turning to the case of catered meals for the ECE sector and lessons learned from the pilot central kitchen project.

Structural Barriers: Rural Food Access, Local Food Infrastructure, and the ECE Sector

The early local food movement focused on direct sales between farmers and consumers, with farmers markets and community supported agriculture (CSAs) as its hallmarks (Brown & Miller, 2008; Hinrichs, 2000). As local food systems developed beyond direct markets, researchers and scholars identified a need for local food intermediaries, and the corresponding infrastructure, to scale up local food systems by improving farmers' access to markets and meeting increasing consumer demand (Friedmann, 2007; Jablonski et al., 2011). The first of these intermediary infrastructural developments were food hubs, which aggregate local products among multiple farmers to recreate the economies of scale and distributional efficiencies observed in mainstream food systems. Usually, food hubs have the social mission of fair returns on farmers' investments and increasing low-income consumer access to healthy food (Barham et al., 2012; Feenstra et al., 2019; Jablonski et al., 2011; Lyson et al., 2008; Rysin & Dunning, 2016).

More recently, the interest in local food products has sparked growth in small-scale businesses focused on value-added local food products, especially in metro- and metro-adjacent areas (Bowser & Holcomb, 2018; Freake & Godfrey, 2017; Low et al., 2021). This trend has included the growth of commercial kitchens with the goal of fostering local food systems. Commercial kitchen models include "on-farm kitchens, incubator kitchens, licensed kitchens at farmers' markets, and larger-scale food processing establishments" (Bowser & Holcomb, 2018, para. 2). Community-based shared use kitchens have also grown in popularity, often with the dual purpose of creating new markets for farmers' products, while also increasing consumer access to healthy foods. Sometimes these kitchens result in added benefits to the local workforce through professional development, increased job opportunities, and incubation of new food businesses (Fitzsimmons et al., 2023; Freake & Godfrey, 2017).

Local food infrastructure, such as shared use kitchens and small-scale food processors, is often heralded as part of a regional food system development strategy to bring community economic development to rural areas (Barham et al., 2012; Jablonski et al., 2011; Low et al., 2021). However, the potential for these efforts to contribute to rural economic development and thrive as local food businesses may ultimately be restricted by the fact

that they are often operating at a smaller scale and purchasing local food from smaller-scale farmers, which goes against the prevailing logic of the mainstream food system (Bloom & Hinrichs, 2011; Feenstra et al., 2019; Fitzsimmons et al., 2023; Lyson et al., 2008). Following World War II, the mainstream food system was characterized by increased industrialization, consolidation, and concentration (Hendrickson & Heffernan, 2002; Howard, 2016). As the food system industrialized, production and processing were concentrated in the operations of a small number of farms and food processors (Hendrickson & Heffernan, 2002; Howard, 2016; Lyson et al., 2008). These larger scale farms and food businesses can take advantage of economies of scale to lower costs and introduce efficiencies. As the local food movement matured across the 2000s, a major question emerged as to whether they could be "scaled up" in order to mimic the efficiencies observed in the mainstream food system (Friedmann, 2007; Jablonski et al., 2011; Lyson et al., 2008; Rysin & Dunning, 2016). Food hubs and commercial kitchens providing value-added processing opportunities are seen as re-introducing the infrastructure that was lost through the industrialization process and are part of a strategy to bring the local food system to scale (Feenstra et al., 2019; Jablonski et al., 2011; Lyson et al., 2008; Rysin & Dunning, 2016).

These recent developments in local food infrastructure are part of broader efforts in developing values-based supply chains. Values-based supply chains are distinct from traditional supply chains in that they focus on transparency, partnership across the chain, and fair returns on investment (Lyson et al., 2008; Stevenson & Pirog, 2008). Proponents of values-based supply chains believe they hold promise in countering the negative repercussions of the mainstream food system (Stevenson & Pirog, 2008). However, the businesses and nonprofit organizations participating in these chains struggle to meet buyer's low-price expectations and maintain consistent supply because of their comparative smaller size[2] (Bloom & Hinrichs, 2011; Jablonski et al., 2011; Feenstra et al., 2019). Research has also shown that many small enterprises struggle to purchase from local farmers due to these farmers' "inability to meet volume requirements, unreliable supply and lack of year round supply (Feenstra et al. 2019, p. 239). These challenges to local food procurement have also been seen in other local food initiatives that attempt to support local farmers while also increasing community food access, such as farm to institution programs (Boys & Fraser, 2019; Harris et al., 2012). To overcome these challenges, local food businesses, such as food hubs, commercial kitchens, and processors, often find themselves relying on grant funding to help them get started, and also over the long term as they work toward viability (Fitzsimmons et al., 2023; Freake & Godfrey, 2017; Jablonski et al., 2011; Rysin & Dunning, 2016).

There are several reasons why local food businesses, and commercial kitchens specifically, struggle with financial viability. First, there are many costs associated with starting up small-scale local food businesses, including those related to food safety (and other regulations), insurance, utilities, supplies, and labor, among others (Fitzgerald et al., 2024; Fitzsimmons et al., 2024). Many of these regulations require capital investments to bring buildings, facilities, and equipment up to code. In addition, research shows that small to very small processors are often unaware of the food safety regulations they need to follow, lack knowledge of how to implement them, and perceive costs to be a barrier to implementation (Fitzgerald et al., 2024). While the cited research is related specifically to compliance with Hazard Analysis and Critical Control Point (HACCP) and Preventive Controls for Human Food (PCHF) food safety regulations, it provides an indication of the challenges facing

[2] For a reference point on size of local food businesses, according to the U.S. Food and Drug Administration's Good Manufacturing Practice, Hazard Analysis, and Risk-Based Preventive Controls for Human Food (PCHF) Rule, small and very small processors are defined as "(1) very small businesses defined in the PCHF Rule as averaging less than [US]$1 million (adjusted for inflation each year) per year in both sales and unsold value of the food over a 3-year period or (2) facilities that have average annual sales over a 3-year period of less than [US]$500,000 (adjusted for inflation each year) and make at least half of the sales to consumers or to local retailers or restaurants within the same state or within 275 miles" (Fitzgerald et al., 2024, p. 161).

small-scale local food businesses related to regulations more generally.

In addition to the challenges of starting up new local food businesses, there are also general challenges associated with rural food access, as well as challenges that are specific to the early care and education sector. Food insecurity is defined as access to "enough food for an active, healthy life for all household members" (Coleman-Jensen et al., 2020, p. i). Food insecurity is consistently higher in rural areas than in urban areas and is higher both for people of color and those living in the South (Bowen et al., 2022; Haynes-Maslow et al., 2020; Byker Shanks et al., 2022). In part, this is due to the industrialization and consolidation of the food system, as described earlier. As the food system industrialized and farm size grew, fewer farmers were needed, leading to urban migration and the subsequent depopulation of rural areas (Blanchard & Matthews, 2007; Bowen et al., 2022; Morton & Blanchard, 2007). As a result, it became challenging for rural grocery stores to survive without a sufficient customer base (Blanchard & Matthews, 2007; Morton & Blanchard, 2007). Transportation, specifically, poses challenges to healthy food access in rural areas, due to the larger distances between population centers and sources of food (Bowen et al., 2022; Haynes-Maslow et al., 2020). Research has also shown that customers' ability to afford healthy food is critical to achieving food security (Bowen et al., 2022). Food prices are often higher in rural areas due to the long distances that food travels, while under- and unemployment is a serious issue, also contributing to higher rates of food insecurity (Bowen et al., 2022). At the same time, researchers note that rural areas possess unique assets, such as access to farms, gardens, and hunting and fishing, which are often used as food security strategies by rural residents (Bowen et al., 2022).

Finally, we consider the unique challenges facing the ECE sector. In the U.S., a majority (60%) of children under the age of six years old are enrolled in childcare programs (National Center for Education Statistics [NCES], 2019). On average, children spend 27 hours per week in childcare centers where they consume a significant portion of their daily meals. Childcare centers are a key source of meals for children ages 0–5, especially in communities of color. The Child and Adult Care Food Program (CACFP) is a federal food assistance program that provides reimbursements for centers that serve children living at up to 185% of the federal poverty guidelines (Gordon et al., 2011). It is essential that meals and snacks provided in this setting meet children's daily nutritional requirements for normal growth, development, and maintenance of healthy body weight. National guidelines recommend that half-day childcare programs (4–7 hours per day) provide at least one-third of children's daily nutrition requirements, and full-day programs (>8 hours per day) provide half to two-thirds of children's nutritional requirements (Benjamin Neelon & Brileyet al. 2011). However, extensive research shows that childcare meals and snacks at most childcare centers do not adequately contribute to children's daily requirements for calories and critical micronutrients, while also having too much sodium and saturated fats (Ball et al., 2008; Logan et al., 2021). The literature on this topic suggests that, in general, many childcare facilities struggle to prepare healthy meals due to staffing shortages, limited kitchen capacity, and the burden of applying for federal meal reimbursements through CACFP (Lee et al., 2022). While CACFP reimbursements are critical to supporting healthy meal preparation, a 2021 survey by the USDA found that "over half of child care [*sic*] centers and Head Start programs reported that they experienced challenges to participating in CACFP because meal reimbursement was inadequate" (Logan et al., 2021, p. 5). Based on this review of the literature, we believe it is possible that a central kitchen that caters meals to childcare providers could address the structural challenges of operating meal service in the ECE sector, while also serving as infrastructure to build the local food system.

The Case for Central Meal Preparation in Childcare

Some communities have developed central kitchens that cater meals for childcare centers as a strategy to provide healthy meals to children ages 0–5 who are in ECE facilities (Carpenter et al., 2017). A central kitchen that serves prepared meals to childcare facilities offers several potential benefits,

including commercial-grade equipment, labor, improved meal quality, support with CACFP paperwork, and increased volume of local food purchased (Carpenter et al., 2017).

A central, professional kitchen has the ability to house more robust kitchen infrastructure with industrial grade equipment than individual childcare centers. Currently, many childcare centers are short-staffed, and so meal preparation responsibilities often fall on teachers or childcare center directors (Salas Atwell et al., 2024). In a central kitchen model, trained food-service professionals can be hired, which frees up childcare staff to focus on the care and education of children, while also reducing the impact of frequent staff turnover on a center's ability to offer meal services. In addition, central kitchens have the potential to improve meal quality by increasing scratch cooking and reducing the reliance upon processed foods.

Central kitchens can also take on the administrative burden of following CACFP guidelines and submitting paperwork to receive federal reimbursement to support low-income families. Research has shown that childcare facilities that participate in CACFP serve meals that improve dietary quality, such as increased fruit and vegetable offerings, as compared to non-CACFP sites (Andreyeva & Henderson, 2018; Andreyeva et al., 2018; Erinosho et al., 2018; Lee et al., 2022). Improvements in meal quality may be especially evident when combined with farm to early care and education (farm to ECE) programming, which emphasizes the inclusion of local food in meals combined with experiential learning around cooking, nutrition, and gardening (Gibson et al., 2014). Previous research has shown improved meal quality in the context of farm to ECE programming, as well as evidence that children are more willing to try and like new fruits and vegetables (Gibson et al., 2014; Izumi et al., 2015). In part, these improvements are due to the inclusion of fresh fruits and vegetables, since most childcare centers rely on canned or frozen produce because they are more time- and cost-effective.

Central kitchens may also be an asset for local food sourcing as part of farm to ECE programs. Previous research by the authors has identified challenges with ECE local food procurement such as a low volume of produce ordered and decentralization of childcare centers (Bloom et al., 2022; Rutz et al., 2018). The low volumes that childcare centers order are due in part to the smaller serving sizes for children ages 0–5 compared to children served in K–12 school districts. In addition, many centers are hesitant to incorporate fresh produce and therefore may only order enough for snacks and not meals (Bloom et al., 2022). As a result, it can be hard for childcare providers to serve as a viable market for farmers, especially when they require delivery. In contrast, central kitchens order larger volumes of food, as they prepare meals for multiple centers. These kitchens act as aggregators, reducing the burden on individual centers to establish new ordering systems with local farmers or food hubs and increasing the market for local farmers. Given the capital investments needed to build a new facility (as outlined above), interest has grown in the potential to repurpose existing commercial kitchens to be used for catered meals or as shared-use kitchens, including the use of food bank and county fairgrounds kitchens (Carpenter et al., 2017; University of Arkansas Cooperative Extension Service, n.d.).

Despite the potential benefits of catered meals for ECE, research has indicated some key challenges, which mirror the challenges described earlier, related to shared use and commercial kitchens as local food infrastructure. For example, a pilot catered meal program through a food bank found that the increased cost of meals was a barrier to adoption, as were transportation, delivery logistics to individual classrooms, and lack of on-site storage (Carpenter et al., 2017).

North Carolina Central Kitchens and Prepared Childcare Meals

In North Carolina, successful central community kitchens that cater to childcare centers have operated for many decades in urban areas. The authors identified these kitchens and their potential benefits through the implementation of farm to ECE programming, and as a result, we formed a work group to explore the possibility of replicating this model. This work group's purpose was to explore the potential viability of a rural central kitchen as well as key factors for successfully incubating a

central kitchen that prepared meals for rural childcare centers.

The primary example of a successful urban central kitchen that we were familiar with is housed in a church. Some of the factors that contribute to its success include that kitchen staff are able to use the industrial cooking facility during the day without interfering with church activities, in addition to the benefits of central kitchens listed above. Since churches are often one of the major community institutions in rural areas, and their kitchens represent existing infrastructure that could be leveraged in many communities, we wondered if this collaboration could be replicated.

In 2019, our team received a small planning grant from the Funder,[3] which allowed us to collect data in order to inform the development of the rural central kitchen concept (see Methods section). In 2020, the Funder awarded two grants to support the development of a central kitchen preparing meals for childcare centers in a rural area. One grant was made to a church in a rural area (we will use the pseudonym Pilot Church) to fund the renovation of their kitchen and start-up central kitchen project. The other grant was made to our working group to provide technical assistance and evaluation. Originally, we planned to assess the project's financial viability, community impacts, and health implications for children served. However, the project we planned to evaluate faced a series of challenges and failed to progress, and Pilot Church ultimately returned its funds to the Funder. In response, after consulting with our program officer, we changed our evaluation's purpose to focus on the project's development process in order to derive a set of lessons learned to guide future projects. In the next section, we will briefly describe our research methods before we draw on semi-structured interviews and the researchers' own experiences with the project to create a narrative timeline. This allows us to identify critical leverage points where the project faced challenges that it was not able to overcome. We will then provide a set of lessons learned from this attempted pilot of a rural central kitchen serving childcare meals, as well as recommendations tailored toward funders and communities who may be interested in replicating this model.

Methods

This study used qualitative methods to conduct a process evaluation of the Rural Central Community Kitchen[4] project. The team of researchers conducted six semi-structured interviews with key stakeholders, including two pastors who had been involved with the project, a member of church leadership, the former kitchen director, a childcare center director, and a member of the technical assistance team. Our evaluation team developed a set of questions for each stakeholder category. Questions were designed to elucidate each person's role, their perspective on what went well, the challenges they faced, and advice they would give to other communities interested in starting a similar project. Two of our team members conducted the interviews, which were subsequently transcribed verbatim by a commercial transcription service. Four team members reviewed the transcripts to jointly identify themes, patterns, and key issues, which led to an abbreviated code book with a list of themes. One of the four members conducted a qualitative coding analysis using this code list and NVivo 12 qualitative data analysis software. The research team met to compare themes and identify issues and drafted a set of lessons learned and recommendations. This research was approved by the North Carolina State University Institutional Review Board (Protocol #24444).

We recognize that this study is based on a small sample size[5]; however, our sample represents the viewpoint of all parties involved. The value in telling this project's story, and the factors that impeded its success, is that there are important lessons for other communities interested in this type

[3] Please note that this is a pseudonym to maintain the confidentiality of participants.
[4] Please note that this is a pseudonym to maintain the confidentiality of participants.
[5] Our original evaluation plan included establishing control sites to be able to compare and draw conclusions about changes in fruit and vegetable intake, among other metrics. Since the project never launched, we were unable to establish control groups as points of comparison.

of project. In addition, the authors were all involved with the project from its inception, including identifying the pilot partner, providing technical assistance, and designing and implementing the evaluation. We draw on our experiences to also inform our understanding of why this project ultimately was unable to launch.

Project Background and Narrative Timeline

A multi-institutional working group[6] came together in 2018 after initial conversations among themselves and with the Funder about replicating this central kitchen model in a rural part of the state. These conversations generated a number of questions to address as project objectives. Could the central kitchen model operating in more urban areas work in rural communities? What key factors enable a community to take on this type of project?

In July 2019, the working group conducted a survey of North Carolina Smart Start[7] executive directors that indicated a need for a supply of healthier meals for childcare centers. At the same time, these survey responses also indicated a potential barrier in the need to convince childcare programs of the benefits from sourcing from a central community kitchen. Table 1 shows selected survey responses, which indicate respondents' perceptions related to inadequacies of current meals served in the ECE sector in North Carolina, as well as interest in a central kitchen model to address these challenges.

Our team used survey responses to select a pilot county for the rural ECE central kitchen project. We received responses from 53 organizations (72 individual responses) across the 67 rural counties[8] in North Carolina. To narrow the focus, the project team ranked 67 rural counties based on: (1) Smart Start director identifying child health as a high priority in the survey; (2) Smart Start director's interest in pursuing the central kitchen concept; (3) an index of Child and Adult Care Food Program (CACFP) participation in the county; (4) a measure of childcare program density in the county; and (5) the incidence of childhood obesity and overweight in the county. There were 17 counties identified as potentially a good fit for submission of a grant, based on these criteria. To help discern which counties were candidates for replicating the central kitchen model in a rural area, members of the working group visited county-level stakeholders and potential kitchen sites in six counties. These counties were chosen based on where our working group and the Funder had relationships with community groups, or where the county reached out to our team to express their interest.

Table 1. Selected Responses from the NC Smart Start Survey (*n* = 72)

What is your perception of the quality of the meals served by the childcare providers in your service area?	% response
All providers are providing healthy and nutritious meals utilizing scratch cooking	5
Some providers struggle to serve healthy and nutritious meals and often utilize processed heat and serve foods	42
Most providers struggle to serve healthy and nutritious meals and often utilize processed heat and serve foods	37
Do not have enough information to answer this question	16
Do you feel that the Central Community Kitchen model could be beneficial for your service area?	**% response**
Yes	52
No	5
Maybe	43

[6] The work group included the authors, as well as the Technical Assistance Organization (pseudonym), and another nonprofit organization that works closely with rural churches.

[7] Quasigovernmental Smart Start organizations work in all 100 North Carolina counties through the North Carolina Partnership for Children and 75 local partnerships. See https://www.smartstart.org/

[8] We defined rural counties based on USDA classifications: https://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx

During these visits, the research team informally discussed the resources for and barriers to implementing a central community kitchen, and invited local county stakeholders to visit the kitchens in urban areas of the state so that they could observe a working model.

In consultation with the Funder, our team decided that Pilot County[9] provided the best fit for submission of a grant application. Pilot County was selected based upon: (1) interest from Pilot Church; (2) presence of an on-site childcare program run by the church that would provide an initial demand for meals; (3) easy highway access to numerous childcare programs in the northern suburbs of a nearby urban area; (4) expression of support from the Pilot County Partnership for Children; and (5) the Funder's established grantee relationship with Pilot Church. The Funder helped start Pilot Church, which was founded as a social enterprise centered around the on-site childcare center, which also made it an appropriate fit for this project. In terms of its rural classification, the U.S. Department of Agriculture's (USDA) Economic Research Service classifies Pilot County as Nonmetro-Urban population of 20,000 or more, adjacent to a metro area. According to the U.S. Census, Pilot County has approximately 225 residents per square mile, while the North Carolina Division of Child Development and Early Education and Anne E. Casey Foundation Kids Counts Database report there were a total of 1,856 children in childcare, across 64 childcare programs. The research team anticipated that the low population density in the county would pose challenges in creating this type of centralized food distribution due to the transportation challenges identified earlier.

In addition to the survey and site visits, our team conducted additional research to further support the development of this project. One team member identified and interviewed three central kitchens catering meals to childcare in North Carolina, as well as four additional kitchens nationally. The result was a white paper that was used internally to present key considerations identified by these seven model central kitchens catering meals to childcare centers. Based on these interviews, the team member conducted financial analyses to determine how many children the kitchen would need to serve in order to reach financial viability. For modeling the prices, he used a North Carolina urban central kitchen that caters to ECE sites, referred to by the pseudonym Technical Assistance Organization, as a model. Using food costs and labor staffing provided by the Technical Assistance Organization, in 2020 a member of our working group constructed a pro forma profit and loss (P&L) analysis for a central kitchen providing meals to 400 children (see Appendix for a simplified version). This P&L assumed that the central kitchen could prepare and deliver meals (breakfast, snack, lunch) to childcare programs at US$4.00 per child per day, which was consistent with the urban central kitchen pricing at the time and could be fully covered by CACFP reimbursements. This pro forma indicated that a central kitchen could break even within three years using these assumptions, excluding any capital that would be required to outfit a commercial kitchen. It was also clear that distribution costs to rural childcare programs had the potential to be higher than in an urban area, but were hard to estimate because we did not have a concrete case to use as an example, including estimates for travel time and delivery options. Determining delivery costs in a rural area was one goal of piloting a central kitchen concept in a rural community.

In 2020, Pilot Church was invited by the Funder to apply for a grant to start a pilot central kitchen to cater meals to childcare centers in Pilot County, and the grant was awarded in January 2021. The financial assessments described above were provided to the Pilot Church, and they used them to develop their proposal, project plan, and budget. The grant covered any necessary upgrades and expansions of the church's existing kitchen, as well as the costs of hiring and training staff and contracting the Technical Assistance Organization. The goal was to provide daily meals for the approximately 100 children who attended the Pilot

[9] We refer to this county as Pilot County, and the associated Church as Pilot Church, as pseudonyms to protect the identity of participants.

Church's existing on-site childcare center, as well as five to six additional childcare centers in the area, to reach the estimated 400 children needed to break even. A separate grant was given to NC State University, with subawards to Duke University and the Technical Assistance Organization. The University of North Carolina at Chapel Hill participated without any funding. This second grant was intended to provide technical assistance and conduct an evaluation of the new central kitchen.

Planning and remodeling the Pilot Church's kitchen was intended to begin shortly after funds were granted. However, when COVID-19 hit in March of 2020, Pilot Church's childcare program was forced to close. When the Pilot Church received the grant funds early in 2021, its staff consulted with the program officer and decided to put the project on hold. The Pilot Church's childcare site reopened in March 2021, but due to the ongoing difficulties caused by COVID, the childcare center closed permanently in June 2021. The church arranged for Pilot County Community Action Head Start/Early Head Start to lease the space in September 2021 and open a program in the now-vacant childcare space at the church. The Church leadership hoped that the new central kitchen could provide meals to the Head Start children on site, and perhaps some of the other Head Start programs managed by the Community Action Agency.

In March 2021, the pastor who submitted the grant application was informed that they would be reassigned to two new churches in another county. Before their departure, the pastor approached district-level leadership in the Pilot Church to inform them of the project and to request that either a pastor be assigned with the capacity to manage the project, or that they return the grant funding to the Funder. The replacement pastor of the Pilot Church arrived in July 2021. The outgoing and incoming pastors discussed the grant during their transition period, and also had conversations with lay church leadership. Ultimately, the incoming pastor decided to proceed with the grant because they felt that they had the experience needed for this type of project, as they had nonprofit work experience and an MBA. The construction to renovate the existing kitchen began shortly after the second pastor arrived. A church member was identified who had experience managing a large kitchen and could help advance the project. This church member began working on the project in August 2021 as a volunteer, and served as kitchen director from October 2021 until resigning in April 2022. In July of 2022, the second pastor was reassigned, and the Pilot Church—whose membership had dropped drastically post-COVID to only about 20 members—hired a part-time pastor to replace the second pastor. In addition to the issues facing the implementation of this project, the Church struggled post-pandemic due to the closing of the childcare center (which had been a major source of revenue) and internal conflict related to changes in pastoral leadership (including racial tension).

During the start-up phase of this pilot central kitchen, three issues arose that ultimately led the church leadership to terminate the project. First, there were a number of permitting and construction issues that arose during the upgrading of the kitchen. The most significant issue was that the existing septic system was judged to be inadequate by the Pilot County Health Department for the number of meals the Pilot Central Kitchen wanted to serve, and the resulting upgrades to meet code were cost prohibitive, so they were unable to obtain a permit. Second, the Head Start program also ran into licensing issues related to the change in the kitchen's classification from serving an on-site childcare center to being considered a caterer. The Head Start Program would have had to invest in renovations to install a modified kitchen in order to receive catered meals into their facility. These potential additional costs led them to decide not to open a location at Pilot Church. Finally, with the departure of the second pastor and the kitchen director stepping down, there was no one to lead the project. In September 2022, the leadership at the Pilot Church decided to terminate the project and return unused grant funds to the Funder.

Results: Key Findings

Through semi-structured interviews with key stakeholders involved in the attempted pilot of a rural central kitchen designed to cater meals to childcare centers, as well as the authors' own experiences with the project, we are able to identify a set of

issues that we believe other communities should be aware of before attempting to replicate this type of project. We also describe why stakeholders were originally interested in this project, and why we believe it has value for other communities to consider replication, despite the roadblocks faced in this particular attempted pilot project.

Key Findings: Identified Issues that Inhibited the Project

A number of issues inhibited the progress of the Rural Central Community Kitchen project, ultimately leading to Pilot Church's leadership's decision to cancel the project in September 2022. Some of these issues were unprecedented, such as the COVID-19 pandemic, which placed the pastor at the time under a great deal of stress and which led to the closing of the on-site childcare center. In this section, we attempt to focus on the issues that we believe are generalizable to other communities interested in this type of project, rather than those which were more specific to the Pilot Church and the period of time in which they attempted to launch the kitchen. These four central issues provide guidance for communities interested in pursuing similar projects and include (1) the power dynamic between funder and grant recipient, (2) the pastor as a project lead, (3) lack of buy-in from church leadership and community stakeholders, and (4) sanitation and permitting roadblocks.

1. Power dynamic between funder and grant recipient

The effects of the latent power dynamic between the funder and grant recipient need to be acknowledged and addressed. During the evaluation interviews, multiple stakeholders expressed that the former pastor felt pressured to pursue the project by the Funder's direct invitation to apply for the Central Kitchen Pilot grant. When the on-site childcare center closed and the pastor originally applying for the grant was reassigned, multiple stakeholders thought it was time to cancel the project and return unspent funds to the Funder. However, the Pilot Church continued with the project when the newly assigned pastor arrived, as the pastor believed the project was viable, in part because they were not yet aware of the issues with the sanitation and permit requirements.

2. Pastor as project lead

The potential success of the central kitchen project relied too heavily on the pastor as the sole project leader. In the case of Pilot Church, having the church pastor lead the project presented two major challenges that offer guidance for other communities interested in similar projects. First, in some denominations, pastors maintain their appointments for three years, but sometimes less. In the case of the Pilot Church, a new pastor was appointed one and a half years after the grant was awarded, and again after only one year. This regular reappointment structure within the church disrupted and destabilized the project progress because the pastors were the project's lead. Second, the former pastor expressed that having primary leadership reside with a pastor is not reasonable given the other wide-ranging pastoral responsibilities within the church. The pastor should maintain oversight of the project, but not be responsible for its daily management.

3. Lack of buy-in from church leadership and community stakeholders

The evaluation interviews indicated that the central kitchen project at Pilot Church did not have buy-in within the church (from church leadership and lay members) or outside of the church (from other community stakeholders). Without buy-in from these groups, the project lacked critical engagement and support. During evaluation interviews, stakeholders expressed that there was a lack of buy-in from the church leadership and congregation due to concerns over the capacity of the small, aging congregation to fully engage and support the project. Thus, these interviews indicate that the greater Pilot Church community never felt that the central kitchen project was a good fit for the church as a whole. The Funder and the technical assistance and evaluation team were unaware of these concerns and the internal church dynamics, as the research team had a relationship with the original pastor on whom we relied for building buy-in from the church community.

The pilot project leaders did not fully engage other community stakeholders, such as the local Health Department (Environmental Health) and Smart Start, early in the planning process. More

specifically, the Health Department was not consulted before the kitchen renovations were begun. The County Smart Start was initially engaged during the planning process, but due to COVID-19 and the subsequent delays of the project, there was a lapse in further engagement and partnership with them. Although the central kitchen project was canceled before beginning to serve meals, establishing necessary community relationships and engaging with stakeholders during the planning process of the project would benefit a planning team by allowing them to incorporate the stakeholders' guidance to address anticipated future project challenges. A larger team involving the community and invested stakeholders would allow for shared leadership, addressing the second issue we identified (relying too heavily on the pastor as the project champion).

4. Regulations

The Rural Central Community Kitchen was unable to meet the requirements of the county's health and sanitation codes, even after kitchen renovations were complete. Previously, the kitchen had been used to prepare meals for the Pilot Church's on-site childcare center. However, Environmental Health considers central kitchens to be caterers; when the use of the kitchen shifted from on-site meal preparation to a central kitchen (i.e., caterer), the applicable regulations changed accordingly. Specifically, the number of meals being prepared increased, and the capacity of the church's septic system was deemed inadequate to meet the new parameters of the caterer permit.[10] In addition, when the kitchen was reclassified as a caterer, the on-site childcare fell under new guidelines as well, and would have had to modify the childcare center site so that it could receive and store meals prepared by the Rural Central Community Kitchen. Thus, it is of great importance to engage the local departments responsible for granting health and sanitation licenses early in the process. As suggested by the earlier review of the literature, there are many regulations that new food processing businesses need to be aware of, including labor laws and zoning in addition to those related to food safety.

Identified Benefits of the Central Kitchen Concept

Despite the numerous roadblocks the Pilot Church faced, which led to the premature termination of the central kitchen grant, almost all of the stakeholders interviewed during the evaluation process agreed that a central kitchen catering childcare meals would be a beneficial addition to their rural community. They identified four major benefits of a central kitchen in a rural area:

1. There is a potential to serve fresh, local, and healthy meals by the central kitchen. Rural childcare centers may not be able to prioritize providing these types of meals on their own due to budgetary, personnel, and capacity considerations. For example, the childcare center director said: "When I think about the private childcare facilities, [this] would save them so much. It really would. And they would be getting quality. That's a big thing with us, we want quality meals for these kids. Sometimes these private centers do the bare minimum because it is expensive."
2. It would reduce the administrative burden on childcare centers in terms of reporting for the Child and Adult Care Food Program. Childcare centers purchasing from central kitchens in urban areas benefit from easier reporting. In general, CACFP administration has been documented to be challenging for small childcare centers (Lee et al., 2022).
3. Some centers, especially in rural towns, struggle with recruiting and/or retaining skilled kitchen personnel to prepare meals. A central kitchen, with its trained personnel, can serve multiple childcare centers, removing this potential burden from individual centers.

[10] These regulations can be found in 15a NCAC 18a .1949, of North Carolina's Department of Environment, Health, and Natural Resources regulations: http://reports.oah.state.nc.us/ncac/title%2015a%20-%20environmental%20quality/chapter%2018%20-%20environmental%20health/subchapter%20a/subchapter%20a%20rules.pdf

4. At least one respondent brought up the importance of bringing healthy nutrition and childcare into the forefront of the church community. This respondent felt that this focus on health and wellbeing for children aligned well with their rural ministry. Furthermore, they believed the increased focus and involvement by the church community in these operations would benefit their overall community.

Structural Issues

As described in the literature review, there are many challenges to developing a start-up business to create infrastructure in local food systems. Many of the challenges that the Rural Central Community Kitchen faced could have been anticipated based on the previously mentioned challenges of operating small-scale businesses in the mainstream food system, including those related to high costs, increased labor needs, and difficulties meeting regulations (Fitzgerald et al., 2024; Fitzsimmons et al., 202, 2024). Costs and labor requirements are especially challenging in a system that favors large-scale businesses that can reduce costs based on economies of scale, and that also relies on a low-wage economy to reduce labor costs (Lyson et al., 2008). Attempting to challenge this system by operating at a smaller scale and paying staff a living wage predisposes a project to facing challenges, which is why many commercial kitchen startups and other local food infrastructure with social missions find themselves reliant on grant funding (Fitzsimmons et al., 2023; Freake & Godfrey, 2017; Jablonski et al., 2011; Rysin & Dunning, 2016). There are other structural issues which this project would have faced if it had progressed beyond the renovation stage, in addition to financial viability. Figuring out the logistics of transportation for deliveries to individual centers, given the rural nature of the location, remains a challenge that we were not able to explore how to address, and which other communities should be aware of as they consider the appropriateness of a similar project.

Importance of Technical Assistance

Stakeholders also identified the technical assistance provided as a positive aspect of the project. The Technical Assistance (TA) Organization has been successfully running central kitchens serving multiple childcare centers in three different urban counties for over three decades. They were instrumental and essential in advising both in the feasibility study as well as after the Pilot Church started implementing their grant. The Technical Assistance Organization offered in-person and online services to the Pilot Church. Throughout the process, the Technical Assistance Organization traveled to visit the church kitchen and facilitated a tour to their kitchens in urban areas, which allowed Pilot Church pastors and kitchen manager to observe an example operation.

In addition, they offered a menu of TA options (Figure 1). Due to the timing of the need for specific TA services, some of these options were utilized and some were not needed (as the kitchen never became functional). One lesson that our TA team learned during the course of this project is that the Technical Assistance Organization was less prepared to offer guidance related to licensing and permits, for two primary reasons. First, the licensing and permitting for the three

Figure 1. Menu of Technical Assistance (TA) Options Provided by Technical Assistance Organization

a. Contract Development	g. Sanitation Compliance
b. Budget and Business Plan	h. Spreadsheets and Templates Package
c. Transportation Options	i. Staff Training After Opening
d. Staffing and Training Advice Before Opening	j. Menu Support and Design
e. Organizing the Kitchen Systems	k. Recipes
f. Licensing and Permits Assistance	l. Group Purchasing Contract

Technical Assistance Organization kitchens in urban areas had occurred before either of the technical assistance providers had joined the Technical Assistance Organization, and therefore they did not have firsthand knowledge about the process. Second, in North Carolina, while there are statewide public health regulations, each county health department has the flexibility to interpret how they implement these rules, which can sometimes lead to county-based differences. Because of this, we recommend that any community interested in starting a central kitchen work directly with their county health department to ensure that they understand the parameters of the regulations that they need to meet. In addition to the fact that our team should have been more prepared to offer food-safety technical assistance and support with complying with appropriate regulations (Fitzgerald et al., 2024; Fitzsimmons et al., 2023), in retrospect we also should have provided support to the church earlier in the process, and done more outreach to build a community coalition interested in supporting the process. We also recommend that technical assistance providers help conduct a financial viability assessment before entering a market, either by developing their own profit and loss assessment, as our team did, or by using tools that are publicly available (see Bowser & Holcomb, 2018; Fitzsimmons et al., 2023).

Recommendations

Since there is still a need to pilot the concept of a rural central kitchen for childcare meal preparation in order to identify barriers and facilitators, our recommendations are targeted toward funders who might be interested in funding a pilot project. We also believe that community groups who might be interested in understanding whether the model is a good fit for their community will also benefit from these recommendations.

Primary Recommendation

Our primary recommendation is to make funding available through an open-call, competitive request for applications (RFA), and to break the funding availability into three phases. Offering funding through an open call will address the funder–recipient power dynamic that we observed, while a phased RFA will allow a funder to set the requirements a community group needs to meet before accessing additional funding. The requirements can be designed specifically to address the issues we identified, while a phased approach gives both the community and funder the chance to assess project viability before committing to the project. TA should be available to the community during all phases of funding and may include visits to urban examples of childcare kitchens, as well as evaluation support. The research team proposes the following phases and respective requirements to address identified issues.

Phase 1: Planning

Any rural community group can apply for planning funding. At the end of this one-year, small grant, the lead Community group would need to demonstrate to the funder that they have completed the following steps in order to apply for continued funding:

1. Assembled a Leadership Team that includes representation from local childcare support organizations, the County Health Department (Environmental Health), Cooperative Extension, local food hub, and/or other relevant community organizations and groups.
2. Engaged with county or state food safety Extension agents or specialists, or hired a food safety consultant.
3. Conducted outreach (for example, survey, listening session) with childcare centers to assess demand for catering services.
4. Identified a potential site for the central kitchen.
5. Worked with their County Health Department to determine if the site can be renovated to meet all necessary permitting requirements.
6. Worked with an architect to develop a set of plans or kitchen renovation that meets all licensing and permitting requirements.
7. If working with a Church, engaged with the Church advisory council and congregation to build interest and commitment to the project.
8. Developed a budget, business plan and an estimate-based break-even analysis.

Once a county team has demonstrated that it has a shared leadership model, buy-in from community groups and childcare centers, as well as a site with a set of renovation plans that have been reviewed and approved by the County Health Department (Environmental Health), they could apply for Phase 2 funding to implement the central kitchen model.

Phase 2: Implementation

Phase 2 would include:

1. Hiring a project manager.
2. Renovating the site.
3. Identifying vendors, including local food suppliers.
4. Training staff.
5. Developing recipes and submitting CACFP paperwork.
6. Creating standard operating procedures.
7. Entering into contracts with childcare centers.
8. Designing delivery logistics.
9. Preparing and delivering food.
10. Offering farm to ECE programming to participating centers.

Phase 3: Evaluation

Phase 3 would overlap with Phase 2 so that a participating community can consult with the evaluation team to set goals and determine a set of metrics and tracking tools that it can use to assess the process and measure impacts. An evaluation framework would be used to evaluate:

1. Improved meal quality.
2. Economic impacts on centers.
3. Financial viability of central kitchen (including updating the estimates in the break-even analysis developed in Phase 1 with actual financial outcomes).
4. Community impacts of the central kitchen.
5. Process evaluation of project planning, implementation, and technical assistance.

Conclusions

There were several factors that impeded the success of this pilot central kitchen project, both externally and internally. We have identified those issues that we believe may be generalizable to other communities, although we recognize the limitation of our study with regards to the small sample size. While we realize that there are many factors that are unique to this project, we also think that there is value for other communities to consider the obstacles that this project faced if they are contemplating developing their own community kitchen project. In addition, we recognize that one limitation to this study is our team's involvement in both the technical assistance and the evaluation of the project, which may have introduced bias into our interpretation of the factors leading to this project's lack of success. To address this, we have made attempts to be as objective as possible and to rely heavily on primary data that was collected. Our primary commitment has been to prioritize the lessons learned from the project, without blaming or passing judgment. We believe that it is important and often overlooked to critically examine and share information from failed projects.

From the examination of this case, the authors' recommendations for rural communities interested in central kitchens are the following: First, ensure community buy-in and shared leadership, rather than relying too heavily on an individual champion to lead the project (especially a pastor). Second, engage the County Public Health Department (Environmental Health unit) early in the process. We believe that these two primary recommendations can be addressed through a carefully crafted request for proposals (RFP) issued by a funder, which would have the added benefit of addressing the latent power dynamic between the funder and recipient.

We believe that the concept of a central kitchen that caters healthy meals to childcare centers in rural areas continues to bear merit. While the COVID-19 pandemic negatively affected this Rural Central Community Kitchen project, our community partners across the state have expressed that the current labor shortages experienced by most childcare centers make the provision of prepared meals a timely intervention. This perspective is supported by post–COVID-19 research about the factors impeding applications to

the CACFP program, where centers were interested in learning more about how to outsource meal preparation (Lee et al., 2022).

As the childcare sector continues to recover from the pandemic and to feel the aftershocks of supply-chain disruptions and understaffing, catered meals that incorporate healthy, local food may provide an important strategy. This context makes it all the more important to move forward with determining the success factors for starting up a successful rural central kitchen.

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Appendix. Pro Forma Costs for a Central Kitchen Supplying Meals for 400 Children per Day

(Pro Forma Generated in 2018)

Central Kitchen Revenue per Child Fed per Day

Breakfast	$0.75
Lunch	$2.10
Snack	$0.60
Delivery Revenue	$0.55
Total	$4.00

Central Kitchen Meal Cost per Child Fed per Day

	Ingredient Cost	Labor Cost	Total
Breakfast	$0.29	$0.26	$0.55
Lunch	$0.99	$0.71	$1.70
Snack	$0.24	$0.25	$0.49
Delivery Expense			$0.55
Total			$3.29

Central Kitchen Annual Fixed Expense

General & Admin	$24,000
Rent	$24,000
Repairs	$5,000
Insurance	$5,000
Other G&A	$5,000
Total	$63,000

Note: Capital expense dependent upon current kitchen infrastructure

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Crafting a grassroots introduction to food policy course

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Abstract
This reflective essay provides insights from a pilot, public-facing virtual course, Introduction to Food Policy, that was developed and delivered in summer 2022. Building on interest and efforts in Florida in urban agriculture, agroecology, and fostering more equitable food systems through food sovereignty principles, the University of South Florida Food Sovereignty Initiative and the Florida Food Policy Council collaborated on constructing and delivering this introductory course, which was accessible to students, community members and policy makers. Over a six-week period, the pilot course featured weekly presentations from food system specialists in the areas of (1) understanding food policy, (2) researching food policy, (3) environmental food policy, (4) food policy advocacy, (5) civic engagement with food policy formulation, and (6) regional food policy. In this reflection, the authors, a collective of leadership of the Florida Food Policy Council and faculty from the Food Sovereignty Initiative, offer insights about the process of creating the course, delivering the weekly lectures, and some overall concluding observations. We include participant comments from a post-course survey and an outside evaluation from the North American Food Systems Network. This reflection is intended to help strengthen the evidence base in the literature on community-based collaborative

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educational interventions related to food sovereignty and related food policy issues. It serves as an example of how a locally organized, virtual educational intervention has the potential for local and national influence on food policy awareness.

Keywords
food policy councils, course development, urban agriculture, agroecology, virtual intervention, food sovereignty

Introduction

Food policy councils (FPCs) have emerged in the last several decades as a response to the growing national and international need to coordinate local food initiatives that address food insecurity, increased access to healthy food, and environmentally sustainable methods of food production and consumption (Santo et al., 2020; Schiff et al., 2022; Scherb et al., 2012). Schiff et. al's scoping review of studies of FPCs from 1999–2019 notes four major themes that emerged: activities, organizational dimensions, challenges, and facilitators. They also identify a sub-theme of equity and diversity efforts along racial and economic lines. Activities that FPCs focus on include influencing food policy at municipal, regional, and state levels. FPCs also engage in work outside policy formation, such as implementing food programs, facilitating discussion among various food system stakeholders, building urban agriculture projects, and creating educational programs (LeGreco & Douglas, 2021; Schiff, 2008; Schiff et al., 2022). Building transparency in food policy formulation is a core goal of creating food democracy, the capacity of an active citizenry to participate in building an "ecologically sound, economically viable, and socially just system of food and agriculture" (Sieveking, 2019, p. 50). FPCs strive to "work across sectors, engaging with government policy and programs, grassroots/ nonprofit projects, local businesses and food workers" (Harper et al., 2009, p. 2).

Massive disruptions in global supply chains caused by COVID-19 revealed the fragility of current supply chains and spawned heightened interest in urban agriculture, sustainable food production practices, agroecology, and food sovereignty (Borras et al., 2020; Dagunga et al., 2023). Additionally, the murder of George Floyd sparked renewed global dialogue on structural racism in all social institutions. Food system stakeholders urged local, county, and state programs to re-examine social inequalities and how institutional power relations impact decision-making processes (Garth & Reese, 2020; Palmer et al., 2020). Public health researchers also reinvigorated discussions on how inequitable access to healthy food has negatively impacted nutritional quality along racial lines (Singleton, 2022). Faced with these challenges and opportunities, FPCs "identify and propose innovative solutions to improve local or state food systems, spurring local economic development and making food systems more environmentally sustainable and socially just" (Harper et al., 2009, p. 2). The dual circumstances of the pandemic and the heightened awareness of structural inequities involving racial and environmental injustice in food systems contributed to new food policy discussions (Palmer et al., 2020).

Paolo Freire's concept of critical consciousness raising (*conscienziação*) has established the field of critical literacy in ways that are informing how we think about food policy literacy (Ramos-Gerena, 2022). Freire asserts that developing a critical consciousness involves economically disenfranchised and socially marginalized groups forming their own understanding of situations and challenges impacting their daily lives. Only through developing a critical consciousness and ultimately articulating solutions to their own problems, do communities begin to shift relations of power (Freire, 2018). As Ramos-Gerena has noted, because people of different socio-economic, cultural, and educational backgrounds engage with the food system in different ways, from the micro-level (e.g., nutritional) to the macro-level (e.g., social, environmental, political), we need a critical examination of the power dynamics involved in how people learn about food policy and what constitutes food knowledge. Failing to connect people's food literacy and policy literacy risks leaving gaps in knowledge and diminishing opportunities to participate in food policy decisions. Alternatively, "a critical awareness of the food system and its policies could result in more structural food policy transformations" (Ramos-Gerena, 2002, p. 323).

Because building awareness about our food systems and policies is essential, evaluating the effectiveness of such educational campaigns is critical. Competency-based education has been developed to provide more accessible, affordable, transparent, and outcome-oriented learning experiences (Dankbar et al., 2023). Discussing food systems education, Dankbar et al. assert that a competency-based educational framework "allows independent local food systems learners to identify specific competencies they need to gain, based on their own professional and educational backgrounds and goals" (2023, p. 290). The flexibility and malleability of this framework allows communities to evaluate their existing assets (e.g., educational institutions, citizen groups and students, government organizations) and build food systems curricula accordingly. A competency-based framework might better equip students and citizens with a broad understanding of food production, distribution, and marketing in addition to the complex nature of community-engaged development projects (Hilchey et al., 2021).

Supporting the movement to promote competency-based education, in 2019 a national group of educators and practitioners developed the Local Food System Practitioner and Educational Resource Database, which included a competency metric that food system leaders and educators can use to evaluate their curricula. In 2019, the North American Food Systems Network (NAFSN) helped develop a Food System Core Competency that food systems practitioners can use to tailor their food systems educational programs to particular community needs or gaps (Dankbar et al., 2023). The Core Competency metric includes three levels of learning competency by which food system practitioners can identity gaps and opportunities for their educational projects.

The COVID-19 pandemic and the global Black Lives Matter protests ushered in new local and global power dynamics in the form of new food polices and projects related to supply chains (Florick & Park, 2022), systemic inequalities in food access, and opportunities to imagine building more resilient local food systems through new forms of partnership and collaboration, such as community gardens and urban agriculture (Joshi & Wende, 2022; Schanbacher & Cavendish, 2023), and food sovereignty initiatives (Loker & Francis, 2020). Given the magnitude of the paradigmatic shifts in global food policy and social politics impacting the work of state universities and nonprofits in Florida, researchers, legislators and practitioners will face new challenges and opportunities in food systems policy work. This reflective essay provides insights from a pilot, public-facing virtual course, Introduction to Food Policy, that began navigating this new terrain of food policy education and literacy.

Methodology

The course Introduction to Food Policy was developed and delivered by the Florida Food Policy Council (FLFPC) and the University of South Florida Food Sovereignty Initiative (FSI) in summer 2022. This paper was developed collaboratively by the author team through reviewing field notes taken while creating and organizing the course, along with the actual execution of the curriculum and review of participant feedback on the course. Data presented is based on these notes, as well as reviews and analyses of post-course evaluation survey comments from participants. The data collection instrument and process was approved by the University of South Florida Institutional Review Board (IRB) on August 2, 2022 (Study 004535).

The FLFPC collaborated with the FSI, a transdisciplinary network of faculty members who are researching and teaching courses related to food sovereignty and agroecology.[1] One of the few university-led food sovereignty initiatives in the U.S. (Food Sovereignty Initiative, 2025), the FSI was recruited to help develop program evaluation and consult on community-based research methods. As a relatively new initiative (two years old at the time of the food policy course), the FSI recognized that addressing issues of food justice required dedicated partnership and collaboration with surrounding communities, especially underserved communities

[1] At the time we conducted this course, our name was the USF Food Sovereignty Group. The name has changed to the USF Food Sovereignty Initiative.

that face food insecurity and low access to healthy food. While programmatic initiatives were important, we also recognized a lack of coherent food policy and food policy awareness, which prompted the FLFPC and FSI team to apply for the University of South Florida Creative Scholarship Grant to explore how food policy education could contribute to the food sovereignty theme of democratizing our food systems.

The Florida Food Policy Council (FLFPC)

The FLFPC, established in 2016 as a 501(c)(3) nonprofit, is a grassroots organization that works toward fair and healthy food for all Floridians. Director Erica Hall reflects on the evolution of the FLFPC and its grounding in the JEDI approach—justice, equity, diversity and inclusion (FLFPC, n.d.)—as it led to the creation of the Introduction to Food Policy course:

> This process of enshrining a JEDI approach into food policy council work is critical yet challenging work. The Council is an important voice for groups throughout the state and provides a safe place to encourage and engage in sometimes uncomfortable dialogue and discussion. Council leadership is also deeply entrenched in the intersectionality and connection between food, racial, social, climate and environmental justice. Out of necessity, training and research has become cross-disciplinary, incorporating public health, the built environment, transportation, agronomy, ecology, and the social sciences.

The FLFPC experienced an internal shift during the pandemic and social justice movements in 2020, reconsidering and reflecting upon its core values and endeavoring to reframe its mission and vision because of the national and global changes taking place. Like many food policy councils in 2020–2021, the FLFPC wanted to reimagine how changing local and global dynamics changed its relationships with its constituents and communities, and how it would respond to the paradigmatic shifts of the time (Hall, 2023, Palmer et al., 2020).

Inspired by the work of Malik Yakini and the Detroit Black Food Sovereignty Network (White, 2018), the FLFPC decided to conduct a visioning session to strategize its future. After this meeting, the FLFPC decided to pursue a JEDI approach, which meant revaluating every aspect of the organization and implementing a renewed commitment to accountability, equity, and inclusivity in its general public membership, FLFPC Board, and staff. The FLFPC surveyed its members, partners, collaborators, and stakeholders to ask what type of topics would be important and useful to the communities. These inquiries found that communities wanted a greater awareness about the dynamics of food systems, food policies, and opportunities for greater participation in their food choices.

Building the Introduction to Food Policy Course

Prior to developing the course content and description, the FLFPC conducted a survey of its community partners to ask what they would like to see in a food policy course. After evaluating the responses, the FLFPC began developing the framework for the course, keeping in focus its new vision, mission, and goals. The course challenged the FLFPC team to remain intentional about fostering collaboration by strengthening intersectional, interdisciplinary, and intergenerational relationships. The FLFPC leadership team was also determined to make the course affordable, accessible, and comprehensive enough to meet the needs of community stakeholders at all levels of food system participation (e.g., producers, distributors, consumers). The course was promoted to anyone who was interested in obtaining foundational knowledge of food policy and in developing the skills needed to advocate for better food systems. Because of this broad target audience, FLFPC leaders decided it was important for the course to introduce basic concepts and fundamental terminology as well as more complex insights, innovations, and multidisciplinary aspects of food policy work.

Spanning six weeks, the course provided attendees with a foundational knowledge of food policy and tools to engage in advocacy. It featured renowned experts from U.S. organizations who spoke about their experiences working with food policy, food systems initiatives, and food policy councils. The sessions in weeks 1–5 had two components: Hour 1 was presentations by experts, and Hour 2 was breakout sessions. Each week, there

was a variety of breakout sessions for attendees to choose from. Week 6 was a Town Hall, showcasing regional food policy work in Florida, with two components: short presentations from panelists and a community question-and-answer session. The course was held on Wednesdays, 6:30–8:30 pm EST, July 27–August 31, 2022, with the following structure:

Topics:

Week 1: Introduction to Food Policy and Food Policy Councils (July 27, 2022)
Week 2: Understanding Food Policies and How to Find Them (August 3, 2022)
Week 3: The Intersection of Food Policy and the Environment (August 10, 2022)
Week 4: Effective Strategies for Food Policy Advocacy (August 17, 2022)
Week 5: Civic Engagement and the Legislative Process (August 24, 2022)
Week 6: Virtual Town Hall: Regional Food Policy Work in Florida (August 31, 2022)

At the beginning of the course, enrollees received the course outline and workbook which included short biographies of guest speakers. Speakers included nationally renowned scholars such as Anne Palmer, director of practice at the Johns Hopkins Center for a Livable Future, academics such as University of South Florida professor and FSI Director William Schanbacher, and local urban farmers and food justice advocates. The workbook provided the weekly discussion themes for each guest speaker as well as some leading questions for discussion. It also included a column for notes, questions, and feedback, which was used to evaluate the course.

To build accountability into their efforts, the FLFPC asked the North American Food Systems Network (NAFSN) to assess the course against the Food Systems Core Competencies matrix tool (Dankbar et al., 2023; Long & Chase, 2020). The Introduction to Food Policy course was one of the first instances in which NAFSN deployed this tool so it was helpful for them in validation and continued tweaking of the tool. The following section outlines the NAFSN mission and its participation in assessment.

North American Food Systems Network

North American Food Systems Network (NAFSN) is a professional association for people who work to strengthen local and regional food systems. At its founding in 2015, NAFSN initiated the development of core competencies in food systems to establish a uniform standard of skills and knowledge that food systems professionals need to have acquired to be successful in different roles in food systems development. In 2019, NAFSN joined a formal collaboration led by Iowa State University Extension and Outreach and other national partners on a project funded by the U.S. Department of Agriculture (USDA) Agricultural Marketing Service to identify core competencies for food systems professionals. In 2021, NAFSN adopted the core competencies as foundational to its work in support of food systems professionals. It should be noted that this is a still growing and dynamic body of knowledge that will require regular review, open dialogue, and a solid commitment to equitable inclusion.

NAFSN was approached by a member of the FLFPC to conduct an assessment of the Introduction to Food Policy course using the competencies in the Food System Core Competency Project matrix. NAFSN identified two volunteer members of its leadership circle to conduct the assessment as reviewers. Both reviewers have experience as community food systems leaders, one from Connecticut and one from Georgia. One reviewer participated in all six sessions of the course in real time. The other reviewer (who also participated as a featured speaker for the course) attended two of the six sessions in real time and reviewed recordings of the other four sessions. Both reviewers also conducted extensive reviews of the course materials.

To prepare for the assessment after the course, the reviewers read the Food System Core Competency Project report to familiarize themselves with its matrix of competency categories and subcategories. The reviewers then met with an Iowa State University Extension and Outreach faculty member to discuss and clarify the definitions in the matrix for Level 1 learning (novice/knowledge change), Level 2 learning (intermediate/behavior change), and Level 3 learning (master/systems change).

To conduct the assessment, each reviewer began by working alone to reflect upon the coursework and materials of the course with respect to each competency outlined in the Food System Core Competency Project's matrix. If a competency from the matrix had been discussed in a meaningful and memorable way during the course, according to their personal assessment, the reviewer marked it as having met a Level 1 competency. Otherwise, it was left blank and therefore considered unmet.

Results: Post-Program Assessment

NAFSN evaluators agreed that knowledge acquired by taking an introductory course such as this one can only meet the requirements of Level 1 learning, and that it would be infeasible to demonstrate Level 2 or Level 3 learning from the experience of taking this course. It was acknowledged that each enrollee would bring their own lived experiences and work experiences to the educational series; however, this pilot assessment could not definitively account for the value of any subsequently emergent knowledge assets.

In addition to the NAFSN assessment, the University of South Florida team developed a post-program survey to help depict participant experiences. Table 1 presents a sample of the feedback to key questions in the post-program assessment survey. While there were 42 participants in the course, participation in the surveys was optional and all responses were anonymous.

From the sample of qualitative responses, key themes emerged. From the first question, the importance of how food policies are created and of navigating them for advocacy, and variation at local levels were identified by participants as important topics. From the second question, mapping and data collection, community building, and navigating food policies were areas in which participants stated they improved their skills. From the third question, key policy issues learned included the relationships between local food initiatives and public health, urban planning, land use, and the importance of zoning policies as they impact urban agriculture and gardening projects.

In addition to our qualitative questions, we included three quantitatively framed questions (27 responses for each question) based on a five-category Likert Scale:

- How familiar are you with food policy?
- How familiar are you with strategies for food policy advocacy?
- How familiar are you with the legislative process for food policies?

Table 2 summarizes the quantitative responses received from the three questions.

The majority of respondents indicated moderate familiarity with each of the question topics, indicating that there was a cohort-level propensity for understanding and appreciating food policy issues.

Discussion

The role of the FLFPC changed during the COVID-19 pandemic. As Hall noted, along with fighting a public health crisis, racial and social injustice took center stage in national and local politics (Gamblin & King, 2021; Palmer et al., 2020). The murder of George Floyd that re-energized the Black Lives Matter movement, and the 2021 Great Resignation in which employees voluntarily resigned from their jobs had waterfall effects that flowed into food system work. Hall reflected on the challenges of the time, noting that her own resignation came at that time, and was due to physical and mental exhaustion as a Black woman nonprofit leader. She experienced backlash and burnout which contributed to racially induced trauma. (Doherty et al., 2023).

Complex and interconnected challenges faced by FPCs make it difficult to navigate tumultuous social, cultural, and political terrains as well as to develop processes for evaluating the effectiveness of food policy solutions (Calancie et al., 2018). FPCs engage public health officials to address chronic health problems like heart disease, obesity, and Type II diabetes. They engage scholars and activists to critically investigate the impact of structural racism, inequitable access to healthy food, food insecurity, and barriers to participation in food policy decision making. FPCs face the dual challenge of educating an often misinformed or unaware public of these issues while persuading

political officials to make meaningful policy change (Coplen & Cuneo, 2015). To meet the challenge, scholars and activists highlight the need for effective channels of communication between the public and political spheres of power.

As Director Hall reflected, the nature of food

Table 1. Sample of the Feedback to Key Questions in the Post-Program Assessment Survey

Qualitative Survey Question	Sample of Responses
What did you learn about food policy from the course (e.g., how food policies work, what are food policies, activism)? (26 total responses)	1. I learned lots about how to find food policies, even more of how they impact our food and the environment, and how to advocate for just food policies. 2. I learned that food policies lay the groundwork, stipulations that support or break healthy food access. 3. I learned that different states have different situation in terms of food policy, when we make these policies, we have to consider the local situation as well as the local people's opinion. 4. How food policies work and what are ways to get involved from a local level. 5. Policy is a key lever for food systems transformation. And the research and data that inform policy has to be rooted in lived experience, and the wisdom and intelligence of the community. 6. I learned about some good ways to gather data for advocacy, I learned of a ton of new resources for research and collaboration, and I learned a lot more about the different categories of food policy and power structures that uphold different types of policy. 7. That activism is key for success making food available for everybody. 8. I learned about looking for food policies and to be aware of written biased and targeting of specific groups.
What skills or competencies did you improve from the course? (e.g., navigating local legislative and policy processes, community organizing, relationship building)? (25 total responses)	1. Definitely more insight about how I can become more of an organizer in my community. 2. Map Data (Future land use maps + city codes and ordinances)—this was a hard skill that I had not known before, despite working with rental assistance and using property appraisal sites daily. 3. I was able to improve on learning about policy processes, organizing within my community and building relationships. 4. One of the greatest skills and resources I am walking away with are 1, the ability to properly collect data through well thought out mapping, and 2, the importance of thinking with geographic layers in mind when approaching a grant proposal. Thank you! 5. How to get the evidence-based type of information needed for advocacy. 6. Relationship building. 7. The course helped me to improve the community organization and relationship building that are the most important goals of our urban community farm that was created in an area that had complicate relationships with a community with drugs problems. 8. Navigating local legislation and policy processes.
What policy issues did you learn about during the course (e.g., land use, business, education, public health)? (25 total responses)	1. I learned how inefficient some of our actual food policies are for the integration of urban food programs, the lack of representations and community voice in the advocacy of legislation that can promote food sovereignty principals. 2. So many! urban planning, agriculture, food security, water and soil preservation… 3. How public health protects and improves communities, promoting healthy lifestyles for communities, children and families; ensuring high-quality health-care services; through safeguarding and improving the quality of the citizens promoting to consume healthy, natural and organic food with the urban farming. 4. Importance of urban planning. 5. Land use and zoning. 6. Land use, famers rights, public health.

Table 2. Quantitative Responses Received to the Three Questions

Question	Not familiar at all	Slightly familiar	Moderately familiar	Very familiar	Extremely familiar
How familiar are you with food policy?			55%; *n* = 15	37%; *n* = 10	
How familiar are you with strategies for food policy advocacy?			63%; *n* = 17	22%; *n* = 6	4%; *n* = 1
How familiar are you with the legislative process for food policies?			44%; *n* = 12	22%; *n* = 6	4%; *n* = 1

policy work and education often involves difficult conversations related to inequity on the food system:

> We must address issues related to environmental racism, food system injustice, and white privilege. In a food system where communities of color suffer the highest rates of food insecurity, where Black and Indigenous people have been forced off land and out of agriculture, and where indigenous lands continue to be stripped of their food, cultural, and spiritual resources we must continue to spotlight the historical roots of discrimination and oppression that have created the situation we are in today.

The course workbook served as a helpful tool for course enrollees to prepare discussion questions, reflect on how food policies impacted them personally and as members of a larger community, and jot down ideas for the breakout sessions during the course each week. Breakout sessions provided a more intimate setting to discuss difficult issues. Following the principles of Paulo Freire's (2018) *conscienziação*, the development of a critical consciousness, enrollees from various racial, economic, educational, and generational cohorts were able to use the workbook prompts to reflect on their own identity and situation and bring their perspectives to the weekly discussions. The virtual format allowed for community members from across the country to join the conversation. It also spawned new ideas, such as virtual food markets and "shop don't stop" efforts to support local businesses (Radcliffe et al., 2021).

FPCs locally and nationally play a vital role in coordinating and organizing food responses across multiple sectors. Many FPCs, including the FLFPC, have expanded their roles to include new functions and areas of focus. At the time of the course, Florida laws pertaining to growing foods and DEI programs were beginning to change. The FLFPC activated its networks to support Florida communities struggling with food insecurity, climate change, public health, racial injustice, anti-LGBTQ legislation, value chain coordination, and protections for food workers. Policy areas that FPCs were especially active in during the pandemic included supporting emergency food provision, keeping farmers markets open, and expanding access to federal food and nutrition assistance. The FLFPC's policy focus expanded to include not just food policy and advocacy but other areas such as emergency management services that were outside the original scope of the FLFPC.

As is often the case in underresourced and marginalized communities, the immediate needs of the community often took time away from the FLFPC's ability to focus on policy research and development. For example, the FLFPC also engaged in efforts to educate communities about the pandemic and vaccination safety. Prior to and after the food policy course, the FLFPC had been conducting educational workshops, Florida Food Forums, which featured food system experts, FLFPC members, community advocates, and citizens in monthly online meetings. In the early stages of the pandemic and during the racial tensions of 2020–2021, the forums provided a safe place to engage in sometimes uncomfortable but necessary discussions on topics such as food justice, racial equity, regenerative farming, climate change, food

waste, agriculture technology, food access, and urban agriculture. The FLFPC Food Forums grew their participation numbers, particularly in the sessions on Black farming. FLFPC Facebook followers grew from 393 in January 2020 to 1,012 in January 2021, and membership grew from 58 to 181 in 2021.

The policy course also enlivened FLFPC communication and outreach efforts by building collaborations with organizations such as the Florida Department of Agriculture and Consumer Services (FDACS), and the University of Florida IFAS Family Nutrition Program to keep community leaders and residents aware of food policy issues such as SNAP, COVID-19 resources, and local policies on growing food in home gardens. For example, in St. Petersburg the FLFPC collaborated with the city to initiate new amendments to the land development regulations to address food insecurity in Pinellas County. The amendments related to urban agriculture allowed residents to grow fruits and vegetables on their property and sell them to the public. This initiative helped supplement healthy food availability in low food access areas of St. Petersburg and opened new opportunities for urban agriculture community gardens.

This food policy course provided an opportunity to address social issues that affect food policies and the need for equitable access to healthy food. It presented a democratic forum for diverse food system stakeholders to learn, have dialogue, and advocate for practical solutions to the most pressing food systems problems. As the remarks from our post-program assessment illustrate, participants learned about a multitude of essential food policy topics including preparation for developing food policy, how to engage with community to establish foundations for building food systems knowledge, collecting data, advocacy techniques, and identifying important issues such as zoning laws, public health concerns, and soil preservation. Additionally, participants expressed surprise but appreciation for the interconnected dimensions of food policy work. Formulating policy requires building knowledge and relationships with multiple stakeholders, and participants reported that the course provided the groundwork and strategies to begin this process.

Conclusion and Recommendations for Developing a Food Policy Course

To drive home the importance of food policy in our local governments, prior to, and during the course, Director Hall and other members of the FLFPC met with city officials to walk through various zoning laws, land-use policies, and public-health frameworks to provide tangible connections to how these issues relate to local food systems (Gosch et. al, 2024). Additionally, Hall introduced city officials to the work of the USF Food Sovereignty Initiative and they all explored effective and ineffective food policy projects in other locales (Gupta et. al, 2018). Working with city officials prior to and during the development of the course itself, helped the FLFPC team to design course materials with a more intimate knowledge of the way local city officials are thinking about food issues and provide a case study for how other communities can work with their context-specific political and policy arrangements. Conducting community food assessments and working with existing governmental and nongovernmental organizations to better understand the needs and desires of the community helped determine guest speakers for the course. One way in which we did this was through virtual community town hall meetings. These virtual sessions provided commentary information that is not always captured in formal surveys and academic studies.

Working with community stakeholders and community champions was also important for keeping a pulse on community needs and hopes. The FLFPC had previous experience collaborating with communities on developing community gardens, home food production initiatives, revising local food-related city ordinances, and amending local land development and zoning ordinances to be more amicable to growing food. The competency-based framework and evaluation tools developed by NAFSN provided a robust method for delivering and measuring the outcome of food policy educational projects (Dankbar et al., 2023). Practitioners that consider developing their own food policy course might consider, as the FLFPC did, resources such as the Healthy Food Policy Project (n.d.), and the Racial Wealth Gap Learning Simulation (Gamblin, 2018). This simulation pro-

vides resources for users to learn more about the historical relationship between poverty, hunger and equity.

The University of South Florida's FSI learned that developing partnerships with the community was a prerequisite for collaborating on the food policy course development. It was important that our team understood food insecurity challenges as well as how community members talked about racism in the food system, using their own words, stories, and experiences. Understanding the lived-experiences of marginalized communities occurred through consistent conversation, engagement and, in the case of the director of the FSI, actually living in a food insecure neighborhood. Furthermore, the director of the FSI and the director of the FLFPC had been working together on various community projects for over two years prior to the delivery of the course. This established a baseline of trust that is necessary, but often missing, from academic-community partnerships.

The NAFSN evaluation that this particular food policy course met the requirement of Level 1 learning provided helpful insight and served as a launching point for further development of subsequent programs of action. Future iterations of this Intro to Food Policy course might consider collaborating with University faculty in areas such as political science, the humanities, and public health to build community engaged curricula that can explore how different disciplinary fields might leverage their expertise to address challenges related to food insecurity, agricultural development, and enhanced democratic participation in food system policy. The COVID-19 pandemic exposed fundamental weaknesses and inequities in our food system that continues to motivate discussions on the future of our food system (James et al. 2021). We hope that this case study of an Introduction to Food Policy course will provide a useful resource for those developing food policy education and literacy in their own contexts.

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Unpacking innovation demands for climate-resilient mixed farming systems in sub-Saharan Africa: A case of northern Ghana

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Abstract

According to the United Nations (n.d.), climate change is the long-term shift in temperatures and weather patterns due to natural changes, such as the sun's activity and significant volcanic eruptions, or human activities, such as burning fossil fuels like coal, oil, and gas. The effects of and challenges caused by climate change on farmers' ability to manage mixed farming systems in sub-Saharan Africa are well documented in the literature. However, the synergies among mixed farming systems' components and farmers' innovation demands and responses to climate change impacts remain fragmented. Using a case of mixed crop-livestock-tree

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(MCLT) systems in northern Ghana, this paper examined farmers' responses, their innovation needs, and how these innovations can be catalyzed to enable more farmers to adopt similar climate change adaptations. Our findings show that climate change impacts mixed farming systems in several domains, with these impacts being more visible in some domains. Significant productivity declines are observed in crops, livestock, and the whole mixed farming system. Productivity declines lead to decreased incomes, food availability, and household food security. Female farmers' access to production factors, resource management, and market participation is reduced. Farmers make technical, managerial, and business changes in response to climate change impacts. Such changes are dominated by technical changes, including using high-yielding, disease-resistant, and early-maturing crop varieties, crop and animal pest and disease management, agricultural water and land management, and wind and bush fire control. Interconnections between the MCLT system components include cross-component investments, additional income generation, animal feeding and healthcare improvement, nutrition exchanges, and family nutrition improvement. These interconnections generate income and cash flow and support food and nutrition security, enabling farmers' adaptation. Climate-resilient innovation bundles to enable farmers' adaptation include good agricultural practices, circular farming techniques, irrigation packages, information services, and value-chain linkages. Scaling climate-resilient innovations in northern Ghana and other sub-Saharan African contexts require multiple pathways, including innovation platforms, innovation bundling, multi-actor partnerships, inclusive finance, and multistakeholder dialogues to support farmers' adaptation to climate change.

Keywords
climate change impact, climate-resilient innovation bundle, innovation scaling pathway, mixed food crop-livestock-tree system, northern Ghana

Introduction

Over the last several decades, climate change has profoundly impacted farming systems across sub-Saharan Africa (SSA). The changes are visible by increased temperatures, droughts, floods, erratic precipitation patterns, increased incidence and types of pests and diseases, and declining soil fertility leading to crop failures and livestock mortality in much of SSA landscapes (Abegunde & Obi, 2022; Akinyi et al., 2021; Malhi et al., 2021; Tui et al., 2021). These climate change impacts (CCIs) and other challenges, such as limited access to markets, capital, technology, extension services, and labor, significantly hinder smallholder farmers from benefiting from farming activities.

Mixed farming systems (MFSs), a complex feature of the agriculture sector, dominate SSA landscapes. Smallholder farmers in SSA manage about 33 million mixed farms (Kim et al., 2021; Lowder et al., 2016) for their livelihoods (Tui et al., 2021). Cereal-based cropping with small ruminants covers about 24% of SSA's land area and provides a livelihood for about 34% of the region's population (Low et al., 2020). Livestock provides draft power, skins, transportation, manure, and protein sources to farmers' incomes and diets. Livestock is also a primary asset that can easily be converted into cash, provides a source of prestige for farmers, and fulfills various sociocultural functions such as dowry payments, religious festivals, and funerals, in addition to a source of emergency cash. Crop residues may be used to feed livestock, while animals provide manure for crop production (Kuyah et al., 2021). Therefore, the livestock component is critical, directly and indirectly contributing to the MFSs' climate change adaptation.

According to Kuivanen et al. (2016), northern Ghana has several farm types based on farm size, household size, hired labor, land use, livestock, and income variables. These are (a) large farms; (b) semi-large farms; (c) medium-size farms; (d) small-size farms and (e) micro-size farms, as summarized in Table 1.

Large farms (over 6.3 hectares or 15.6 acres) have about 50% of the cropped area dedicated mainly to the production of maize. The average livestock per household with a large farm is about 10 cows, 10 goats, and 10 sheep, and non-farm activities contribute to about 32% of incomes. These farms have large households of about 22 people providing most of the on-farm labor. Semi-

Table 1. Farm Types in Northern Ghana

Farm type	Farm size (ha)	Average household size and involvement	Land use	Average household livestock holding	Hired labor	Income variables
Large	Over 6.3	22 people; main source of on-farm labor	50% in maize	10 cows, 10 goats, 10 sheep	Minimal	32% of income from non-farm activities
Semi large	Up to 6.3	Relatively large household; main source of on-farm labor	33% in maize, 33% in legumes	7 cows, 4 goats, 3 sheep	Minimal	More than 50% of farm income from crop sales
Medium	Up to 5.2	Medium household size; on-farm labor provided by household and hired labor	33% in maize, 33% in legumes	0 cow, 9 goats, 9 sheep	About 8%	Mainly from crop sales
Small	Up to 3.5	Small household size; on-farm labor provided by household and hired labor	Mainly maize and legumes	1 cow, 6 goats, 9 sheep, 34 poultry	About 14%	Mainly from crop sales up to 50% Little to no off-farm income
Micro	Up to 2.6	Small household size; on-farm labor provided by household	47% in maize	Mainly poultry	None	About 42% of the farm income from poultry About 25% of household income from off-farm activities

Note: 1 hectare = 2.5 acres.
Source: Kuivanen et al., 2016.

large farms (with an average of 6.3 hectares or 15.6 acres) have over a third of the area cropped to maize and another third to legumes. These farms rely heavily on selling crops, with more than half of all crops sold. The average livestock per household with a semi-large farm is seven cows, four goats, and three sheep. Farm labor is provided mainly by relatively large households. Medium-sized legume-and-maize-oriented farms have an average area of 5.2 hectares or 12.8 acres. Of that, a third is cropped to maize and another third to legumes. Livestock of the household is dominated by small ruminants, averaging no cattle, nine goats, and nine sheep. About 8% of the farm labor is hired. Small-size, crop-based farms have about 3.5 hectares or 8.6 acres, with the cultivated area dominated by maize and legumes. About 50% of all crops are sold on the market, and farm income comes mainly from crop product sales. Households cultivating these farms have about one cow, six goats, and six sheep. About 14% of labor is hired due to the smaller household size. Small-size maize and legume farms have almost no income from off-farm activities, and have a low amount of hired labor. Livestock is mainly small ruminants and poultry, consisting of about one cow, six goats, nine sheep, and 34 poultry. Lastly, micro-size farms have an average land size of 2.6 hectares, with about 47% allocated to maize. Livestock is mainly poultry, which provides about 42% of the farm income. About 25% of income comes from off-farm activities. Household sizes are relatively small, and farms hardly use hired labor.

In MFSs, farmers adapt to CCIs at various scales and with different strategies. At the farm level, autonomous adaptation involves farmers changing farming practices, adjusting their farming management, and altering their livelihood activities, such as reallocating resources (Akinyi et al., 2021). Their adaptation varies according to their resources, needs, and capacities (Magesa et al., 2023). Such responses may be technological (e.g., controlling bushfires and managing temperatures, floods, droughts, and strong winds) (Abdul et al., 2022;

Asare-Nuamah & Antwi-Agyei, 2022), behavioral (e.g., changing dietary choices), and managerial (e.g., changing farm management and investment practices) changes. Farmers combine technical, managerial, and business changes relevant to their farming systems based on local knowledge, previous experiences, extension advice, resource availability, and expectations for future changes. These responses may be gendered, with men responding differently from women due to differences in resource access (Wrigley-Asante et al., 2017). Men, for instance, respond mainly using on-farm activities, while women combine both on-farm and off-farm activities. Such responses reflect farmers' adaptation and resilience to CCIs (Antwi-Agyei & Nyantakyi-Frimpong, 2021; Assan et al., 2020).

Various innovation approaches have been applied to support farmers' climate change adaptation (Abegunde & Obi, 2022; International Water Management Institute [IWMI], 2023; Schut et al., 2018). Systemic innovation approaches enhance systems' capacity to respond to changes using dialogue and negotiation, discovery-based activities, stakeholder experimentation, reflection, and joint learning (Edlmann & Grobbelaar, 2021; Maryono et al., 2024). The approaches facilitate more flexible and adaptive processes, resulting in context-specific innovations that meet farmers' needs. Climate change adaptation is a part of development and vulnerability reduction interventions that foster farmers' ability to act toward CCIs. Technology-centric approaches focus on technology dissemination to increase agricultural productivity using training, demonstrations, and technology transfer (Abdul et al., 2022; Acheampong et al., 2017). These approaches emphasize the importance of transferring improved inputs, mechanical technologies, good agricultural practices, and advanced crop-livestock production techniques. Farmers in SSA have adopted suitable interventions to support their adaptation to CCIs. However, many other interventions must be tailored to increase their relevance to local contexts and farmers' heterogeneity. Farmers are often perceived as passive actors with predetermined intervention outputs and deliverables, limiting these interventions' support for farmers' adaptation to CCIs.

Climate change impacts, challenges, and adaptation strategies are well documented (e.g., Akinyi et al., 2021; Assan et al., 2020; Gbodji et al., 2023; Minh et al., 2020; Sherman et al., 2016). However, farmers' adaptation is a complex and dynamic decision-making process (Akinyi et al., 2021; Wiréhn et al., 2020; Zhao et al., 2018), involving characteristics and transitions of farming practices under changing climatic circumstances, socioeconomic conditions, and rural livelihoods. There is a need to understand how interconnections among MFSs' components and CCIs on different aspects of farming systems influence farmers' adaptation (Thornton & Herrero, 2015). Integrating innovation perspectives into MFSs and farmers' adaptation is needed to analyze synergies among systems' components, farmers' changes in farming practices, and their innovation needs. Furthermore, insights into innovations that farmers need in mixed farming systems in SSA are still fragmented, although innovation adoption is highlighted as essential to support farmers' adaptation (e.g., Adjei et al., 2020; Akrong et al., 2023; Schut et al., 2018). Systemic innovation approaches have shown a foundation to support climate change adaptation. The remaining question is how we operationalize the systemic approaches to scale innovations to facilitate farmers' responses to CCIs, while minimizing tradeoffs and improving synergies in the SSA's MFS contexts (Akinyi et al., 2021; Boon et al., 2021).

To address these gaps, we analyzed farmers' adaptation to climate changes in SSA's MFS contexts. Specifically, we investigated how farmers respond to CCIs, what innovations farmers need to respond to the impacts, and how the innovations can be catalyzed to enable farmers' adaptation.

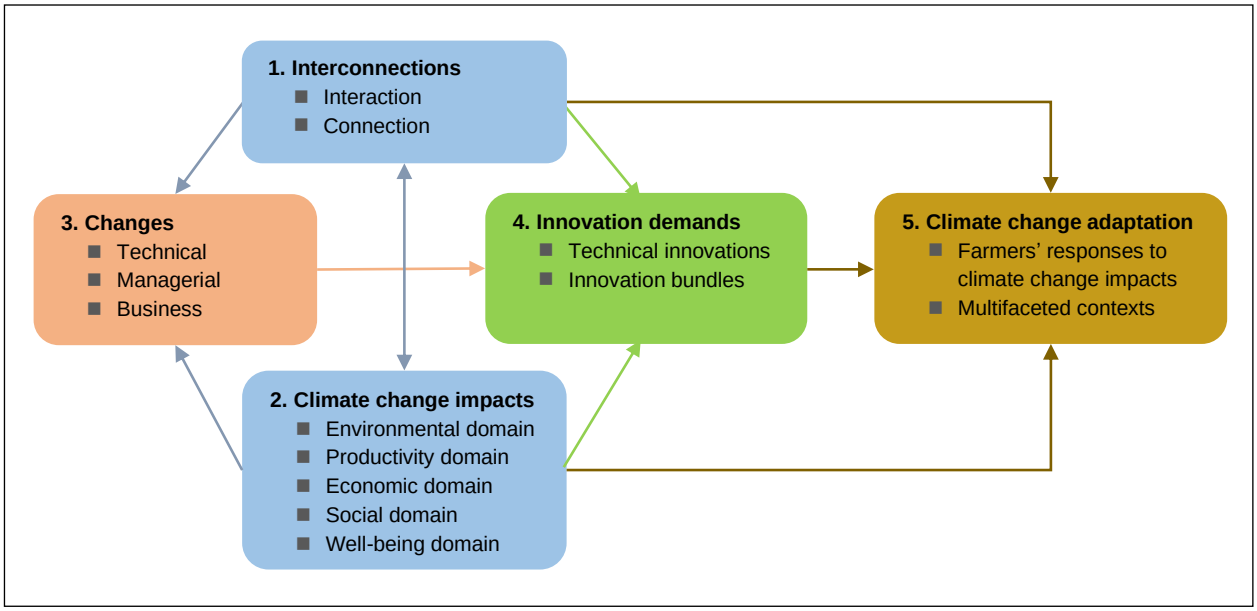
This article presents a qualitative analysis of the mixed crop-livestock-tree (MCLT) systems in northern Ghana, contributing to various aspects of climate change adaptation literature. Farmers have diverse responses to CCIs in their farming systems. Technical changes combining local and improved agronomic practices are dominant. Managerial and business changes in cropping season, livestock, investment focus, farming de-intensification, and reduction in commercial scale are limited, indicating farmers' modest responsiveness and adaption to CCIs. Climate-resilient innovation bundles that farmers need for their adaptation include circular

farming techniques, information services, irrigated farming, and value-chain linkages. These bundles are characterized by suitability to farmers' MFS needs, inclusivity to diverse farmers' capacities and available resources, and adaptability to dynamic changes in multifaceted contexts. These highlight a need for multiple pathways for scaling climate-resilient innovations in MFSs, especially in SSA.

Analytical Framework

Scholars define mixed farming systems (MFSs) from a broad or narrow perspective. The narrow perspective views MFSs as farmers combining cropping with livestock cultivation and drawing interactions and synergies from these activities (e.g., Liang et al., 2018; Thornton & Herrero, 2015). The broad perspective views MFSs as diversified agriculture, such as rainfed and flooded cereals, groundnuts, cotton cash crops, and extensive livestock raising (Manlay et al., 2004), and interactions between crop and livestock subsystems and the underlying agroecological and socio-economic conditions (Parthasarathy & Birthal, 2008). Aligning with the broad perspective, we define MFSs as "systems where multiple components of livestock, trees, subsistence crops, cash crops, and horticultural crops exist and interact on the same farm or landscape, offering opportunities to capitalize on synergies" (Hoeschle-Zeledon & López Ridauray, 2021, p. 3). To analyze farmers' climate change adaptation under the climate change-affected MFSs, we used a holistic framework to analyze the MFSs at the farm level, capturing five interconnected analytical elements (Figure 1). First, interconnections are interactions between the MFSs' core and complementary components and connections between the component's outcomes. The core component include main MFS activities that generate primary income sources and household food security. Complementary components include other farming activities that provide farmers with secondary incomes and cash flows (Ahiagbe et al., 2021; Danso-Abeam et al., 2021). For example, in cereal-based cropping systems, maize, sorghum, and millet are the core components, complemented by roots and tubers (e.g., cassava, yam, and potatoes), legumes (e.g., pigeon peas, cowpeas, beans, soya beans, and groundnuts), and livestock (e.g., goats, sheep, and cattle) (Kuyah et al., 2021). In tree-based systems, cash crops like cashews and mango serve as the core component, and food crops are complementary (Danso-Abeam et al., 2023). These interactions and connections enhance farming and economic resilience, such as through

Figure 1. Analytical Framework for Unpacking Farmer Innovation Demands for Climate Change Adaptation in Mixed Farming Systems



the reuse of animal droppings, soil health improvement, control of pests, diseases, weeds, and temperature, as well as using cropping income to support livestock production and vice versa, and livelihood improvements such as income risk management and nutrition improvement (Danso-Abbeam et al., 2021).

Second, *climate change impacts* have multiple aspects (Musumba et al., 2017). The environmental aspect examines pest levels that may influence agricultural productivity, water resources, availability, and sufficiency for crop irrigation and household consumption. The productivity reflects crop productivity (in kg/ha/season), measuring annual plant production per unit area per unit time or net primary productivity. Yield refers to the output for a given land area in a season. Crop biomass productivity is forage production per kg/ha/season, which assesses the land unit's productivity in terms of all produced, not just the grain yield. The economic aspect includes income diversification, which measures the household's income generation from multiple sources and food security during production or weather risk. Furthermore, labor requirements consist of hours, cost, and the seasonal supply and demand needed for farming production. Market participation examines where farmers sell agricultural commodities and buy inputs. Market orientation investigates the household's MFS production destined for the market (Musumba et al., 2017). The social aspect scans gender equity at the field, farm, and household levels by assessing differential ownership and access to resources for agriculture, control over resources (agency), time management, and sources/control/use of incomes. The well-being aspect includes household nutrition and food (in)security, such as availability and accessibility. Food accessibility requires adequate quantity and quality to meet household members' nutritional requirements. Food availability reflects enough quality food supplied through domestic production or importation for a productive life.

Third, changes in MFSs due to CCIs refer to what farmers do differently at the farm level in response to CCIs. For example, technical changes are new or adjusted agronomic practices applied to farming. Managerial changes reflect how farmers manage the whole mixed farming system when it or its specific component is affected by climate change. Business changes are different ways farmers do farm business, focusing on markets and private investments. Fourth, *innovations* farmers need to respond to CCIs are in the form of technical innovations or bundles of contextually relevant products, services, and business management farmers require to adapt their farming systems to CCIs (IWMI, 2021; Minh et al., 2024; Ofosu & Minh, 2022a).

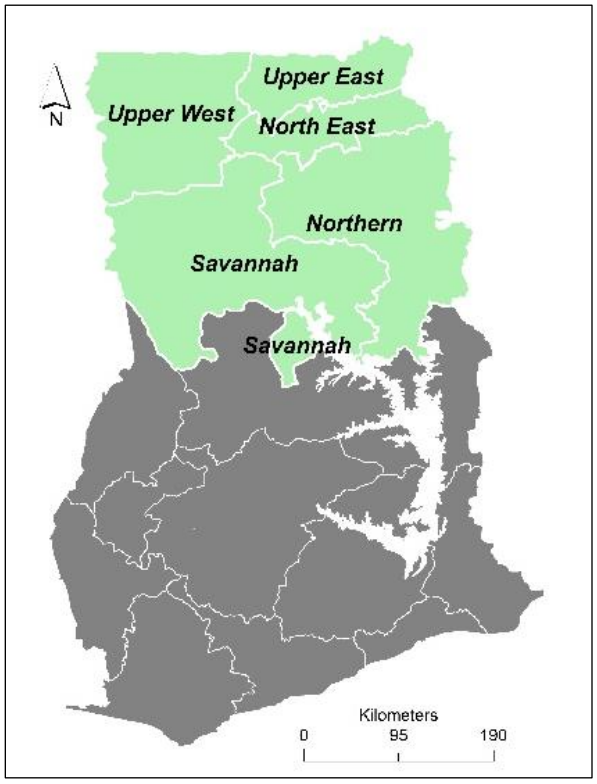
Fifth, Climate Change Adaptation is a process of adjusting to the actual or expected climate and its effects to minimize the trade-offs and optimize the synergies (Akinyi et al., 2021). Such adaptation is essential for households and communities to secure their livelihoods and build resilience to CCIs. Akinyi et al. (2021) categorized farmers' climate change adaptation into five broad strategies: crop, risk, soil/land, water, and livestock management. In this study, climate change adaptation refers to farmers' responses to CCIs embedded in the complex MFS context, multiple impacts, and dynamic enabling environment factors such as innovations, value-chain linkages, socio-economic barriers, and opportunities. Such multifaceted contexts shape farmers' needs to make technical, managerial, and business changes to deal with the risks and shocks posed by climate change.

Methodology

Study Areas and Case

This study focused on northern Ghana's (NG) mixed crop-livestock-tree (MCLT) systems to analyze changes, emerging trends, and innovations needed to enable smallholders to cope with CCIs. The study areas encompass the Northern Region (NR), Northeast Region (NER), Savannah Region (SR), Upper East Region (UER), and Upper West Region (UWR) (Figure 2). It is a central agricultural hub in Ghana for crops and livestock and a source of employment for about 95% of the population. Northern Ghana is vulnerable to climate change impacts due to high temperatures, the single rainfall season, and high poverty levels (Klutse et al., 2020).

Figure 2. Study Area in Northern Ghana



Map credit: Komlavi Akpoti, IWMI.

The NG MCLT system was chosen for this study because it is the primary farming system in the zone, is heavily affected by climate change, and provides livelihoods for many households. In these systems, the crop component is dominated by rain-fed maize and irrigated vegetables for home consumption and local and export markets (Cudjoe et al., 2021; Rahman et al., 2019). They employ local and modern methods of pest management and post-harvest management (Acheampong et al., 2017; Amedor et al., 2020; Asare-Nuamah, 2020). The dominant livestock are West African dwarf goat and sheep breeds, kept mainly in free-range systems (Abdul et al., 2022). Common trees include shea and *dawadawa* (*Parkia biglobosa*), which grow naturally in the environment, and cashews and mango, which farmers grow as cash crops.

Primary Data and Analysis

Primary data were collected from 2020 to 2024 using semi-structured interviews, focus group discussions, and stakeholder workshops with farmers and other value-chain actors. We conducted 46 semi-structured interviews, 29 focus group discussions, and 11 stakeholder workshops. Semi-structured interviews and focus group discussions covered broad topics. These topics include different components and their interconnections and farming techniques in the MCLT system, including crop and tree cultivation, livestock raising, irrigation practices, on-farm and off-farm alternative income-generating activities, climate and weather condition impacts on farmers' farming and livelihood practices, changes in farming practices, investment, and livelihood strategies, and individual and farmer group preferences for innovations to assist with the changes. Stakeholder workshops reflected on the impacts, changes, and innovation preferences identified through the semi-structured interviews and focus group discussions and consulted participants on practical ways for them to access innovations. Initial respondents for semi-structured interviews, focus group discussions, and stakeholder workshops were identified with the help of Ghana's Ministry of Food and Agriculture extension agents. The snowball technique was then used to identify other respondents across the five regions. The UER, UWR, NER, SR, and NR respondents were involved in investigating farming practices, irrigation system investments and applications, market linkages, and value-chain dynamics. In 2024, we conducted additional semi-structured interviews and focus group discussions in SR to understand the tree component in MCLT systems better. Data was collected in local languages and then transcribed and translated into English for analysis.

We assigned labels to quotes from the primary data to describe the respondents as follows. "Aggregator" refers to middlemen who buy food crops, shea nuts, and cashews from farmers for bulk sale to other markets or companies. "Male farmer group" refers to a formal or informal group of male farmers. Female farmer group" refers to a formal or informal group of women farmers. "Young male/female farmer" refers to men or women farmers up to 35 years old. "Middle-aged male/female farmer" refers to men or women farmers between 36 and 50 years old. "Old male/female farmers" are men or women farmers over 50 years old. "Gender researcher" refers to a male

or female person who carries out academic or scientific research with a focus on issues relating to women and/or men.

We employed qualitative content analysis (Elo & Kyngäs, 2008), following preparation, organization, and presentation phases for a rigorous, category-led, inductive, primary data analysis. In the preparation phase, we reviewed each transcript several times to familiarize ourselves with it. Our reading was guided by questions such as who tells what happens, where, when, and why to immerse in the data and obtain a general understanding of NG MCLT systems. Based on the understanding and analytical category-led scheme presented in Figure 1, all transcripts were read through again to identify texts with contents related to the analytical dimensions (e.g., interconnection, climate change impacts, changes, and innovation demands) and arrange them according to each category under the corresponding dimension (e.g., interaction and connection under the "interconnection" dimension). We also started organizing the identified texts into categories, enabling us to recognize and recontextualize the data to give a fresh perception of visible themes.

We then developed a tentative, more extensive set of subthemes (or codes) to identify reoccurring themes that were later used to form subcategories under each category. The most frequent words and short phrases in the categorized texts that contributed most to describing and interpreting the meaning of themes were entered into the coding. Guided by the identified subthemes, we reread the data excerpts to search and refine the reoccurring themes. We organized them into themes under categories corresponding to the analytical dimension inductively. We analyzed the organized themes to reflect relationships, make arguments, and present them together in coherent stories that answered the research questions. During this process, we reflected on the relevance of subthemes and reoccurring themes to research questions. We also compared the categorized data with other observations from other themes to increase the understanding of connections between and among subthemes and categories, providing a means of describing the climate change adaptation phenomenon under each dimension. Figure 3 presents an overview of the coding scheme and process.

Results

We present the results of our study, focusing on the interconnections among MFS, climate change impacts, farmer changes under changing climate conditions, and climate-resilient innovations required to support smallholder farmers.

Interconnections in Mixed Crop-Livestock-Tree Systems

Analyses show various interconnections among MCLT systems' components. Cross-component nutrient exchanges are found when farmers use byproducts from one component as inputs for other components. For example, farmers apply poultry, cattle, and small ruminant manure to improve soil quality. They use crop residues to complement livestock feeding, soil fertilizing, and fuel sources. Crop residues and tree crops feed animals as supplementary diets during the dry season: "I feed guinea fowls and chickens with millet and maize. I feed them with termites trapped with cow dung from my farm" (Old male farmer, Bonia, UER). However, using crop residue is minimal due to multiple challenges, as expressed by farmers: "We do not get crop residues from our farms because the Fulani cattle are always around to eat the residues. The cattle sometimes consume even parts of the harvest" (Mixed farmer group, Chancheri, SR). An agriculture department staff member in Savelugu, NR, also indicated,

> Storing crop residues for livestock feed is always challenging, except for the late peanut harvest when there is less rain. Livestock do not feed much on rice straw because farmers do not know how to prepare it. Wild bushfires also burn crop residues as farmers focus more on securing their harvest.

Technical integration occurs when farmers manage all components as a single unit to optimize benefits while addressing tradeoffs. Farmers cultivate crops and raise animals to benefit from improved soil fertility and healthy crops and animals. Farmers grow vegetables on the loamy part

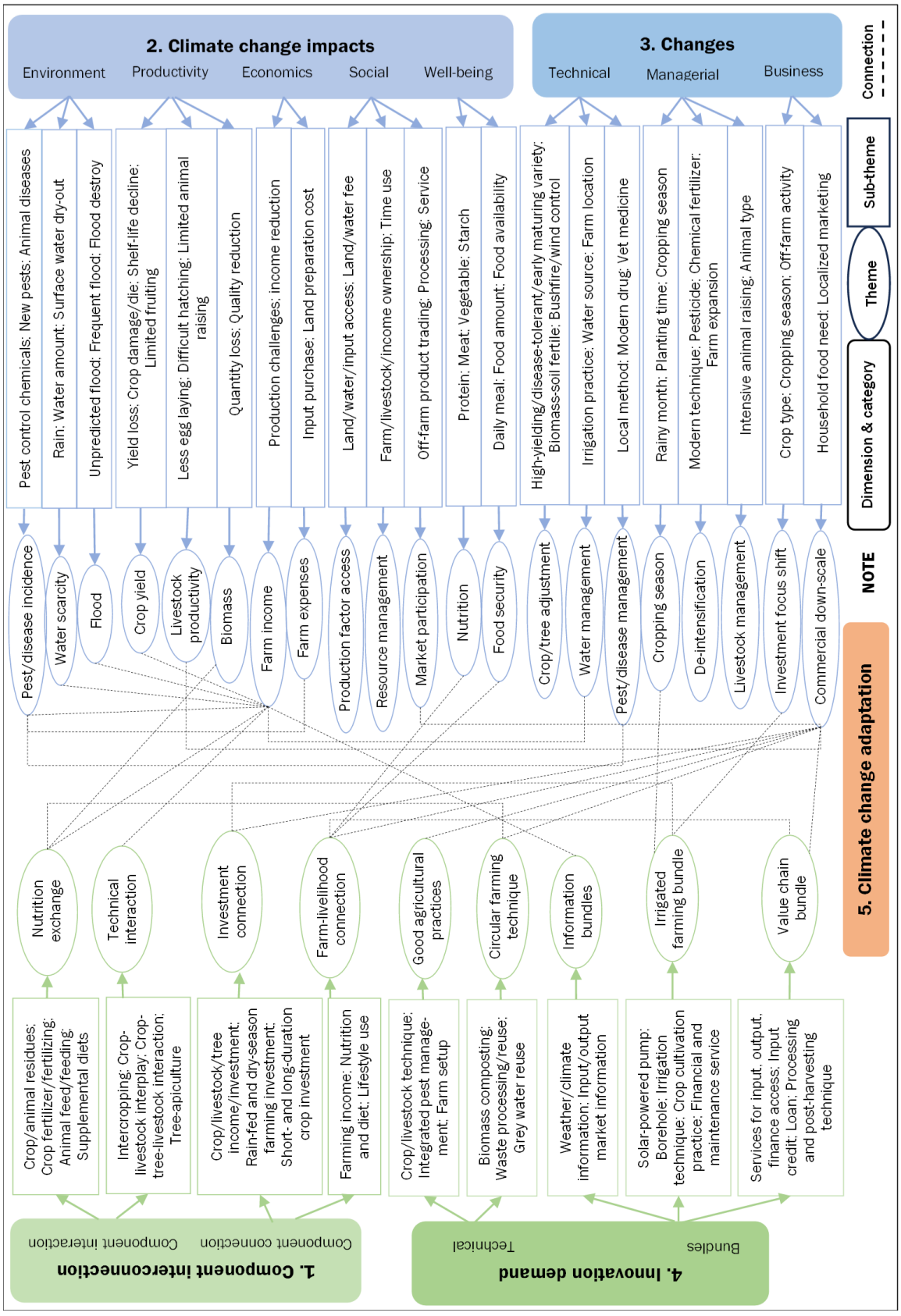


Figure 3. Overview of Data Analysis, Capturing Subthemes and Themes Identified from the Data, their Corresponding Categories and Dimensions Presented in the Analytical Framework, and Connections among Themes across the Dimensions

of their farm and rice on the clayey portion, which is prone to floods, while using rice residue for feeding their poultry: "Vegetables cover about two acres, and the rice covers another two acres. I feed chickens and guinea fowls with rice residue" (Old male farmer, Bonia, UER). Farmers also maximize benefits from connecting different farming activities. Some cashew farmers indicated higher yields on trees that contain beehives due to improved pollination: "I have noticed that the trees fruit better after hanging the hives on them. The bees take nectar from the tree but also offer some benefits" (Young female farmer, Canteen, SR). Raising bullocks and donkeys helps crop cultivation by aiding with preparing the land, transporting inputs, and bringing farm produce to the markets.

Investment connections are found when incomes from one component are used to invest in others. Farmers use incomes from rain-fed and tree crops to purchase inputs for dry-season cultivation, and vice versa. Farmers sell short-duration crops to buy the essential inputs such as fertilizer and pesticides needed to re-invest in more profitable long-term core crops. They also purchase livestock with income from rain-fed and dry-season cultivation and tree crop outputs: "During the dry season harvest, we use money from the sale of shea nuts and butter to buy ruminants and other animals" (Farmer groups, Gingani, NR, and Akuriyi, SR).

Finally, farming-livelihood connections occur when different components of MCLT systems support family nutrition, social, and health needs. For example, hunting for game and wild birds complements farmers' diets and incomes: "We hunt rabbits, grasscutters, rats, and monkeys, and collect wild honey" (Mixed farmer group, Akuriyi, SR). The tree component supports families in several ways besides providing income:

> Shea butter is a body lotion, and the shea residue is used to ignite fires when cooking. The shea branches and trees serve as firewood. The shea and dawadawa trees have medicinal properties. The baobab leaves are used for soup, and the fruit is eaten or used to make yogurt." (Gender researcher, Tamale, NR)

Climate Change Impacts on Mixed Crops-Livestock-Tree Systems

We found visible climate change impacts across five sustainability domains. However, these impacts are more visible in some domains than others, as some are more impacted. In the environmental domain, climate change increases pest and disease incidence, water scarcity, and floods. Farmers observe new crop pests and diseases, but they have no experience to assist with management:

> Any chemical we try to control grasshoppers, maggots, and snails does not work. Snails are new to us, and we do not know how to handle them. Snails will leave our crops alone if they eat enough of the maize. Sometimes, we do not feel like going to our farms again. (Farmer groups, Akuriyi, SR)

Farmers also observe more extreme water scarcity and its consequences: "We cut down all the big trees for charcoal, so now the rains do not come as expected. When there is no rain, many cattle come here to drink water, reducing the water amount for our cashew nursery" (Farmer groups, Akuriyi & Seripe, SR). "Around April or May, most of these dugouts get dried up. Only a few near the dam still have water to produce a few vegetables. Those who cultivate in large areas run out of water" (Male farmer group, Kaleo, UER). Floods occur unpredictably, causing farmers near surface water bodies to restart farming activities on other lands or limit cultivation to only one season: "I only farm during the dry season because the flood destroys the crops during the rainy season" (Young male farmer, Bole, SR). Floods sometimes lead to total crop loss: "The floods happen yearly, and parts of our farm get flooded. Last year, the water washed every crop on the farm" (Mixed farmer group, Daboya, SR).

Consequently, these environmental impacts influence farm productivity. Rain, temperature variability, and soil fertility affect crop and livestock productivity: "It has been hotter in recent years than before. The heat makes our crops wilt. Yams and okra die from excessive heat; cashews are not fruiting well. The chickens find it difficult to lay eggs or hatch them" (Farmer groups in Chancheri, Seripe, and Bole, SR). Vegetable shelf-life declines,

as observed by a farmer in Saboro, UER: "In the dry season, we cultivate perishable vegetables. At harvesting, vegetables are exposed to high temperatures, reducing their shelf life." Soil fertility, crop yields, and residues are declining due to hungry cattle damaging crops while looking for food, and unintended fires in the dry season:

> About five years ago, I harvested about three to four 160 kg bags per acre by adding fertilizers. Now, I am even lucky to get a basin of maize, which is about ¼ of a bag. Wild bushfires burn most crop residues because we do not create fire belts around our farms. (Mixed farmer group, Akuriyi, SR)

In the economic domain, climate change reduces farmers' farm incomes while increasing farm expenses due to increasing activities to manage pests and diseases, high temperatures, floods, droughts, bushfires, and cattle invasions. This limits their ability to reinvest in farming activities. Describing the main challenges of vegetable farming, a middle-aged male farmer in Bole, SR, indicated, "We have many challenges, starting from buying the seed to selling products and getting money from the market. We face unfavorable weather conditions, cattle invasion, no water, and plant disease." Due to high temperatures, the increased perishability of vegetables pushes some farmers to sell on credit, locking up their business capital: "The sun is hot now and then, destroying plants. Vegetable traders buy and sell peppers and make their profits. However, they will not bring your money unless you remind them. This is a big challenge for us" (Young male farmer, Gia, UER). "When water was enough to grow crops, we harvested more, sometimes up to 300 Ghana Cedis [~US$21]. However, due to water scarcity, we can only make about 40 Cedis [~US$3]" (Female farmer group, Seripe, SR). Cattle searching for water and pasture invade farmers' farms, making the soil compact and increasing their cost of land preparation: "The cattle walking on the field makes the soil hard. It is costly to use a tractor to till such hard soil. A tractor charges 300 Cedis [~US$20] per acre. Now I pay 350 Cedis [~US$24] for hard soil" (Farmer group, Chancheri, SR.

In the social domain, climate change affects women's access to production factors, resource management, and market participation. Women access land through joint cultivation with husbands and sons, community generosity, rental, or labor-for-land arrangements: "One acre of land is for my father, but the other three acres are rented. I pay 50 Cedis [~US$4] per acre each season" (Middle-aged female farmer, Tinguri, NER). Land contentions favor men, as expressed by a middle-aged woman in Tatale, SR: "We were the first to cultivate this land, but last year, we did not even get a place to farm because men claim the land is not for us." Women cannot optimize crop cultivation due to limited access to inputs: "Women have difficulty accessing inputs, costly fertilizers. They find it difficult to intensify cultivation even on the small land they can access" (Gender researcher, Tamale, NR). Women's water access is also affected. Women pay to use the community borehole even for domestic purposes, while the men use the water for irrigation for free: "We do not pay for the water. Women pay. We use the money we take from the women to pay for electricity to operate the pump. This is because when the pump breaks down, the men fix it" (Young male farmer, Daboya, SR). Some also abandon their farms due to water shortage: "Sometimes there is no water for three months, starting in March. Our group had 60 women, but some left because of difficulty carrying water in basins for irrigating crops" (Female farmer group, Bole, SR; Young male farmer, Wovogma, NR).

The above-mentioned environmental impacts affect women's resource management. Farmland loss increases for women while they spend more time farming. Some youth frustrated with challenges in agriculture migrate to southern Ghana or other communities as farmhands or illegal gold miners. This results in labor shortages that impact women's use of time: "It is difficult to get hired labor, so women spend more time on farms. Women fetch water early in the mornings and prepare food late in the evenings" (Mixed farmer group, Seripe, SR). Furthermore, increases in pests and diseases reduce women's livestock ownership and incomes from both livestock sales and farm crops: "Our fowls and other animals died this year.

Only the vaccinated ones survived" (Female farmer group, Bodia, SR). Women's involvement in decision-making is limited due to socio-cultural norms and limited access to land, water, and other resources. This relates to agricultural production and earnings decisions, membership in agricultural associations, and on-farm and off-farm activities:

> Woman gives to her husband to buy her poultry when she has money. She cannot decide whether to buy or dispose of poultry. She can only suggest that her husband sell one bird to meet a need. He negotiates the price and gives his wife some or all the money because the poultry was raised in his compound. (Gender researcher, Tamale, NR)

Women's market participation in input markets shifts toward trading on-farm and off-farm products. As limited land, water access, and yields decline, women shift to trading food items, local alcohol (*pito*), repackaged fertilizer and cement, and offering services such as rice threshing and drying or harvesting crops: "The women are more involved in the marketing of farm produce because they are not strong enough to draw the water. There have been instances of people falling into the water" (Male farmer group, Kaleo, UWR). They also reduce the quantity of their purchase of farm inputs such as seeds, fertilizers, herbicides, and pesticides to a smaller scale.

Human nutrition and food security are the most impacted indicators in the well-being domain. Farmers take one to three meals daily, with family sizes of five to 25 members. Carbohydrates dominate the family meal, complemented by local leafy vegetable soups with limited protein intake due to income constraints. Respondents indicated that they prefer to consume three to four meals daily and enrich them with proteins: "If we have more money from our farm, we want to eat three times daily instead of two. We will add fish, meat, chicken, and guinea fowl to vary our meals. April to July is the most difficult time when we exhaust food stock, and planting crops has just begun. We buy food from the market, reduce the food amount, and warm leftovers for the family during these months" (Mixed farmers group, Akuriyi, SR).

Changes Under the Changing Climate Conditions

Our data analyses showed several technical, managerial, and business changes by which farmers respond to climate change impacts. Technical changes were found in adjusting techniques to manage crops and trees. Farmers start using high-yielding, disease-resistant, and early maturing crop varieties at a limited scale as, "New seeds are expensive and are unavailable even for those who have the money to buy" (Gender researcher, Tamale, NR). They control bushfires by creating fire belts and maintaining farm sanitation: "Bushfires disturb cashews a lot. I avoid them by weeding around the trees at least twice yearly" (Male farmer, Damongo, SR). They grow trees at farm edges to manage strong winds and integrate crop residues and tree leaves into the soil where they are available to improve fertility. They combine traditional and modern pest and disease control methods in crops and livestock: "We control stem borers by sealing holes with sticks or spraying them with pesticides and weevils using ash or a mixture of powdered pepper and finely sieved sand" (Farmer groups, Akuriyi and Seripe, SR).

Farmers change irrigation practices to save water: "Water is not enough in my borehole. So, I work with drip to manage the water better" (Young male farmer, Saboro, UER). Others combine drip and sprinkler irrigation and use irrigation to wash off small insects without wasting water: "Drip economizes the water, but I also use water to control pests and diseases in the dry season. It also saves agrochemicals" (Stakeholder workshop participant, Bolgatanga, UER). Others explore groundwater by sinking multiple boreholes or dugouts and farming with residual water: "I sunk this borehole because of low water yield" (Young male farmer, Gambibgo, UER). "Women dig dugouts in waterlogged areas to collect water for irrigation" (Mixed farmer group, Balawa, UER). Surface and groundwater use changes local communities' rules to manage water scarcity in the dry season: "We can only use buckets to irrigate in the dry season. If motor pumps are allowed, some people will draw more, and water will run out quickly" (Mixed

farmer group, Baakye, UWR). Farmers have also changed the location to farm during the dry season: "We grow crops within the riverbed as the water declines. When the dam dries, the soil still has moisture enough for crops" (Male farmer group, Daboya, SR). Some abandoned their plots, reduced cultivation, and used grey water: "From March, the water has gone, so we reduced the size of our gardens. I use any water in my field, even if it is unclean" (Mixed farmer group, Bole, SR; Young farmer, Saboro, UER).

Managerial changes due to limited capital and CCIs include cropping calendars, low farm intensification, and livestock adjustments. Farmers shift cropping calendars in response to erratic rainfall patterns: "We change planting time to wait for rains to come. June used to be the rainy month. Now, rain has not come, maybe because of excessive logging, especially the mahogany and rosewood, and cutting trees for charcoal" (Farmer groups, Akuriyi & Seripe, SR). Crop de-intensification to reduce farming investments and risks was observed across study areas with decreasing use of expensive, modern techniques: "We spray pesticides on only parts of the farm due to lack of money" (Mixed farmer group, Chancheri, SR). Elderly farmers expand their farms continuously for prestige despite their limited ability to manage large farms: "We are getting older and weaker. We need to concentrate on farm size. However, some still expand their cultivation as they have much land they want to farm before stopping" (Mixed farmer group, Damongo, SR). Changes are also visible in adjusting livestock components: "We do not rear pigs anymore because they have swine fever, which wiped out the pigs, and it recurs. Keeping our goats, sheep, and poultry intensively is better than losing them to disease" (Mixed farmer group, Damongo, SR).

Business changes are found with shifting investment focus and commercial scale. Investment changes occur with farmers shifting cultivated crops, cropping seasons, and non-farm activities. Some farmers shift from long- to short-duration crops, such as vegetables, to harvest before the severe water and pasture scarcity periods that attract herders to allow their animals to graze at their farms. Replacing vegetables with longer maturing crops, like cereals and tubers, increases harvests to avoid glut and high perishability. Some farmers farm only one season to respond to water scarcity: "In the dry season, I do not cultivate because there is no water" (Old male farmer, Bonia, UER). This is typical among "mobile" farmers who move from their communities to rent land close to water bodies to cultivate: "We mostly rent land close to water sources to farm during the dry season" (Male farmer group, Bamboi, SR). Others focus on cultivating dry-season vegetables to take advantage of high prices:

> Vegetable prices are vastly different between wet and dry seasons. In the rainy season, vegetables are available and cheap compared to the dry season, when water is scarce. A bag of peppers that sells for 800 Cedis in the dry season [US$55] will sell for 300 Cedis [US$21] in the wet season. (Farmer groups, Baakye and Jambosi, UWR)

Farmers often invest in wet and dry seasons to compensate for harvest losses in one season: "Sometimes the wet season can fail. Harvest levels are not adequate. We fall on the dry season farming to compensate for the loss" (Mixed farmer group, Gingani, NR). Farmers abandon crop components and invest more in off-farm activities in regions with extreme drought and weather conditions like SR: "Yield has reduced because challenging weather and cattle destroy our crops. We sometimes lose 2 to 3 acres. Some people have stopped farming and ventured into charcoal production and trading" (Mixed farmer group, Chancheri, SR).

Finally, reduction in commercial scale is visible when farmers balance household food consumption needs and earning income for other livelihood activities: "As our harvest is reduced, we decrease products selling to markets. When we have 20 bags of maize, we keep six at home. For cassava, we keep four out of 20 for food. We sell maize to aggregators and cassava to gari [roasted cassava flakes] processors in the village or buyers in the Bono East Region" (Mixed farmer group, Damongo, SR). Other farmers cultivate with the intention of selling but cannot do so: "We grow food crops to sell some, but because of low yields,

we end up eating them all" (Mixed farmer group, Bodia, SR). Farmers sell more of their produce within the communities due to food shortages among farming families: "This year, it is difficult for families to come by foodstuffs. We used to send maize to the market, but now, people here buy because of the food shortage" (Mixed farmer group, Akuriyi, SR).

Climate-Resilient Innovations to Support Smallholder Livelihoods in Northern Ghana

We clustered farmers' needs for climate-resilient innovations in their MCLT system into two categories, as presented in Figure 3. Technical innovations include good agricultural practices related to all aspects of farming, such as farm setup and organization, crop and animal production techniques, and integrated pest management. These practices help farmers increase the productivity of crops, livestock, and trees, making them more resilient to climate change impacts. Some farmers indicated their GAP needs:

> We must plant at the correct time, apply fertilizers, pesticides and herbicides, and prune. We must keep animals in clean pens and bathe them. We want to know how to supplement feed and clean water for animals and invite veterinarians to check them occasionally." (Mixed farmer group, Damongo, SR)

Farmers also need circular farming techniques such as crop residue composting and storage and farm waste and/or water recycling to enhance soil, crop, and animal health, reduce chemical inputs, and reinforce biodiversity, as an old farmer in Bole, SR, indicated: "I have a cashew farm with yam, a fishpond, and a vegetable garden. When I change the water from the fishpond, I use it to irrigate the garden."

Innovation bundles include information, irrigated farming, and value-chain bundles. Information bundles encompass weather and climate and input and output market information that supports farmers in making farming-related decisions: "Rain pattern and frequency have changed over years. We could initially predict when the rain would come and farm, but now, it is unpredictable. We need more reliable weather information" (Cashew aggregator, Damongo, SR). Digital weather forecasts and radio and television help improve farmers' access to weather and climate information. In addition, farmers need extension services to provide crop and livestock production information: "The number of times the extension officers visit us depends on our relationship with them. Hence, our older women advise us on what to do because they have been farming for years. Our brother also comes around" (Middle-aged female farmer, Daboya, SR; Female farmer group, Bihee, UWR).

Irrigated farming bundles include water-source development (e.g., borehole development and mechanization), water lifting, storage and application (e.g., motor and solar pumps, drip systems, sprinklers, rain tubes, and storage tanks), irrigation practices, agronomy techniques, and financial services. Bundles of solar-powered irrigation pumps and pay-as-you-go (PAYGO) or pay-as-you-own (PAYOWN) financing models are suitable for investing in irrigated farming, as farmers can better access surface and groundwater and accessible solar energy sources. The bundles are in high demand for farmers to improve access to water for dry season farming:

> Solar-powered pumps can fit our farming conditions. We can pay the upfront cost of the pump. We can also pay part of the amount and commit to paying the rest. We have a payment agreement based on how much we can pay regularly. We can spread the cost according to our harvest cycle or monthly. Finally, we can have pay-as-you-go or pay for the water we use. (Middle-aged male farmer, Gia, UER)

Value-chain bundles encompass services that help farmers access input and output markets, finance and credit, processing techniques for value addition and post-harvesting, and farm business and investment management. The bundles strengthen access to climate-resilient vegetable seeds, mechanization, storage, processing, markets, market linkages, information, goods, and services flow along the MCLT value chain. Accessible and affordable inputs such as

seeds, planting materials, and chemicals are needed:

> We need fertilizers and other inputs which we buy from the agricultural office or agro-chemical shops about 5 km or more away. Sometimes, these inputs can be found only in Bole, about 10 km from here. Some of us travel to Techiman, which is over 100 km, to buy inputs." (Farmer groups, Akuriyi, Bodia, and Seripe, SR)

As many farmers and aggregators indicated, financial services include extended- to medium-term loans and input credit:

> Farmers need fertilizers, herbicides, and money to hire labor and buy inputs. We [aggregators] supply these inputs to farmers as a form of credit. This helps recover our investments in two or three repayments. We also have agreements with farmers to sell us their produce." (Cashew and shea aggregator, Akuriyi, SR)

Demands for processing techniques and post-harvest handling for value addition are visible: "We need inputs for vegetables and processing techniques to produce drinks, jam, and candy from cashew apples. We also make shea butter, Dawa Dawa-fruit food condiment, and roasted cassava flakes" (Farmer groups, Damongo and Akuriyi, SR).

Discussion

Climate Change Impacts and Farmers' Responses to the Mixed Farming Systems

This analysis shows a significant decline in crop yield, livestock productivity, and productivity of the NG MCLT due to multiple CCIs. This is visible in the declining quantity and quality of food and cash crops, biomass, trees growing naturally in the landscape, and livestock. Abdul et al. (2022) also indicated that regional maize yield is about 1.6 tons/ha out of a potential of 5.5 tons/ha, mainly due to erratic rainfall patterns and reported declining livestock productivity as a result of dry season water shortages and high animal mortality.

MCLT systems' productivity decline results in a reduction in farmers' incomes and household food security. This is reflected in less diverse diets and declining household food quality and quantity. Our study shows that households consume up to two maize-based or millet-based meals daily, despite a high preference for various foods and three to four daily meals. Acheampong et al. (2017) indicated that climatic conditions in NG do not permit some households to produce diverse crops, contributing to food insecurity among over 20% of farming families in the region. Households are food secure when they have continuous physical, social, and economic access to "sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (World Food Summit, 1996, cited in FAO, 2022, p. vii). Danso-Abbeam et al. (2023) indicate that average households in NG consume about eight food groups weekly, and farmers with large landholdings are less food-insecure. However, our study shows that large landholding farmers are not necessarily more productive due to their inability to purchase adequate inputs and the limited application of good agricultural practices due to low labor availability.

Interconnections between components in the NG MCLT systems help generate income and cash flow while improving food and nutritional security. For example, farmers use incomes from rainfed crop cultivation to invest in livestock raising, and incomes from livestock sales to invest in dry-season farming. Farmers improve animal feeding and healthcare and enhance soil quality using crop residues as fodder and mulch (Ahiagbe et al., 2021; Akrong et al., 2023). Such cross-component nutrition exchange and investment connections support additional income generation and improved family nutrition, as confirmed by other authors (e.g., Assan et al., 2020; Danso-Abbeam et al., 2021). Access to nutritious foods and a higher income strengthens farmers' ability to adapt to CCIs. This enables them to diversify their farming activities and provide financial capital to engage in new on-farm and off-farm activities or expand existing businesses.

Our findings identify diverse managerial and business changes farmers made in responding to

CCIs. Most farmers focus on technical changes, such as planting, pests, crop diseases, bushfire control, and animal breeding, feeding, and healthcare (Asare-Nuamah, 2020; Wrigley-Asante et al., 2017). These technical changes may lower farm risks more quickly than managerial and business changes. Technical changes often combine indigenous and modern methods, depending on farmers' information access and perceptions of climate change severity and threat (Malhi et al., 2021). Changes in planting timing, livestock management, and investment focus are examples of farmers' short-term actions toward CCIs, reflecting farmers' limited responsiveness and adaptability to adopt CCIs on their MFSs. Furthermore, the commercial downscale reflects their vulnerable livelihoods. Their farming de-intensification due to land and water scarcity and pest and disease incidence negatively affect their livelihood and well-being. Hence, the effects of managerial and business changes are visible over a more extended period and have a higher failure cost for farmers.

Climate-Resilient Innovation Bundles for Farmers' Climate Change Adaptation

This study highlights different innovation bundles farmers can adopt to enhance MFS components' interconnections and respond to CCIs. Good agricultural practices support farmers in increasing yields, reducing crop and animal losses, and sustainably using natural and purchased resources. This results in improving their incomes from crop, livestock, and tree components, and enabling cross-component investments. Circular farming techniques strengthen nutrition exchanges between crops and livestock components. Information bundles provide farmers with relevant information, enabling farmers' timely and wise investment decision-making to improve farm efficiency and support investment connections and technical interactions. Irrigated farming bundles enable farmers' cultivation in the dry season while supplementing crop water needs in the rainy season, increasing farm productivity, incomes, and household nutrition. Value-chain bundles improve farmers' access to input and output markets and family nutrition through improved access to food quantity, quality, and variety. These innovation bundles are climate resilient, increasing farmers' possibilities and responsiveness to CCIs.

Key Characteristics of Climate-Resilient Innovations

We characterize the climate-resilient innovation bundles' suitability, inclusivity, and adaptability. Suitability reflects these bundles' relevance to farmers' MFS contexts and their innovation needs to respond to CCIs. The bundles gather available solutions and services; some have been tested and showed their best fit to the MFS contexts, such as the solar-based irrigation bundles presented in the section on climate-resilient innovations to support smallholder livelihoods in northern Ghana. The bundles are new but suitable for farmers in NR and NER, as farmers in these regions have similar MFS conditions such as water availability, high radiation, land types and availability, demand segments, and established supply chains for solar-based irrigation investments (IWMI, 2023). Co-developing and scaling such bundles need to involve farmers, other value-chain actors, and stakeholders in analyzing the existing situation and context, identifying and packaging the existing, relevant innovations, products, services, resources, and businesses to address the dynamic CCIs and contextual changes. Applying innovation bundling—a process of combining different technological, social, institutional, financial, business, and process innovations and services at several scales to achieve a desired goal (Ofosu & Minh, 2022a)—enhances the innovation bundle suitability, enabling farmers to respond effectively to CCIs while minimizing trade-offs from their investments in MCLF systems.

Inclusivity emphasizes the bundles' capacity to meet the resources and abilities of different farmer segments to address their CCI needs. Demand segmentation by the private sector helps identify clients' available resources and investment preferences, thereby better targeting different farmer segments with inclusive business models (IWMI, 2023). Inclusivity enhances equitable access for marginalized groups to innovation bundles by addressing multiple barriers. For instance, the irrigation bundle presented under the section on climate-resilient innovations to support smallholder

livelihoods in northern Ghana identifies the demand and supply financial constraints of women, youth, and resource-poor farmers by including PAYGO and PAYOWN services and a water supply business model that enables access for various farmer segments.

Adaptability is the ability of the bundles to be customized to fit into several contexts and to adapt to dynamic contextual changes. Adaptability, for instance, supports the deployment of the irrigated farming bundle mentioned in the section on climate-resilient innovations to support smallholder livelihoods in northern Ghana at several scales, such as the farm, project, country, or cross-country levels (Ofosu & Minh, 2022a). The bundle may also be repackaged to suit several MFSs, such as tree-based systems in SR, vegetable-dominated systems in UER and UWR, and supplemental irrigation requirements in rainfed cultivation in all five regions in NG. Further, the bundles are amenable to farmers using surface water, groundwater, and a combination of surface and groundwater. Adaptability, therefore, highlights the capacity of the bundles to be modified for new contexts, uses, or purposes. Adaptability is strengthened when farmers test and modify innovation bundles to suit their existing farming activities based on their resources and farm management practices.

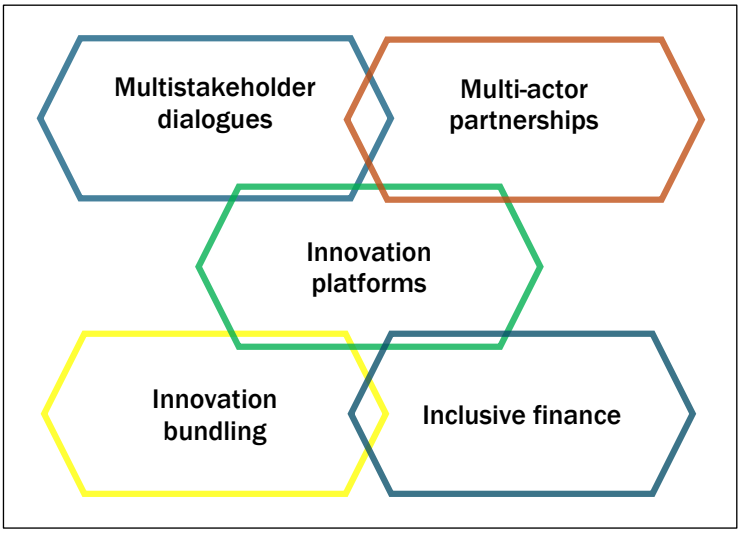
Multiple Scaling Pathways Supporting the Climate Change Adaptation of Mixed Farming Systems

Many opportunities exist to scale climate-resilient innovations to enable farmers' climate change adaptation in the MFS contexts. Multiple stakeholders are growing interested in interventions to address CCIs on MFSs (Abdul et al., 2022; Abegunde & Obi, 2022). There are numerous barriers to scaling climate-resilient innovations, such as poor access to natural, financial, and human capital; group and value-chain dynamics; lack of best-fit innovation bundles; and unfavorable enabling environment (Acheampong et al., 2017; IWMI, 2023; Ofosu & Minh, 2022a). The sustainable climate change adaptation literature suggests that adaptation should only be integrated into socially and environmentally sustainable development (Magesa et al., 2023). Therefore, multiple pathways are needed to scale climate-resilient innovations for sustainable adaptation of MFSs (Figure 4).

Innovation platforms create spaces for farmers and other actors to develop and invest in actionable solutions that meet their needs (Edlmann & Grobbelaar, 2021). The platforms initiate the identification of bottlenecks, problems, opportunities, key stakeholders, and facilitators, followed by deciding the focus and options for solving challenges while harnessing opportunities, testing and refining solutions, and implementing and scaling up successful solutions to increase adoption, including individual farmers (Schut et al., 2018). Platforms operate at one or several scales, including community, district, national, value-chain, or economic sector. When operating at the community and value-chain scales, innovation platforms develop innovations and solutions that best fit farmers' needs of climate-resilient innovations to respond to CCIs. Bundling different, relevant solutions together enhances the bundles' suitability and inclusivity, as shown in the case of the value-chain and irrigated-farming bundles for the NG MCLT systems.

Innovation bundling provides contextually rel-

Figure 4. Pathways for Innovation Scaling Toward Climate Change Adaptation of Mixed Farming Systems



evant solution bundles for farmers, combining existing and innovative technologies, products, and services (Minh et al., 2024). Social and technical innovations often are not stand-alone solutions, but interact; one may require, or even catalyze, another. Innovation bundling brings synergies to minimize obstacles and trade-offs associated with introducing individual innovations, while minimizing farmers' risk and the private sector's investments (Ofosu & Minh, 2022a). Innovation bundling involves multiple value-chain actors co-developing the bundles with options for farmers and then adapting them to a larger geographical scale. Effective stakeholder interactions, high demand for innovation bundles, and supportive policies and interventions are essential for innovation bundling. The bundling identifies one or more high-demand core innovations, making them accessible to different farmers' investment segments. Core innovations, such as climate-smart seeds, solar-powered pumps, or postharvest techniques, are bundled with complementary solutions—supporting technologies or services—that make the core innovations suitable for the contexts and needs, enabling farmers' investments. One example discussed in this study is the irrigated farming bundles, bundling solar-powered pumps with PAYOWN and PAYGO financial services, and tailoring business models to different demand segments of the NG farmers.

Multi-actor partnerships are formal or informal collaborations between organizations or individuals to strengthen linkages and leverage each other's strengths and resources to address common challenges, maximize opportunities, and leverage synergies for catalyzing innovation. Partnerships can emerge from innovation bundling processes, platforms, or value-chain actor networks. Partners join and invest in partnerships based on agreeing on the collaboration's scope and objectives and members' roles and responsibilities (Maryono et al., 2024). Partners offer knowledge, products, services, and other resources that help to address one or more aspects of challenges associated with catalyzing innovations and investing in new or existing markets, agricultural value chains, and businesses. In scaling irrigated farming bundles for the NG MCLF systems, farmers' financial constraints and the irrigation equipment suppliers' investment risks are a few of the profound challenges (Ofosu & Minh, 2022b). Scaling partnerships between private-sector irrigation equipment suppliers, government agencies, research organizations, and development actors enable farmers to invest in solar-based irrigation with tailored supply business models and PAYOWN and PAYGO services to diverse demands, mobilizing joint investments in irrigation markets and creating market linkages with digitalizing sales and service networks. Meanwhile, partnerships help to reduce the risk of irrigation businesses by reducing business-to-business transactions, increasing business transparency and outreach, and raising the solar technology market beyond the niche level (Minh et al., 2024).

Inclusive financing involves strengthening the financial ecosystem to accelerate farmers' investment and de-risk private-sector businesses (Minh et al., 2024). Operationalizing inclusive financing in scaling climate-resilient innovation bundles requires identifying demand and supply constraints associated with financing farmers' and agribusinesses' investments, co-developing innovative mechanisms and solutions with finance ecosystem actors to address the constraints, and catalyzing successful solutions to lower farmers' financial barriers at a large scale. Inclusive financing leverages several funding sources to improve financial access for farmers, especially for vulnerable groups, including women, youth, and resource-poor farmers. These sources include blended, concessional, and carbon financing, performance-based subsidies and grants, revolving funds, green bonds, and insurance. For the private sector, inclusive financing improves liquidity by expanding lending to farmers and de-risking their investment in inclusive business models (Minh et al., 2024).

Multistakeholder dialogues are physical and institutional spaces where stakeholders of common interests work together to identify needs, negotiate priorities, develop solutions, mobilize and exchange resources, reach institutional commitment, and build institutional capacity and memories (Minh et al., 2020). By engaging and partnering with multiple stakeholders, multistakeholder dialogues develop sustainable and inclusive scaling pathways, provide and share scaling knowledge and

experiences, and foster interactive learning to benefit the participation of women, youth, and geographically marginalized groups. Operationalized at the macro level, dialogues capitalize on "'good scaling practices"' for resource mobilization and develop scaling ideas to feasible solutions through "'do-reflect-adapt-do"' loops. Dialogues can support MFS-related policies and planning processes by sharing experiences and insights into farmers' responses and innovation needs for climate-change adaptation and facilitating open policy dialogues. When scaling irrigated farming and value-chain bundles in Ghana, multistakeholder dialogues shift a significant investment role onto the private sector while contributing to government and other actors seeking to support farmers' and marginalized populations' adaptation to CCIs (Minh et al., 2020).

Some of these innovations have been promoted to farmers in SSA for several years. However, climate change has increased the need for smallholder farmers to modify their systems to meet their needs better. These scaling pathways interact and support each other in the adaptive scaling of innovations for MFSs' climate change adaptation. Innovation platforms and bundling support the development of innovation bundles and multi-actor partnerships for scaling the bundles, and vice versa. Inclusive financing further catalyzes the scaling of innovation bundles while supporting innovation platforms and the partnerships' activities. Multistakeholder dialogues stimulate systemic changes by leveraging several levels of innovation platforms, innovation bundling, inclusive financing, and multi-actor partnerships, facilitating the transformational adaptation in the MFS context. Crucial to scaling climate-resilient innovations toward MFSs, climate change adaptation safeguards stakeholders' institutional capacity and memory to ensure continued business and development alignment as we advance.

Conclusion

This study analyzed farmers' climate change adaptation in mixed crop-livestock-tree (MCLT) system contexts in northern Ghana. Climate change impacts (CCIs) in MCLT systems are visible in declining soil fertility, yields, productivity, and incomes simultaneously with increasing temperature variability, water scarcity, erratic rainfall patterns, pest and disease incidences, and input costs. These impacts lead to household nutrition and food insecurity, while challenging women's access to production factors and markets. In response, most farmers focus on combining indigenous and modern farming methods, adjusting agronomic practices, and adapting irrigation management to lower the associated risks. Managerial and business changes in cropping season, de-intensification, livestock management, investment shift, and commercial downscaling negatively affect farmers' livelihood and well-being over a more extended period. The sustainable and inclusive facilitation of farmers' climate change adaptation requires multiple pathways to catalyze climate-resilient innovation bundles, such as good agricultural practices, climate information services, irrigated farming packages, and value-chain linkages to combat CCIs effectively.

This study has several implications for policy, development, and research. First, tailoring interventions to diverse innovation needs is essential to support climate-change adaptation strategies that sustainably manage tradeoffs and synergies from farmers' responses to CCIs in MFSs. The tailoring requires integrating farmers' context specificities, leveraging enabling environment factors, and involving private-sector investments and multistakeholder support in co-designing, bundling, and scaling climate-resilient innovations. Second, operationalizing systemic approaches to support climate-change adaptation should adopt multiple innovation-scaling pathways to address MFS as a whole and profound CCIs. Collaboration and coordination of efforts must be enhanced to mobilize funding from multiple sources and harmonize interventions while minimizing the duplication and contradiction of efforts. Further research should examine MFS practices under changing climatic conditions in other parts of sub-Sahara Africa to generate holistic insights into climate-resilient innovation bundles and recommendations for sustainable climate-change adaptation.

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What does matter most for farmers' choice of marketing channels? Evidence from coastal Bangladesh

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Abstract

This study aimed to identify the marketing channel preferences of small-scale farmers and explore the factors influencing their choices in three coastal districts of Bangladesh. The results showed that farmers mostly preferred to sell from farm stands, while a significant percentage preferred to sell at the marketplace or use both channels. A multinomial logistic regression (MNL) analysis revealed that factors such as gender, farm size, family income, ownership of cart/vehicle, and distance significantly influenced farmer marketing channel preferences. Specifically, female farmers, farmers

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Data Availability Statement
Data is available from the first author upon request.

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The authors declare no conflict of interest.

Ethical Approval Statement
There is no formal provision for obtaining ethical approval from the institution where the study was conducted; however, to adhere to general ethical standards, the purpose of the data collection was explained to all respondents, and interviews were undertaken only upon receiving their informed consent to participate in the survey.

with lower incomes, and farmers without vehicle access preferred selling directly from farm stands. The findings suggest that programs promoting market inclusion or farmer cooperatives should be further explored to increase farmers' participation in marketing channels. Overall, improving access to business opportunities and addressing transportation issues can help small-scale farmers overcome market-related inefficiencies and improve their economic development.

Keywords
marketing channel, agriculture, farmers, coastal, Bangladesh, multinomial logistic regression

Introduction

Farmers markets are common facilities where growers or producers gather regularly and sell their farm produce directly to consumers. While traditional farmers markets play a crucial role in the daily lives of local people, ensuring fair marketing practices is crucial for small-scale farmers in developing nations to achieve broader goals such as food security, poverty alleviation, and sustainable agriculture (Taruvinga & Fraser, 2013). The persistent challenge of farmers being deprived of fair prices—prices untainted by market power or asymmetric information—remains a central issue in the development dialogue. Limited bargaining power leaves farmers vulnerable, enabling intermediaries to capture disproportionate profits. This results in a significant gap between the prices farmers receive and the prices consumers pay (Uddin, 2021).

Intermediaries often control key aspects of the marketing chain, dictating prices and securing substantial profits due to their extensive networks. Consequently, farmers endure financial hardships while consumers face inflated prices. Although farmers may seek access to more extensive or different market opportunities to reach broader customer bases and achieve higher revenues (Shilpi & Umali-Deininger, 2008), they are hindered by various barriers. These include inability to meet market requirements such as food safety standards, readiness for market entry, and the durability of agricultural products. Additional challenges, such as low production volumes, inadequate access to market price information (Jayne et al., 2002), insufficient knowledge of modern post-harvest handling and storage techniques, and poor infrastructure, further exacerbate their hardships. Moreover, farmers' lack of awareness of alternative marketing opportunities and value-addition options often results in oversaturated markets, restricted access for farmers, and high transaction costs. Thus, farmers rely on traditional market channels that may not offer competitive prices.

Farmers in geographically challenged regions like the coastal belts of Bangladesh, unlike those located in the inland plains, face unique vulnerabilities. These regions are characterized by a fragile ecology, climate vulnerability, drought and saltwater intrusion, and poor physical infrastructure. Such challenges limit farming activities and lower farmers' confidence in marketing their products to profitable sales outlets, further depriving them of fair pricing of their produce.

Consequently, the marketing channel preferences of coastal farmers require a distinct focus compared to their inland counterparts, which has inspired the researchers to address two fundamental questions: (1) what are the preferred marketing channels for coastal farmers, and (2) what are the factors that influence most farmers' preferences? It is worth noting that while farmers' channel preferences is not entirely a new topic of study, it still remains relevant and important due to having been relatively little explored. Most of the prior studies we reviewed focused on farmers of specific crops or farmers from inland areas. Our study aims to provide insights from the coastal regions of Bangladesh, where we explore three types of marketing channels: farm stand sales, directly to buyers; marketplace sales, sales through intermediaries at the marketplace; and a mixture of both. In order to understand the dynamics of the three channel preferences, a number of variables, such as farmer demographics and socio-economic factors, were considered. The findings are expected to extend the existing literature by incorporating scenarios from coastal regions, which can inform policy formulation regarding agricultural market system development. Thus, the following objectives were formulated to guide the study:

1. To identify farmers' preferences for marketing channels (direct vs. intermediary-based vs. both);
2. To explore the contributing factors influencing farmers' preferences for marketing channels to sell their produce.

Literature Review

Farmer-trade relations in countries in the Global South are ineffective because of the lack of institutional infrastructure and imperfect competitiveness in agricultural markets (Pagare et al., 2022). Therefore, many agricultural marketing boards and governments have created transaction guidelines to control these exchanges and lessen inefficiencies (Giuliano & Scalise, 2009). Different forms of direct marketing have been developed in practice, including on-farm retail markets, roadside stands, pick-your-own, and community supported agriculture (CSA) (Bruch & Ernst, 2010). For example, the Bangladesh Department of Agricultural Marketing (DAM) opened a weekly farmers market on the premises of Shech Bhaban on Manik Mia Avenue in Dhaka (*Dhaka Tribune*, 2019) for vegetable farmers. This initiative allows small-scale farmers to sell products directly to consumers and learn about market conditions (Young, 1995). The growth of private participation has resulted in the availability of many kinds of marketplace, allowing farmers to select their markets (Onumah et al., 2007). However, the characteristics of these markets may vary, from quality and quantity standards to availability of price discovery mechanisms (Argade & Laha, 2018).

The existing literature generally interprets small-scale farmers as passive decision makers whose market choices are based on government support prices and the accessibility of transportation, which serve as enabling or impeding conditions (Argade & Laha, 2018; Park & Lohr, 2006; Schipmann & Qaim, 2011; Umberger et al., 2015; Xaba & Masuku, 2013; Zanello et al., 2014). However, Pagare et al. (2022) argue that farmers are active decision makers, since farmers' market choices are based on external and internal factors as well as behavioral factors. Small-scale farmers with relatively low farm income are more likely to rely on direct marketing channels than to participate in the larger marketplace (Wolanin, 2013). A study of cherry growers in the Kamalpasa District of Izmir in Turkey found that the duration of farming experience, orchard size, level of cherry production specialization, and size of yield significantly impact farmers' choice of marketing channel (Adanacioglu, 2017). This finding about marketing channels is consistent with a study in Austria, where family farmers particularly use direct marketing (Fujisawa et al., 2015). This study further demonstrates that small-scale farmers' sales from farm stands are a common decision to make because they can set their pricing and have cheap marketing costs related to informal or direct markets (Nkhori, 2004).

It clearly appears that food exchange, transportation, storage, and processing tasks performed by intermediaries are eliminated via direct marketing (Cottingham et al., 1994). A study reported that consumers' willingness to purchase farm-fresh, high-quality produce might encourage them to support local or small farmers (Alberta Ag-Info Centre, 2013). Thus, direct marketing may guarantee the availability of wholesome food for consumers, boost farmer income, and support farmers' living standards (Fehér, 2012). In summary, farmers' choice for marketing may be influenced not only by government policy but by other factors such as transportation cost, distance to the formal market, farm input, and market information.

Farm income and farm size greatly influence farmers' choices of marketing channels. Since larger farmers produce larger volumes, they will likely participate in larger markets to sell their products rather than from their farm stands. The gender of the household head also impacts the choice of marketing channel (Sserunkuma & Alex, 2010). Male-headed agricultural households make up a higher percentage of farms than their female counterparts. As a result, female farmers sell less produce than male producers, who prefer to travel to distant places to participate in larger markets for higher prices (Gebre et al., 2021).

In developing and transitional nations, through wholesale markets or collectors/wholesalers, nontraditional marketing chains such as supermarkets or export markets have recently begun to coexist with traditional

marketing chains. As a result, farmers now have more lucrative opportunities to sell their goods. Small-scale farmers can choose from an expanding variety of possible buyers. Recently, a growing group of educated farmers with commercial and medium-sized farms geared toward supermarkets has made up the bulk of supermarket suppliers, boosting production and quickening the pace of economic growth. Therefore, a sustainable marketing system is essential. An effective marketing system may provide a high level of the producers' share of the consumer price, decrease the number of intermediaries, lower marketing costs, and decrease unethical marketing techniques (Panda & Sreekumar, 2012). However, most marketing channels in developing nations are lengthy, intricate, and have large transaction costs. Moreover, high fixed costs for market information (Aker, 2010), improved technology (Barrett, 2008), and transportation facilities (Fafchamps & Hill, 2008) due to poor and remote road conditions prevent small-scale farmers from obtaining fair prices and reduce their chances of negotiating better deals. With limited access, they often rely on local buyers or intermediaries who pay significantly less than the market or expected price. Therefore, the rising interest in direct marketing among small-scale farmers is due to several factors. This study intends to investigate those factors triggering farmers' decision-making to participate in direct or intermediary-based marketing.

Researchers and decision-makers have investigated agri-food systems and farmers' preferred marketing channels, particularly in response to evolving market conditions and policy changes (Fafchamps & Hill, 2005; Goetz, 1992; Rao et al., 2012). Scholars have recently researched the dynamics of the agricultural supply chain; however, contracts (Zegher et al., 2019), cooperatives (An et al., 2015), and intermediation (Ferreira et al., 2017) have received the majority of attention. While available research primarily concentrates on value chains and production data, studies on channel preference have received relatively little attention in Bangladesh, particularly the coastal region, which is uniquely diverse and vulnerable compared to the inland. Farmer participation in markets is crucial for reducing poverty and inequality and promoting sustainable economic growth, as this allows them to sell their produce to a larger customer base and creates opportunities for better prices. Access to diverse marketing channels can ensure a fair price, reduce intermediaries' interference and the strain on consumers for paying unjustified prices, and improve food safety. The overall system can contribute to economic growth and farmers' living standards. Multiple interrelated variables, including market conditions, demographics, and economic and social factors, were thus considered in this study to determine the factors that drive farmers' choice of marketing channels to sell their produce. Research of this nature is rarely done in Bangladesh, especially in coastal regions, and remains less common compared to other studies in the country. Therefore, this research aimed to fill the gap by exploring farmers' preferences between different marketing channels and their related consequences.

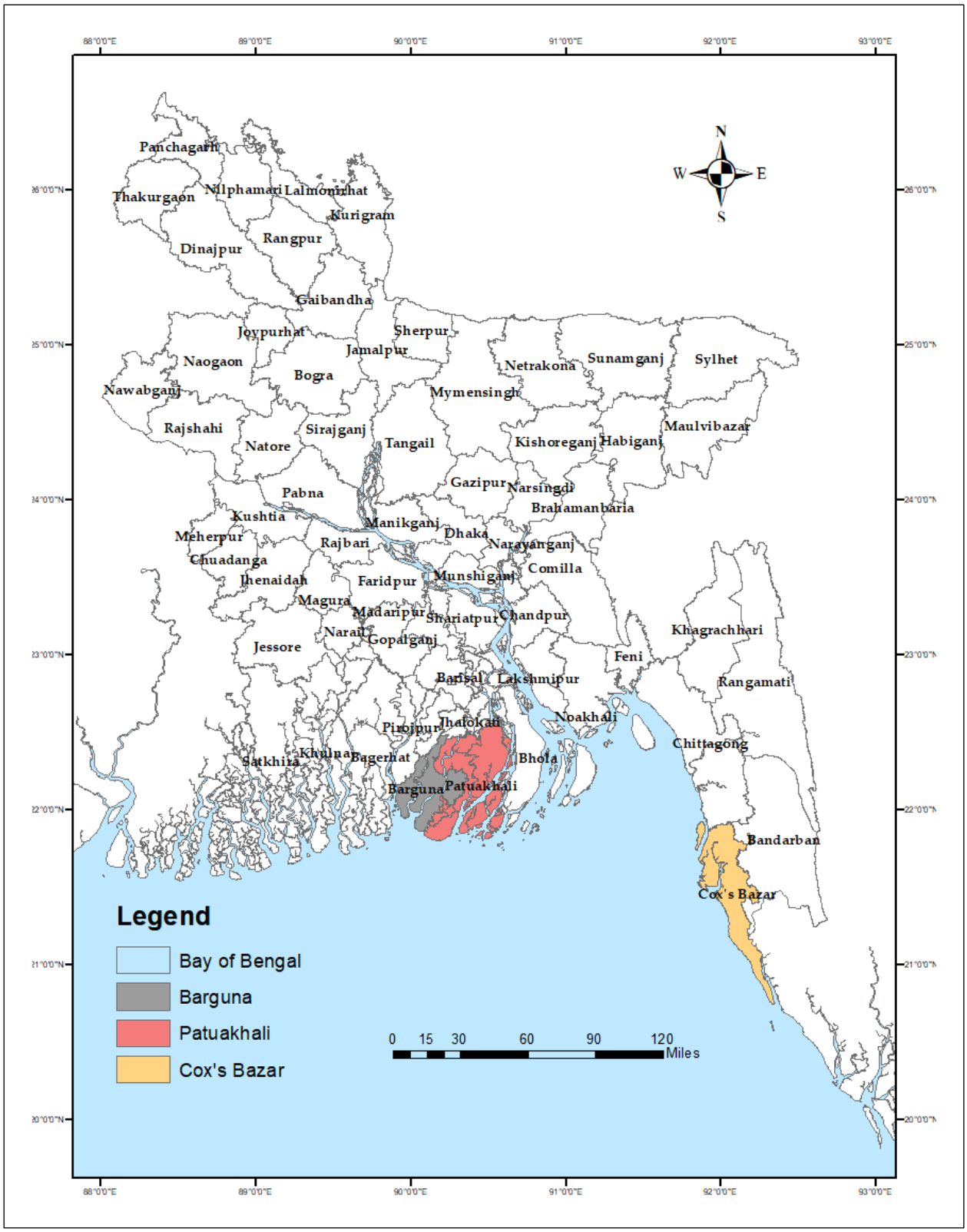
Methods

In this study, farmers' use of marketing channels was broadly classified in three ways: direct sales, i.e., sales from the farm stand ("farm stand sales"); indirect sales, i.e., sales through intermediaries at the marketplaces ("marketplace sales"); and both channels, i.e., sales combining direct and indirect sales based on convenience.

Study Area

The study deliberately selected coastal regions since livelihoods and transportation facilities are more likely to be vulnerable and limited in the coastal areas than in the floodplain or inland. Moreover, the objective was to explore factors influencing coastal area farmers for their marketing channels. Therefore, strategies were formulated to address the market-related problems of the coastal regions. Three coastal districts of Bangladesh were chosen as the study area (Figure 1), close to the Bay of Bengal: Cox's Bazar (which has the world's longest beach), and Patuakhali and Barguna, which are vulnerable to climate change impact but feature diverse marine and other resources vital to the agricultural sector of Bangladesh. One upazila (i.e., subdistrict) from each district was randomly selected for data collection.

Figure 1. Bangladesh Map Showing Study Areas with their Proximity to the Bay of Bengal



Sampling Method

The study adopted a convenient sampling technique to ensure rapid data collection within the time and budget constraints. While this approach may not statistically represent the entire population, it allows for an initial exploration of the research topic. It serves as a foundation for more comprehensive statistical analyses in future studies.

Data Collection

Based on the prior literature search (Adanacioglu, 2017; Wolanin, 2013; Xaba & Masuku, 2013) and considering local socio-economic and market-related conditions, a structured interview schedule was prepared and pre-tested with 12 respondents from one of the sampled areas. Based on the pre-test experience, the instrument was modified and finalized according to the objectives of the study.

After meeting at a focal point of the locality, the two enumerators chose two different routes, walked through nearby villages and farmlands, and approached possible respondents for the interview, stating the objectives of the study. If a respondent showed his or her interest and gave full consent to participate in the survey, the enumerator collected the data in a face-to-face situation using the structured interview schedule. The enumerators successfully interviewed 197 respondents (Table 1).

Data Analysis

A multinomial logit regression model was chosen to explore the factors influencing farmers' preferences for marketing channels to sell their produce. It provides an estimation between a dependent variable with three or more categories and one or more independent variables. This model is suitable for analyzing unordered responses with more than two choices (Pham et al., 2019; Wooldridge, 2010).

Table 1. Sample Size of the Study

Name of district	Name of the upazila (subdistrict)	Number of respondents	Percentage
Cox's Bazar	Ramu	101	51.27
Patuakhali	Sadar	50	25.38
Barguna	Patharghata	46	23.35
Total		197	100

While there are many ways for farmers to sell their produce, any way to sell is included in either a direct or indirect marketing system or both, as they are broad aspects of marketing. Therefore, this study considered three marketing options: direct (farm stand sales), indirect (formal marketplace sales through intermediaries), and a choice of both channels. The analysis was run using SPSS (v24) software program. The model is expressed in terms of log odds or logit. The equation for the log odds of category "i" are relative to the reference category. Farmers' choices of marketing channels can be analyzed as:

$$\text{logit}\,(P(Y=i|X)) = \log\,[P(Y=i|X) / P(Y=\text{reference category}|X)] \quad \text{(i)}$$

where $P(Y=i|X)$ is the probability of the dependent variable being in category i given the values of the independent variables X, and $P(Y=\text{reference category}|X)$ is the probability of the dependent variable being in the reference category given the values of the independent variable X.

The equation for the multinomial logistic regression model with k independent variables is written as:

$$\text{logit}\,(P(Y=i|X)) = \beta 0i + \beta 1X1 + \beta 2X2 + \ldots + \beta kXk \quad \text{(ii)}$$

where $\beta 0i$ is the intercept for category i, $\beta 1$ to βk are the coefficients for the independent variables X1 to Xk, and $\text{logit}(P(Y=i|X))$ is the log odds of category i relative to the reference category. "Sales from farm stand" was considered the reference category.

The model estimated coefficients for each independent variable, as well as the standard errors, Wald chi-square statistics, and significance levels. These coefficients can be used to calculate the log odds of the dependent variable being in each category given the values of the independent variables indicating gender, family income, farm size, asset ownership (cart/vehicle), distance from the market, access to market information, access to farm input information, and frequent access to extension support services.

From the utility perspective, each respondent farmer will choose a marketing option if the utility gain from that option is greater, considering his or her manageable resources. than that of other marketing options with regard to the selected determinants. To estimate the likelihood ratio, all the determinants were treated as dummy variables. Measurements of the variables are given in Table 2.

Results

Data revealed that most farm respondents (46.7%) prefer selling their produce from the farm stand. In comparison, one-fourth of the respondents prefer to sell through intermediaries in the marketplace (25.4%), and a little over one-fourth of the respondents (27.9%) use both marketing channels.

An overwhelming majority of the respondents (84.8%) were male and had low family income (less than 3 lac BDT per year; 1 USD = 105 BDT). A little over one-fourth of the respondents (27.9%) had a large farm (i.e., >1 ha.), and less than one-fifth (18.3%) had a cart or vehicle that was used to carry their produce to the nearest marketplace. Half the respondents lived one kilometer away from the nearest marketplace. Most had access to market-related and farm input-related information; however, only 14.7% had frequent access (i.e., once a week) to local extension services.

Data in Table 3 show that for female respondents, only 10% used both marketing channels. Farm stand sales were the most preferred marketing channel for male (41.9%) and female (73.3%) farmers. Nonetheless, it is evident that most male farmers (58%) tend to sell through intermediaries.

Table 4 has a likelihood ratio chi-square test that

Table 2. Variables and Measurements Used

Name of the variables	Measurement technique
Gender	1 = Male, 0 = Otherwise
Family income	1 = >3 lac/year, 0 = Otherwise
Farm size	1 = >1 hac of land, 0 = Otherwise
Asset ownership (Cart/vehicle)	1 = Owned cart/vehicle, 0 = Otherwise
Distance from markets	1 = >1 km far from market, 0 = Otherwise
Access to market information	1 = Access, 0 = No access
Access to farm input information	1 = Access, 0 = No access
Access to extension service	1 = Frequent access (once a week), 0 = Otherwise

Table 3. Frequency Distribution of the Respondents Within Groups

		Sales (Farm stand)	Sales (Marketplace)	Both
Variables		Count (%)	Count (%)	Count (%)
Gender	Male	70 (41.9%)	45 (26.9%)	52 (31.1%)
	Female	22 (73.3%)	5 (16.7%)	3 (10.0%)
Farm size	Small	72 (50.7%)	36 (25.4%)	34 (23.9%)
	Large	20 (36.4%)	14 (25.5%)	21 (38.2%)
Family income	Low	87 (51.5%)	42 (24.9%)	40 (23.7%)
	High	5 (17.9%)	8 (28.6%)	15 (53.6%)
Cart/ Vehicle	Not owned	84 (52.2%)	36 (22.4%)	41 (25.5%)
	Owned	8 (22.2%)	14 (38.9%)	14 (38.9%)
Distance	Not far	33 (34.0%)	25 (25.8%)	39 (40.2%)
	Far	59 (59.0%)	25 (25.0%)	16 (16.0%)
Market information	No access	3 (33.3%)	4 (44.4%)	2 (22.2%)
	Access	89 (47.3%)	46 (24.5%)	53 (28.2%)
Farm input information	No access	4 (44.4%)	3 (33.3%)	2 (22.2%)
	Access	88 (46.8%)	47 (25.0%)	53 (28.2%)
Extension contact	Less frequent contact	79 (47.0%)	43 (25.6%)	46 (27.4%)
	Frequent contact	13 (44.8%)	7 (24.1%)	9 (31.0%)

Table 4. Model Fitting Information

Model	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	214.952	221.518	210.952			
Final	189.182	248.280	153.182	57.770	16	.000

Table 5. Goodness-of-Fit

	Chi-square	df	Sig.
Pearson	90.682	76	.120
Deviance	91.217	76	.112

Table 6. Pseudo R-Square

Cox and Snell	.254
Nagelkerke	.289
McFadden	.138

compares the full model (i.e., the model with all predictor variables) against a null model (i.e., a model with no predictors). The result shows that the final model is a significant improvement in fit over a null model [$\chi 2$ (16) = 57.770, p<.001].

The goodness-of-fit model (Table 5) has the Pearson and deviance chi-square values that show whether the model is a good fit or not. Generally, nonsignificant results are expected to indicate that the model fits well with the data. In both cases, the model fits well with the data [$\chi 2(76) = 90.682$, p>.05] and [$\chi 2(76) = 91.217$, p>.05].

In general, there is no strong guidance as to how to interpret the R-square value (Table 6), particularly in the MNL, even though pseudo-R-square values are treated as rough analogs to the R-square value in the ordinary least squares (OLS)-based model. Nonetheless, Table 6 indicates that the model could explain 28.9% of the variance of the dependent variable (Nagelkerke = .289).

While the pseudo R-square values are expected to be treated cautiously, the likelihood ratio tests (Table 7) are important determinants of the MNL regression model. Data show the overall contribution of each independent variable to the model. Using the conventional threshold (p<.05), gender, farm size, family income, cart/vehicle ownership, and distance from the market were the significant predictors of farmers' preferences for the marketing channel. In contrast, market- and farm-input-related information and extension contact did not show any significant influence.

Table 7. Likelihood Ratio Tests

Effect	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	chi-Square	df	Sig.
Intercept	189.223	241.755	157.223	4.041	2	.133
Gender	194.074	246.606	162.074	8.892	2	.012*
Farm Size	191.430	243.961	159.430	6.248	2	.044*
Family Income	192.534	245.065	160.534	7.352	2	.025*
Cart/vehicle	192.083	244.614	160.083	6.901	2	.032*
Distance from market	197.889	250.420	165.889	12.707	2	.002**
Market-related information	187.043	239.574	155.043	1.861	2	.394
Farm input information	185.600	238.131	153.600	.418	2	.811
Extension contact	185.700	238.232	153.700	.518	2	.772

The chi-square statistic is the difference in -2 log-likelihoods between the final and reduced models. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

The parameter estimates (Table 8) provide information that compares each choice against the reference category, farm stand sales. The regression coefficients specify which predictor variables significantly differ between farmers who sell through both channels and those who sell from the farm stand, and between farmers who sell through intermediaries at the marketplace and those who sell from the farm stand.

The first section of Table 8 compares marketplace sales (coded 1) and farm stand sales (coded 0). Two predictors, gender and cart/vehicle ownership, were found significant ($\beta = 1.133$ & $\beta = 1.302$, respectively, $p<.05$). The positive significant sign denotes that respondents scoring higher on these predictors were highly likely to sell their produce through intermediaries compared to sales from the farm stand. The odd ratio of gender [Exp(B) = 3.106] and cart/vehicle ownership [Exp(B) = 3.677] indicate that for every one-unit change in gender (here, male), the odds of selling through the marketplace changed by a factor of 3.106, while in case of cart/vehicle ownership, the odds increase by a factor of 3.677.

The second set of coefficients compares farmers who prefer to sell from their farm stand and those who explore both channels for selling their produce. Data in Table 8 show that gender ($\beta = 1.616$), farm size ($\beta = 1.025$), family income ($\beta = 1.613$), and distance from the market ($\beta = –1.438$) were all found to be significant predictors of farmers' choice of marketing channel, while only distance from market showed a negative influence. The odds of farmers using both the marketing channels increase by a factor of 2.788 and 5.020, respectively, with an increase in farm size and in family income. Furthermore, the odds were found to increase by a factor of 5.031 for male farmers compared to female farmers. However, in the case of distance from the market, the odds [(EX(B) = .237] decrease.

Discussion

Farmers from the coastal regions of Bangladesh face challenges in accessing contemporary transportation facilities due to infrastructure challenges such as poor road quality, inadequate vehicles, distance to inland markets, transportation costs. Furthermore, the geography of many areas renders them remote, increasing costs associated with travel and transportation of produce from the farm stand to the nearest markets. This limitation impedes farmers' ability to secure higher prices for their produce. Enhancing farmers' access to profitable markets is crucial to raising their farm incomes and productivity, supporting better livelihoods, and promoting rural development. Consequently, the objectives of this study were to find the farmers' preferences for marketing channels and to investigate the factors influencing their choices of marketing channels for selling their produce.

From the findings of this study, direct sales from farm stands are most preferred by the respondent farmers. This preference is understandable given the dynamics of the coastal region. Factors such as environmental conditions and shipment costs may encourage farmers to sell their produce directly from their farms or roadside stands near their fields. This type of sales is possibly the most straightforward market channel for them.

It is also reported that male farmers tend to travel to distant markets more often than female farmers, showing that the gender of respondents influences their choices of marketing channels. This study confirms that gender significantly impacts the preference for marketplace sales ($\beta = 1.133$) and both marketing channels ($\beta = 1.616$) over farm stand sales. Moreover, males can manage more risks because they can enforce negotiations and contracts and handle larger amounts, which allows them to deal with professional intermediaries and local traders (Gebre et al., 2021; Maina, 2015).

Farm size and farm income are two more important determinants that help explain choices of marketing channels. The results revealed that farm size has a significant impact ($\beta = 1.025$) on farmers' choices of marketing channels; farmers with large farms (23.9%) were likely to explore both marketing channels (sales from farm stands and sales at the marketplace) according to their convenience. The findings support that producers become less dependent on direct marketing channels as farm size and family income increase.

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Table 8. Parameter Estimates

Marketing Channel Option		B	Std. Error	Wald	df	Sig.	Exp (B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
Marketplace sales	Intercept	–.834	1.155	.521	1	.470			
	Gender	1.133	.567	3.989	1	.046*	3.106	1.021	9.444
	Farm size	.402	.415	.939	1	.332	1.495	.663	3.373
	Family income	.880	.649	1.836	1	.175	2.410	.675	8.606
	Cart/vehicle	1.302	.512	6.466	1	.011*	3.677	1.348	10.030
	Distance	–.376	.399	.888	1	.346	.686	.314	1.502
	Market information	–.895	.843	1.129	1	.288	.408	.078	2.130
	Farm input	–.125	.842	.022	1	.882	.882	.169	4.599
	Extension contact	.167	.544	.094	1	.759	1.181	.407	3.428
Sales through both channels	Intercept	–2.794	1.480	3.562	1	.059			
	Gender	1.616	.686	5.553	1	.018*	5.031	1.312	19.286
	Farm size	1.025	.413	6.174	1	.013*	2.788	1.242	6.259
	Family income	1.613	.625	6.666	1	.010*	5.020	1.475	17.086
	Cart/vehicle	.877	.545	2.585	1	.108	2.403	.825	6.998
	Distance	–1.438	.422	11.628	1	.001*	.237	.104	.542
	Market information	.220	1.043	.044	1	.833	1.246	.161	9.630
	Farm input	.497	.994	.250	1	.617	1.644	.234	11.535
	Extension contact	.392	.543	.522	1	.470	1.480	.510	4.294

[a] The reference category is: Farm stand sales

Consistent with work by Monson et al. (2008), this finding has several supporting arguments. Bigger farms can better overcome the obstacles that hinder most small-scale farmers from entering other potentially lucrative markets, including supermarkets. In addition, farmers with large farms may be enticed to reduce their marketing expenses by selling to buyers who can absorb more of their supply than direct market clients, who often make only modest purchases. This suggests that relying on direct and indirect marketing channels will rise as household income does. Monson et al. also pointed out that higher-income farmers might become wealthier due to their involvement in both marketplaces. Again, family income ($\beta = 1.613$) positively affects choice of both marketing options, which may imply that a higher-income family earns more as they choose both farm stand and marketplace sales.

Park et al. (2014) concluded that farm income greatly influences farmers' choice of marketing channels. Furthermore, Wolanin (2013) states that smaller farm sizes and low-income farm households tend to favor farm stand sales. The results of this study, consistent with earlier findings, indicate a significant association between these factors and the likelihood of using direct marketing channels. This preference may stem from the inability of such operations to consistently deliver high-quality produce or meet the high-volume demands of intermediaries and retail outlets.

The analysis of market channel selection decisions also highlighted the significance of market distance as a key variable. The negative association between distance and sales from farm stands suggests that farmers opt for farm stand sales due to discouragement imposed by traveling to distant markets. The inclination to participate in distant markets was significantly inversely correlated with proximity to the nearest markets (Maina, 2015). Farmers show less inclination to sell at any market farther away than the nearest market, preferring direct sales to buyers through alternative channels like farm stands. Distance from the market often dissuades farmers from traveling to the nearest market, leading them to prefer selling their produce directly from their farm stands.

However, a different pattern appears when farmers own a cart or vehicle, making transporting their produce to nearby markets easier. Compared to farmers without any cart, those with a cart or vehicle show greater flexibility in selling through direct market actors. Results show that farmers who owned carts/vehicles were inclined to choose sales at the marketplace. The findings suggest that farmers with vehicle access are likely to explore more opportunities, enabling them to transport agricultural produce to distant marketplaces. Similarly, higher-income groups have greater propensity to explore various marketing options, while respondents living far from the marketplace tend to favor direct sales from their farm stands.

The decision to participate in the market strongly correlates with owning transportation equipment, as demonstrated by studies conducted by Makhura et al. (2002) and Olwande and Mathenge (2012). Farmers' choices about marketing channels are significantly influenced by the availability of transportation, particularly if they are distant from market centers (Taruvinga & Fraser, 2013). This finding may vary somewhat from a study conducted by Muthini (2015), which determined that farmers were more inclined to sell directly to consumers than at a marketplace if they owned a vehicle, lived close to a paved road, and had access to market information. Thus, distance to the marketplace is intricately linked to the selection of marketing channels, with farmers discouraged from selling their produce in formal market channels due to distance between their farms and the markets.

Moreover, farmers with higher income and who are aspiring to earn more, prefer to sell through all available channels rather than only from their farm stand. The findings clearly show that small-scale farmers with lower family incomes, farmers lacking adequate vehicle facilities, and female farmers tend to favor sales from farm stands compared to other alternative options.

Conclusion and Recommendations

Choosing a marketing channel is one of a farmer's most challenging and pivotal decisions. Each channel system caters to a distinct group of target consumers and entails varied income possibilities

and costs. This study aimed to find farmers' preferences for selecting marketing channels and to explore the contributing factors. The key findings are summarized here, along with additional recommendations for enhancing the structure of all marketing channels.

Most farmers in this study prefer direct marketing channels. Gender of the respondents significantly influences farmers' preference for marketing channels, as male farmers are more inclined to explore multiple channels than their female counterparts, who typically prefer sales from farm stands. Farmers who own vehicles have the advantage of selling their produce to nearer market, while those with large farms and higher incomes tend to diversify their sales through all channels rather than solely from their farm stands. The results show that small-scale farmers with lower family incomes, without or with inadequate transportation facilities, and female farmers tend to favor farm stand sales over other options.

Although earlier research has examined potential factors in farmers' decisions to engage in direct marketing, the consequences of these factors may vary depending on region and crop-specific factors. Most importantly, we found a lack of research investigating decisions in coastal regions. Therefore, our study not only demonstrates but also reaffirms the dynamics of farmers' marketing channel choices. These findings can encourage policymakers, agricultural extension agents, agricultural marketing institutions, and other stakeholders to develop targeted interventions for specific contexts.

Selecting a sales channel is critical in marketing agricultural and non-agricultural products. Our findings reveal that factors such as gender, farm size, family income, vehicle ownership, and distance from markets directly contribute to farmers' preferences for marketing channels. Moreover, factors like farmers' access to market and price information and transportation facilities can limit their marketing channel preferences.

Coastal farmers face greater difficulties accessing markets due to unique climatic conditions, limited vehicle ownership, and significant gender disparities in farming compared to inland farmers, where farming practices are more stable and transportation facilities are superior. These differences highlight the impact of geographic and socio-economic factors on market participation for coastal farmers. Therefore, a multi-faceted approach is recommended to promote and enhance farmers' participation in markets within coastal regions. Government and nongovernmental organizations should prioritize establishing strong relationships and collaborating with local farmers and food processors to create a stable, year-round buyer base. Policymakers should focus on sustainable market restructuring and improving supply chain continuity, particularly for small-scale and female farmers, who often lack access to formal marketing channels. Furthermore, relevant authorities should develop an inclusive market infrastructure that would contribute to agricultural productivity and boost farmer income by enabling direct trade between small-scale farmers and buyers. Creating local markets close to farming communities or implementing a "bring the market to farmers' doorstep" model, through mobile markets or localized aggregation points near farmland, can reduce farmers' dependency on distant markets. We believe this model, coupled with the development of transportation infrastructure, effectively tackles coastal farmers' unique logistical challenges and enhances market access. Supporting farmer cooperatives and community-based agricultural market systems can empower farmers by improving their collective bargaining power and facilitating access to formal markets. Developing timely and reliable market information services is also a good strategy to encourage small-scale farmers to participate in distant and more profitable markets. To foster sustainable and resilient coastal region agricultural practices, further research is recommended to explore other factors affecting coastal farmers' trading systems, such as climate resilience, post-harvest storage, and transportation infrastructure.

This study has its limitations, particularly the generalizability of its findings. While agricultural marketing research is well-established, exploring coastal farmers' marketing channel preferences remains relatively uncommon in Bangladesh as well as globally. Concerns about the applicability of our findings to other contexts, such as inland or non-

coastal farming, are valid. We encourage readers to interpret our findings with this limitation in mind. However, from a methodological standpoint, our selection of methods is proper given the objectives and background of the research. We carefully selected variables that sufficiently captured the nuances of the research. Despite its regional scope, the insights gained have broader relevance. These can be applied to other coastal areas and regions facing similar resource constraints due to geographical challenges. Therefore, these recommendations are informed by our research results and are designed to address the specific needs of coastal farmers. Focusing on these tailored solutions, our study contributes to a deeper understanding of how to support farmers effectively in these unique geographies.

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Understanding smallholder dairy productivity and poverty reduction in Eritrea: An A-WEAI approach

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Abstract

Improving the poverty status of smallholder dairy farmers in Eritrea necessitates an increase in dairy production efficiency. This study investigated the influence of empowerment programs on smallholder dairy production, specifically those aimed at fostering the development of knowledge and skills for both male- and female-headed households. The Abbreviated Women Empowerment in Agriculture Index (A-WEAI) and an instrumental variable estimator (IVE) were used to analyze data collected from 379 households in three Eritrean communities. The findings show that male household heads are more empowered than their female counterparts. Analysis at the Zoba (regional) level showed disempowerments for all households in Anseba

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Conceptualization, Stephen Onakuse; methodology, Lilian Treasure and Stephen Onakuse; software, Stephen Onakuse and Lilian Treasure; investigation, Okbasilassie Msghina and Kahsay Negash; data curation, Lilian Treasure; writing—original draft preparation, Lilian Treasure; writing—review and editing, Lilian Treasure and Stephen Onakuse; supervision, Stephen Onakuse; project administration, Stephen Onakuse; funding acquisition, DeSIRA project team. All authors have read and agreed to the published version of the manuscript.

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(65.42%), followed by Debub (57.02%) and Maekel (33.11%). Empowerment had a positive effect on labor productivity among male- and female-headed households, resulting in increases of 11.50% and 18.49%, respectively, and on poverty reduction, with empowerment increases of 10.57% and 9.91%, respectively. In addition, the level of education, the farmers' age, and the price of milk had a negative effect on labor productivity among male and female dairy farmers. Dairy experience, labor cost, and membership in a cooperative had a positive effect on the labor productivity of male farmers. Herd size (with a positive coefficient), type of dairy production practice, and perception of government policies on dairy farming (with negative coefficients) were essential factors that affected labor productivity among male and female dairy farmers in Eritrea. Land rent, frequency of extension visits, milk unit price, dairy experience, and number of lactating cows affected asset accumulation among Eritrean dairy farmers. We recommend context-specific innovative empowerment strategies to boost productivity and market access and reduce poverty, particularly for female farmers. Gender disparities in Eritrean dairy farming show that women face greater disempowerment. Involving more women in these strategies can reduce the gender gap, promote gender equality, and support sustainable development in Eritrea.

Keywords
smallholder, dairy, women, market, A-WEAI, productivity, instrumental variable (IV), Eritrea

Introduction and Literature Review

Like many other developing countries, the agricultural sector employs about 80% of Eritreans (World Bank, 2021), and dairy farming constitutes a significant component (Climate Smart Agriculture Research and Innovation Support for Dairy Value Chains in Eritrea [CSARIDE], 2021). Eritrean small-scale subsistence farmers own approximately 90% of all dairy animals (Doss et al., 2013). Dairy farming is a significant source of income and an important livelihood activity for most households in Eritrea, contributing to food security and poverty reduction (CSARIDE, 2021). All land in Eritrea is owned by the government, which reduces dairy farmers' access to the Agricultural Land Food and Agriculture Organization database (FAOLEX, 2023). The Eritrean government temporarily grants access to land for farmers and can be inherited. On the one hand, the land reforms only allow allocation of land on usufruct, or for temporary use, though land can be inherited and leased, but not sold or granted as a gift (Castellani, 2000; Fullerton Joireman, 1996). This individual allocation of land restricts large-scale allocation and further enforces settlement for small farms. Enforced settlement increases production costs for small-scale farmers and is ineffective (Fullerton Joireman, 1996). Dairy farming in Eritrea allows women to earn income that contributes to their livelihoods, provides room for women to make decisions, propose ideas that improve household and community poverty status, and take on leadership roles (Ahn, 2022). Consequently, smallholder dairy farming activities promote women's participation in decision-making and enhance their economic and social status (Ahn, 2022; Dohmwirth & Hanisch, 2018; Heyde, 2001).

Although robust legal frameworks that incorporate gender equality and equity exist in developing countries, social norms and customs work against women's rights and limit their potential to contribute to decisions that will improve dairy farming and reduce poverty within households (Boeding, 2017; Doss et al., 2013; Price, 2020). Gender discrimination exacerbates household poverty by limiting access to agricultural resources and reducing the bargaining power of women within households, communities, and society. There is a paucity of data on the actual population of Eritrea and the rates of poverty (World Bank, 2021); however, about 66% was estimated to live below the

Conflict of Interest Disclosure
The authors declare no conflict of interest as the authors agreed to the design of the study, data collection, analysis, or interpretation of the literature materials, the writing of this manuscript, and the decision to publish the results. The views expressed and arguments employed in this paper are the authors' sole responsibility and do not necessarily reflect the official position or opinions of the organization with which the authors are affiliated.

Data Availability Statement
Data for this study will be made available upon request.

poverty line in 2018 (Jennings, 2018), and the poorest among them are female-headed households (United Nations International Children's Emergency Fund [UNICEF], 2022). Several agricultural transformation models are currently being implemented to improve the poverty status of Eritreans (Ministry of Women Affairs, 2017). However, due to a significant shortage of agricultural resources and poor program implementation (Adams, 2017), poverty persists, especially among the 65% of the population residing in rural areas, who depend on agriculture for livelihood (Boeding, 2017).

Consequently, most agricultural projects in Eritrea are designed to improve productivity and reduce poverty among dairy farmers, often focusing on empowering women. Empowerment is a multidimensional process ensuring that essential capacities, participation in socioeconomic and sociocultural domains, and the legal rights of the most vulnerable people are achieved (Patel & Patel, 2022). Women's empowerment increases autonomy over their lives, bodies, finances, social interactions, and external environment (Idris et al., 2023; Kabeer, 2005; Kishore & Lekha, 2008). However, this result is paradoxical. Studies have shown that while ownership of cows by women enhances empowerment and gender equity, it may also disempower them by increasing women's "time poverty," that is having too many things to do but with limited time to do them, due to increased labor responsibility (Bain et al., 2020; Hyde et al., 2020; Rodgers, 2023)

Dairy farming is labor-intensive. Labor accounts for approximately 15–20% of the total cost of production (Durst, 2020) and can easily be under- or overutilized. Therefore, to avoid productivity loss, proper labor management in dairy farms is necessary because it enhances the scale and volume of production and improves cost efficiency (Stankov, 2020). Because labor is an essential factor in dairy production, it was used to evaluate productivity in this study. To develop a comprehensive measure of the effect of interventions on labor productivity and poverty reduction among small-scale dairy farmers, the Abbreviated Women's Empowerment in Agriculture Index (A-WEAI) approach was used. This measure is used in the context of gender inequality in access to agricultural resources. A-WEAI comprises five domains (5DE): production, resources, income, leadership, and time. According to Alkire et al. (2013), the production domain is concerned with sole or joint decision-making about inputs in crops/food, livestock, or fisheries production. The resource domain is concerned with ownership of at least one major household asset as well as sole or joint access to and decision-making authority over credit, and the income domain concerns control over the use of household income and expenditure either solely or jointly among household members. The leadership domain focuses on being an active member of at least one formal or informal social or economic group, and time is an indicator of the workload of household members in dairy production, either solely or jointly, while deriving satisfaction for leisure activities.

Though there are empirical studies on agricultural productivity and poverty reduction, very few studies have focused on dairy farming, poverty reduction, and empowerment (Bain et al., 2018, 2020; Kabunga, 2014; Lyatuu et al., 2022; Martin et al., 2020; Ruiz-Torres et al., 2022; World Bank, 2016). Dairy farming can reduce farmers' (CSARIDE, 2021). However, with the notable exception of Bain et al. (2020) and Bain et al. (2018), there is very little literature on dairy productivity, poverty reduction, and empowerment as measured by WEAI. Thus, this study addressed the following questions:

- How does empowerment, as measured by A-WEAI, affect the productivity of smallholder dairy farmers in Eritrea?
- Are there any regional differences in the levels of empowerment and disempowerment among smallholder dairy farmers in Eritrea?
- Which factors are the most significant determinants of labor productivity and poverty among Eritrean dairy farmers?
- How do household characteristics, such as education, age, and dairy experience, influence dairy farming productivity and the economic status of households?

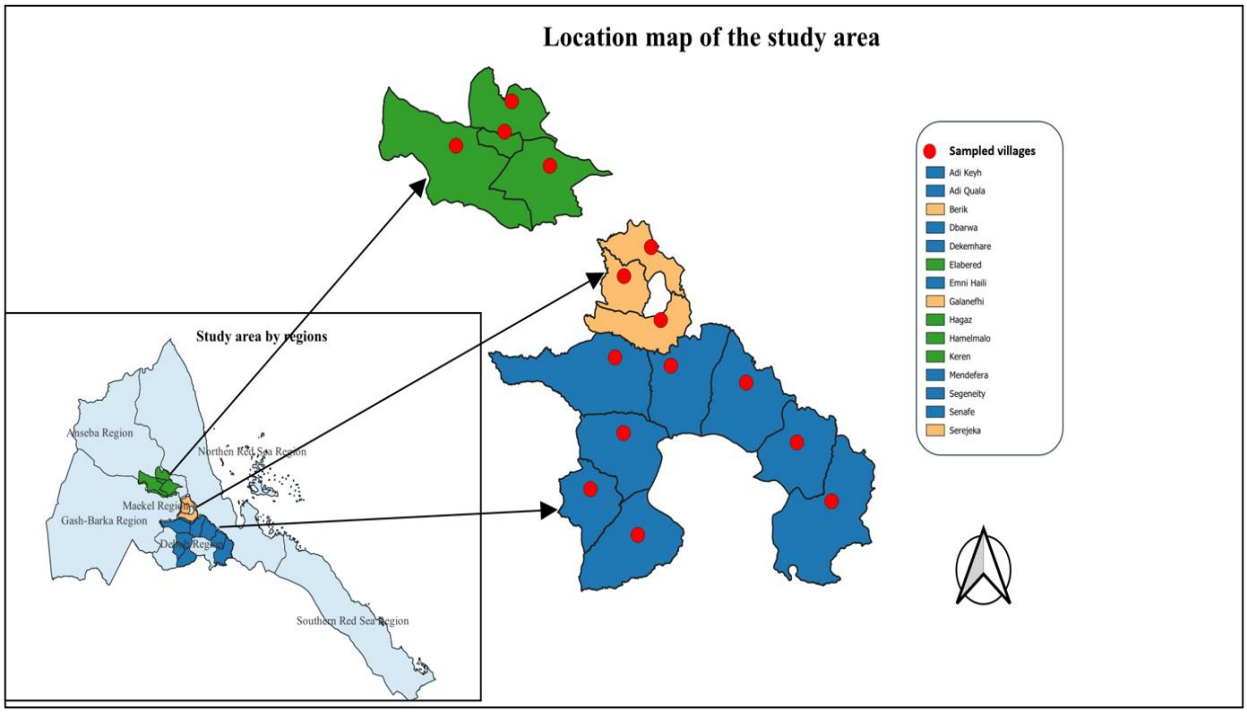
To address these questions, this study focuses on labor productivity and poverty reduction, measured as the asset index score (AIS) among small-scale dairy farmers. Additionally, empowerment was measured using the A-WEAI tool. The effect of empowerment on labor productivity and poverty reduction was specified using an instrumental variables (IV) estimator. However, this study was limited by the low participation of women in the intervention programs because of social norms and culture. This may have influenced the outcome of this study, particularly in comparing the level of empowerment between male- and female-headed households in Eritrea.

Research Methods

Three key dairy regions in Eritrea were carefully selected for this study: Debub, Maekel, and Anseba (CSARIDE, 2021). These regions, which are among the most populous and economically significant in the country (World Bank, 2011), were chosen for their administrative importance. Maekel includes the capital city of Asmara, and Debub is central to the country's governance and economy, making the two regions critical areas for understanding broader regional dynamics (Efrem et al., 2023). In addition, both regions have substantial dairy cattle populations. Studies reveal that Maekel has an estimated 4,696 dairy cattle in 1,118 herds, whereas Debub has 7,778 dairy cattle in 1,511 herds (Efrem et al., 2023). Furthermore, Maekel offers reliable infrastructure and accessibility, facilitating data collection and sample analysis.

The chosen regions represent different agro-ecological zones, with Maekel and parts of Debub being highland areas and Anseba representing midland areas (Figure 1). The study population comprised all male- and female-headed dairy farming households in Debub, Maekel, and Anseba. From each zoba, or administrative region, sub-sobas were randomly selected, and 421 dairy farmers were randomly chosen across all the zobas based on the number of participants from each. The selection of these regions is necessary because they are areas of project intervention (CSARIDE, 2021). In total, 140 dairy farmers were chosen from Debub, 141 from Maekel, and 140 from Anseba. Maekel has many dairy farmers in its zobas (CSARIDE, 2021).

Figure 1. Map of the Study Area



Author's description of the study area using QGIS 3.30.3, 2024.

However, owing to missing values, only 379 dairy farmers were included in the analysis. The data showed a higher proportion of male dairy farmers than female dairy farmers. The data collected included demographic and individual characteristics of dairy farmers, dairy production information, and intrahousehold decision-making on dairy production.

Conceptual and Analytical Framework

Recently, initiatives and strategies have been implemented in Eritrea to enhance farmers' knowledge and production capabilities. These efforts aim to modernize traditional agriculture and livestock systems using advanced technologies, with the goal of boosting productivity and alleviating poverty (African Development Bank [AfDB], 2017; CSARIDE, 2021; Climate Smart Dairy Eritrea [CSDE], 2023). Specifically, enhanced cow breeds and technological practices have been introduced to dairy households to improve milk production (AfDB 2017). Therefore, a collective approach that considers the multifaceted nature of household members with different preferences was adopted in this study to conceptualize the relationship between these empowerment programs and dairy productivity. This approach assumes an intrahousehold bargaining process among household members (Vermeulen, 2002) with heterogeneous preferences for allocating resources, such as time and money, to maximize individual utilities (Doss, 2013; Lundberg & Pollak, 2008; Saelens, 2019). This differs from the unitary model, which views a household as a single unit that pools all household resources, thus implying equal welfare among members (Alderman et al. 1995; Beninger & Laisney, 2002; Falkingham & Baschieri, 2005; Lundberg & Pollak, 2008). Empirical evidence (Ankrah et al., 2020; Deschênes et al., 2020; Diiro et al., 2018; Wekwete, 2013) shows that intrahousehold bargaining power depends on an individual's ability to access, control, and use agricultural resources, which in turn influences dairy productivity and household poverty reduction.

Dairy productivity within this framework was measured using the Partial Factor Productivity (PFP) index instead of the Total Factor Productivity index, which combines all the inputs used to produce outputs. The choice of PFP was based on innovative dairy technologies and practices introduced to farmers to enhance labor and on the available data. PFP measures technological change and development in agriculture and is easily calculated and interpreted, although there are accuracy issues (Hayami & Ruttan, 1991). For instance, innovative technologies, such as milking machines or the mechanization of other production processes, primarily affect the labor requirements of dairy farmers (Jansik &, Irz 2015). Productivity is usually measured as the ratio of gross output or value added to gross input (Organisation for Economic Co-operation and Development [OECD], 2001). A wide range of indicators, such as land and labor, are used to measure productivity. Labor productivity can be calculated using monetary values such as turnover, revenues, gross and net value added, or labor units, such as the number of hours worked, worker-days, work shifts, or the average number of employees (Stankov, 2020; Zdeněk & Lososová, 2014). Jansik and Irz (2015) and Van Der Meulen et al. (2014) expressed labor productivity as the mean number of cows per annual working unit. However, Trakia (2020) and Feng and Patton (2018) expressed labor productivity as the actual volume of milk produced per worker in litres/work-hour (natural method) or income or revenue/wage (value method). In this study, labor productivity was calculated as the total quantity of milk per work-hour, i.e.,

$$\mathrm{LP_i} = \frac{\mathrm{Q_i}}{\mathrm{L_i}} \quad (1)$$

where *LP* is the labor productivity of *i* dairy farm, Q_i is the quantity of milk produced per day and L_i is the labor spent per day in hours. The total quantity of milk produced per household was used in the study. The value of milk consumed by households or gifted to friends was included in the total quantity estimated. It is important to note that because of the poor milk value chain in Eritrea, the major dairy product is milk, and the bulk of farm production is sold at local markets or to individuals (AfDB, 2023b; CSARIDE, 2021).

The asset index score (AIS) proposed by Filmer and Pritchett (1999, 2001) was used to

measure poverty reduction. AIS has been used to measure household economic status and is a valid proxy for poverty measures (Alleluyanatha & Treasure, 2021; Filmer & Pritchett, 2001; McKinnon et al., 2014; Saif-Ur-Rahman et al., 2018; Smith et al., 2020; Tareq et al., 2021; Van de Poel et al., 2008). The AIS was preferred in this study because other poverty measures, such as household income and expenditure, are endogenous (Alleluyanatha & Treasure, 2021). Principal component analysis (PCA) was applied to define the household asset index scores categorized into quintiles of the asset index.

Furthermore, the relationship between household empowerment, dairy productivity, and poverty reduction was examined by including the empowerment variable (M_i) as an additional input variable to the vectors of household (H_i), farm (F_i), and community (C_i) characteristics that influence milk production. Thus, the outcome variables, labor productivity and poverty reduction, *Y*, are functions of

$$Y = f(X = M_i, H_i, F_i, C_i) \quad (2)$$

where *Y* is labor productivity, *M* is the measure of women's empowerment status, and *H*, *F*, and *C* are household, farm, and community characteristics, respectively.

Using ordinary least squares regression, the effect of empowerment on labor productivity and poverty reduction can be expressed as:

$$Y_i = \alpha + \beta X_i + u_i \quad (3)$$

where the subscript *i* denotes household *i*. Y_i are the outcome variables: labor productivity and poverty reduction of household *i*; X_i means a vector of covariates of *M*, *H*, *F*, and *C*; *a* and β are the coefficients to be estimated; and u_i is the random error term. However, empowerment could be endogenous because of hidden traits in an individual, such as management and leadership, that the researcher could not observe. To this, ordinary least squares regression is not a good fit for this analysis. Therefore, an instrumental variable estimator was used to account for unobservable variables embedded in empowerment. Following Diiro et al. (2018) and Alkire et al. (2013), the equation is expressed as

$$Y_i = \alpha + \psi M_i + \beta X_i + \varepsilon_i \quad (4)$$

$$M_i = \pi V_i + \delta Z_i + \mu_i \quad (5)$$

where $E(\mu_i|Z_i) = 0$ and $E(\mu_i, \varepsilon_i) \neq 0$, V = vector of the explanatory variables, Z = vector of instruments, and ε_i and μ_i = error terms.

The instruments used included perception of government policies, cooperative membership, number of improved-breed cows, sub-zoba, and agreement with potential buyers. Several intervention projects in Eritrea have resulted in the development of new policies that ensure smooth implementation, including the formalization of the dairy value chain, increasing the number of breeding cows for enhanced productivity, and developing the capacity and knowledge of small-scale dairy farmers in the use of modern technologies (CSARIDE, 2021). Farmers' perceptions of the outcomes of government policies, such as providing breeding cows to farmers and training in modern dairy practices, are believed to encourage farmer participation in some of the organized interventions for small-scale farmer empowerment. Thus, farmers' perceptions of government policies and several improved cow breeds are included as instruments. Extension cooperative formation is also a component of some intervention projects, and dairy farmers are encouraged to join them. Farmer membership in cooperative associations is essential to project participation (CSARIDE, 2021). Therefore, interventions in empowerment projects that involve policies on dairy farming can directly influence farmers to form and subsequent join cooperative societies, which then impacts farmers' empowerment and ultimately affects labor productivity. Similarly, sub-zobas are included as instruments because most intervention projects start with pilot zobas and sub-zobas before extending to other locations. This gives farmers from pilot zobas or sub-zobas an advantage in terms of experience over other farmers due to the dominance of available milk markets. To this end, the project's benefits may vary depending on location. Furthermore, depending on the location, dairy farmers may have a purchase agreement with buyers who

provide financial support or inputs, such as feed, concentrates, milking machines, or vaccines, empowering farmers to produce milk for that buyer. In these cases, farmers are bound to supply milk to particular buyers, which is a form of empowerment that will not have a direct effect on farmers' poverty status, except through this empowerment.

Furthermore, factors influencing the individual indicators of 5DE—production, resources, income, leadership, and time—were determined using a multivariate regression equation (MRE). MRE measures the angle of more than one dependent variable and estimates the relationship between multiple independent variables if they are linearly correlated (Alexopoulos, 2010). It is used to predict the outcome behavior and the subsequent relationship with the predictor variables, as well as the changing patterns of these predictor variables (Alexopoulos, 2010).

Estimation Methods

To compute farmer empowerment, equal weights of ⅕ were assigned to each of the five domains. First, an aggregate score of a farmer's empowerment was determined across the five domains. Then, the level of empowerment of a farmer's A-WEAI was defined as empowered = 1 if the farmer achieved more than 80% of the weighted domains; otherwise, the farmer was deemed disempowered = 0. Following Alkire et al. (2013), the disempowered headcount ratio (H_P) was calculated as the ratio of disempowered farmers to the total population, while the intensity of the disempowered (A_P) was obtained as the average of the disempowered farmers.

Afterward, the five A-WEAI domains were used to examine the effect of each domain on the outcome variables. Production, resources, income, and leadership domains were counted, while time was expressed (as a dummy variable) in work-hours of 0 to 10.5 hours = 1 otherwise, 0. The disempowerment index across the five domains (M_0) is the product of the disempowered headcount ratio (H_P) and the intensity of the disempowered (A_P); then 5DE was computed as $1 - M_0$. To calculate the AIS, asset variables were categorized into dummies: 1 if the household had assets; otherwise, 0. To distinguish between the households' frequency of occurrence of each asset included in the AIS, percentages of less than 5% or more than 95% were eliminated. Principal component analysis (PCA) was then used to assign indicator weights and index values, which were standardized to calculate the factor loadings for each household. The indicator values were multiplied by the loadings and added to generate the index value for each household. The first principal component generates an asset index that assigns a larger weight to assets that differ the most across households while giving a weight of zero to an asset found in all households (McKenzie, 2005). Additionally, the asset score for each household is calculated by summing the standardized value of each variable, as shown in equation 6:

$$AIS_i = \sum_{i=1}^{k} \mathrm{S_i}\left(\frac{Xi-\bar{x}}{\sigma_i}\right), \mathrm{i} = 1,2 \ldots\ldots\ldots n \quad (6)$$

where Si = scoring factor for the asset i, $\bar{x}$ = mean of asset i, and σi = standard deviation of asset. Then, the scores for each household were ranked in ascending order and divided into quintiles, with approximately 20% of the population in each quintile ranging from 1 to 5. The variables—dependent, independent, instrument, and other covariates used in the data analysis—are presented in Table 1.

Results

This section includes the distribution of the level of empowerment among male- and female-headed households, the effect of empowerment on labor productivity and poverty reduction among small-scale dairy farmers, and the determinants of empowerment across the 5DE in Eritrea.

Level of Empowerment Among Small-Scale Dairy Farmers

Appendix A presents the 5DE in Eritrea, showing the male- and female-headed household disempowerment index and average inadequacy score. The results show that 48.58% of male-headed households and 56.45% of female-headed households are disempowered (Table 1). The inadequacy achievement scores for male- and female-headed households were 63.73% and 58.96%, respectively.

On average, the disempowerment indices for Eritrean (overall), male-headed, and female-headed households were 0.687, 0.690, and 0.667, respectively. This result was further validated by subjecting it to a z-test, and there was no significant difference between male- and female-headed households (see Table A2). This test was necessary due to the sample size of female-headed households.

Figure 2 shows the decomposition of 5DE by dimension and indicator. Resources (which are determined by household decisions regarding ownership and access to land and other productive assets) were the most significant indicator leading to disempowerment in dairy farmers' households, followed by leadership, especially among women. However, production was the least important factor contributing to farmers' disempowerment.

Table 2 shows the decomposition of the disempowerment of small-scale dairy farmers according to the sex of the household head and the zobas of interest. At the zoba level, the least empowered is Anseba (65.42%), followed by Debub (57.02%) and then Maekel (33.11%).

Effect of Empowerment on Labor Productivity and Poverty Reduction

Tables A2, A3, A4, and A5 in the appendices present the first-stage regression and two-stage

Table 1. Results of the 5 Domains of A-WEAI (5DE): Production, Resources, Income, Leadership, and Time

Indexes	Eritrea	Male	Female
Disempowered headcount (H)	49.87%	48.58%	56.45%
Average inadequacy score (A)	62.85%	63.73%	58.96%
Disempowerment Index (M_0)	0.313	0.310	0.332
5DE Index ($1 - M_0$)	0.687	0.690	0.667
Number disempowered	189	154	35
Number of observations	379	317	62

Source: Field survey, 2023. Authors' calculation.

Figure 2. Decomposition of 5 Domains of A-WEAI (5DE): Production, Resources, Income, Leadership, and Time by Dimension and Indicator

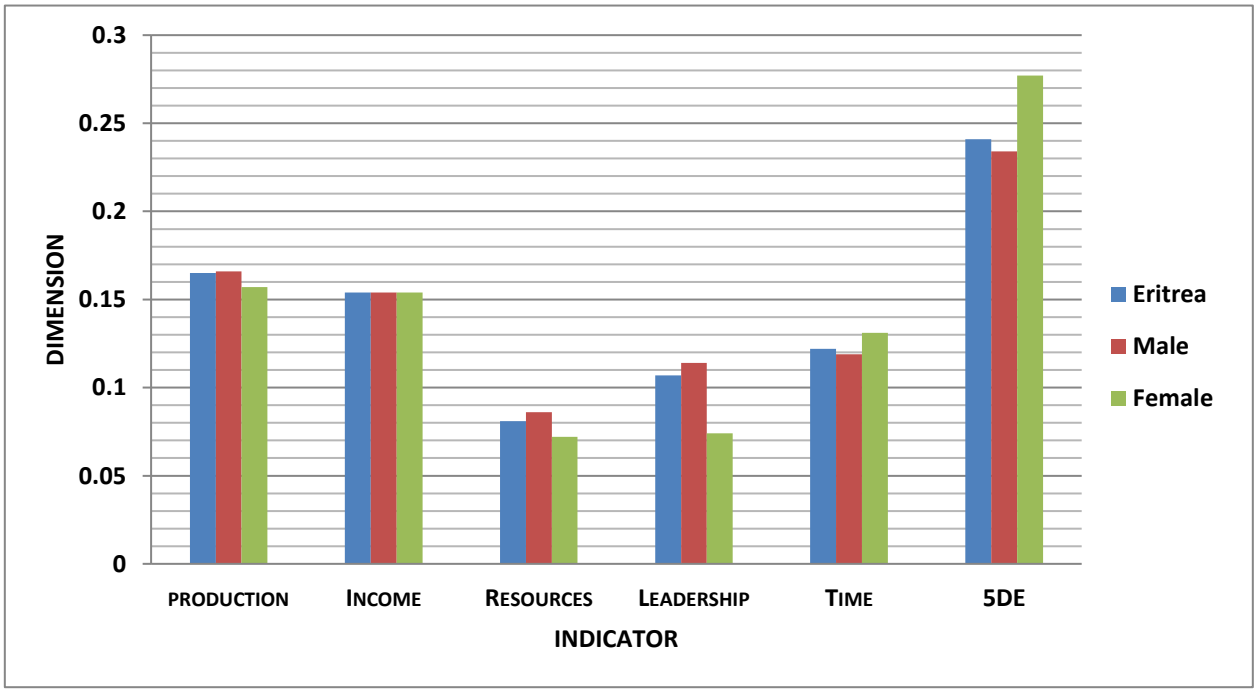


Table 2. Distribution of the Level of Empowerment

Level of Empowerment	Number Disempowered	Number Empowered	Frequency	Percentage	Number Disempowered	Number Empowered	Frequency	Percentage	Number Disempowered	Number Empowered	Frequency	Percentage	Number Disempowered	Number Empowered	Frequency	Percentage	Number Disempowered	Number Empowered	Frequency	Percentage
	Male				Female				Anseba				Debub				Maekel			
0.2–0.39	7	0	7	2.21	4	0	4	6.45	5	0	5	4.67	4	0	4	3.31	2	0	2	1.32
0.4–0.59	33	0	33	10.41	13	0	13	20.97	20	0	20	18.69	23	0	23	19.01	3	0	3	1.99
0.6–0.79	114	0	114	35.96	18	0	18	29.03	45	0	45	42.06	42	0	42	34.71	45	0	45	29.80
0.8–1	0	163	163	51.42	0	27	27	43.55	0	37	37	34.58	0	52	52	42.98	0	101	101	66.89
Total	154	163	317		35	27	62		70	37	107		69	52	121		50	101	151	

Source: Field survey, 2023. Authors' calculation

least-squares instrumental variable (IV) estimations of the effect of empowerment on labor productivity and asset index scores for Eritrea, male-headed households, and female-headed households, along with validity and endogeneity tests of the instruments used. The first-stage F-statistic was employed to test for the weakness of the instruments based on the Stock & Yogo (2002) rule of thumb, indicating a value of less than 10. All the instruments used had F-statistics above 10. In addition, the Durbin and Wu-Hausman endogeneity tests were significant at under 5% across the estimations, except for the female farmers, for whom some instruments were significant at 10%. This signifies that the instruments, which include the number of improved cow breeds, sub-zobas, share of dairy income, membership in a cooperative, and perception of government policies, are related to the endogenous variable (empowerment) in the models for labor productivity and poverty reduction. Furthermore, the Sargan and Basmann tests for overidentification were insignificant across the relevant instruments, implying that the instruments were not overidentified. This shows that the choice of instruments is consistent with the model's assumptions, and there is no evidence to indicate that the instruments are invalid or that the model is misspecified. All the signs and magnitudes of the instruments correspond with the a priori expectation that an increased number of improved cow breeds, residing in a more empowered sub-zobas, larger share of dairy income, and membership of a cooperative improve the labor productivity and poverty status of dairy farmers, whereas their negative perception of government policies influences the outcome variables. Therefore, we are confident that the instruments utilized in our regression model are valid in assessing the effect of empowerment on labor productivity and poverty reduction for dairy farmers in Eritrea.

Table A2 shows that while the educational level of female-headed households was significantly positively associated with women's empowerment in Eritrea, the number of lactating cows had a negative relationship with women's empowerment. Similarly, extensive dairy production is a specific factor that contributes to men's disempowerment. Furthermore, the price of milk and cooperative membership contributed to empowerment. At the same time, farmers' perceptions of government policies as deterrents to production resulted in the disempowerment of both male- and female-headed households. See Table A2 for results from the first-stage IV regression on dairy empowerment.

The coefficient for 5DE is significant and positive (Table A3), indicating that empowerment increased labor productivity among male- and female-headed households by 11.57% and 17.56%, respectively, representing an overall increase of 12.58% across all households. Increased herd size is associated with higher labor productivity. Additionally, the adoption of semi-intensive practices

contributed to lower labor productivity. The coefficients of dairy experience, the price of milk, and the perception of government policies were particularly important factors influencing labor productivity in male-headed households. While the price of milk negatively affected labor productivity, the other two factors had a positive relationship, suggesting that an additional year of dairy experience and viewing government policies as a major constraint increased labor productivity. The age and educational level of the household head, as well as practicing extensive dairy production, were factors that influenced labor productivity among female-headed households, although negatively in this case. Older women and women with higher levels of education were less productive in dairy farming. This necessitates the creation of opportunities to make investment and engagement in dairy farming attractive to young people.

Table A4 shows the factors affecting empowerment in Eritrea based on the AIS. Milk price was the core factor that determined the level of empowerment in the study area. The relationship between milk production and asset accumulation was inverse, suggesting that higher milk production may not be sufficient to alleviate poverty in male-headed households. Meanwhile, the number of lactating cows among female-headed households served as a source of empowerment, whereas the educational level acted as a source of disempowerment.

Table A5 shows the coefficients of 5DE to be positive and significant, indicating that empowerment increased asset accumulation among small-scale dairy farmers overall, as well as among both male- and female-headed households, reducing household poverty in the study areas by 7.42%, 5.81%, and 11.89%, respectively. Dairy experience and the number of lactating cows were significant and positively related to household asset accumulation, while semi-intensive dairy production is significant and negatively related to asset accumulation in Eritrea. This suggests that increased dairy experience and the number of lactating cows lead to a corresponding increase in asset accumulation for both male- and female-headed households in Eritrea. Enhanced dairy experience and the number of lactating cows may thus improve asset accumulation for both male- and female-headed households in Eritrea, while semi-intensive dairy farming diminishes asset accumulation. Extensive dairy production and low milk prices are two key factors that have a significant negative impact on asset accumulation among male-headed households.

Determinants of Empowerment (5DE) Indicators in Small-Scale Dairy Farming

Table A8 presents the marginal effects of empowerment in dairy farming, with labor productivity and asset index scores included as covariates alongside other individual, farm, and community characteristics. The two variables were regressed against the 5DE indicators, both with and without covariates. Table A1 presents the detailed results of the coefficients for male- and female-headed households. Labor productivity has an increasing influence on production, resources, and income. By contrast, the asset index score has an increasing effect on production and leadership indicators but a decreasing effect on time. This indicates that, with increased labor productivity and a reduced poverty status, decision-making and autonomy can be managed more efficiently within small-scale dairy households regarding input purchasing, land and asset ownership, sales, transfers, credit access, and the management of dairy income and expenditures. With greater access to assets, social and economic capital increase, creating a conducive environment for farmers to be recognized and lead in the community. Assets accrued within a dairy household could reduce the time spent on dairy production by allowing farmers to purchase labor-saving equipment, such as milking machines (Jansik & Irz, 2014).

However, by including other covariates in the equation, labor productivity and asset index scores were significant and held both positive and negative relationships with the time indicator, while remaining insignificant with respect to other indicators. It can be inferred from this result that for sustainable dairy production among small-scale dairy farmers in the study area, individual characteristics such as dairy experience, frequency of extension visits, gender, and the educational level of the household head are most important. Adequacy among female-headed households in the

leadership indicator is significantly negative, reflecting societal gender inequality. The educational level of the household head was significant but negatively related to the production indicator, meaning that additional years of education were associated with reduced household production adequacy in dairy farming. Dairy experience is also significantly and positively related to production indicators. Similarly, it has a significant and negative relationship with the time indicator, meaning that as farmers' experience in dairy farming increases, the time spent on labor decreases. Furthermore, increased extension visits to dairy farmers reduced the resource indicator while increasing the time indicator. Regarding farm characteristics, the number of lactating cows, milk processing, and the method of dairy production are essential for empowerment in dairy production. A unit increase in the number of lactating cows reduces the time indicator, suggesting the need to encourage farmers to adopt improved labor-saving dairy technologies. The probability of processing milk was significantly and negatively associated with the production, resources, and income indicators. This implies that the more farmers are involved in milk processing, the less they participate in decisions about the input market, assets or land acquired or transferred, and income and expenditure. Semi-intensive dairy production methods were significantly and positively related to the production, resources, and income indicators of empowerment. Therefore, farmers should be encouraged to adopt semi-intensive production methods for sustainable empowerment and poverty reduction.

Community characteristics, such as the price of milk and the zoba, were significantly and positively associated with the production indicator, showing that a unit increase in the price of milk results in an increase in production capability among farmers. Farmers in Maekel had a significant and positive relationship with all 5DE, which could stem from the position of zoba as the administrative center of Eritrea. Most dairy farms are intensive, and milk processing collectors are closer to farmers, with many intervention programs using it as a pilot region (CSARIDE, 2021). This has given Maekel an advantage over other zobas.

Discussion

Thus, there is a need to examine productivity and poverty reduction among small-scale dairy farmers in Eritrea. Most interventions to improve people's lives and livelihoods are funded for limited periods; however, there is a need for sustainable, long-term outcomes. Previous projects aimed at promoting dairy production in Eritrea have addressed improving farmers' skills and knowledge of innovative dairy production for increased income, employment opportunities, and the general growth of the nation's economy, thereby reducing poverty among small-scale dairy farmers in the short term. The skills and knowledge acquired during project implementation are expected to guarantee sustainable empowerment among beneficiaries, thereby maintaining the productivity of the entire dairy value chain while simultaneously accruing assets. Invariably, farmers' levels of productivity and poverty status in the long run have become sources of empowerment for farmers. We used the A-WEAI approach to understand the impact of these interventions on the empowerment of dairy farmers in Eritrea. Women were more disempowered than men, and as such, they had inadequate achievements. Likewise, the 5DE indicated a high intensity of disempowerment among women, likely due to the high level of gender inequality that reduces women's access to agricultural inputs and resources in Eritrea (Tesfamariam, 2015).

The most important factor that jeopardized empowerment and labor productivity in the dairy sector was the low level of education, particularly among women. Most of the women had a primary education, whereas some men were able to receive secondary education. Recall that the educational level of both men and women had a nonsignificant negative relationship with labor productivity, and AIS was used as a proxy for poverty reduction. Nevertheless, education is an important factor for empowerment among female-headed households. The lack of significance in education could be associated with the level at which it exists. One compelling explanation for the decrease in productivity among dairy farmers with higher education levels is the potential disparity between the skills and knowledge gained from academic learning and the hands-on demands of dairy farming. Occasionally,

well-educated dairy farmers prioritize theoretical understanding and managerial elements, overlooking the essential practical skills and experience needed for effective farm management. This discrepancy may result in inefficiencies, delays in decision-making, and less-than-optimal farming methods, ultimately causing a decline in productivity on dairy farms. Therefore, this calls for policy reform that improves both men's and women's access to formal and informal education and training to enhance labor productivity in dairy farming, which will increase dairy output and income, and bring about poverty alleviation. This is especially relevant for female-headed households, which are most affected by poverty. It is well established that education for girls and women provides knowledge and skills that enable them to compete in the labor market, make personal decisions about their lives, and achieve socioemotional stability; thus, it is a prerequisite for poverty reduction (Awan & Malik, 2020; UN, 2022; World Bank, 2022). Similarly, Diiro et al. (2018) and Mobaork (2021) proved that empowering women increased agricultural productivity through independent decisions that positively influenced productivity, efficiency, and technical change.

Respondents' ages negatively influence dairy labor productivity because productivity decreases with age. Since the average age of respondents in this study is above 50 years, ensuring improved labor productivity among small-scale dairy farmers in Eritrea necessitates creating opportunities and making dairy farming attractive to young people (Olagunju et al., 2022). It was also observed that those who are more educated in Eritrea are less productive in dairy farming, suggesting a tendency toward greater involvement in non-dairy farming. This aligns with Bragg and Dalton's (2004) observation that higher diversification of farm income, poor proceeds relative to variable costs, and higher non-dairy income are likely factors influencing the decision to exit dairy farming. Particular attention should be paid to women, who were more productive than men in this study. Additionally, herd size, the type of dairy production practice (i.e., semi-intensive and extensive), and membership in a cooperative are other important factors in the dairy sector. Increased herd size heightens the tendency to apply practices and technologies that improve milk yields and labor productivity (MacDonald, 2016), thus enhancing efficiency (Deming et al., 2020). Qi et al. (2022) observed that unimproved managerial ability impedes labor productivity as herd size increases due to the low adoption of improved dairy practices. Promoting dairy production among small-scale farmers entails intensive development of farmers' skills and knowledge of new innovations in dairy production. The intensive method of dairy production was reported to be more labor productive than the semi-intensive and extensive methods (Wijethilaka et al., 2018), while membership in a cooperative increased labor productivity (Ahmed & Mesfin, 2017; Kumar et al., 2013). However, the findings of this study suggest that with increased herd size and more lactating cows, women tend to reduce their involvement in dairy production and diversify their sources of income into higher-yielding livelihood activities along the dairy value chain, such as processing. Murphy (2009) emphasized that Eritrean women are more involved in food processing than in production. However, this finding contradicts the findings of Niketha et al. (2017). There is also a need to create awareness of the importance of small household sizes to promote empowerment in both male- and female-headed households, which corresponds with Ayevbuomwan et al. (2016). Dairy experience, total production cost, and milk prices were specifically important factors influencing labor productivity in male-headed households. However, Zdeněk and Lososová (2014) reported an insignificant connection between milk prices and labor productivity.

Empowerment increased asset accumulation among small-scale dairy farmers in Eritrea and male- and female-headed households in the study area by 12.10%, 10.57%, and 9.91%, respectively, thereby showing a reduction in household poverty. Correspondingly, Yasmin and Ikemoto (2015) and Wei et al. (2021) found that women's empowerment increased women's economic power, independence, and financial autonomy, which helped women in dairy farming to improve their quality of life and advance out of their poverty status. Again, dairy farming was confirmed as the cause of higher household welfare (Food and Agriculture

Organization of the United Nations [FAO] et al., 2018). Further reduction of poverty among small-scale dairy farmers in Eritrea will require the development of extension systems along with increases in milk prices and herd size.

The 5DE indicators, namely production, resources, income, leadership, and time, were affected by different factors among male- and female-headed households. Improving labor productivity and the assets index among dairy farmers could be an essential tool for enhancing the 5DE indicators. The results showed that women's access to leadership positions or to organizations in Eritrea might still be impeded, thus requiring policies that would enhance women's involvement in intra- and interhousehold decision-making and community decision-making for economic growth within households and society at large. Taliento and Madgavkar (2016) and OECD (2001 reinforced the importance of women's participation in the household and community economy for equitable governance, economic growth, and public trust. Another factor is the use of intensive methods of dairying, which are more profitable than semi-intensive and extensive methods (Bandara et al., 2011). However, this method was more common in Maekel than in the other zobas, highlighting regional inequality among the three zobas studied. Dairy empowerment should be spread evenly among dairying zobas to support poverty reduction in all regions. A favorable environment and favorable market conditions, especially in Debub, can boost dairy farming productivity, making dairy farming economically viable using value-additive techniques. This could increase product value, expand market share, reduce milk price risks, and make Eritrea's dairy industry competitive. Therefore, there is a need to decentralize some input outlets, such as milking facilities, to enhance milk processing and increase the price for dairy farmers, who mostly sell raw milk and thus may not maximize profit.

Conclusion

Small-scale dairy farming in Eritrea is a promising industry with the potential to reduce poverty among dairy farmers if productivity is improved. Thus, efforts to develop the dairy sector in Eritrea have increased since Eritrean independence in 1991.

The results show that male household heads were more empowered than their female counterparts, and among the 5DE indicators, resources and leadership had a glaring evidence against empowerment, especially among women. At the zoba level, Anseba showed the highest level of disempowerment (65.42%), followed by Debub (57.02%) and then Maekel (33.11%). Empowerment has a positive effect on labor productivity and poverty reduction at varying levels. Among male and female household heads, empowerment resulted in increases in productivity of 11.50% and 18.49%, respectively, and reduced poverty by 10.57% and 9.91%, respectively. This suggests that gains in productivity reduced poverty more among female dairy farmers than among male dairy farmers.. The specific factors that affected labor productivity among the female dairy farmers were the level of education and age. In contrast, dairy experience, labor costs, milk prices, and belonging to a cooperative were particularly relevant to men. However, for both male and female dairy farmers, factors such as herd size, type of dairy production practice, and perceptions of government policies on dairy farming had a negative impact on labor productivity. Nonetheless, the frequency of extension visits, the unit price of milk, dairy experience, and the number of lactating cows influenced asset accumulation among dairy farmers in Eritrea.

Furthermore, important factors require adequate attention for the 5DE indicators to be improved, ensuring that dairy farmers, both male and female, are empowered in the long term. These factors include education and household size, particularly among women, dairy experience, frequency of extension visits, the number of lactating cows, milk processing, and the price of milk. Additionally, for the overall empowerment index, membership in cooperatives and government interventions must be enhanced for sustainability.

The findings from this study call for policy reform to improve women's access to formal and informal education and training, not only in dairy production for increased productivity but also for general capacity building among women. Improving the educational status of women and

girls is a prerequisite for poverty reduction. Innovative approaches are required to reduce the demand for labor through improved technology. This is crucial in creating opportunities that will make dairy farming attractive to young and educated individuals. Furthermore, there is a need to provide milk processing plants for dairy product processing to raise prices. In other words, developing the dairy value chain is paramount for increasing prices and encouraging dairy production in Eritrea. Similarly, the availability and affordability of improved cow breeds are necessary to enhance the overall productivity of farmers.

For further studies, WEAI has a gender disparity aspect that was not covered in this study due to the lack of data on primary males and females within households. Understanding intrahousehold gender disparity, coupled with the 5DE, will shed light on the levels and dynamics of intrahousehold decision-making for poverty reduction. There is also a need to thoroughly examine the dairy production value chain and productivity along the chain.

In sum, this study examined the role of empowerment initiatives in enhancing the productivity of smallholder dairy farms and reducing poverty in Eritrea, utilizing the A-WEAI framework. The findings revealed a disparity in empowerment between male and female household heads, with males typically being more empowered than females. The research established a positive effect of empowerment, productivity gains, and poverty alleviation in households, with a notably higher impact observed in those headed by females. Key determinants affecting productivity and poverty include the level of education, age, experience in dairy farming, herd size, and the influence of governmental policies, underscoring the need for tailored empowerment strategies to bolster the dairy sector and combat poverty.

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Appendix. Data Tables

Table A1. Description of Variables

Variable		Eritrea		Male		Female	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Number of observations		379.00		317.00		62.00	
Outcome variables							
Asset index score		3.01	1.43	3.03	1.43	2.94	1.47
Labor productivity		2.97	4.52	3.14	4.75	2.092	3.01
Production		0.18	0.05	0.18	0.04	0.17	0.04
Resources		0.09	0.03	0.09	0.02	0.08	0.03
Income		0.18	0.06	0.18	0.06	0.17	0.05
Leadership		0.15	0.85	0.16	0.81	0.13	0.96
Time		0.16	0.08	0.16	0.08	0.16	0.08
Endogenous variables							
Disempowerment index	Index from 0–1 (0.0–0.79 = disempowered, 0.81= empowered)	0.50	0.50	0.51	0.50	0.44	0.50
Instruments							
Perception on government policies	Ranked 1-8	3.14	2.30	2.96	2.20	4.03	2.59
Member of cooperative	Yes = 1 No = 0	0.77	0.42	0.79	0.41	0.65	0.48
Number of improved cow breed	Number (counts)	2.39	4.59	2.32	4.25	2.73	6.08
Sub-zoba		12.26	5.16	12.47	4.92	11.19	6.16
Agreement with buyer	Yes = 1 No = 0					0.50	0.50
Household characteristics							
Age of household head	Years	57.21	12.72	57.61	12.65	55.21	13.02
Sex of household head	Yes = 1 No = 0	1.16	0.37	1.00	0.00	2.00	0.00
Educational level of household head	No education = 1, primary school = 2 Secondary School = 3; Vocational School = 4; University education = 5	2.43	0.99	2.47	0.97	2.21	1.03

Dairy experience	Years	16.51	10.81	16.65	10.92	15.82	10.32
Household size	Number	6.89	2.93	7.07	2.92	5.98	2.82
Share of dairy income to household income	Proportion between 0 and 1	0.36	0.28	0.35	0.27	0.41	0.30
Dairy farm characteristics							
Rent on land	Nafka	4,047.26	13,536.91	3,706.31	11,305.07	5,790.48	21,674.25
Land size for food production	Acre	0.69	0.38	0.69	0.37	0.68	0.43
Frequency of extension visit	Number	2.22	1.15	2.15	1.12	2.56	1.22
Number of lactating cows	Number	3.25	3.48	3.27	3.32	3.11	4.26
Herd size	Number	6.83	7.15	6.96	6.58	6.15	9.58
Total cost of production	Nafka	102,243.40	148,614.80	105,838.30	149,642.50	83,862.69	143,003.70
Type of dairy production practice	Intensive system = 1; Semi-intensive = 2; Extensive = 3	1.36	0.57	1.33	0.54	1.53	0.69
Price of milk	Nafka/litre	16.35	5.70	16.56	5.32	15.25	7.27
Perceived income from milk	Decreased Much = 1; decreased = 2; Same = 3; Increased = 4; Increased much = 5	2.83	1.04	2.87	1.04	2.65	1.01
Quantity of milk produced	Litre/day	11.91	46.25	12.36	50.44	9.64	8.33
Processed milk	Yes = 1 No = 0	0.21	0.41	0.21	0.41	0.21	0.41

Source: Field survey, 2023.

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Table A2. IV First-Stage Regression on Dairy Empowerment

	Eritrea			Male			Female		
Empowerment	Coef.	Std. Err.	T-test	Coef.	Std. Err.	T-test	Coef.	Std. Err.	T-test
Age of household head	0.000	0.002	0.33	-0.000	0.002	-0.3	0.003	0.004	0.80
Gender of household head	-0.041	0.059	-0.78						
Educational level of household head	0.018	0.024	0.67	-0.004	0.027	-0.13	0.102**	0.051	2.00
Dairy experience	0.000	0.002	0.07	0.000	0.002	0.05	0.003	0.005	0.73
Household size	0.001	0.007	0.13	0.001	0.008	0.13	0.022	0.016	1.37
Herd size	-0.011***	0.003	-3.30	-0.010	0.004	-2.69			
Number of lactating cows							-0.34***	0.012	-2.94
Semi-intensive dairy production practice:	0.127**	0.054	2.33	0.045	0.061	0.74	0.080	0.097	0.83
Extensive dairy production practice	-0.068	0.099	-0.69	-0.225*	0.128	-1.76	0.107	0.145	0.74
Price of milk	0.018***	0.004	4.69	0.020***	0.005	4.42	0.016**	0.006	2.61
Member of cooperative	0.602***	0.052	11.51	0.615***	0.060	10.17	0.529***	0.104	5.08
Perception on government policies	-0.042***	0.009	-4.40	-0.035***	0.011	-3.16	-0.201*	0.118	-1.7
Debub	0.023	0.065	0.36	-0.010	0.074	-0.13			
Maekel	-0.016	0.066	-0.25	-0.041	0.073	-0.56			
Number of improved cow breed	0.012**	0.006	2.19						
Sub-zoba	0.015***	0.004	3.77						
Share of dairy income	0.345***	0.088	3.93	0.438***	0.102	4.29			
Agreement with buyer							0.291***	0.091	3.21
Constant	-0.490***	0.176	-2.78	-0.272	0.201	-1.35	-0.676**	0.317	-2.13
No of observation		379			317			62	
F-stat	19.07***			15.29***			11.17***		
R-squared	0.457			0.396			0.659		
Adj. R-squared	0.433			0.370			0.600		

Source: Field survey, 2023.

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Table A3. IV Estimation of Empowerment on Labor Productivity

	Eritrea			Male			Female		
Log of labor productivity	Coef.	Std. Err.	Z-test	Coef.	Std. Err.	Z-test	Coef.	Std. Err.	Z-test
Empowerment (5DE)	1.258***	0.304	4.14	1.157***	0.467	3.36	1.756***	0.647	2.71
Age of household head	-0.007*	0.004	-1.83	-0.004	0.004	-1.08	-0.015*	0.009	-1.69
Gender of household head	-0.287**	0.112	-2.56						
Educational level of household head	-0.035	0.049	-0.72	-0.023	0.050	-0.45	-0.249*	0.129	-1.92
Dairy experience	0.011***	0.004	2.62	0.009**	0.005	1.96	0.004	0.011	0.4
Household size	-0.015	0.014	-1.06	-0.017	0.015	-1.18	-0.013	0.068	-0.19
Herd size	0.063***	0.008	8.36	0.088***	0.008	11.06			
Number of lactating cows							0.187***	0.027	6.81
Semi-intensive dairy production practice	-0.513***	0.104	-4.92	-0.469***	0.125	-3.74	-0.940***	0.214	-4.39
Extensive dairy production practice	-0.428**	0.190	-2.25	-0.232	0.270	-0.86	-0.847***	0.314	-4.39
Price of milk	-0.032***	0.010	-3.08	-0.038***	0.014	-2.76	-0.012	0.018	-0.65
Perception of government policies	-0.943***	0.218	-4.33	0.097***	0.028	3.48	0.047	0.041	1.15
Member of cooperative	0.062***	0.021	2.92	-1.015***	0.301	-3.37	-0.996**	0.417	-2.38
Debub	-0.410***	0.124	-3.32	-0.488***	0.146	-3.35			
Maekel	0.093	0.122	0.76	0.119	0.145	0.82			
Constant	0.589*	0.337	1.75	0.894**	0.420	2.13	1.532*	0.817	1.87
No of observation	379			317			62		
Wald chi2	369.22***			230.24***			113.04***		
R-Squared	0.452			0.312			0.611		
Test of instruments									
F stat	13.378***			18.403***			12.192***		
Durbin (score) chi2(1)	8.701***			8.104***			4.152**		
Wu-Hausman F(1,362)	8.529***			7.923***			3.518*		
Sargan (score) chi2(1)	2.637			3.689			0.436		
P-value	0.268			0.158			0.509		
Basmann chi2(1)	2.537			3.532			0.417		
P-value	0.281			0.171			0.518		

Source: Field Survey, 2023

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Table A4. IV First-Stage Regression on Dairy Empowerment

	Eritrea			Male			Female		
Empowerment (5DE)	**Coef.**	**Std. Err.**	**T-test**	**Coef.**	**Std. Err.**	**T-test**	**Coef.**	**Std. Err.**	**T-test**
Age of household head	0.002	0.002	0.87	0.000	0.002	0.12	0.005	0.004	1.17
Gender of household head	-0.080	0.058	-1.38						
Educational level of household head	0.036	0.025	1.47	0.006	0.028	0.22	0.116**	0.055	2.12
Dairy experience	-0.000	0.002	-0.10	0.000	0.002	0.11	0.002	0.005	0.33
Household size	0.003	0.007	0.39	0.001	0.008	0.08	0.009	0.019	0.48
Semi-intensive dairy production practice	0.045	0.050	0.91	0.024	0.056	0.43	0.132	0.105	1.26
Extensive dairy production practice	-0.083*	0.101	-0.82	-0.180	0.129	-1.39	0.155	0.159	0.98
Price of milk	0.020***	0.004	5.24	0.019***	0.005	4.24	0.021***	0.007	3.17
Number of lactating cows	-0.012*	0.006	-1.86	0.009	0.007	1.24	-0.006**	0.017	-0.38
Quantity of milk produced	-0.000**	0.000	-2.23	-0.000*	0.000	-1.80	-0.000	0.000	-1.40
Perception of government policies	-0.034***	0.009	-3.58	-0.033***	0.011	-3.02	-0.037**	0.018	-2.03
Member of cooperative	0.605***	0.050	12.04	0.614***	0.058	10.55	0.594***	0.106	5.59
constant	-0.362**	0.182	-1.99	-0.353*	0.214	-1.65	-0.819**	0.377	-2.17
No. of observation		379			317			62	
F-stat	19.08***			14.60***			9.25***		
R-squared	0.4046			0.3656			0.6626		
Adj. R-squared	0.3834			0.3403			0.5793		

Source: Field survey, 2023.

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Table A5. IV Estimation of Empowerment on Asset Index Score

	Eritrea			Male			Female		
Asset Index Score	**Coef. nb.**	**Std. Err.**	**Z-test**	**Coef.**	**Std. Err.**	**Z-test**	**Coef.**	**Std. Err.**	**Z-test**
Empowerment	0.742***	0.245	3.03	0.581**	0.269	0.216	1.189**	0.52	2.28
Age of household head	-0.002	0.006	0.34	-0.005	0.007	-0.70	-0.011	0.016	-0.73
Gender of household head	0.092	0.177	0.52						
Educational level of household head	-0.020	0.078	-0.26	-0.041	0.084	-0.49	-0.179	0.180	-1.00
Dairy experience	0.027***	0.007	4.10	0.020***	0.007	2.90	0.051***	0.017	3.02
Household size	0.001	0.023	0.07	0.015	0.027	0.54	-0.067	0.068	-0.99
Semi-intensive dairy production practice	-1.141***	0.151	-7.55	0.000***	0.000	3.80	-0.621*	0.334	-1.86
Extensive dairy production practice	-0.846	0.321	-2.64	-0.138*	0.073	-1.89	-0.195	0.135	-1.45
Price of milk	-0.045***	0.012	-3.57	-0.067***	0.014	-4.81	0.018	0.027	0.67
Number of lactating cows	0.093***	0.030	3.02	0.075**	0.037	2.04	0.210***	0.058	3.64
Quantity of milk produced	-0.000	0.000	-0.33	-0.000	0.000	-0.04	-0.000	0.000	-1.52
Constant	3.171***	0.559	5.67	3.752***	0.618	6.07	2.554*	1.360	1.88
No of observation	379			317			62		
Wald chi-squared	169.00***			155.42***			21.154***		
R-squared	0.2517			0.2824			0.4343		
Test of instruments									
F stat	82.47***			60.81***			18.96***		
Durbin (score) chi2(1)	16.05***			11.82***			2.98*		
Wu-Hausman F(1,362)	16.14***			11.78***			2.48*		
Sargan (score) chi2(1)	0.0885			0.2736			0.0314		
P-value	0.7660			0.6010			0.8593		
Basmann chi2(1)	0.0852			0.2626			0.0249		
P-value	0.7703			0.6084			0.8747		

Source: Field survey, 2023.

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Table A6. Determinants of the 5DE Indicators in Dairy Farming

	Delta-method			Delta-method			Delta-method			Delta-method			Delta-method		
	dy/dx	Std. Err.	T-test	dy/dx	Std. Err.	T-test	dy/dx	Std. Err	T-test	dy/dx	Std. Err.	T-test	dy/dx	Std. Err.	T-test
	Production			Resource			Income			Leadership			Time		
LOG Labor productivity	0.004*	0.002	1.90	0.004***	0.001	2.90	0.007**	0.002	2.31	0.003	0.004	0.66	0.002	0.004	0.43
Asset Index Score	0.003**	0.001	2.26	-0.000	0.000	-0.21	0.000	0.002	0.21	0.010***	0.003	3.37	-0.012***	0.003	-4.26
Other Covariates	No			No			No			No			No		
LOG Labor productivity	0.002	0.003	0.96	0.001	0.002	0.54	0.005	0.005	1.09	-0.005	0.006	-0.81	0.041***	0.004	7.26
Asset Index Score	0.001	0.002	0.37	0.000	0.001	0.02	-0.001	0.002	-0.39	-0.002	0.004	-0.46	-0.001***	0.003	-3.37
Age of household head	-0.000	0.000	-1.35	-0.000	0.000	-0.48	-0.000	0.000	0.02	0.000	0.000	-0.47	0.001	0.000	1.55
Gender of household head	-0.005	0.005	-0.98	-0.004	0.003	-1.15	0.002	0.008	0.27	-0.034***	0.012	-2.88	-0.004	0.008	-0.43
Educational level of household head	-0.006**	0.002	-2.71	-0.001	0.001	-0.83	0.000	0.003	0.08	-0.003	0.005	0.60	0.005	0.005	1.21
Dairy experience	0.000**	0.000	2.06	0.000	0.000	0.49	0.000	0.000	0.34	0.000	0.000	-0.98	-0.001***	0.000	-3.17
Household size	-0.001	0.001	-1.29	0.000	0.000	0.38	0.000	0.001	0.01	0.002*	0.001	1.68	-0.001	0.001	-0.52
Frequency of extension visits	-0.002	0.002	0.9	-0.002**	0.001	-2.31	-0.001	0.003	-0.23	0.003	0.004	0.80	0.008**	0.003	2.28
No lactating cows	0.001	0.001	1.11	-0.000	0.001	-0.02	0.000	0.001	0.35	-0.001	0.002	-0.66	-0.009***	0.002	-4.55
Quantity of milk	0.000	0.000	-0.49	0.000	0.000	0.01	0.000	0.000	0.8	0.000	0.000	0.34	0.000*	0.000	1.74
Processed milk	-0.013***	0.005	-2.57	-0.009**	0.003	-2.52	-0.018**	0.008	-2.22	-0.007	0.011	-0.7	-0.007	0.008	-0.78
Semi-intensive	0.016***	0.006	3.07	0.010***	0.004	2.77	0.014*	0.008	1.78	0.009	0.011	0.77	-0.027***	0.010	-2.72
Extensive	-0.034***	0.009	-3.71	-0.004	0.006	-0.65	0.006	0.015	0.39	-0.036*	0.020	-1.75	-0.018	0.016	-1.16
Price of milk	0.001***	0.000	2.92	0.000	0.000	1.34	-0.001	0.001	-1.41	0.001	0.001	1.27	0.003	0.001	-3.67
Zoba: Debub	0.022***	0.006	3.72	0.000	0.004	0.04	0.003	0.010	0.34	0.043***	0.013	3.22	0.036***	0.012	3.06
Maekel	0.040***	0.056	7.24	0.019***	0.004	4.94	0.037***	0.009	4.14	0.083***	0.012	6.69	-0.030***	0.011	-2.71
Ramsey RESET test	3.76**			11.40***			2.90**			3.68**			9.50***		
Breusch-Pagan / Cook-Weisberg test	150.69***			146.17***			104.80***			62.55***			61.27***		

Source: Field survey, 2023.

Table A7. Multivariate Analysis of Determinants of the 5DE Indicators in Dairy Farming among Male and Female Household Heads

	Female			Male			Eritrea		
5DE indicators / Production	**Coef.**	**Std. Err.**	**t**	**Coef.**	**Std. Err.**	**t**	**Coef.**	**Std. Err.**	**t**
LOG Labor productivity	-0.001	0.009	-0.14	0.002	0.003	0.51	0.002	0.003	0.68
Asset Index Score	0.002	0.005	0.35	-0.002	0.002	-0.96	-0.001	0.002	-0.62
Age of household head	0.000	0.000	0.02	0.000*	0.000	-1.94	0.000	0.000	-1.59
Gender of household head	0.000	(omitted)		0.000	(omitted)		-0.008	0.005	-1.45
Educational level of household head	-0.005	0.006	-0.91	-0.007***	0.002	-2.74	-0.006***	0.002	-2.71
Dairy experience	0.000	0.001	0.05	0.000*	0.000	1.94	0.000**	0.000	2.06
Household size	-0.001	0.002	-0.48	-0.001	0.001	-0.78	-0.001	0.001	-1.02
Frequency of extension visits	-0.001	0.004	-0.22	0.000	0.002	-0.06	-0.001	0.002	-0.38
No lactating cows	0.000	0.004	-0.07	0.001	0.001	0.87	0.000	0.001	0.48
Quantity of milk	0.000	0.000	-0.06	0.000	0.000	-0.86	0.000	0.000	-0.79
Processed milk	0.015	0.013	1.15	0.013**	0.006	2.34	0.016***	0.005	3.07
Semi-intensive	-0.024	0.017	-1.39	-0.041***	0.011	-3.59	-0.034***	0.009	-3.71
Extensive	0.002**	0.001	2.52	0.001	0.000	1.46	0.001***	0.000	2.92
Price of milk	0.053***	0.020	2.64	0.020***	0.007	2.94	0.022***	0.006	3.72
Zoba: Debub	0.074***	0.020	3.68	0.038***	0.006	6.31	0.040***	0.006	7.24
Constant	0.102**	0.044	2.31	0.186***	0.018	10.12	0.178***	0.018	9.84
Resources									
LOG Labor productivity	0.012*	0.007	1.78	0.002	0.002	0.84	0.003	0.002	1.45
Asset Index Score	-0.006	0.004	-1.58	-0.001	0.001	-0.98	-0.002	0.001	-1.45
Age of household head	0.000	0.000	-0.21	0.000	0.000	-0.32	0.000	0.000	-0.36
Gender of household head	0.000	(omitted)		0.000	(omitted)		-0.002	0.004	-0.59
Educational level of household head	0.000	0.005	0.06	-0.002	0.002	-1.19	-0.001	0.001	-0.83
Dairy experience	0.000	0.000	-0.02	0.000	0.000	0.55	0.000	0.000	0.4
Household size	-0.001	0.002	-0.32	0.000	0.000	-0.48	0.000	0.000	-0.24
Frequency of extension visits	-0.004	0.003	-1.08	-0.002*	0.001	-1.67	-0.003**	0.001	-2.31
No lactating cows	0.001	0.003	0.17	0.000	0.001	-0.18	0.000	0.001	-0.02
Quantity of milk	0.000	0.000	-0.37	0.000	0.000	-0.17	0.000	0.000	-0.44
Processed milk	0.021**	0.010	2.05	0.006*	0.004	1.65	0.010***	0.003	2.77
Semi-intensive	0.015	0.013	1.09	-0.020***	0.007	-2.68	-0.010	0.006	-1.6
Extensive	0.001	0.001	1.46	0.000	0.000	0.65	0.000	0.000	1.34
Price of milk	0.030*	0.016	1.89	-0.004	0.004	-0.9	0.000	0.004	0.04

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Zoba: Debub	0.050***	0.016	3.15	0.015***	0.004	3.73	0.019***	0.004	4.94
Constant	0.059*	0.035	1.68	0.097***	0.012	8.05	0.092***	0.012	7.50
Income									
LOG Labor productivity	0.002	0.016	0.14	0.005	0.005	1.05	0.005	0.005	1.09
Asset Index Score	-0.004	0.008	-0.47	-0.004	0.003	-1.38	-0.004	0.003	-1.44
Age of household head	0.000	0.001	-0.05	0.000	0.000	-0.28	0.000	0.000	-0.02
Gender of household head	0.000	(omitted)		0.000	(omitted)		0.002	0.008	0.28
Educational level of household head	0.002	0.011	0.17	-0.002	0.004	-0.43	0.000	0.003	-0.11
Dairy experience	0.000	0.001	-0.13	0.000	0.000	0.49	0.000	0.000	0.5
Household size	-0.004	0.004	-0.89	0.001	0.001	0.46	0.000	0.001	0.15
Frequency of extension visits	-0.007	0.008	-0.87	0.001	0.003	0.34	-0.001	0.003	-0.23
No lactating cows	0.001	0.007	0.11	0.000	0.002	0.17	0.000	0.002	0.03
Quantity of milk	0.000	0.001	-0.21	0.000	0.000	-0.21	0.000	0.000	-0.16
Processed milk	0.022	0.024	0.91	0.010	0.009	1.14	0.014*	0.008	1.78
Semi-intensive	-0.012	0.031	-0.38	-0.006	0.018	-0.34	-0.006	0.015	-0.41
Extensive	0.000	0.002	-0.31	-0.001	0.001	-1.08	0.000	0.001	-0.88
Price of milk	0.040	0.037	1.09	-0.001	0.010	-0.12	0.003	0.010	0.34
Zoba: Debub	0.083*	0.037	2.24	0.033***	0.009	3.55	0.037***	0.009	4.14
Constant	0.177**	0.081	2.17	0.181***	0.029	6.31	0.170***	0.029	5.94
Leadership									
LOG Labor productivity	-0.021	0.021	-1.02	-0.005	0.007	-0.83	-0.005	0.006	-0.81
Asset Index Score	0.019*	0.011	1.73	-0.002	0.004	-0.39	0.002	0.004	0.62
Age of household head	0.002	0.001	1.41	-0.001*	0.000	-1.67	0.000	0.000	-0.96
Gender of household head	0.000	(omitted)		0.000	(omitted)		-0.034***	0.012	-2.88
Educational level of household head	-0.004	0.014	-0.3	-0.002	0.005	-0.33	-0.003	0.005	-0.6
Dairy experience	0.000	0.001	-0.12	0.000	0.000	-0.32	0.000	0.000	-0.19
Household size	0.014***	0.005	2.71	0.002	0.001	1.27	0.002*	0.001	1.68
Frequency of extension visits	-0.007	0.010	-0.68	0.005	0.004	1.32	0.003	0.004	0.8
No lactating cows	-0.020*	0.010	-2.01	-0.001	0.002	-0.34	-0.002	0.002	-0.81
Quantity of milk	0.002	0.001	1.63	0.000	0.000	0.32	0.000	0.000	0.39
Processed milk	-0.015	0.032	-0.47	0.012	0.012	0.96	0.009	0.011	0.77
Semi-intensive	-0.080*	0.041	-1.94	-0.019	0.024	-0.76	-0.036*	0.020	-1.75
Extensive	0.000	0.002	0.12	0.001	0.001	0.71	0.001	0.001	1.5
Price of milk	-0.005	0.049	-0.11	0.049***	0.014	3.45	0.043***	0.013	3.22

Zoba: Debub	0.060	0.049	1.21	0.088***	0.013	6.87	0.083***	0.012	6.69
Constant	-0.043	0.108	-0.39	0.127***	0.039	3.22	0.133***	0.040	3.30
Time									
LOG Labor productivity	0.025	0.015	1.61	0.041***	0.006	6.73	0.041	0.006	7.26
Asset Index Score	0.000	0.008	0.03	-0.013***	0.004	-3.57	-0.011	0.003	-3.37
Age of household head	0.001	0.001	0.99	0.000	0.000	1.18	0.001	0.000	1.55
Gender of household head	0.000	(omitted)		0.000	(omitted)		0.005	0.010	0.45
Educational level of household head	0.017*	0.010	1.66	0.004	0.005	0.78	0.005	0.004	1.21
Dairy experience	0.001	0.001	0.56	0.000	0.000	-1.18	0.000	0.000	-1.26
Household size	0.009**	0.004	2.33	0.000	0.001	-0.12	0.000	0.001	0.17
Frequency of extension visits	-0.005	0.008	-0.61	0.011***	0.004	2.81	0.008	0.003	2.28
No lactating cows	-0.029***	0.007	-4.04	-0.007***	0.002	-3.29	-0.009	0.002	-4.55
Quantity of milk	0.001**	0.001	1.99	0.000	0.000	-1.33	0.000	0.000	-1.06
Processed milk	-0.031	0.023	-1.33	-0.030***	0.011	-2.66	-0.027	0.010	-2.72
Semi-intensive	0.018	0.030	0.59	-0.049**	0.023	-2.17	-0.026	0.018	-1.44
Extensive	0.002	0.001	1.2	0.002***	0.001	2.92	0.003	0.001	3.67
Price of milk	-0.045	0.036	-1.25	0.041***	0.013	3.09	0.036	0.012	3.06
Zoba: Debub	-0.084**	0.036	-2.36	-0.027**	0.012	-2.31	-0.030	0.011	-2.71
Constant	0.118	0.078	1.51	0.127***	0.036	3.47	0.114	0.036	3.18

Source: Field Survey, 2023.

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Measuring community power: A scale to measure collective self-determination, Embodied Earth Care and Connection, and Ubuntu among urban farmers and gardeners

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Abstract

Participation in community farming and gardening increases and improves social support, collective agency, care, and resistance in many historically exploited communities. Black- and Brown-led food justice organizations have expressed the need for an instrument that captures what is most important to them: information on how their programs impact land-based knowledge, spirituality, collective agency, resistance, and mental health. This study used a survey instrument to develop a scale using exploratory factor analysis. Participants were recruited with the help of key partners and influencers from U.S.-based agricultural networks. The final analyzable sample contained 363 respondents. The scree plot, parallel test, and eigenvalues all supported a five-factor structure as most appropriate for the data. These five inter-related factors explain a concept called "Agricultural Community Power" and refer to Collective Self-determination, BodyMind Community Care, Land-based Spiritual Wellbeing, Embodied Earth Care and Connection, and Ubuntu/Interdependence. This model had adequate internal consistency reliability (Cron-

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bach's alpha = 0.93). The Agriculture Community Power Scale (AgCPS) is a tool that (1) can be used for program evaluation and (2) is better aligned with the values, priorities, and impacts of many community-rooted environmental organizations. AgCPS moves food justice evaluation away from standard metrics (such as BMI and fruit and vegetable consumption) and toward metrics of community care, collective agency, land-based spirituality, and community power.

Keywords
agriculture, community gardens, urban farming, self-determination, community power, spirituality, ecospirituality, wellbeing, scale development, Ubuntu

Introduction

Community farming and gardening have consistently been associated with positive and improved health outcomes for both the consumers of the food and the people who participate in growing. These agricultural activities have been shown to improve depression, anxiety, stress, and physical health (Fang et al., 2021; Gregis et al., 2021; Lampert et al., 2021; Soga et al., 2017). Participation in community farming and gardening has also led to increases and improvements in social support, collective agency, care and wellbeing, and resistance in many historically exploited communities and organizations (Gripper, 2023). Among these groups and organizations, Black-led and Black-serving urban agriculture organizations have highlighted racial disparities in philanthropic funding (Reynolds, 2015), since U.S.-based white-led and white-serving organizations tend to receive much of the funding available for environmental education and stewardship (Ghose & Pettygrove, 2014).

Black-led organizations have expressed the need for an instrument that captures what is most important to them: information on how their program impacts land-based knowledge, spirituality, collective agency, resistance, and mental health (Bartram's Garden, n.d.; Gardening The Community, n.d.; Soil Generation, n.d.; The Urban Farming Institute, n.d.). Many Black people do not grow as a hobby or to partake in trends, but as resistance for healing and self-determination (Gripper, 2020). The health benefits and ecosystem services of Black agrarianism and urban agriculture extend beyond physical health. However, urban agriculture organizations have repeatedly shared that their funders often measure the success of their programming based on the amount of produce grown, changes in body mass index (BMI) of participants, and/or average fruit and vegetable consumption (Daftary-Steel et al., 2015). These evaluation metrics are not only misaligned with what organizations want to show, but they are also often in direct opposition to programmatic missions and goals (Bartram's Garden, n.d.; Cohen & Reynolds, 2015; Soil Generation, n.d.; Soul Fire Farm, n.d.). Since a widely accepted, validated, and established tool does not exist to capture what is most important to many urban growers, there is a need for one to be developed.

There are existing scales that measure individual agency, social capital, and community mobilization generally (Cavazzoni et al., 2022; Saito et al., 2017; Tapal et al., 2017). There is also an instrument measuring social and dietary outcomes in relation to community garden participation (Burt & Delgado, 2020). However, no single scale exists to measure "community power," nor does an instrument exist to measure community power as it manifests for Black agricultural communities in the U.S. (Gripper, 2023). Measuring these latent constructs may help Black-led agricultural organizations better assess their project and programmatic impacts and secure funding to expand their work. The goal of this study was to develop a new scale that measures community power among urban farmers, gardeners, and growers and that can be used by urban agriculture organizations in the U.S. to assess their programming; the scale allows it to be used in national studies as well. This concept of community power encompasses latent constructs such as collective agency, care and relationship-building, interdependence, and what I am calling "Embodied Earth Care and Connection."

Methods

Scale development has unavoidable bias (Andersen et al., n.d.). The lack of transparency and awareness around our different internal biases and lack of cultural understanding is in part why there are issues

with how scales have been developed (Kayes & McPherson, 2010). Before choosing and using scales, researchers should ask: What demographic of people were these scales created for? What populations were considered as scales were designed and developed? On what populations were the established scales initially validated? These questions and considerations were prioritized throughout the development of this study's aims, instrument, and scale.

Many epidemiologists and social scientists treat scales as one-size-fits-all, thinking that they will operate similarly across racially, culturally, ethnically, and economically diverse populations. Morgado et al. highlighted the need for "more diverse views to be considered to reflect more comprehensive perspectives of human knowledge-creating behaviors to strengthen the validity of developed scales" (p. 14). If researchers are designing scales for a specific community, then research should start with engaging that community.

Scale Development Methodology

I[1] began the process of item and scale development by hosting focus groups with Black and white urban growers in Philadelphia (Gripper, 2023). During these focus groups, I asked about their experiences with growing food and the self-determined impacts on their health and communities. During these focus groups, I also provided participants with an opportunity to share any agriculture-related topics that they think should be further investigated and uplifted in research settings. The qualitative data gained from these focus groups informed, influenced, and shaped the content and development of the present scale (Gripper, 2023).

I also conducted informal interviews and intentional conversations with Black agrarian communities across the U.S. and the Caribbean. During these conversations, people emphasized the benefits of urban agriculture for spirituality, collective agency, mental health, and community-building and organizing. While there are validated instruments to measure spirituality, most of these tools focus on spirituality in the context of religion. To date, there are few, if any, instruments that capture land-based, holistic spiritual wellbeing. I use land-based spirituality to refer to spiritual practices originating in African indigenous cultures that emphasize the divinity of and reverence for ancestors, nature, and God (p'Bitek, 2011; Somé, 1994, 1999). Such a tool could be useful as an alternative impact measure for grassroots organizations and community-rooted groups whose work centers collective care and agency, as well as the cultures, foods, and spiritual practices of the African diaspora.

There are scales that aim to measure community capacity-building, which is related to the concept of community care and relationship-building (Gripper, 2023), but with some key differences. Community capacity is the "combined influence of a community's commitment, resources, and skills that can be deployed to build on community strengths and address community problems and opportunities" (Deaton, 2022, "What is capacity," para. 1). This concept focuses on the resources, skills, and commitments that move through a community. "Community care and relationship-building," as outlined in Gripper (2023), places its focus and emphasis on the care and wellbeing of the people who make up a community, not necessarily the resources or skills that flow between people.

Using collective agency and community resilience (CACR) as a guiding framework (White, 2017), I draw from my experiences as a Black urban farmer, subject matter expertise, informal interviews with urban growers, and focus group data (Gripper, 2023) to determine the items and factors included in the instrument. This study sought to build on qualitative findings from earlier studies by developing a scale to measure community care, collective agency, and resistance, as well as the various concepts that are captured within them. Embedded in these concepts are the following themes: political education, resource sharing, economic autonomy, collective decision-making, environmental health literacy, spiritual wellbeing and practice, health, and interdependence.

[1] Throughout this manuscript, both first and second person point of views are incorporated. When "I" is used, it refers to the first author. "We" is used in the context of the study's coding and analysis which, at times, was conducted by the authors collaboratively.

Survey Administration

This study used a survey instrument to develop a scale using exploratory factor analysis. Surveys were administered online and collected anonymously through Qualtrics. Institutional review board (IRB) approval for this study came from the Office of Regulatory Affairs and Research Compliance at the Harvard T.H. Chan School of Public Health. I recruited participants with the help of key partners and influencers in agricultural communities in the U.S. through a variety of approaches. The survey link and recruitment materials were shared with community partners and comrades. People then shared the survey link and/or recruitment emails with their networks and listservs. Urban agriculture organizations also discussed the study with their members via word of mouth. The survey link, accompanied by a description of the research, was also shared on several online mailing lists, newsletters, and social media pages, such as Philadelphia Urban Farmers Network (PUFN), Northeast Sustainable Agriculture Working Group (NESAWG), Northeast Farmers of Color (NEFOC), and others.

Participants included urban farmers and gardeners from across the U.S., with an emphasis and targeted outreach for the following cities: Atlanta, Baltimore, Boston, Chicago, Cleveland, Detroit, Houston, Minneapolis, Philadelphia, Portland, San Francisco Bay Area, and Seattle. These areas were chosen to increase regional and geographic variability. They were also selected because they have an urban agriculture presence and/or movements and are not as well studied as some other major urban areas. To be eligible to participate in this study, individuals had to (1) garden or farm outdoors with other people, (2) be at least 18 years of age, (3) grow produce or herbs, and (4) grow in an urban context.

The survey was initially open to participants for three weeks. On day three of data collection, Qualtrics' built-in software detected bots and duplicate responses. To limit additional bots from completing the survey, I added a reCAPTCHA question and made the race/ethnicity text entry fields mandatory. Prior to the third day of the survey, race/ethnicity text entry fields were suggested but optional. After the survey closed, consideration was given to re-opening it based on interest and feedback from potential participants. The survey was reopened for four additional days.

I collected demographic information on race, ethnicity, gender, age, occupation, education, type of growing project, and length of time farming. I also collected data on the respondent's mental health, physical health, and spiritual wellbeing. Participants were able to opt into a raffle for a US $50 gift card at the completion of the survey.

Bot Detection

I imported data into Excel to be cleaned and managed. Qualtrics contains built-in "unsophisticated" bot-detection, fraud detection, and duplicate detection software (Simone, 2019; Storozuk et al., 2020). This software determined that a small portion of respondents were likely bots and/or duplicate responses. In order to filter out low-quality and fraudulent responses, I exported the remaining responses into Excel. After initial bot detection measures were implemented, I then searched for and filtered out ineligible respondents and sophisticated bots (Simone, 2019; Storozuk et al., 2020) before reaching a sample that included all eligible and analyzable responses. Sophisticated bots are robots that use the survey's language to create responses to text entry questions (Simone, 2019; Storozuk et al., 2020). To detect these bots, I looked for nonsensical answers to straightforward questions such as "what is your occupation" and "what is your ethnicity." Coupling this knowledge with information in the email address fields, I discovered that bots, hackers, and duplicate responders tend to send consecutive survey responses that contain the same email address structure (Simone, 2019; Storozuk et al., 2020). To identify bots, I also looked at fraud and duplicate scores. These scores are calculated through Qualtrics' reCAPTCHA software. I evaluated all this information concurrently to determine which responses were definitely bots and which respondents were legitimate. These bots also register from different IP addresses and latitudes and longitudes. This makes bot responses seem more realistic and difficult to differentiate from legitimate responses. Sophisticated bots with a CAPTCHA-determined fraud score of greater than or equal to 20, i.e., manual bot detection, were

excluded. Table 1 outlines the data cleaning process and exclusions. After filtering out Qualtrics-detected bots and duplicate responses, there were 690 respondents. Further analysis of the data revealed an additional 128 "sophisticated" bots that had completed the survey.

Factor Analysis

All analyses were performed in R. I considered results from the scree plot, parallel test, and eigenvalues to get a sense of how many potential factors to extract. Reverse coded items were recoded to be on the same scale as other items. We then performed an exploratory factor analysis (EFA) extracting one, three, four, five, and eight factors, and examined factor loadings and item correlations of each model (DeVellis, 2017). I assessed internal consistency reliability, content validity, and discriminant validity (DeVellis, 2017). Single-rated mental health, single-rated physical health, and single-rated spirituality items were included in the scale to provide additional context and understanding around the health of urban growers. Content validity of the scale was evaluated by experts in Black agricultural studies, survey design, and scale development (DeVellis, 2017).

I selected EFA because traditional regression techniques are insufficient for scale development and assessing latent variables (McCoy, 2019a). In the EFA model, we included an oblique rotation since the underlying latent constructs are likely correlated with one another (DeVellis, 2017). Within urban agriculture and Black agricultural communities, it is very likely that the concept of community care is also related to collective agency and community resistance.

I chose to retain items with factor loadings >0.3 and evaluated cross-loadings (Boateng et al., 2018; Tavakol & Wetzel, 2020). If there were cross-loadings, an item was assigned to the factor on which it had the largest loading. This analysis did not rely heavily on model fit statistics because this is an exploratory factor analysis and not a confirmatory factor analysis (McCoy, 2019b). I did, however, observe and note reliability statistics for the overall model. For the final scale, I dropped items with factor loadings <0.3 from the model and scale. After dropping items with low loadings, we re-ran the exploratory factor analysis and evaluated internal consistency reliability and model fit statistics. Analyses of item-scale correlations, Cronbach's alpha for reliability, and factor correlations helped determine which items to retain (DeVellis, 2017).

Results

The final analyzable sample contained 363 respondents. Black people composed 19% of the sample. Native American, Asian, and mixed-race respondents made up 15% of the sample. Many respondents were in Philadelphia (26%), Boston (14%), Baltimore (10%), Chicago (9%), and the San Francisco Bay Area (7%). Participants' ages ranged from 21 to 83. Most participants had completed at least some college (95%).

Table 2 lists health indicator statistics by race. About 94% of people who completed the survey rated their physical health as good, very good, or excellent. Among Black people, 94% of participants rated their physical health as good, very good, or excellent. Roughly 83% of all respondents rated their mental health as good, very good, or excellent, while 17% rated their mental health as fair or poor. Most growers indicated that

Table 1. Bot Detection and Final Sample Size

Step	Reason Excluded	*n* Excluded	*n* Remaining After Exclusion
1	1 - Preview	4	913
2	2 - Bot: Qualtrics	223	690
3	3 - Bot: Manual Detection	128	562
4	4A - Not Eligible (Q7): Does not grow w other people	63	499
	4B - Not Eligible (Q7): missing grow w other people	57	442
	4C - Not Eligible (Q4): Fish/Animals or Fruit Trees Alone	19	423
	4D - Not Eligible (Q5): In Water or Indoors Alone	4	419
5	5 - Incomplete	56	363

they think about their spiritual wellbeing (85.7%). This was slightly higher among Black growers: about 94% of Black growers said they think about their spiritual wellbeing. Of all racial groups, Black people had the highest engagement in spiritual practices (85.5%). When asked to rate their spiritual wellbeing and/or practices, 70.2% of all survey respondents said their spiritual wellbeing is good, very good, or excellent. About 19% of all respondents said their spiritual wellbeing was fair or poor and about 11% of respondents said that this question was not applicable to them.

The scree plot, parallel test, and eigenvalues all suggested that a four or five-factor structure is most appropriate for the data. Model fit statistics were examined but not used to determine how many factors to retain. Model fit statistics were adequate and minimally adequate, respectively, using RMSEA >0.07 cut-off value (RMSEA = 0.07, TLI = 0.7).

Five factors were extracted, which means that there are five underlying constructs that compose this scale. Table 3 shows which items or statements load onto specific factors. The exploratory factor analysis with an oblique rotation yielded very few cross loadings. There were five items that did not load onto any factors based on a cut-off of <0.3 (Q22, Q30, Q31, Q41, Q47). I used item-scale correlations to determine which items to keep in the model and which items to remove from the model

Table 2. Health Indicators by Race

		Black (*N* = 6)	Native American / Alaska Native (*N* = 4)	Asian (*N* = 20)	White (*N* = 241)	Mixed race (*N* = 29)	Total (*N* = 363)
Self-rated physical health	Excellent	10 (14.5%)	N/A*	1 (5%)	43 (17.8%)	6 (20.7%)	60 (16.5%)
	Very good	26 (37.7%)	N/A*	10 (50%)	116 (48.1%)	13 (44.8%)	168 (46.3%)
	Good	29 (42%)	N/A*	8 (40%)	69 (28.6%)	7 (24.1%)	114 (31.4%)
	Fair	4 (5.8%)	N/A*	1 (5%)	12 (5%)	1 (3.4%)	18 (5.0%)
	Poor	0 (0%)	N/A*	0 (0%)	1 (0.4%)	2 (6.9%)	3 (0.8%)
Self-rated mental health	Excellent	10 (14.5%)	N/A*	0 (0%)	30 (12.4%)	5 (17.2%)	45 (12.4%)
	Very good	25 (36.2%)	N/A*	4 (20%)	80 (33.2%)	6 (20.7%)	117 (32.2%)
	Good	21 (30.4%)	N/A*	10 (50%)	96 (39.8%)	10 (34.5%)	139 (38.3%)
	Fair	12 (17.4%)	N/A*	6 (30%)	30 (12.4%)	8 (27.6%)	56 (15.4%)
	Poor	1 (1.4%)	N/A*	0	5 (2.1%)	0	6 (1.7%)
Consideration of spiritual wellbeing	Yes	65 (94.2%)	N/A*	15 (75%)	204 (84.6%)	24 (82.8%)	311 (85.7%)
	No	4 (5.8%)	N/A*	2 (10%)	25 (10.4%)	3 (10.3%)	35 (9.6%)
	Unsure	0 (0%)	N/A*	3 (15%)	12 (5%)	2 (6.9%)	17 (4.7%)
Engagement in spiritual practices	Yes	59 (85.5%)	N/A*	11 (55%)	149 (61.8%)	19 (65.6%)	241 (66.4%)
	No	6 (8.7%)	N/A*	6 (30%)	64 (26.6%)	5 (17.2%)	82 (22.6%)
	N/A	4 (5.8%)	N/A*	3 (15%)	28 (11.6%)	5 (17.2%)	40 (11.0%)
Self-rated spiritual wellbeing	Excellent	14 (20.3%)	N/A*	0 (0%)	16 (6.6%)	2 (6.9%)	33 (9.1%)
	Very good	22 (31.9%)	N/A*	5 (25%)	48 (19.9%)	7 (24.1%)	84 (23.1%)
	Good	23 (33.3%)	N/A*	6 (30%)	95 (39.4%)	13 (44.8%)	138 (38.0%)
	Fair	8 (11.6%)	N/A*	6 (30%)	45 (18.7%)	1 (3.4%)	60 (16.5%)
	Poor	1 (1.4%)	N/A*	0 (7.1%)	6 (2.5%)	2 (6.9%)	9 (2.5%)
	N/A	1 (1.4%)	N/A*	3 (15%)	31 (12.9%)	4 (13.8%)	39 (10.7%)

* *N* is too small to report per ethical standards.

(DeVellis, 2017). One item was removed from its corresponding factor to allow for a clearer interpretation (Q34). Other items with slight cross loadings were assigned to the factor under which they made

Table 3. Agricultural Community Power Scale Factor Loadings

Factor	Load	Item	Item Question
ML 3	0.697	Q39	My community is determined to work through challenges together
	0.628	Q40	My community works together to develop shared practices or values
	0.562	Q29	I am aware of opportunities to become more involved in community matters
	0.557	Q25	My community openly shares our goods and resources with one another
	0.547	Q27	I have access to material support or resources through my community
	0.450	Q26	When money is tight, I can depend on my community for financial support
	0.370	Q64	If someone in my community is in need, we can depend on each other for support
	0.369	Q33	My community is currently practicing or plans to practice cooperative economics
	0.357	Q23	I am aware of community spaces where I can speak openly with others about politics
	0.332	*Q54	If I get sick, I can count on my community to help me through it
	0.328	Q36	I work with others to strengthen our collective economic power
	0.310	Q24	When my community works together, we have strong political will and power
	−0.597	Q37	My community works together to make decisions on how to use or consume our shared resources
	−0.699	Q38	When my community is threatened, we work together to come up with a solution
ML 4	0.671	Q53	Because of my experience gardening and/or farming, I feel a deeper responsibility to care for the Earth
	0.619	Q50	Gardening and/or farming have helped me feel more connected to the Earth
	0.549	Q43	I share what I know about the environment and health with my friends, family, or colleagues
	0.540	Q45	I am more knowledgeable about the foods that I eat than I was before I started gardening/farming
	0.513	Q46	I think about the distance food has traveled when I shop at the supermarket or grocery store
	0.512	Q32	I give time, money, or labor to help support or improve my community
	0.456	Q63	I think about how my actions will impact my community
	0.425	Q59	I feel less anxious when I garden and/or farm
	0.390	Q60	I feel less depressed when I garden and/or farm
	0.386	Q61	Gardening and/or farming has helped me improve my physical health
	0.380	Q35	My community has more power when we pool financial resources
	0.336	Q44	When purchasing produce, I prefer to buy pesticide-free products
	0.323	*Q52	Growing food has helped me to feel or be more connected to my ancestors
	0.305	*Q51	Gardening and/or farming have helped me develop deeper spiritual practices
ML 1	0.865	Q56	Knowledge from my community has improved my physical health
	0.780	Q55	Knowledge from my community has influenced my physical health and/or activities
	0.679	Q58	My mental health has improved because of the knowledge or care I have received from my community
	0.584	Q57	My mental health has been influenced by the knowledge I received from my community
	0.361	*Q54	If I get sick, I can count on my community to help me through it
	0.356	Q42	I have gained knowledge from my community about the ways the environment impacts my health
ML 5	0.841	Q49	My spiritual wellbeing or practice has been improved by knowledge or care I received from my community
	0.841	Q48	My spiritual wellbeing or practice has been influenced by knowledge I received from my community
	0.650	*Q51	Gardening and/or farming have helped me develop deeper spiritual practices
	0.377	*Q52	Growing food has helped me to feel or be more connected to my ancestors
	0.372	Q34	I am exploring economic alternatives to capitalism by myself or with my community
ML 2	0.887	Q66	My wellbeing is connected to other people's wellbeing
	0.833	Q65	My humanity is connected to other people's humanity
	0.492	Q67	I make decisions about my actions based on how they might impact other people
	−0.449	Q62	My actions do not affect other people; I should be able to do what I want

* Denotes cross-loaded item

the most sense (Q51, Q52, Q54). The five factors were moderately correlated with one another, supporting the choice of a single scale with five interdependent subscales. This model had adequate internal consistency reliability (Cronbach's alpha = 0.93).

Discussion

The primary goal of this study was to develop a valid and reliable scale that measures the impact of grassroots and community-based urban agriculture projects.

Factor and Construct Interpretation

Based on the factor loadings, item groupings, and my subject-matter expertise, the five factors represented in the scale refer to Collective Self-determination, BodyMind Community Care, Land-based Spiritual Wellbeing, Embodied Earth Care and Connection, and Ubuntu/Interdependence, described in detail below. Together, these factors and constructs form the Agricultural Community Power Scale (AgCPS; see Table A in the Appendix) and measure community power as it manifests among urban farmers and gardeners.

Collective Self-determination

Each of the items that loaded onto the Collective Self-determination factor contained the word "community." These items focused on concepts like economic autonomy, political education, resource and information sharing, and collective decision-making. Together, they explain processes of how people think, decide, and act together to determine what is best for the community as a whole. The collection of items that loaded onto this factor almost entirely capture the following strategies of resistance outlined in *Freedom Farmers: Agricultural Resistance and the Black Freedom Movement*: Commons as Praxis, Prefigurative Politics, and Economic Autonomy (White, 2018). For example, item 25 says, "my community openly shares our goods and resources with one another." This statement is one of several consistent with Commons as Praxis, which "refers to the resource commons and includes collective decision making, collective action, and fair allocation of shared resources" (Gripper, 2023, p. 4). Overall, Collective Self-determination had the most items loaded onto it of any factor, and loadings ranged from moderate to strong.

Embodied Earth Care and Connection

The 17 Environmental Justice Principles from the First National People of Color Environmental Leadership Summit call for deep-rooted care of Earth and articulate alternative ways to engage with communities that have perpetually experienced environmental exploitation and injustices (The First National People of Color Environmental Leadership Summit, 1991). Embodied Earth Care and Connection demonstrates the ways that participation in community agriculture has helped people to realize their connections to Earth as well as their responsibility to care for Earth. The items that loaded onto the Embodied Earth Care and Connection factor refer to knowledge, understandings, and perceptions that people have gained from participating in agricultural activities, specifically related to food and harmful environmental exposures. It also includes the ways Earth has cared for and facilitated healing for people. One example of this is item 59, which says, "I feel less anxious when I garden and/or farm." The items that loaded onto Embodied Earth Care and Connection also captured participants' experiences with agriculture, that is, the feelings and sense of responsibility that participating in agricultural activities initiated in people. Examples of items that loaded onto this factor include item 43, "I share what I know about the environment and health with my friends, family, or colleagues," and item 53, "because of my experience gardening and/or farming, I feel a deeper responsibility to care for the Earth." Loadings on this factor were moderate (0.31–0.65).

BodyMind Community Care

These items refer to ways that one's community has shaped, influenced, or improved their health. It includes people's perceptions of how their community cares for them when they experience mental or physical illness. The focus of this factor is the health-related care that communities provide through sharing information and mutual aid. Examples of items that loaded onto this factor include item 56, "knowledge from my community

has improved my physical health" and item 54, "if I get sick, I can count on my community to help me through it." These items loaded moderately to strongly onto the BodyMind Community Care factor.

Land-based Spiritual Wellbeing

All items that loaded strongly onto this factor are related to agriculture and how participation in an agricultural community impacts spirituality. These items relate to how community gardening and farming facilitates spiritual wellbeing, deepening of spiritual practices, and connection to ancestors. Spirituality in this context is facilitated through connection to Earth, land, and agriculture. Items that loaded strongly onto this factor include but are not limited to item 49, "my spiritual wellbeing or practice has been improved by knowledge or care I received from my community," and item 51, "gardening and/or farming have helped me develop deeper spiritual practices."

Ubuntu and Interdependence

Ubuntu is a South African principle from the Zulu tribe (Foundation, 2017). It is often defined and described as "I am because we are" or "I am a person through you." Ubuntu is about the interdependence and interconnection of all humanity and Earth. The items that loaded onto this factor are about understanding one's own positionality in relation to other people. For instance, one item says, "I think about how my actions will affect other people." Another item was reverse coded and says, "My actions do not affect other people. I should be able to do what I want." The remaining items that loaded onto this factor mentioned the interconnections of humanity, collective wellbeing, and decision-making. These loadings were strong.

Sensitivity Analyses

We performed several sensitivity analyses. We repeated the exploratory factor analysis using data that included potential bots. This analysis yielded similar findings to the main analysis of the data that excluded bots. We also performed a sensitivity analysis restricted to participants who were Black, Native American, Asian, and mixed-race. This analysis was not sufficiently powered; however, it did yield similar results. One notable difference was the emergence of an additional factor that was not explicitly captured in the initial scale. This factor included items 23, 24, 29, and 35, and encompasses some of the ways that activism and resistance manifest through community gardening and farming. In the qualitative research that preceded this study, there were subtle and obvious differences between Black and white focus groups in their discussions about activism and resistance (Gripper, 2023). The excerpt below highlights some of those differences and offers a potential explanation for why the factor analysis for this sensitivity analysis included an additional factor.

> "Activism and resistance" was one of several subthemes that made up the larger theme "growing food as a demonstration of agency and power." … White participants engaged with concepts of resistance, activism, and justice from social positions that differed from Black participants. While people across racial groups talked about topics related to agency and power, Black participants discussed them more frequently. There was also a difference in the emphasis people placed on specific topics. For instance, in one of the Black focus groups, participants dedicated most of the allotted time to talking about activism and resistance. While White participants also named resistance as an impact of urban agriculture, the conversations around resistance were shorter, less emphatic, and did not contain the same sense of urgency as in the Black focus groups. (Gripper, 2023, pp. 14, 15–16)

Lastly, we compared characteristics of respondents who took the survey before the initial close date and those who took the survey after the initial close date. Seventeen people completed the survey after it reopened. People who took the survey after it reopened were more likely to identify as Black, Asian, or mixed-race ($N = 14$).

Strengths and Limitations

The AgCPS is a tool that can be used for program evaluation for environmental organizations working toward BodyMind Community Care, agency

and self-determination, spirituality, environmental stewardship, and justice. While no measurement tool can definitively determine the extent of a person or group's spiritual connections, the AgCPS offers a measure of land-based spiritual wellbeing that can serve as an alternative impact measure for grassroots organizations and community-rooted groups. The content of this scale is more closely aligned with the values, priorities, and impacts of many of these groups as compared to the scales often used to measure impact (Bartram's Garden, n.d.; Detroit Black Community Food Security Network, n.d.; Neighborhood Land and Power Project, n.d.; Soil Generation, n.d.; The Urban Farming Institute, n.d.; Wozniacka, 2019). This scale moves food justice evaluation metrics away from standard metrics such as changes in BMI or consumption of fruits and vegetables, and toward metrics of collective agency, wellbeing, spirituality, and community power.

While there were many white respondents, all survey questions and statements were primarily designed by drawing on information, wisdom, and experiences from Black growers. Compared to the racial distribution of the U.S. population, this survey had a greater response rate from Black, Native American, Asian, and mixed-race urban growers than expected. Though validated in urban agriculture communities, it is also likely that this scale is transferable to Black rural farming and other justice-centered communities such as abolitionist, spiritual or faith-based, and social movement groups. Future iterations of this work will validate the instrument with different demographics and occupations in order to measure Community Power among other groups.

Another strength of this study was the development of bot-identification and analysis strategies. A small number of bots and duplicate respondents infiltrated the survey early in the data collection process. I realized this issue very quickly and implemented additional security and bot detection measures. I put forth an extensive effort to identify "sophisticated" bots during the data cleaning stage. While the probability of excluding valid responses is very low, it is possible that some bots were included in the final sample. Bots are likely to have responded to survey questions at random, as confirmed through our sensitivity analyses, so there is no reason to think they would differentially bias this study's findings.

This study had several constraints that will be considered in the continuation of this research. The survey was only open for a total of four weeks, which means the number of responses collected was limited. This was due to timeline constraints and was the maximum amount of time it could be open. The survey window was from January 2022 to February 2022 because this time of year is when most U.S.-based farmers and gardeners have paused their "in-the-field" activities. It was important for the data collection to take place during these months so that this research was not adding undue burden to growers during the busiest time of the growing season (spring, summer, and fall). In future studies, surveys should remain open for 6–8 weeks to allow enough time for outreach to different populations.

Another limitation of this study was the inability to pay each respondent for their time and contribution to the research. It is important to value people's time and energy. One of the most tangible and effective ways to do this is through monetary compensation. Due to extreme funding limitations, I was not able to pay each respondent individually for their contribution; instead, they were able to opt in to a raffle for a US$50 gift card at the completion of the survey. Future iterations of this research will include compensation for all people who complete surveys.

Conclusion

In this paper, I introduce a statistically reliable scale to measure "Agricultural Community Power," and describe its development and validation. This 41-item scale is made up of five subdomains: Collective Self-determination, Embodied Earth Care and Connection, BodyMind Community Care, Land-based Spiritual Wellbeing, and Ubuntu. It was developed based on what I and others (White, 2018) heard from Black and Brown urban growers in our communities. The Agricultural Community Power Scale (AgCPS) is one of few instruments to describe Embodied Earth Care and Connection, Land-based Spiritual Wellbeing, Ubuntu/Interdependence, and Collective Self-determination. It

is also one of the only scales designed specifically by, for, and with guidance from Black urban farmers, thus meeting a need that community organizations have expressed for decades.

The Agricultural Community Power Scale is deeply rooted in community-generated questions, knowledge, and wisdom, and likely has utility across different disciplines and fields, including public health, sociology, and psychology. In addition to introducing the AgCPS scale, the approach and methods used throughout this research process offer an alternative way of engaging in community-based and community-rooted research methods. It may serve as a guide for others on how to produce community-engaged scholarship, where qualitative research influences quantitative studies, using an environmental justice approach. In future research projects, researchers should consider utilizing their skills, knowledge, and technical expertise to develop tools that communities have explicitly stated will be useful for them. It can lead to greater impact.

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Appendix

Table A. Agricultural Community Power Scale

Collective Self-determination	23. I am aware of community spaces where I can speak openly with others about politics
	24. When my community works together, we have strong political will and power
	25. My community openly shares our goods and resources with one another.
	26. When money is tight, I can depend on my community for financial support.
	27. I have access to material support or resources through my community.
	29. I am aware of opportunities to become more involved in community matters.
	33. My community is currently practicing or plans to practice cooperative economics
	36. I work with others to strengthen our collective economic power
	37. My community works together to make decisions on how to use or consume our shared resources.
	38. When my community is threatened, we work together to come up with a solution.
	39. My community is determined to work through challenges together.
	40. My community works together to develop shared practices or values.
	64. If someone in my community is in need, we can depend on each other for support.
Embodied Earth Care and Connection	32. I give time, money, or labor to help support or improve my community.
	35. My community has more power when we pool financial resources
	43. I share what I know about the environment and health with my friends, family, or colleagues.
	44. When purchasing produce, I prefer to buy pesticide-free products
	45. I am more knowledgeable about the foods that I eat than I was before I started gardening/farming.
	46. I think about the distance food has traveled when I shop at the supermarket or grocery store.
	50. Gardening and/or farming have helped me feel more connected to the Earth.
	53. Because of my experience gardening and/or farming, I feel a deeper responsibility to care for the Earth.
	59. I feel less anxious when I garden and/or farm.
	60. I feel less depressed when I garden and/or farm
	61. Gardening and/or farming has helped me improve my physical health
	63. I think about how my actions will impact my community.
BodyMind Community Care	42. I have gained knowledge from my community about the ways the environment impacts my health.
	54. If I get sick, I can count on my community to help me through it.
	55. Knowledge from my community has influenced my physical health and/or activities.
	56. Knowledge from my community has improved my physical health.
	57. My mental health has been influenced by the knowledge I received from my community.
	58. My mental health has improved because of the knowledge or care I have received from my community.
Land-based Spiritual Wellbeing	48. My spiritual wellbeing or practice has been influenced by knowledge I received from my community.
	49. My spiritual wellbeing or practice has been improved by knowledge or care I received from my community.
	51. Gardening and/or farming have helped me develop deeper spiritual practices.
	52. Growing food has helped me to feel or be more connected to my ancestors.
Ubuntu / Interdependence	62. My actions do not affect other people. I should be able to do what I want.
	65. My humanity is connected to other people's humanity.
	66. My wellbeing is connected to other people's wellbeing.
	67. I make decisions about my actions based on how they might impact other people.

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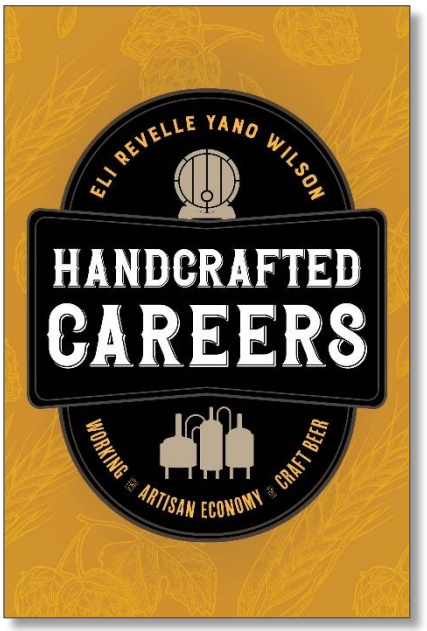
An account of labor market inequality in the craft beer industry



Book review by
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Review of *Handcrafted Careers: Working the Artisan Economy of Craft Beer*, by Eli Revelle Yano Wilson. (2024). Published by University of California Press. Available as hardcover, paperback, and eBook; 264 pages. Publisher's website: https://www.ucpress.edu/books/handcrafted-careers/

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Handcrafted Careers by Eli Revelle Yano Wilson successfully describes the racialized, classed, and gendered dimensions of work in the craft beer industry. The book's research question might be stated as: How does systemic inequality in the labor market manifest in the artisanal craft beer industry? Wilson proposes that artisanal jobs in this new economy are much more idiosyncratic and entrepreneurial, and thus subject to more variation, than the expected patterns shaped by structures of race, class, and gender. While most research on artisanal markets suggests the opposite—that whiteness and gentrification shape access to these artisanal spaces—Wilson poses the possibility that maybe, in spite of this research, craft beer will be different. However, he finds that privilege exerts its influence here as well. "Bearded white guys" enjoy access to exhibit pure passion in the creative pathway, whereas women typically end up on the service path, and minority males are assigned hard labor roles, such as distribution and canning. And so: labor market inequality in the craft beer industry must be addressed in terms of race, class, and gender and acknowledge that micro-level inter-

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actions reproduce an invisible system of power that shapes career choices.

While the book's efforts are well-meaning, its theoretical and methodological limitations could potentially hamper its impact with industry practitioners. The fault lies less with Wilson and more with sociology of inequality overall, which lacks consensus concerning how micro interactions—that, while being shaped by the symbolic interpretations of ascribed characteristics—aggregate into such durable stability for those same interpretations across the landscape of macro systems shared by humans. How *exactly* are interactions and narratives shaped by "race," "class," and "gender"? The implicit belief framing this sociology is that interactions between dominants and subordinates inadvertently reproduces the privileged meaning of whiteness, the undesirability of color, and the submissiveness of femininity for all people everywhere at the same time. How these dynamics linking micro interactions to macro systems might be conceptualized for observation is not known, but this belief continues animating such descriptive scholarship, largely because there is no end to articulating the downstream effects of macro systems on bodies atomized by its power.

Methodological limitations stemming from this undertheorized framework occur when Wilson imposes its implicit belief onto the observations. The methods section claims 128 interviews in the Los Angeles area. Yet it is their "micro-transactions"—meaning the job choices made relative to options available—that explains how the racialized, classed, and gendered dimensions of the space shaped their words. The 128 people interviewed are refracted through a narrow spectrum of interpretation, thus reducing the information their experiences might have offered. This also poses the question that if symbolic interactions are shaping the career trajectories of workers, why are there no observations of interaction? To be sure, we do find colorful descriptions of workplaces, but there is no deep dive into the experiential, symbolic texture of these spaces. Wilson defends this choice, saying, "…sociologists have long argued that people overestimate their own agency and underestimate the influence of social-structural forces" (p. 20). This stance suggests that it is up to the sociologists to explain what these people really meant when they spoke their words. The "ethnographic" scaffolding design of this research does not really observe the relationships shaping the way individuals are interpellated by space, but instead matches categories of respondents (Black, white, male, female, etc.) to types of work: white guys are on this creative path; women are on this service path; minority males are on this hard labor path. There is no systematic analysis of experience or interaction within these designated spaces.

Instead of carefully privileging workers' voice, the implicit frame imposed on selected interview quotes drains the rich insights we might gain. This effectively robs workers of their agency, rendering mute the lessons they may teach us about the texture of their lived experiences in this emerging new form of entrepreneurial, community-focused capitalism. For example, we hear the words of (bearded white guy) Brandon, who appears to be answering the question: "Why am I here?" (p. 66). He goes on to describe how the pay "sucks," and the work conditions are grueling, but the satisfaction of all the brewers working together—and then directly engaging with consumers enjoying the fruits of their labors—is intrinsically rewarding. Wilson analyzes this quote by explaining that Brandon is unaware that his access to "pure passion" as a career path results from his unacknowledged whiteness. Brandon's voice is replaced by the undertheorized, but appropriately signaled, interpretive lens. Brandon does not realize that his hard work and sacrifice come from the privilege granted by his access. Rather, individuals who took dramatic pay cuts, risked their futures, and spent countless hours learning the skills and knowledge needed to create a meaningful product from scratch for local consumption instead become another lesson in how white men reproduce the macro system of inequality.

What is it about craft beer that makes it a *desirable* employment destination for women and minorities? Wilson's respondents are trying to give us this information, but the author continually imposes categorical labels upon their experiences, finding domination they are not aware of. For example, in Chapter 3, we meet Maya and Shelia,

both servers in taprooms. They said that their jobs are intrinsically rewarding because they design menus to reflect their knowledge of the beer styles enjoyed in those locales, gain knowledge of the history and intricacies of beer flavors and feel like work is a constant party. Wilson explains that these women do not realize they accommodate a less rewarding service career since they are women—even though these intrinsically meaningful experiences are literally the words the respondents used to describe their work identities. Another example is Jorge, a 23-year-old Latino person with a high school education who loves his job on the hard labor path: "I'll say it over and over again, this is the only place I feel like it's a family" (p. 106). Minority workers with otherwise poor labor market prospects seem to enjoy working in these spaces. However, rather than seeing this as some endemically progressive energy within the craft beer industry, it is framed as reproducing the macro system's hierarchy, where the "privileged white men … pursuing their self-centered passion for brewing" (p. 105) dominate others.

The irony is that by abstracting the variables of "race," "class," and "gender" as separate causal phenomena detectable in the interviewees' "micro-transactions," Wilson does the opposite of what Patricia Hill Collins (1999) famously argues for in *Black Feminist Thought*. Rather than "intersecting" these variables nominally as categories, Collins calls for an epistemological shift *away* from the causal power of abstractions. She argues that what the matrix of domination *actually* is and how it functions is not yet observable by any epistemology in the social sciences—a point she reiterates in her review nearly 20 years later (Collins, 2015). Privileging the concrete, lived experiences of flesh operating against domination is needed—Black women are the logical point to *begin* seeking the subjugated knowledge necessary to fashion this alternative epistemology, but are by no means the end. By allowing racialized, gendered, and classed categories to substantively frame the interpretation of interviews, Wilson implicitly attributes causality to these abstractions. These oppressive systems are reproduced implicitly by the interactions of people who do not know better.

An entirely different interpretation of these interviews is also possible: Craft beer could have been theorized as the vanguard of resistance against the industry's corporate, state-backed power. Lessons on fighting the legal and monetary resources controlling market spaces—where "bearded white guys" *use* their privilege to create open, inclusive, communal environments that give people informal, collective spaces to express themselves—could have been learned. It would also have been interesting to hear from the woman of color who owned a brewery (mentioned by a respondent on page 69, but never addressed by the author) or examine how owners found ways to subvert, skate, or avoid the corporate power tactics that inhibit tap and shelf space in grocery stores and sports bars. Regrettably, the concrete struggle between scrappy, resourceful individuals fighting macro agents seeking to monopolize the production of beer for mass markets is rather invisible to the theoretical frame applied. The book will likely be lauded in sociology circles as another example of how inequality manifests at the micro level. Meanwhile, the people who advocate for craft beer entrepreneurship, seek to build inclusive urban micro economies, oppose corporate lobbyists, or work in craft beer spaces will likely struggle to apply this research. For sociology to be useful in these applied circles, fresh theoretical approaches linking "upstream" macro systems to many possible expressions of inequality in micro spaces are needed.

References

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