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Regional food system resilience and rural realities

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Abstract

Food system resilience is increasingly recognized as essential for sustaining food security amid shocks and disruptors such as extreme weather and climate change. Yet resilience planning is often limited in rural regions, where vulnerabilities may be higher and institutional capacity is constrained. This study examines how local governments and regional planning entities engage with food systems resilience across the 13-state Appalachian region. Appalachia provides a valuable case due to its high proportion of rural communities, elevated rates of

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Author Contributions

Research conceptualization (LKJ); Data collection & analysis (LKJ & JRS); Article drafting (LKJ); Article editing (LKJ & JRS); & Figure design (JRS).

Data Availability

Anonymized data is available by reasonable request to the corresponding author, Lia Kelinsky-Jones.

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Ethics

This research was reviewed by the Virginia Tech Institutional Review Board (protocol #23-374). Based on HHS and FDA regulations, the research was determined to not involve human subjects research.

Financial Interests

The authors have no competing interests to declare that are relevant to the content of this article.

food insecurity, and documented vulnerability to climate-related disruptions. At the same time, the region's strong agricultural assets make it well-suited to examine actions related to food systems resilience efforts. While resilience scholarship emphasizes the importance of locally rooted and self-organized food systems, regional approaches are often proposed as a means of connecting these localized efforts to enhance coordination across food systems and increase diversity, redundancy, and interconnectivity. Drawing on 32 group interviews with 113 public officials representing 167 counties, we apply Keegan et al.'s (2024) regional food system resilience concepts as a conceptual framework to analyze regional governance–oriented food system resilience actions. Our findings show that governmental actors primarily engage in facilitative roles, advancing food system efforts through food access initiatives, participation in networks, and support for local and regional supply chains. These efforts often build on locally embedded activities but remain unevenly coordinated across jurisdictions. We also find that local governments rely on nonprofit partnerships to advance food access initiatives in both routine times and in anticipation of or following an acute shock, while explicit attention to longer-term shocks, like climate change, remains limited. Despite evidence that locally organized efforts contribute to resilience, we find limited mechanisms for integrating these efforts at broader regional scales, underscoring gaps in multilevel governance. These findings suggest the need for future research on governance models that support coordination across jurisdictions, as well as practical efforts to strengthen planning capacity, integrate food systems into formal policy processes, and align short-term interventions with longer-term resilience planning.

Keywords
food security, Appalachia, governance, climate change, resilience, food systems

Introduction

Natural disasters, pandemics, and geopolitical conflicts continue to disrupt the ability of food systems to function, revealing the importance of building resilience, or the ability to adapt and persist in the face of disturbances (IPES-Food, 2022). Food systems resilience is often defined as "the capacity over time of a food system and its units at multiple levels, to provide sufficient, appropriate, and accessible food to all, in the face of various and even unforeseen disturbances" (Tendall et al., 2015, p. 19). This definition highlights the relationship between resilience and food security, and particularly a system's capacity to maintain food access during disturbances (Hodbod & Eakin, 2015). However, resilience is generally understood as a broader system-oriented concept that requires diversity, redundancy, ecological integrity, sufficient infrastructure, and local organization that enables food systems to adapt and persist over time (Worstell, 2025; Worstell & Green, 2017). For example, Cabell and Oelofse (2012) argue that resilient food systems must not only maintain food supplies during shocks and disruptions but also sustain the ecological systems and livelihoods upon which food systems depend. More recently, Zurek et al. (2022) emphasize resilience as involving not only the capacity to resist and recover from disruptions, but also the capacity for reorientation and transformation toward more sustainable and equitable food systems.

Due to the complexity involved, resilient food systems require intentional planning, as progress does not emerge spontaneously (Freedgood, 2024; Ruhf & Clancy, 2022; Zurek et al., 2022). Reflecting the importance of planning, a seminal text called for governmental planners to address food system issues such as community food security within their local communities (Pothukuchi & Kaufman, 1999). Since then, efforts by local governments to address food systems issues have increased (Raja et al., 2017). This study adopts a food systems governance perspective, examining how local governments and regional planning entities that plan on behalf of local governments respond to food security and increasing risks from climate-related disruptions, while recognizing that this lens captures only a part of the broader ecological and systemic dynamics of resilience.

Locally, food systems planning efforts often appear in comprehensive plans and climate action plans (Mui et al., 2018). The growing inclusion of food in climate action plans reflects how local gov-

ernments increasingly address food and climate objectives together to reduce agriculture's contribution to climate change while simultaneously advancing equity and food security (Cohen, 2022). A substantial body of scholarship further recognizes the critical role of local governments in climate mitigation and adaptation, given their authority over physical infrastructure, waste management, public procurement (including food), public lands, and transportation systems (Kelinsky-Jones & Levine, 2025; Nevens et al., 2013; Reid et al., 2023; Schiappa et al., 2023; Wang, 2012). However, these actions tend to be concentrated among urban localities as rural food security and resilience planning tend to be neglected (Freedgood, 2024; Ruhf & Clancy, 2022). This trend likely reflects the reality that rural governments often have less capacity to respond to climate issues, revealing an urban-rural capacity gap (Headwaters Economics, 2026). This climate and food-related planning gap between rural and urban communities is made worse because food system disruptions appear to negatively affect rural communities more than non-rural communities (Reidmiller et al., 2018). Finally, research tends to focus more on urban localities given the presence of planning to study. As a result, we suggest that investigating rural food system efforts in the face of climate disruptions is increasingly pressing.

Regional approaches are often proposed as a mechanism for improving resilience coordination and capacity, as larger geographic scales can increase interconnectivity, redundancy, responsiveness, and network formation (Blay-Palmer et al., 2026; Clancy & Ruhf, 2010). A region can comprise the area around a large city, multiple counties, multiple states, or mega-regions, such as in our case, Appalachia (Ruhf & Clancy, 2022). Local self-organization is one of several conditions for food systems resilience (Worstell & Green, 2017). Reflecting this, local food system policies are frequently treated as precursors to regional impact (Keegan et al., 2024; Tendall et al., 2015), yet we know little about how local efforts advance food systems efforts in the face of climate change and how they may be connected at regional levels, particularly in rural contexts (Clancy & Ruhf, 2010; J. K. Clark et al., 2021). To address this literature gap, we investigated food systems resilience actions among local governments and regional commissions across the U.S. 13-state mega-region of Appalachia. Importantly, this study does not assume the existence of a singular, coordinated food system across the entire mega-region. Instead, we examine how local governments and regional planning entities engage with food system resilience actions within and across jurisdictions. Accordingly, in this study, "regional" primarily refers to multicounty planning and governance activities. In doing so, this study provides one of the first large-scale empirical examinations of how local governments and regional entities are taking action around food systems efforts across Appalachia.

Regional Food Systems Resilience Conceptual Framework

Food systems resilience is a contested and multidisciplinary concept with roots across ecological, social, engineering, and food systems scholarship (Roosevelt et al., 2023). Existing scholarship variously emphasizes ecological resilience, adaptive capacity, self-organization, governance, food security, regional coordination, and systems transformation (Blay-Palmer et al., 2021; Green et al., 2017; Hodbod & Eakin, 2015; Roosevelt et al., 2023; Ruhf & Clancy, 2022; Tendall et al., 2015; Worstell & Green, 2017; Zurek et al., 2022). This study focuses on how resilience actions are operationalized by local and regional governmental entities. We selected this framework because it explicitly addresses regional food systems resilience.

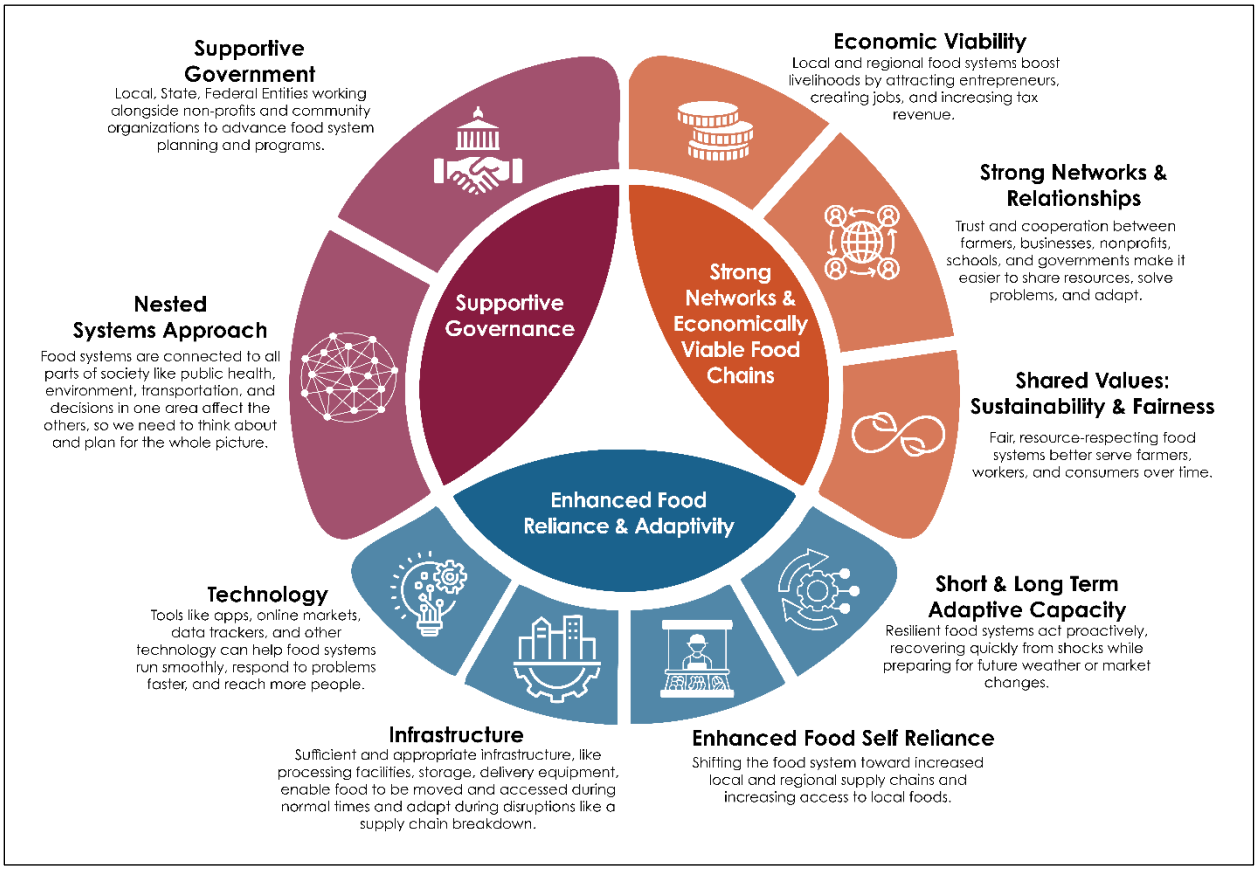
To guide analysis, we employed Keegan et al.'s (2024) regional food system resilience framework as a regional governance-oriented analytical lens (see Figure 1). We selected this framework because it explicitly addresses regional food systems resilience and coordination across scales, dimensions especially relevant to this study's focus on local governments and regional planning entities across Appalachia. At the same time, scholarship on regional food systems emphasizes that resilience is supported by the coordination and sum of local adaptive capacities, relationships, and actions (Clancy & Ruhf, 2010), aligning with broader resilience scholarship emphasizing the importance of local self-organization (Worstell & Green, 2017). We used Keegan et al.'s framework as a structured

approach for examining how public-sector actors engage with food systems resilience through planning, coordination, and institutional action at regional scales. Keegan et al. identify three core constructs that guided our analysis: (1) *supportive governance*; (2) *enhanced food self-reliance and adaptivity*; and (3) *strong networks and economically viable food chains*.

The first core construct, *supportive governance,* comprises multiple layers of governments working in a coordinated fashion across the system alongside nonprofit actors and other entities to address planning and policy efforts related to food systems and resilience (Clancy, 2014; Keegan et al., 2024). Under supportive governance, the two subthemes we derived include *supportive government* and a *nested systems approach*. Supportive government includes food system actions such as planning or policies, farmland preservation, multistakeholder visioning, incentives, or other governmental actions in support of local or regional food system efforts, and engaging with local nonprofits (Freedgood, 2024; Keegan et al., 2024; Zurek et al., 2022). More localized efforts alongside smaller governance institutions can support responsiveness and adaptation rather than larger, more centralized initiatives (Cabell & Oelofse, 2012). A nested systems approach emphasizes the interconnected social, economic, environmental, and institutional dimensions of food systems across scales (Keegan et al., 2024; Schipanski et al., 2016). At the same time, resilience scholarship cautions that higher-scale coordination can create tensions with local agency and self-organization when decision-making becomes disconnected from locally embedded adaptive capacities (Holling & Gunderson, 2002).

The second core element, *enhanced food self-reliance and adaptivity*, addresses the capacity of food systems to respond and adapt to disruptions through local and regional supply chains, infrastructure, appropriate technology, and adaptive capacities that can pivot more quickly than global

Figure 1. Regional Food System Elements Adapted from Keegan et al. (2024)



supply chains during a shock (Keegan et al., 2024). We identified four subthemes under this element, including *enhanced food self-reliance*, *short- and long-term adaptive capacity*, *infrastructure*, and *technology*. Enhanced food self-reliance suggests shifting the food system toward increased local and regional supply chains and increasing access to local foods for all (Keegan et al., 2024; Ruhf & Clancy, 2022). Blay-Palmer et al. (2021) further argue that regions that proactively co-plan for resilient food systems are better able to maintain food access and mitigate impacts on vulnerable populations during disruptions, highlighting the importance of pre-existing social support and food access infrastructures for resilience. Adaptive capacity includes both short-term responses to acute shocks and longer-term responses to build in robustness, or the ability of food systems to continue functioning under changing and uncertain conditions (Zurek et al., 2022). Sufficient infrastructure and appropriate technologies can help producers and other actors across the food system respond to changes both during shorter-term disasters and longer-term shifts (Keegan et al., 2024). For example, novel communication technology supported local food systems to shift during the COVID-19 pandemic (Thilmany et al., 2021).

The third core element, *strong networks and economically viable food chains*, emphasizes the importance of interdependency within a functioning food system because strong networks and relationships can support economic viability across a region (Keegan et al., 2024). Three subthemes emerged for this element: *strong networks and relationships*, *economic viability*, and *shared values*. Strong networks across food systems actors appear key to increasing policy and planning coordination within regional contexts (Blay-Palmer et al., 2021). Such networks speak to the importance of connectivity and coordination to support resilience through adaptive capacity, particularly when these connections include redundancy and flexibility (Worstell & Green, 2017). Second, economic viability speaks to the importance of local and regional food systems as shorter supply chains can support increased adaptation (Keegan et al., 2024). For example, during the COVID-19 pandemic, some regional food supply chains demonstrated flexibility and responsiveness by rapidly adapting distribution and logistics practices, including shifting toward direct-to-consumer delivery and alternative market channels (Marusak et al., 2021). Third, the shared values subtheme reflects how some food systems scholarship links resilience efforts with broader normative goals such as equitable food access, sustainable, and regenerative practices (Blay-Palmer et al., 2021; Ruhf & Clancy, 2022; Schipanski et al., 2016). We developed and employed a codebook based on the themes identified by Keegan and colleagues (2024) to conceptually guide the analysis of the group interviews we conducted.

Methodology

This study employed a qualitative research design to examine how public officials across Appalachia advance food systems efforts in the context of climate-related disruptions. We addressed two research questions: (1) how are local governments and regional planning commissions advancing food system efforts related to food security, and (2) how are these efforts addressing increasing risks to food security posed by climate change and extreme weather as a form of resilience planning? We addressed these research questions using semi-structured group interviews conducted over Zoom with public officials across the Appalachian region.

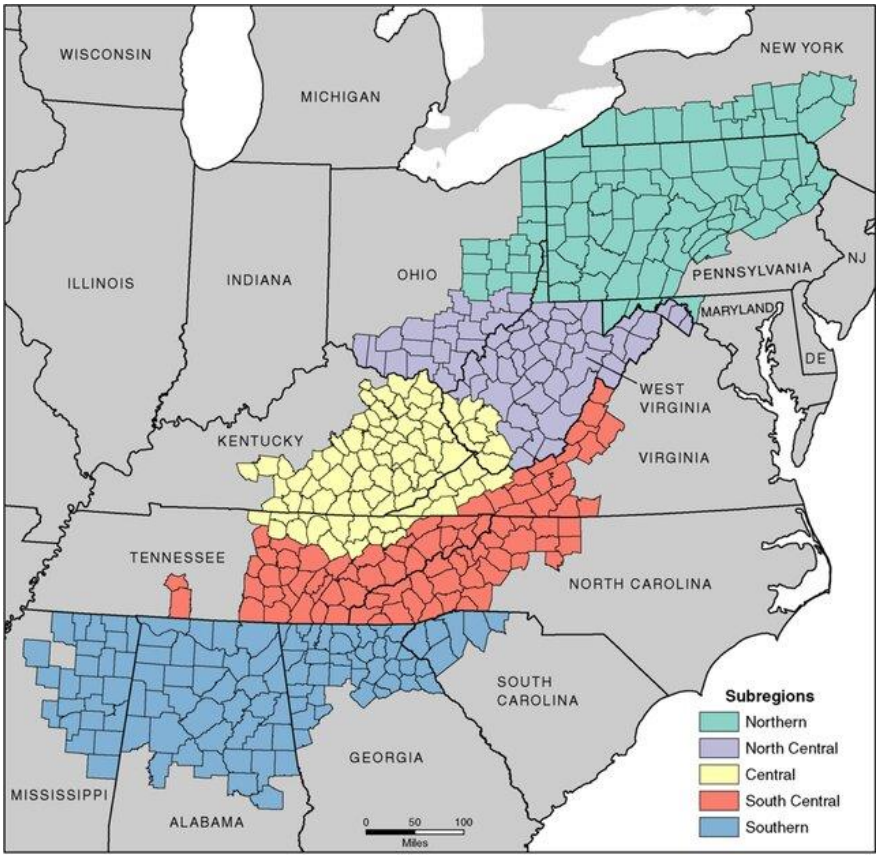
Case Selection and Context

We focused on the mega-region of Appalachia. We used the geographic boundaries established by the Appalachian Regional Commission (ARC), a regional economic development organization. The ARC defines Appalachia as a 13-state region encompassing 423 counties stretching from Mississippi to New York, covering 206,000 square miles or 331,524 square kilometers (ARC, n.d.; see Figure 2). The relative neglect of food systems planning efforts in rural areas (Freedgood, 2024) makes Appalachia a particularly valuable case due to its high proportion of rural communities (ARC, 2021a). Moreover, climate-related disruptions are predicted to worsen food insecurity (Reidmiller et al., 2018), and Appalachia experiences higher food insecurity rates than the national average (ARC, 2023). At the same time, recent scholarship emphasizes that resilience is unevenly distributed across

Appalachia, with some communities experiencing persistent poverty and food insecurity despite the resilience observed among many small farm households (Worstell, 2025).

Additionally, the region possesses significant food system assets that support food system development, including many small farms, strong cultural foodways, crop diversity, natural resource abundance, and successful models for food systems development in the area (Clark, 2015), which are supported by many layers of governance and community organizations working in tandem (Engle & Higgins, 2024). Despite this legacy, scholars have nonetheless identified a need for increased regional food system policy efforts (Appalachian Foodshed Project, 2016).

Figure 2. Appalachian Regional Commission Map of Appalachian Counties



Source: Appalachian Regional Commission. (2021). *Subregions in Appalachia*. https://www.arc.gov/map/subregions-in-appalachia/

Coal mining, mountaintop removal, and timber extraction negatively affected the ecological, social, economic, and cultural fabric of the region, resulting in higher rates of poverty, underdevelopment, and worse health and education outcomes compared to non-Appalachian counties (Austin & Clark, 2012; Clark, 2015; Gaventa, 2019; Newfont, 2011; Scanlan, 2011). Meanwhile, the region faces growing climate-related risks, including increased flooding and drought-worsened wildfire conditions (Arriens et al., 2024; Robbins et al., 2024; Sickels, 2022). Recent disasters illustrate these vulnerabilities: Hurricane Helene caused substantial agricultural damage across Southwest Virginia and western North Carolina in 2024 (Barlow, 2024; Russel, 2025), while eastern Kentucky experienced unprecedented flooding in 2022 (Graves, 2023).

Population and Sampling

We employed purposive sampling to identify public officials engaged in planning, community and economic development, sustainability, and food- or agriculture-related activities across three levels of governance: municipalities, counties, and regional commissions. We selected these positions because food system efforts often show up in sustainability, comprehensive planning, and community and economic development efforts (Deller et al., 2017; Mui et al., 2018). While these officials are not frontline or grassroots food systems actors, such as farmers, distributors, or food entrepreneurs, they nonetheless play important roles in shaping the policy, planning, infrastructure, and institutional conditions that influence food system outcomes. Moreover, there are very few government positions focused on food (Berglund et al., 2021), despite calls for such prioritization over two decades ago (Pot-

hukuchi & Kaufman, 1999, 2000). Reflecting this, food system efforts are showing up in non-food-related plans such as comprehensive, climate, and sustainability planning efforts (Mui et al., 2018). Together, these trends suggest that local and regional governmental actors are increasingly engaging with food systems issues, even when food systems are not their primary institutional focus.

At the municipal level, we focused on sustainability and food-related staff as these roles are most likely to integrate food systems planning into comprehensive plans and climate action efforts (Mui et al., 2018). We identified municipal-level participants through purposive sampling using membership networks of sustainability practitioners, including the Southeast Sustainability Directors Network (SSDN) and the Urban Sustainability Directors Network (USDN[1]). These networks represent established communities of practice for local government officials engaged in sustainability, climate, and food systems planning. We used publicly available member directories and the USDN urban agriculture working group to identify relevant localities, and then located appropriate staff (e.g., sustainability or food systems planners) through municipal websites. At the county and regional levels, we identified administrators and executives as well as planning staff involved in community and economic development, agriculture, environment, or conservation. Across these three populations, we invited a total of 839 unique individuals representing 15 local governments, 423 counties, and 74 regional commissions.

Between July 2024 and March 2025, we conducted 32 group interviews with 113 unique individuals from all 13 states. Collectively, respondents represented 167[2] counties (Figure 3) and one Virginia city, which we identify separately because Virginia cities are administratively independent of counties. Participants were primarily local government and regional commission employees, with occasional inclusion of Cooperative Extension or nonprofit partners; however, our analysis focused on governmental roles and actions only. Since our unit of analysis was organizational action, we did not collect participant demographics beyond location, role, and years in that position. Years of experience ranged from less than one year to over 30 years, with most participants having more than five years of experience in their current roles.

Group Interviews

We conducted exploratory group interviews (Frey & Fontana, 1991) to understand the experiences of participants. Through this qualitative method, we brought together participants from across Appalachia to gather the perspectives of multiple individuals simultaneously (Edmiston, 1944) and to capture any conversation, divergence, and agreement between participants. This method was also useful for "brainstorming" and exploratory discussion (Frey & Fontana, 1991), which aligned with the imaginaries-based question included in the larger study's interview protocol (Appendix A). These group interviews were conducted and recorded via Zoom, in order to accommodate individuals across the region, in a formal, arranged setting with semi-structured interview questions to spark responses from participants (Frey & Fontana, 1991). The group interviews consisted of 3 to 7 participants[3] and lasted up to 60 minutes. To mitigate the potential for groupthink or dominant voices, facilitators regularly moved person-to-person when introducing key questions in order to encourage individual responses before broader discussion and crosstalk among participants. Facilitators also explicitly welcomed differing perspectives and experiences throughout the interviews.

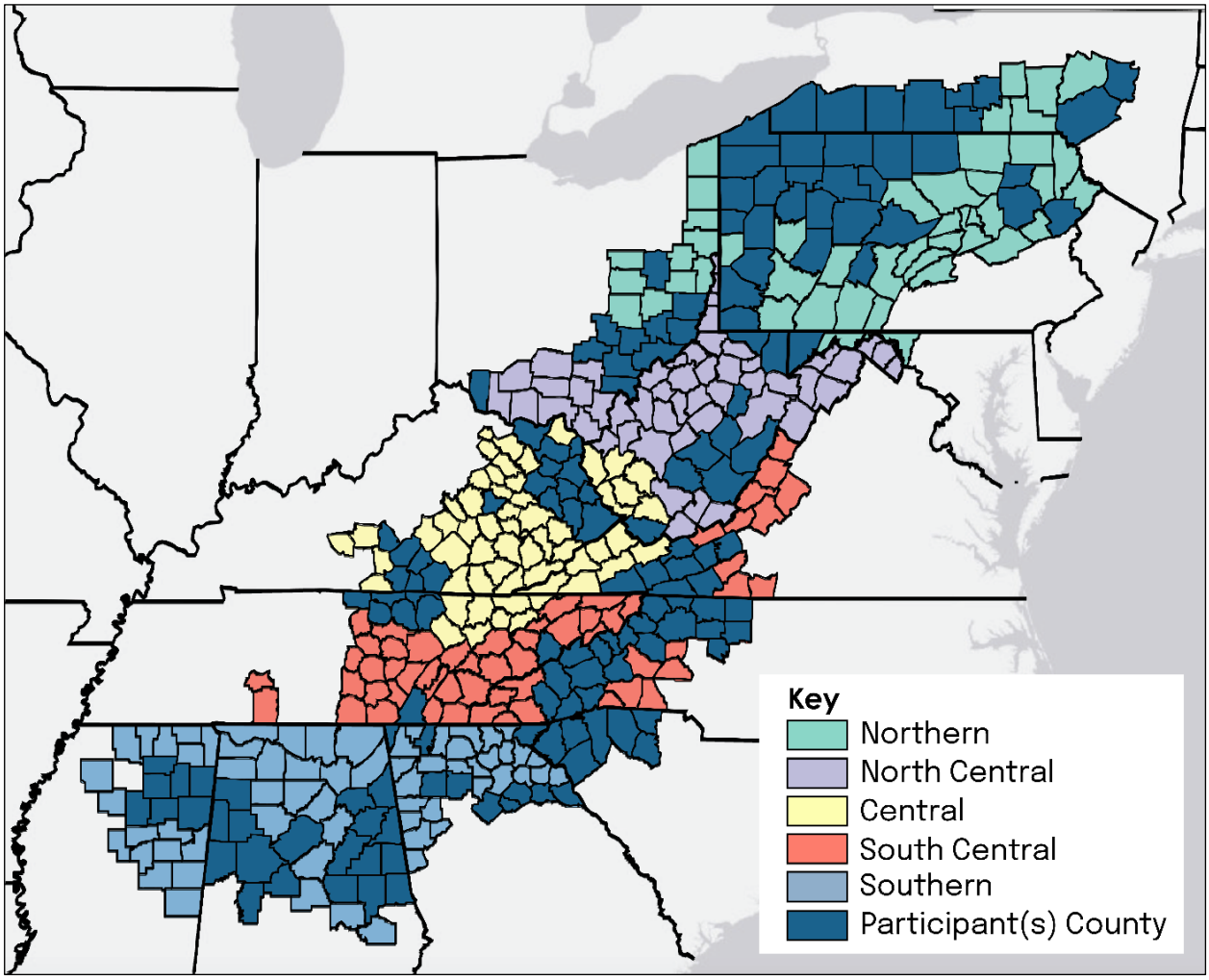
We employed a semi-structured group interview protocol (Appendix A), which addressed multiple research questions related to a larger project within which this study was embedded. Recognizing that food security has been used by some as an indicator of food system resilience (Hodbod & Ea-

[1] Despite the name, USDN is not solely composed of urban planners. For example, Blacksburg, Virginia, is a member and is considered a rural locality.

[2] The number of counties represented is higher than our number of unique respondents because 1 regional commission respondent represented multiple counties simultaneously.

[3] In three instances, we conducted individual interviews with people who could not make a group interview time.

Figure 3. Counties Represented in Group Interviews



Note: Due to our commitment to anonymity, the one Virginia city is not identified in this map.

kin, 2015), we first asked how their governmental organizations respond to food insecurity. Second, given the emphasis on adaptation within resilience frameworks, we asked how these entities respond to food insecurity in the context of increased risks from climatic changes. Our findings derive from these two lines of inquiry. To support clarity and consistency across interviews, we guided the conversation via shared slides that began with a map of Appalachia and a definition of food system resilience from Tendall et al. (2015) before shifting into the interview questions.

Trustworthiness and Credibility

We took multiple steps during data collection and analysis to ensure trustworthiness and credibility within this study as per Lincoln and Guba (1985). To address credibility and transferability, we aimed for and achieved data saturation through conducting a total of 32 group interviews with over 100 participants. After introductions were made at the beginning of the Zoom, we began an audio-only recording of the Zoom sessions to ensure accuracy and verbatim transcription; later, recordings were transcribed using Otter.ai software and checked for verbatim transcription by a graduate student worker for increased authenticity. During analysis, we reinforced credibility by consistent and frequent peer debriefing during data coding and theme formation (Lincoln & Guba, 1985).

Researcher Reflexivity

Researcher LKJ is a faculty member at a university in Appalachia whose work focuses on food systems resilience, policy, and community development. She holds a PhD in community development and food systems and previously held postdoctoral fellowships examining local government efforts related to sustainability, climate change, and food systems resilience. The impetus for this study was a previous collaboration with a local sustainability manager who indicated a need to understand food systems resilience actions at the local and regional governance scales in Appalachia. Researcher JRS was pursuing a doctoral degree in agricultural extension education, with an emphasis in life sciences communication, at a university in Appalachia during the study. Her work focuses on environmentally conscious agricultural practices and food systems resilience, reflecting an ongoing scholarly interest in the topic.

Analysis

As mentioned, we employed Keegan and colleagues' (2024) systematic review of regional food system resilience as an analytical framework to develop a codebook by operationalizing the key constructs and concepts articulated in their research. Using this existing schema supported our aims toward reproducibility, which supports rigor in qualitative research (Lincoln & Guba, 1985). Our coding team included both authors. Using our codebook, our analysis proceeded in four steps. First, we coded a transcript together in person using the codebook. As we worked through the first transcript, we refined our codebook by discussing each code's constructs, reaching consensus on what it meant, and adding examples from the transcript to the codebook. Second, we each coded a transcript individually. We met again, discussed the coding in our respective transcripts, reached consensus, and further refined the codebook. Third, we divided the remaining transcripts in half and coded them individually. During coding, we maintained memos and notes on observations and questions that we regularly shared with one another through email and meetings. To ensure transparency, we used analytical memos to record what we observed. Fourth, upon coding of all transcripts, we met and reviewed every coded statement, and the codes were attributed to ensure accuracy. We anonymized all respondent quotes (except for interviewees from Winston Salem, North Carolina, who requested attribution for their contributions) to reflect the categories of "municipality" (MG), "county" (CG), or "regional commission" (RG), followed by their unique participant ID number. Each quote represents an individual's statement on behalf of their organization.

Results

This section is organized according to the most prominent themes that emerged from respondents: *supportive government*, *strong networks and relationships*, *enabling self-reliance*, and *short- and long-term adaptive capacity*. Across the findings, local and regional governments are engaged in a range of activities related to food system resilience. These efforts span multiple dimensions—including food access before anticipated disruptions, networks, supply chains, and adaptive capacity—but vary in scope, scale, and level of coordination. While respondents described meaningful action within individual areas, these elements are not consistently integrated regionally across jurisdictions. The following sections explore how these efforts are expressed across key dimensions of regional food system resilience.

Supportive Government

Across our sample, respondents most often described their role in food systems efforts as facilitators, funders, and partners. Importantly, these findings reflect the perspectives and activities of governance and planning actors on behalf of their organizations, and do not capture the full range of food systems activities occurring at the community or grassroots level. Many resilience efforts, particularly those led by grassroots and civil society actors, operate outside formal governmental structures. As such, our findings illustrate how governmental actors engage within, support, and interact with these broader systems rather than serving as the sole agents of resilience.

Within this governance lens, actions aligned with supportive government were widely present across the sample, but varied in form, scale, and degree of institutionalization. Many participants de-

scribed supporting food system efforts through partnerships with nonprofit organizations, Extension services, and other public agencies, especially through funding, grants, and infrastructure development. For example, one respondent noted that "we have a really active big, large-scale food bank that has come to us a number of times for grants" (RG1_P04), while another explained how grant funding enabled significant infrastructure investment, stating, "we took an old carpet warehouse and converted that into a facility serving [our region]. … We also constructed a cold storage facility" (CG8_P32). Similarly, others emphasized the role of governmental entities in enabling food access through partnerships, such as establishing donation systems or providing support for food distribution; as one respondent shared, "we set up a donation station at our local farmers market to have people buy food that we donate to a local entity" (CG7_P26). Together, these examples illustrate how governmental actors frequently operate through resource mobilization and partnership rather than direct service provision.

At the same time, respondents consistently pointed to the central role of nonprofit and Extension systems in implementing food system activities on the ground. One regional commission participant stated that, "broadly speaking, the [redacted area] addresses food insecurity almost entirely from a nonprofit lens. That means a lot of little nonprofits" (RG3_P12). Others described how Extension systems facilitate food access and producer engagement, such as "working with our local producers on having direct access food boxes for folks that need support" (CG16_P69), or noted that organizations like food hubs operate outside of government, with "county involvement, primarily through our Extension Service" (CG16_P69). In many instances, participants framed their role as supportive rather than directive, emphasizing coordination rather than implementation. This dynamic was also reflected during disaster response, where one participant explained that food access during a crisis was "all volunteer-based through church organizations and local community groups. That's how we dealt with that" (CG15_P63). These accounts illustrate how governmental actors are embedded within broader nonprofit and volunteer networks. In some cases, these network-building efforts extended across multiple counties.

Formalized food system positions or plans in government were relatively rare, consistent with broader national patterns (Berglund et al., 2021). Most respondents indicated that food-related work was embedded within broader planning roles rather than institutionalized through dedicated positions. As one individual explained, their role was "situated in the planning department … working in food systems and supporting a food council," highlighting an emerging but still uncommon form of institutionalization. More frequently, food system efforts were incorporated into existing planning frameworks. For instance, one respondent explained that food system concerns emerged through comprehensive planning, noting, "we did a comprehensive plan in 2013. … We started to really recognize just how devastating some of our food deserts are. We did a number of zoning amendments to try and increase food production" (MG3_P10). Others described integration into climate planning processes, with one noting that "support for this work was also called up in our municipal climate action plan" (MG1_P03). These examples suggest that food system engagement often occurs indirectly through existing planning mechanisms rather than as a standalone area of governance.

Some respondents also described policy tools that indirectly support food system resilience, particularly through land use and agricultural preservation. For example, one county employee explained, "our county recently updated their countywide ag plan. … In the next couple of years we're really focusing on land preservation" (CG9_P34), while another described a statewide program where "we buy at the development rates so that farm stays in farm production in perpetuity" (CG19_P83). Others highlighted zoning changes intended to reduce pressure on farmland, such as implementing minimum acreage policies for residential development. These efforts demonstrate how supportive governance may occur through policy instruments that shape the broader conditions of the food system, even when food systems are not the primary focus.

Taken together, these findings suggest that supportive governance across the sample is charac-

terized by facilitative, partnership-based approaches in which governmental actors enable, rather than directly coordinate, food system efforts. While these arrangements reflect the multi-actor collaboration emphasized in resilience literature, they also highlight how governance operates as one component within a broader system of actors. As a result, supportive governance appears active but unevenly structured across the region, with most efforts operating through dispersed programs and partnerships rather than coordinated, system-level planning. This pattern also shapes the development of networks, supply chains, and adaptive capacity described in subsequent sections.

Strong Networks and Relationships

Strong networks and relationships are widely recognized as essential for food system resilience, as they increase communication and coordination among actors. Across respondents, network-building efforts such as coalitions, councils, or networking groups were present but are uneven and typically informal, with relatively few examples of sustained, institutionalized coordination across jurisdictions. One regional commission official described participation in a loosely organized statewide effort:

> I am allowed to participate in a semi-established organization called the [state] food system collaborative. … It's a real loosely formed organization of farmers, food hubs, commissions, and other agencies across the state [and] universities that are interested in food systems. We address food security issues, but we fail to address climate change. (RG2_P07)

For example, one regional commission described coordinating a food systems council that is "representative of the 12 counties that we serve … working across the food system and partner organizations from each of those counties" (RG3_P14), illustrating the potential for regional coordination and convening at a broader geographic scale.

At the same time, some local governments described more active convening roles at the county level with an eye toward connecting resources and local procurement. One county official explained:

> We have a coordinated platform in the county. … We meet monthly, and we're sharing info on who may have a better lead on a producer that we can purchase from, the different barriers that the [Municipality] Community Food Bank is facing in sourcing food. … Ultimately our goal is to figure out some different grants or dollars to go towards a coalition … versus everyone going their own direction. (CG18_P79)

Similarly, another county respondent described coalition-building driven by a community health assessment:

> Our Community Health Assessment [identified] … our health priorities, we have three [and] one was food security. As a county, we are bringing partners together [in] a coalition, and we are seeing what our county has to offer, what we need, what we have, doing an assessment. We have WIC staff … SNAP, and we have food pantries around our county. (CG15_P64)

These examples within this theme point to meaningful network-building activity. However, such efforts were relatively rare among the 113 respondents and were less commonly described at a regional scale. This limits the connections needed for a resilient food system to function across geographic and administrative boundaries.

Enabling Self-Reliance

Reorienting food systems toward greater local and regional self-reliance is a central component of resilience, as it can reduce dependence on longer, global supply chains that are vulnerable to shocks. Within this theme, self-reliance primarily took the form of efforts to increase local food production, improve access to locally produced foods, and support local or regional supply chain activities.

Respondents described a range of strategies, including farmers markets, procurement from local producers, community food production on public land, and support for food enterprises. For example, one respondent described efforts to connect local producers with food access initiatives:

> We have a farmers market program that allows our WIC recipients to purchase fresh produce, and we have seen a tremendous decline in those using that program. We came up with a solution … a cooperative of about 15 farmers … is going to be providing veggie boxes. (CG11_P42)

Others focus on the local entity growing food. The respondent from Winston Salem, North Carolina, exemplified this by stating, "we own a large hydroponic greenhouse in a food desert, and have it contracted out to a local nonprofit to grow food, and they just give it out." A county employee described a similar strategy: "community gardens that operate within our park system. Everything harvested from our share rows … is donated back to our emergency food providers" (CG18_P79). These efforts reflect locally embedded strategies to increase food availability and access, although they are often implemented through specific programs or partnerships that may be vulnerable to priority changes rather than broader systemwide shifts in production or distribution.

Additional strategies focused on strengthening local markets and food enterprises. One regional commission described a "[US]$3 million [grant] that will go towards capacity-building and credit enhancement to support food retail and food enterprise in [their] region," an initiative that came out of their "food system assessment to make lending more accessible … with a specific emphasis on BIPOC and women-owned retail and food enterprises" (RG3_P14). Another regional entity used an ARC grant to "look into bringing back food additive or value-added food product. We did this multicounty approach trying to get an added value to some sort of product." They elaborated to say, "unfortunately, that fell apart, like many of the things that go on here. Part of that has to do with the mentality that is bred and lives within the confines of our county" (CGF17_P77). This example highlights the difficulty of sustaining cross-county initiatives over time that span bureaucratic boundaries.

Collectively, these strategies reflect promising movements toward self-reliance. Still, their scope remains limited. Most of the efforts that were described affect local food on the margins of existing systems rather than structurally reorienting toward production and/or procurement toward regional supply chains. The examples of infrastructure investment and value-added development stand out because they are uncommon, pointing to an underutilized mechanism for building continued self-reliance across the region.

Short- and Long-Term Adaptive Capacity

Adaptive capacity is a nuanced construct to assess. It is often considered latent—observable once a disaster or disruption happens (Chodur et al., 2018). Of the four emergent themes, adaptive capacity was the one where the gap between aspiration and action was the most apparent; respondents acknowledged the need for a climate-responsive food system and planning for it but described limited capacity to pursue it. In our sample, the most common adaptive strategies observed were to include food in emergency planning to address short-term disruptions, and to address climate risks to food security and production for a longer-term vantage. Importantly, this area of inquiry was one in which multiple respondents wanted to do more but did not know how to. One respondent stated:

> A lot of [food system resilience efforts are] done by grassroots organizations. … It's not to say that the county doesn't want to be involved … maybe they just don't know how. (CG4_P10)

Among those attending to adaptive capacity, some entities through their "food council [have] been hosting events and having discussions around how to build resiliency in [their] regional food systems" (RG3_P14) or using their "resilience program [to] look at risks and how to address planning for the future" (RG5_P17).

Some respondents spoke of their partnerships with the U.S. Department of Agriculture, Natural Resources Conservation Service (USDA NRCS) or Extension to support climate-adaptive practices among farmers, one stating, "we partnered with [USDA] NRCS which funds half my position, and the USDA has some climate resiliency [efforts] …

that address landscape scale climate-related aspects" (CG4_P11). As far as partnerships with Extension, it mostly took the form of monetary support, exemplified by a participant's statement, "they come to the county and tell us what they need budgetary wise. … That would be our engagement and involvement when it relates to weather" (CG9_P35).

Garnering municipal support for climate-related food system work emerged as a challenge for regional commissions in our sample. This is represented by the following statement from a regional commission employee:

> It's hard to get municipal governments to sign on because some of the climate goals that they have to agree to [are] a challenge. … [We] say, "look you've suffered from how many floods. … We've got to do something." (RG1_P04)

Other municipalities demonstrated early engagement with climate-related food system planning, with one individual explaining, "[in] our climate action plan … local foods are mostly in there because it focuses on greenhouse gas reduction and elimination" (MG1_P01). Another entity called up, "support for this work in our municipal Climate Action Plan that was adopted last year and mentioned in our comp plan" (MG1_P03).

From a short-term disaster perspective, emergency food provision emerged as a dominant theme. Several of these group interviews took place during the historic Hurricane Helene, which caused significant devastation, particularly in the Central Appalachian region. Some respondents described their response to the hurricane, revealing a heavy reliance on their civil society organizations, with one stating, "we were hit hard with Helene and a lot of our food resources were all volunteer based" (CG15_P63). Others discussed their county's direct action, although not necessarily in relation to Helene; one noted, "we distribute shelf-stable meal packs twice a year in preparation for hurricane season and ice storms. So, senior clients have five to eight days' worth of meals" (CG18_P79). One municipality has an effort that seeks to connect disaster preparedness with equity:

> … the final area, which is nascent, and hopefully we'll get more traction, is incorporated within the climate justice initiative with some more emergency food preparedness and equity. The hope there is that there's community-led dialog, not only about what we do in disaster time, but how we care for the community's food needs. (MG1_P03)

These findings reveal a tension at the heart of adaptive capacity across Appalachia: short-term, emergency-focused responses are more common and more institutionalized than long-term climate planning. This is the case even though respondents increasingly recognized the inadequacy of that orientation; for example, one municipal sustainability official stated:

> We're like in reaction mode. … We're not addressing [climate risks to food]. That's why I'm here … We did our climate vulnerability assessment, [and] it just became clear that food insecurity is only going to get worse, and I didn't see that there was much happening to plan at a larger scale. (MG2_P07)

The reactive nature evident across much of the sample—relying on volunteer networks and civil society organizations during acute events like Hurricane Helene—suggests that adaptive capacity remains more latent than enacted, and that explicit investment in longer-term planning infrastructure will be necessary to move the region forward toward genuine resilience. Across all four themes, a consistent pattern emerges: efforts are unevenly developed and rarely co-occur in integrated ways. While respondents described activities aligned with individual elements of resilience, few cases demonstrated coordinated action across governance, networks, supply chains, and adaptive capacity simultaneously.

Discussion

Food system resilience requires governance systems that span multiple levels and actors, including governmental, nonprofit, and private-sector actors (Clancy, 2014; Keegan et al., 2024). Such actions are particularly impactful at regional scales through

networks and coalitions with shared goals (Ruhf & Clancy, 2022). In the U.S., this is challenging, as bureaucratic systems across geographic boundaries were not established with regional cooperation in mind (Clancy, 2014). To our knowledge, this study offers one of the first analyses of local governments' and regional commissions' efforts to increase food system resilience in the largely rural mega-region of Appalachia. Across the sample, respondents described a range of activities aligned with elements of resilience, including food access initiatives, network building, support for local supply chains, and short-term adaptive planning. However, these activities were typically facilitative in nature, relying on partnerships, funding, and coordination rather than direct implementation, and they rarely reflected integrated, long-term planning for climate-related food disruptions.

A central pattern emerging from these findings is that food system efforts are distributed across diverse actors, with local governments and regional commissions frequently acting as conveners or partners in food systems activity. While this approach aligns with regional governance scholarship emphasizing distributed capacity and collaboration (Clancy, 2014; Keegan et al., 2024), respondents rarely described coordinated, regional efforts. When regional efforts were mentioned, they were typically limited to specific projects or relationships rather than integrated strategies connecting food access, production, and planning across jurisdictions.

Many respondents noted that food banking entities are central efforts to ensure food security, and in some cases, contribute to short-term resilience. Some officials described coordinated food access efforts in routine contexts and during crises. These responses may support resilience by enabling the rapid redistribution of food and assistance to vulnerable populations during crises, especially within city-regions (Blay-Palmer et al., 2021). However, respondents did not consistently describe these initiatives as integrated within local or regional production systems. As a result, while they support food access, their contribution to longer-term resilience through increased self-reliance is limited since they rely primarily on external food inflows. In contrast, food access programs that procure from local or regional producers may strengthen supply chains, support farmer livelihoods, and improve access to local foods, all of which have been identified as important components of regional resilience (Keegan et al., 2024). This pattern also reflects a broader critique of the U.S. charitable food system, which tends to rely on surplus production and external supply chains rather than addressing underlying structural inequalities (Lohnes & Pine, 2023).

This distinction reflects a broader tension within resilience scholarship between short-term responses that emphasize "recovery" and longer-term transformation or reorientation that could address structural weaknesses (Zurek et al., 2022). Across the sample, governance activities were more commonly oriented toward immediate needs rather than coordinated, long-term planning for climate-related disruption, a limitation that respondents themselves recognized. This orientation likely reflects the broader governance conditions under which these local actors operate, as policy development and planning processes are often shaped by shorter time horizons, resource constraints, and the incremental nature of policy change (Baumgartner et al., 2018; Clancy, 2014). These dynamics may be particularly pronounced in rural regions such as Appalachia, where local governments often face limited staffing, funding, and technical capacity (Headwaters Economics, 2026). In Appalachia, these challenges may be further compounded by the legacies of extractive industries, environmental degradation, and ongoing social and public health challenges that compete for governmental attention and resources (Austin & Clark, 2012; S. Clark, 2015; Marshall et al., 2017; Schalkoff et al., 2020). This highlights the need to engage resilience not only as adaptive capacity, but also as a framework that accounts for governance conditions and structural change.

Conclusion and Recommendations

This study examined how food systems resilience is operationalized in regional governance contexts, revealing a consistent emphasis on short-term interventions over longer-term structural change. Across Appalachia, local governments and regional commissions are actively engaged in food system

efforts, but their roles are predominantly facilitative, focused on coordination, partnership-building, and programmatic support rather than leading integrated, systemwide initiatives.

Cumulatively, these findings suggest that food system resilience efforts are best understood as forms of supportive governance that can enhance short-term adaptive capacity in collaboration with civil society but are insufficient alone. The challenge facing Appalachia is not a lack of activity, but the limited integration of food system efforts across county lines and planning horizons. Moving from reactive responses toward longer-term resilience will require governance structures capable of connecting local initiatives, supporting adaptation, and fostering regional collaboration. More broadly, these findings highlight the importance of embedding food systems within formal planning and policy processes. Doing so may help align short-term interventions with longer-term adaptation goals while strengthening coordination.

This work also points to important opportunities for future research. Future inquiry could explore governance models for regional coordination across Appalachia and other regions with large rural environments. A significant amount of work has been done exploring regional food systems and governance in the Northeast (see Clancy et al., 2017; Palmer et al., 2017; Ruhf, 2015; Ruhf & Clancy, 2022). Similar work is needed in Appalachia, including comparisons across subregions. We also suggest that investigating food-related networks that exist in concentrated rural areas not adjacent to urban centers would be fruitful to learn more about their organizing efforts toward food system change, extending work on city-region food system resilience (Blay-Palmer et al., 2021). There is also a need to systematically assess governance capacity across the mega-region by inventorying food-related positions, identifying food system goals in local plans, and evaluating intervention effectiveness over time. Further investigation of regional self-reliance potential could also help clarify the role of regional supply chains in supporting resilience.

From a practice perspective, our findings highlight both constraints and opportunities for policy, governance, and decision-making. Although bureaucratic structures in the U.S. system can hinder coordination across jurisdictions, local and regional governmental actors remain uniquely positioned to convene diverse stakeholders around more integrated, whole-systems approaches to food system resilience. This includes facilitating cross-sector networks that connect food access, production, distribution, and planning efforts, which are often addressed in isolation. Our findings also suggest that local and regional governments should embed food systems within comprehensive planning processes and those focused on hazard mitigation and economic development. By leveraging their convening and planning strengths, these entities can help align short-term interventions with longer-term goals, contributing to more coordinated and resilient food systems. We suggest that local and regional governments undertake food system assessments to identify assets, gaps, and interdependencies while convening stakeholders around shared goals. Several respondents pointed to this type of process as an entry point for more coordinated food system planning and action.

Finally, regional economic development entities such as the Appalachian Regional Commission could play a more active role in supporting these efforts by incentivizing multicounty collaboration, funding regional planning initiatives, and facilitating knowledge exchange across communities. Although ARC supported a report on local food systems and economies in 2022, no respondents indicated current support from ARC in their region for improving local food system efforts. This suggests an opportunity for ARC to support and strengthen emerging regional networks that contribute to food system resilience.

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Appendix A. Semi-Structured Group Interview Protocol

1. Begin by presenting this definition of food system resilience, "The capacity over time of a food system and its units at multiple levels, to provide sufficient, appropriate, and accessible food to all, in the face of various and even unforeseen disturbances" (Tendall et al., 2015, p. 19).
    a. How does this definition resonate (or not) with you?
    b. Is anything missing from this definition? Or unclear?
    c. Would you define food system resilience differently?
2. Recognizing the importance of food security to the food system resilience definition, we would welcome you to answer:
    a. Is addressing food security part of your organization's mission?
    b. Is your organization already working on food security? If so, how?
3. Changing precipitation patterns, extreme heat, and intense storms are predicted to worsen existing food security issues.
    a. To what degree is your organization addressing food security with these changes in mind?
4. If you had a magical wand, what local or regional policies or programs do you think would be effective to address food system resilience?
    a. What about state policies? Or federal?
5. Are you already implementing, actively pursuing, or considering any of the policies and/or programs you listed from the previous question?
    a. How would your organization like to respond to food system resilience? What are the barriers?
6. What are the understudied issues, challenges, or critical needs when it comes to food system resilience?
    a. Can you think of particular research or data that would help create better policies or programs?