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Equity and resilience in local urban food systems: a case study

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Abstract
Local food systems can have economic and social benefits by providing income for producers and improving community connections. Ongoing global climate change and the acute COVID-19 pandemic crisis have shown the importance of building equity and resilience in local food systems. We interviewed ten stakeholders from organizations and institutions in a U.S. midwestern city exploring views on past, current, and future conditions to address the following two objectives: 1) Assess how local food system equity and resilience were impacted by the COVID-19 pandemic, and 2) Examine how policy and behavior changes could support greater equity and resilience within urban local food systems. We used the Community Capitals Framework to organize interviewees' responses for qualitative analyses of equity and resilience. Four types of community capital were emphasized by stakeholders: cultural and social, natural, and political capital. Participants stated that the local food system in this city is small; more weaknesses in food access, land access, and governance were described than were strengths in both pre- and post-pandemic conditions. Stakeholder responses also reflected lack of equity and resilience in the local food system, which was most pronounced for cultural and social, natural and political capitals. However, local producers' resilience during the pandemic, which we categorized as human capital, was a notable strength. An improved future food system could incorporate changes in infrastructure (e.g., food processing), markets (e.g., values-based markets) and cultural values (e.g., valuing local food through connections between local producers and consumers). These insights could inform policy and enhance community initiatives and behavior changes to build more equitable and resilient local food systems in urban areas throughout the U.S. Midwest.

Keywords Food justice · Stakeholder interviews · Community Capitals Framework · Policy and behavior change · Supply chain resilience · Future of local food

Introduction

Conventional and local food systems in the United States

The lack of resilience of urban local food systems (LFS) in the United States (U.S.) has become increasingly visible in the context of the recent global pandemic (Vieira et al. 2018). Only 5% of U.S. counties are self-sufficient for fruits and vegetables; these counties are located mostly in the state of California (Nixon and Ramaswami 2022). California leads the nation in producing many table food crops including almonds, avocados, beans, broccoli, tomatoes, and strawberries, among others (Minor and Bond 2017; Vieira et al. 2018). Due to the large quantity of water needed to grow these crops, water quality and quantity are a concern in these areas (Johnson and Cody 2015; Bedsworth et al. 2018). For vegetables, local and seasonal production systems closer to points of consumption may have fewer negative environmental impacts for greenhouse gas emission, energy use and water withdrawal than conventional large-scale specialty crop agriculture (Stone et al. 2021). In a follow-up analysis, producing half of table food for major food groups locally reduced environmental impacts and land use for a U.S. Midwest city (Stone et al. 2023). LFS have

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been proposed as a promising future for U.S. table food that could increase environmental and social resilience potential, compared to the current food system in which most production occurs far from the Midwest, primarily in California (Vieira et al. 2018).

Although there is not a single definition of local food, some researchers have suggested that food miles (distance from production to point of distribution) be used to create one. Some researchers have asserted that measuring food miles can be inaccurate for measuring "local-ness" (Dunne et al. 2011), while others suggest that food miles alone are not a good measure (Schnell 2013), proposing instead a broader definition that includes where food is grown, processed, packaged, and sold (Kim et al. 2009). LFS are difficult to precisely define, even though they are thought to produce important social impacts (Cleveland et al. 2015). For example, fostering more local connections between producers and consumers could build community, improve health and increase food system resilience (Freedman et al. 2022). Social and human capital are also strengthened through shared knowledge of where food comes from and who is providing labor (Vieira et al. 2018).

The social and environmental impacts of LFS make it critical to understand equity and resilience to support effective decision making in this context. One way to evaluate and possibly support equity and resilience of LFS is using the Community Capitals Framework to understand stakeholder responses, leading to more effective governance and behavior changes in the future.

Local food system equity

It has been proposed that global food systems are environmentally unsustainable and socially inequitable, often leading to poor food access and unhealthy diets (Fanzo and Davis 2019; Hebinck et al. 2021b). Similar to frameworks for justice, those for equity have historical, representational, and distributional elements essential to building a holistic definition (Hebinck et al. 2021a, b) For example, in a historical context, the national food system in the U.S. was based on two systemic injustices: Slave labor and land confiscation from Indigenous people (Alattar 2021).

An equitable food system would supply everyone with access to nutritious, affordable, culturally appropriate, and accessible food (FAO 2009). Understanding and addressing inequities in food systems could support development of healthy and sustainable livelihoods for stakeholders from farm to fork (Hinrichs and Kremer 2002). A more holistic definition of distributional equity would include characteristics of sustainable and healthy social dimensions together with protection for ecosystem health and biodiversity (Bellamy et al. 2021).

Although resource access has historically focused on food security for all as an ideal, social movements have also highlighted the importance of food sovereignty to enhance equity in LFS (Carney 2012). While the public appeal of LFS is growing, they do not necessarily produce improved equity outcomes due to approaches that inhibit social inclusion and transformative change (Alkon and Mares 2012; Fanzo and Davis 2019). At their best, LFS can foster environmental sustainability and values such as equity and trust (Plank et al. 2020). At their worst, LFS can reduce equity and inclusion for consumers and producers alike by sustaining exclusive and expensive food environments and promoting "green gentrification" (Raja et al. 2017).

Local food system resilience

Resilience can be defined as the capacity of systems to maintain functions and agency during a disturbance (Holling and Gunderson 2002). Food systems are an example of social-ecological systems (SES), and a resilient LFS could tolerate a greater magnitude of disturbance before moving to another condition or being controlled by different processes (Carpenter et al. 2001). Resilient food systems are described as adaptable and sustainable, with interactions spanning multiple scales and times in a dynamic process that both responds to and shapes changes to enhance capacity (Givens et al. 2018). The nested spatial scales (local, regional, national, global) of most food system characteristics and feedback loops for production supply and demand are essential for resilience and enhanced by increased biodiversity (Vaarst et al. 2018). To understand LFS resilience, examination of disturbances should be combined with assessment of stakeholder responses (including those of policymakers) to understand environmental and social impacts at this important decision-making scale (Béné 2020).

The community capitals framework

Equity and resilience of an LFS are difficult to understand outside the context of a community. The Community Capitals Framework (CCF) was developed to evaluate communities' sustainability and is useful in an LFS context (Flora et al. 2016). Several studies have used the CCF to organize information about food systems. For example, researchers in one study applied CCF to understand how social, cultural and human capitals are related to food access and adaptability in U.S. Midwest communities (Crowe and Smith 2012). In another study, researchers used CCF and grounded-theory methodologies to understand how social capital and LFS interact (Glowacki-Dudka et al. 2013).

The seven community capitals these researchers proposed include built, cultural, financial, human, natural, political and social (Fig. 1). Strong evidence suggests that

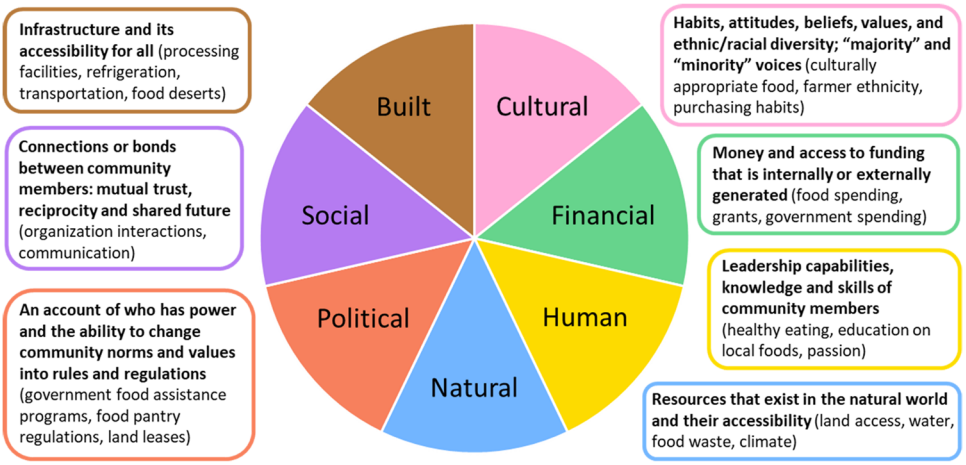

Fig. 1 Examples of the Community Capitals for a local food system case study. Definitions (in bold) are based on Flora et al. (2016) with examples (in parentheses) that could apply to a local food system context

social networks are correlated with more resilient communities (McDaniel et al. 2021). However, in the same study researchers found that the connection between LFS and the development of social networks is only moderately supported by current evidence (McDaniel et al. 2021). Despite previous findings that social capital increased LFS resilience (e.g., Martin et al. 2016), Green et al. (2019) found no correlation between measures of LFS resilience and social capital, indicating that further research is needed in this area. Some research suggests community capitals are strongly associated with farmer participation in local food markets and can enhance the effectiveness of policy interventions (Schmit et al. 2021). Thus, using the CCF to examine equity and resilience of LFS provides a unique opportunity to better understand these systems at local scales.

Study aims

This study aims to address the following questions:

1) How was local urban food system equity and resilience impacted by the COVID-19 pandemic?
2) How could policy and behavior changes support greater equity and resilience for urban LFS?

Methods

Study area

We conducted this investigation as a companion study to a larger research effort to examine integration of local food, energy and water systems in an urban setting with a focus on a mid-sized metropolitan area in the upper Midwest (Thompson et al. 2021; Dorneich et al. 2023). Approximately 3% of the population in the state surrounding the area of study is employed in farm work positions related primarily to commodity crop farming on 30.5 million acres of cropland in this landscape (ISU 2022; USDA-NASS 2022). Although there is a strong agricultural production sector (focused on commodity crops), about 90% of food for direct human consumption (table food) is imported from outside the state of Iowa. Local table food production in this landscape accounts for a small proportion of total agricultural sales (Stone et al. 2023). A survey of fruit and vegetable producers in the region found that table food production areas were small and more than 50% of sales were conducted through direct-to-consumer channels (e.g., farmers' market, community supported agriculture) (Enderton et al. 2017). Our primary study area included a population of just over 210,000 people in 2021 (USDA-NASS 2022). The food insecurity rate in 2020 was 8% (Feeding America 2022).

Study design and data collection

We were interested in the perspectives of stakeholders engaged in an urban LFS to learn more from those who produced, aggregated, distributed, sold and/or acquired local foods in the area of study and to better understand the challenges and opportunities they identified in relation to equity and resilience in the LFS. Based on our knowledge of organizations with a role in the LFS as well as a previous network analysis of participants (Bradley 2019), we identified and contacted a diverse group of nine individuals involved in local food production, marketing and distribution by phone to invite for an interview. We also used a snowball technique (Vos et al. 2020) to identify additional entities involved in the LFS to invite for interviews. We invited 16 stakeholders to participate, and of those invited ten representatives of organizations involved in the LFS indicated they were available and willing to be interviewed.

Interviews were conducted between September 14, 2021 and January 25, 2022 according to a protocol approved by the Iowa State University Institutional Review Board. All

participants we interviewed were active in the LFS as members of an organization (e.g., food aggregator, food distributor) or community initiative (e.g., food rescue, local foods coalition) ongoing in the study area and represented a range of LFS stages and organization types (e.g., for-profit, nonprofit, governmental, Table 1). Because the LFS in this setting was not large, the topics of interest to investigators were adequately described by those who agreed to participate.

Interviews were semi-structured and based on a set of 12 questions developed using the CCF framework together with information from prior LFS producer and consumer focus groups in the study area (Dorneich et al. 2023; Appendix 1). Two investigators (T.F.S., E.L.H.) conducted interviews, one acting as facilitator and one as note taker. Interviews were conducted either in a meeting room in a public facility or in a virtual (Zoom session) format. Informed consent forms describing our project objectives and data management plan to ensure anonymity were provided to and collected from each participant prior to the interview. Interviews were recorded and lasted between 34 and 86 min depending on the duration each interviewee was available. Most respondents addressed the full set of questions, although interviews with three participants included only ten questions due to their time limitations. Each interview was transcribed by personnel in a survey statistics unit independent from the investigators.

Data analysis

Transcriptions were coded in NVivo 1.6.1 (qualitative data analysis software) to categorize interviewee responses by topic (QSR 2022). Three researchers (T.F.S., E.L.H., E.C.H.) coded text segments following a two-tiered structure (described in the following paragraph). Coding for each interview was completed by two of the three researchers and checked for consistency (Vos et al. 2020). Discussions among two researchers were used to reach consensus on placement of text in the coding structure if their initial interpretations were different, and discussion by all three coders if necessary to reach consensus.

The primary coding structure was based on commonly understood descriptions for equity and resilience used in interview questions and previously agreed upon by the three coders. Preliminary examination of all interview transcriptions was used to develop an annotated database containing selected responses that guided subsequent assignment of text to each of the community capitals (Flora et al. 2016). Coding specific to the future food system corresponded directly to interview questions about perspectives on policy, behavior changes and visions for the LFS (Fig. 2). The coding structure was formalized as a codebook with descriptions and text samples for equity, resilience and all seven community capitals as well as text samples taken from transcriptions

Table 1 Study participant demographics for LFS interviewees by organization type

Stakeholder Group	Average Experience	Average Age	Race/Ethnicity	Gender	Education
Total ($n=10$)	8 years	42 years (Range: 30—63)	white (n = 9) multiracial (n = 1)	Female (n = 6) Male (n = 4)	College degree (n = 6) Graduate degree (n = 4)
For-profit ($n=3$)	16 years	57 years			
Institutional ($n=2$)	6 years	42 years			
Non-profit ($n=5$)	6 years	37 years			

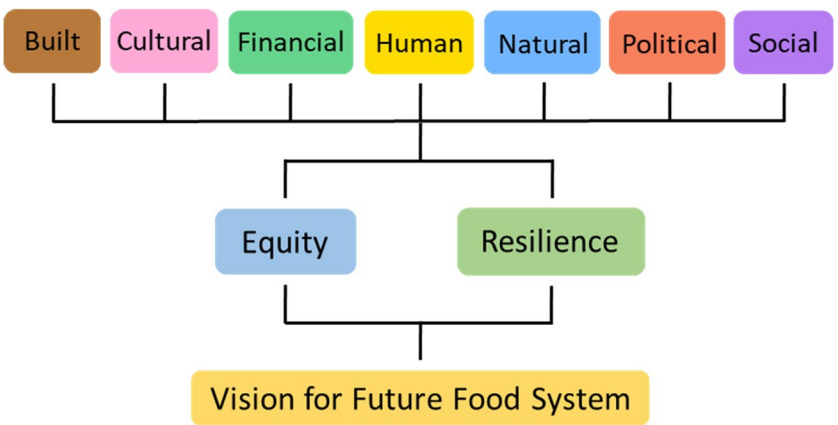

Fig. 2 The coding structure used NVivo to align interview questions with specific community capitals (built, cultural, financial, human, natural, political, social) to address our study aims related to local urban food system equity, resilience, and vision for future food system

(Appendix 2). After coding of text segments was complete, we selected representative responses to illustrate participant perspectives on elements of the LFS related to equity, resilience and four of the community capitals (cultural, social, natural and political) that were most frequently represented.

Results

Interviewees were divided in their perceptions of equitability of the LFS. One institutional and one non-profit participant indicated the LFS was equitable. However, one for-profit and four non-profit participants indicated the current system was not equitable. When asked about resiliency, interviewees frequently noted the small size of the LFS. One interviewee emphasized how small the LFS is:

> "When we talk about the LFS, honestly [in the study area], there's not much of one. There are very, very few local farms. There's not a lot of local food." (non-profit)

The majority of responses about LFS equity and resilience described weaknesses in cultural/social, natural, and political capitals (Fig. 3). Overall, we found that LFS equity and resilience included cultural and social elements that limited producer and consumer resilience and reduced individuals' access to local foods. Natural capital in the LFS was limited based on lack of land access for producers, with high land prices, lack of reliability for leases and land inheritance as barriers preventing participation in the LFS. Political capital was limited based on uneven power access and lack of effective policies. Non-profit stakeholders, in particular, cited limited power access, explaining that those making decisions do not reflect LFS demographics. By contrast, four participants emphasized the strength of human capital that was displayed by local farmers. According to interviewees a better future food system would include three elements – improved physical and political infrastructure, values-based markets to support mid-scale table food production and a cultural shift to include more direct connections across the supply chain, especially those between producers and consumers.

Cultural and social capital in local food systems

Interviewee responses on social and cultural capital highlighted a lack of equitable food access in the LFS. Many participant responses highlighted inequities in social and cultural practices that limited a range of consumers' ability to purchase local food. However, their responses also revealed ongoing efforts and awareness of the importance of improving access to culturally appropriate food while respecting individual dignity. Consumer's social resiliency to support LFS before and during the pandemic was noted by many interviewees as lacking. Some emphasized how lack of a "local brand" has prevented consumers from connecting with and supporting local producers. Others indicated that lack of advertisement along with the perception of higher prices may discourage consumers from buying local products:

> "That only puts these really truly local businesses at a disadvantage, because you have places like Hy-Vee that consider local anything in their seven-state region. Anyone can just slap local on their brand and call it whatever you want, so there's no incentive for [buying local foods]... Places are just able to really water down what that means, so those that are truly local, it just looks like their stuff is more expensive, even though they're probably barely making enough to survive." (non-profit)

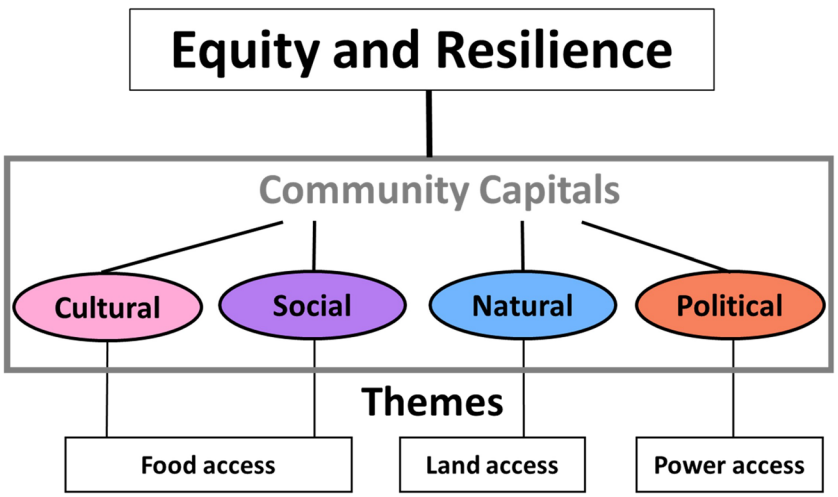

Fig. 3 Themes and subthemes related to food system equity and resilience based on interviewee responses

Several participants emphasized the need for more consumer education about the benefits of buying local food. Particularly freshness, environmental benefits and more humane working conditions that are characteristics of local food production were all described as ways to encourage more consumer support for it. Additionally, one institutional stakeholder expressed the need to continue to build relationships, or social capital, between producers and consumers in the LFS to improve resilience.

Providing culturally appropriate food and ensuring that it is accessible to all were highlighted by interviewees. Some participants spoke about restaurants beginning to serve a wider variety of food and food pantries starting to offer more culturally appropriate foods. A common theme related to strengths of cultural food accessibility was the intent of individuals to improve local food access within the present (often inequitable) system. One non-profit stakeholder specified that income and ethnicity are barriers to involvement in the LFS:

> "I think a lot of people in the LFS have really good intentions and want to approach things in an equitable way but there still kind of seems to be this divide of who is involved or purchasing local foods based on class and race a lot of the time." (non-profit)

Several interviewees indicated there was insufficient education for preparation of different foods, lack of producer diversity, and generational differences as key elements that prevent improvement for cultural access to local food. Specifically, one non-profit stakeholder said it is difficult for minority producers to fit in at the farmers' market. Another interviewee associated with a non-profit stressed that providing free food in a manner that respects individuals is a major obstacle to expanding local food access:

> "There's a lot of people who will never go to a food pantry or a free meal site, and I recognize that because I was one of those people who needed help when I was in a position that wasn't paid enough, but I was not going to go to a food pantry and be judged by someone else who's supposed to be helping me. So I think that's really been the big impetus to try to figure out how to make it easy and dignified and let people have this good food without having to sacrifice any of those things." (non-profit)

Overall, protecting individuals' dignity while providing access to culturally appropriate local food are cultural weaknesses of the LFS at present.

Changes in food purchasing habits as a result of the pandemic also demonstrated lack of resilience for the LFS. Challenges of supplying food without contact and operating stores safely during the pandemic also revealed weaknesses in the system's social resilience. However, interviewees also expressed that there was a lack of social support for the LFS even before the pandemic. Two for-profit interviewees described food spending habits as a barrier preventing consumers from purchasing local food:

> "You might even pay twice as much, but it's twice as fresh and if you can afford it and the environment is something you care about, then it's a conversation we need to have. I mean, people in the United States spend a lot less on food than in a lot of other countries." (for-profit)

Two non-profit and two for-profit stakeholders expressed admiration for local farmers' drive and passion that was not dependent solely on financial gain, providing an exception to interviewees' otherwise negative views of LFS resilience. In contrast, a for-profit participant expressed that training more farmers will be necessary and a challenge for maintaining producer resilience.

Transportation is also a limitation for our study area and was cited as a barrier for local food accessibility. Specifically, three interviewees referred to the absence of mobile food pantries and the presence of food deserts which exacerbate transport issues, making local and healthy foods physically inaccessible to some populations in the city. However, this challenge could be mitigated by social and cultural shifts that could increase demand and thus opportunities for transporting local products.

Natural capital in local food systems

Access to land is vital to an LFS because local food cannot be grown without local land. Interviewee responses included natural capital and elements of cultural and financial capital that served as barriers to land access. One participant emphasized that the core weakness of the LFS is how difficult it is to own or lease land:

> "It's not that people lack the skills or the desire or the knowledge. They lack access to, first, land. You're not going to invest in capital expenses if you don't have the land." (non-profit)

Land inheritance involved cultural and financial capital factors that contribute to inequal land access. Individuals who inherit land in the study area are more likely to be white and, as one non-profit interviewee pointed out, do not perceive issues with land access:

> "I'm part of some groups where it happens to generally be middle-aged white men that are like, 'There's no problems with land access, and I was like, 'That's interesting coming from you, someone who inherited land and didn't have to do anything to get it.'" (non-profit)

Conversely, immigrant farmers, women and ethnic minorities are less likely to inherit land in our study area. Land inheritance reinforces a clear inequity within the LFS, leading some individuals to resort to short-term land leases. Current governmental policies make it difficult for farmers to obtain and maintain long-term leases from the city. Two non-profit interviewees spoke about the lack of political support for urban farming. The inability to lease land is yet another barrier for individuals who do not inherit and cannot afford to purchase land. For local beginning farmers, land access appears to be a key inequity that prevents them from contributing to the LFS.

One interviewee emphasized how weather and access to land makes producing table food more difficult for local farmers. Another interviewee voiced how the pandemic and climate change events have revealed lack of resiliency in the LFS:

> "We are not building food systems that are able to respond to these types of disasters. And with climate change, I think we'll be seeing a lot more of these types of, not necessarily speaking in pandemic, but just more, we've seen it already with the just weather events in Iowa and that has a huge impact too, especially on agriculture." (non-profit)

Political capital in local food systems

A lack of power sharing in governance reduces equity and representation in the LFS. Multiple participants associated with non-profit organizations expressed disappointment at the lack of diversity of LFS leadership. Two stakeholders from non-profits highlighted the majority presence of white and high-income individuals as consumers and power holders in the LFS. One non-profit participant emphasized that for the LFS to become more equitable, those with access to power need to share it:

> "So those kinds of issues are difficult to discuss, but also really difficult when there's people who are supposed to be in positions of power and talking about trying to make changes in the space who do not recognize their own benefits and why, in order for some of this stuff to change, they might have to give up some power that they're currently holding." (non-profit)

Overall, non-profit participants shared the perspective that individuals with power in the LFS do not reflect the demographics of the city. Responses from for-profit, institutional and non-profit participants alike revealed an equal number of strengths and weaknesses regarding interactions between organizations that are part of the LFS. Interviewees in all three stakeholder groups highlighted collaboration between groups. Providing markets for farmers, sharing resources equally and partnerships between organizations were specifically identified as strengths. An institutional stakeholder praised the increasing connectivity of LFS in our study area:

> "I think there's a lot more communication about food access in the city. The local food organizations have a good reputation that they're working hard to improve food access." (institutional)

In contrast to positive responses, for-profit and non-profit participants pointed out favoritism and territorialism between local food group organizations. Two stakeholders associated with non-profits indicated there was competition between organizations. One stakeholder further explained that other organizations were reluctant to work with them because they "don't serve people directly." Another for-profit stakeholder emphasized the challenge of ensuring equal collaboration:

> "So we've definitely had to step in and say, or have talks with receivers at retailers if they have a personal relationship, we'll say, 'okay, but you actually are partnered with both these organizations, you need to distribute equally'." (for-profit)

Participants perceived that current governmental and organizational policies reduce the resilience of the LFS. One non-profit interviewee (in response to a question about policy and behavior changes) expressed that in addition to unequal subsidies, land reform is also important to support local table food producers:

> "So I would say just more policies to support growers who are not growing commodity crops. I think also land access is a huge part of that because you have a bunch of young farmers who want to grow fruits and vegetables and they can't afford any land. And so I think land reform is probably not something that a lot of politicians … are too keen on taking on." (non-profit)

Some non-profit participant responses highlighted specific ways that policies are hindering their organizations and the LFS as a whole. Two interviewees described issues related to their limited capacity to accept food (which may have increased food waste) and lack of support for distribution of additional COVID-19 relief food which created difficulties for other local non-profits. The USDA policies that subsidize large-scale conventional farming infrastructure without directly supporting farmers was also criticized.

Many interviewee responses also identified government policies and food assistance programs as inaccessible for some consumers who may need assistance. These policies also complicate food distribution for some non-profits in the area. The Emergency Food Assistance Program

(TEFAP, a USDA program), which only distributes food to non-profits that prove they serve individuals within a certain income range (USDA 2020), was specifically identified by interviewees as a policy that limits food access. One participant indicated that if their organization did not collect income information from patrons, they would not be able to receive food from the USDA.

Along with income limits, citizen and legal residency status excludes individuals from using government food assistance programs. As one non-profit stakeholder pointed out, the U.S. Supplemental Nutrition Assistance Program (SNAP) is unavailable to undocumented individuals. This presents a clear inequity in food access. One non-profit stakeholder indicated that despite the large amount of federal spending designated to support food bank organizations, food access is still not universal.

Interviewees also highlighted two programs that may remove financial barriers to consumer participation in the LFS. One for-profit business in the study area assists individuals using SNAP by collecting donations to pay for membership fees and other charges. This program helps those receiving government food assistance to gain access to local food products. Another policy tool noted by interviewees was the "Double Up Food Bucks" program, which enables SNAP users to purchase more fresh produce by providing an extra dollar for every dollar they spend on those items (Fair Food Network 2021). One for-profit and one non-profit interviewee praised the "Double Up" program's paper vouchers for their versatility since they can be used in stores and at farmers' markets without additional technology and cost (e.g., internet access and card readers). However, an interviewee from another for-profit group indicated the program was difficult to manage in an online system. Although one government program and one for-profit business are working to help make local food more accessible, on the whole, participants indicated the perspective that policies often reduce access to local food.

Visions for future food systems

For the stakeholders we interviewed, a better future food system included increases in both local food production and consumption. Local production presently makes up less than 10% of total consumption in the area (Stone et al. 2023). In the words of interviewees, the way toward a better future food system could incorporate many aspects of community capital. Interviewee visions for the future highlighted important connections among the capitals, bridging ideas that could enable food system transformation. Several non-profit interviewees highlighted the nuanced relationship between access to healthy food and factors like income, health insurance, and ability to grow food. One non-profit stakeholder made reference to built, cultural, financial, human, and political capitals, all of which are essential for a better LFS:

> "So anyone who wants to grow food can, has a space to grow it. Farmers are well-respected, well-paid, so they have ownership of or financial equity in land and in their business. Local, healthy food is accessible to everyone. And leadership of the movement is well-representative within the community." (non-profit)

When interviewees shared their visions for a better LFS with interviewers, many explicitly or implicitly framed them around significantly increasing local food production and consumption beyond current levels in our study area. Several interviewees indicated increasing local production and consumption is central to building a more equitable and resilient food system. Collectively, interviewees identified three key themes that could support a better future LFS, including enhanced local food infrastructure, values-based markets, and a culture associated with the value of food as a means to improve equity and resilience (Fig. 4).

Local food infrastructure

The majority of interviewees visions for a better future included improved built and political capital, both of which

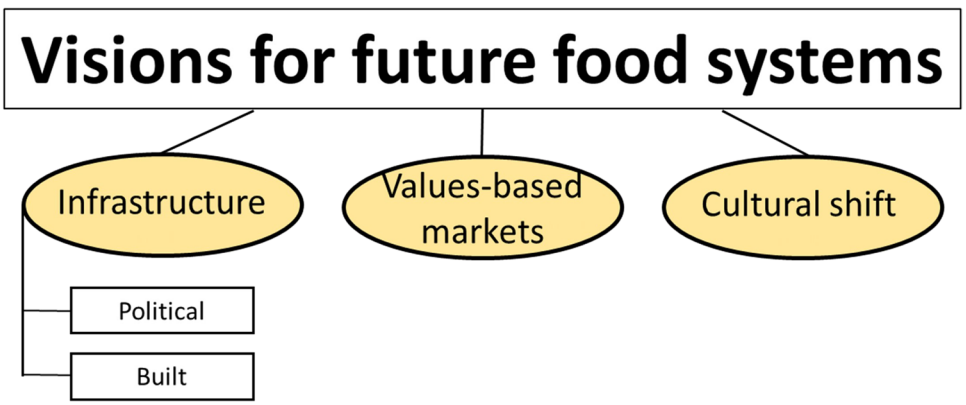

Fig. 4 Themes and subthemes of interviewees' responses on visions for future urban local food systems

are vital for the LFS in our study area. Several stakeholders expressed that lack of governmental incentives for companies to purchase local food meant it was cheaper and easier for most companies to buy non-local food. State food policy funding as well as federal food policies like SNAP could be used to support local food but currently there are not built-in or strong incentives to purchase locally. Producers of table foods also experience limited political support compared to conventional agricultural (e.g., row crop) producers:

> "I think making sure that smaller producers are given sort of the same chance... living under the same policies as kind of some larger farmers who are getting, for example maybe tax breaks or getting special benefits because of the size or because their ability to be able to grow the [large] quantities... I think creating policies at state level to make sure that local food producers are able to compete in a world where if you are not big you are not noticed." (institutional)

Participants' visions for physical infrastructure included increasing community resources to support the food system as a whole (e.g., coolers, storage, processing, support networks) as well as smaller-scale producers. The scale of local producers, lack of opportunities for food processing, and food safety concerns were all cited as significant barriers for local food production. Participants associated with local institutions expressed that such infrastructure was lacking and that they were looking for support from both for-profit wholesalers (for processing) and institutions like university extension (for ensuring food safety). Increased funding was an important part of the vision of businesses that supported LFS, while improving consumer awareness was a goal that interviewees expressed could be achieved by harnessing social capital:

> "We can work together maybe on the education piece of this and getting this information out, but I think we lack infrastructure in the state generally for an ability to make the farmers life easier, and storage ... We would love to be a food hub with more capacity, if we could have the funding to get that done." (for-profit)

Cultural norms also shape LFS infrastructure. However, there was not agreement among different kinds of stakeholders about whether cultural or infrastructural solutions would be the best way toward a better future LFS. For example, one stakeholder's vision included growing food year-round using controlled environment farming practices (greenhouses and hydroponics or aquaponics). Another stakeholder's vision included a cultural shift for both consumers and institutions, where each would purchase as much local food as possible throughout the year by shifting to more seasonal dietary patterns and building menus, shared knowledge and community relationships with producers to support this shift. Several stakeholders also highlighted the importance of infrastructure to enable local food producers' products to enter retail and institutional markets, whereas several stakeholders emphasized that local food currently is too heavily dependent on farmers' markets:

> "I'd like to see more of that type of culture permeate the city where, we're doing things that help support locally-grown foods, and people have a pathway to get that food to market other than just the downtown farmers' market. How do we create a pipeline to get better, healthier foods into our school cafeterias, into our corporate cafeterias, things like that?" (institutional)

Developing values-based markets

Challenges to developing local markets in our study area are impacted by many interconnected physical and social factors. Corn and soybean row-crop production is dominant in the regional agricultural landscape, leaving table food producers with insufficient infrastructure and markets to sell food locally:

> **"**And then the environmental side, it's like, here…. we have so much capacity to grow food that people eat. And the barriers to that are big. A lot of the farmers that try it, give up because it's just too much. It's too much to grow the food and figure out how you're going to market it." (for-profit)

Interviewees noted that economic and financial challenges contributed to a lack of LFS sustainability and resilience. One for-profit participant shared that their organization is completely reliant on grant funding to continue operating. An interruption in funding would negatively impact their organization's ability to operate, thus displaying low financial resilience. Five interviewees noted the pandemic caused a reduction in economic resilience. For example, the farmers' market operated only virtually in 2020, which limited an important local venue for farmers to sell their goods. A host of supply-chain issues also reduced the amount of local food that was available. This "built capital" response from a non-profit stakeholder illustrates how the pandemic damaged the LFS economy:

> "The pandemic really shook up a lot of things. I kind of liken it to the real estate thing when it [the banking system] was too big to fail ...Well, the same thing happened with our food system and some of these processing facilities and all of this stuff. We're like, oh, these little meat lockers and shops, they can't process fast enough or meet the demand. Well, it would have been a whole lot better if we had 100 more of those when these large processing facilities shut down and then,

not only were you not processing the food, you were killing animals just because they didn't have anywhere to get processed. So I think the pandemic shined a light on how this global food system isn't actually feeding the world or feeding anybody." (non-profit)

Interviewees indicated a misalignment of table food production for local markets (primarily small-scale) with food market infrastructure (set up for mid- to large-scale production). One interviewee expressed that policy incentives for schools and larger institutions to purchase local foods would make it easier for producers to change purchasing behaviors, building relationships and breaking into middle-scale chains. The theme of behavior change was consistent and emerged in the responses from several participants. The downtown farmers' market was highlighted as the most common outlet that producers and consumers had to sell and buy local food:

"So I think it's interesting when we're talking about LFS, people oftentimes think directly to farmers' markets. The downtown farmers' market is really more of a festival, it is not like a great place to go buy your vegetables every week. And so it is way more built for yuppies...to go shop local vendors and get pies and stuff, right? It's not a place to go buy cheap tomatoes and I think often-times people don't necessarily understand that when we're talking about local foods... Where can people get local foods? I don't know." (institutional)

Improving market infrastructure was a topic highlighted by all interviewees. Offering greater access to local food by increasing quantity wholesale and retail outlets for local food and the variety of foods available (especially processed fruits and vegetables, other value-added products). One non-profit stakeholder viewed capitalism as the anchor that upholds the *status quo* where markets are not linked to values other than economic ones and wanted to see a change in community perspective toward values-based markets, which could inspire behavior changes including enhanced participation. Several future visions offered by interviewees from different organization types acknowledged the important role of money and the desire to use it to build a better future LFS:

"If money really rules the world then let's use it how we can." (for-profit).

Interviewees had different perspectives, however, about how to begin building a culture and support behavior changes to include local food and values-based markets. One non-profit stakeholder indicated removing the consumerism and instead building community knowledge and relationships in support of local food would provide increased benefits for the whole community. For one for-profit stakeholder, increasing the connections between environmentally-conscious farmers and consumers would cause consumers themselves to care more and change their food-related behaviors to reduce potential impacts. Another non-profit stakeholder expressed that collaboration and strategic regional planning for food could contribute to better LFS:

"So I think there's a huge opportunity for us to just work smarter and work more collaboratively to make sure that those [who] are growing the food or processing the food and serving the food are able to still serve their families and have health benefits and be successful." (non-profit)

A cultural shift toward valuing local food to improve equity and resilience

Several interviewees expressed the importance of adjusting cultural values and changing behaviors to support a better LFS in the future. The specifics expressed by interviewees varied. Some indicated consumers needed to be more willing to try new foods, especially those with ethnic origins, while others noted consumers needed to be introduced to and educated about local foods in schools, especially why it matters. Some interviewees also expressed concern for food-insecure individuals after discontinuation of federal programs following the initial response to the pandemic:

"For those who are trying to improve access to food for everybody…the system is not set up for that. So I've been really focused on the role that we can play is just to provide more transparency into what's happening in our community and where there are gaps, and to talk about those gaps." (non-profit)

Shifting attitudes, priorities, and behaviors related to local food for all so that it could become a "new normal" was also considered vital for a better LFS. Adjusting cultural values and behaviors by changing reward and incentive structures were also cited as needed to support sharing resources and reducing waste. The idea of working collectively was central to almost every vision for the future articulated by interviewees, as summarized by this participant:

"I think the food is there, the knowledge is there. Just connecting the right people." (non-profit)

Discussion

Local food system equity and resilience

Interviewee responses to questions about equity and resilience of the current LFS reflected different planning approaches and levels of understanding for these two concepts. Equity was a more familiar concept within the LFS. Participants were more uncertain in their responses

when asked about resilience – two participants indicated that they "didn't know" about resilience. Interviewees representing both non-profit and for-profit organizations emphasized equity, or rather inequity, as a central focus of the LFS. Increasing financial support, reaching diverse populations, providing culturally appropriate foods and maintaining individual dignity were all equity-focused initiatives described by stakeholders. In contrast to equity, interviewees did not mention current measures taken by their organizations to ensure the resilience of the LFS. Resilience was only considered in relation to disturbances, like the COVID-19 pandemic, which threatened the function of the LFS. Even so, recent academic literature has focused more on resilience than equity, possibly in an attempt to better understand and quantify the concept.

We found three major themes for equity and resilience in the LFS related to weaknesses in four community capitals: insufficient food access (cultural/social capitals), lack of land access (natural capital), and unequal power access (political capital). Interviewees spoke about increasing levels of food insecurity for low-income and marginalized communities in our study area; another study found associations between limited food access, geographic location and neighborhood gentrification, which may further increase urban food insecurity (Ong et al. 2021). Interviewees also noted that economic challenges, both pre- and post-pandemic, contributed to a lack of LFS sustainability and resilience. Most local consumers currently seek lower food prices and may not be willing to pay more for local food even though it could keep money, infrastructure and knowledge in the community. In addition to willingness to pay, disparate access to healthy food has long been racialized in the U.S. and is also associated with food-related health issues (Alkon et al. 2020). Both race and income level have led to Latino/a/x and Black households in the U.S. consuming cheaper foods typically associated with poor health outcomes and increased environmental impacts (Bozeman et al. 2019). Disparate food access contributes to the erosion of LFS equity and resilience and has led to LFS that often do more to deliver to local white and wealthy consumers than they do to reduce systemic inequities for stakeholders throughout the food system (DeLind 2011). Additionally, a lack of local producers, processors and markets were highlighted by interviewees along with the need to develop consistent consumer marketing and understanding of what constitutes local products.

Many interviewees noted the small size of the LFS. When asked about its resiliency, participants did not think an LFS with such small food volumes could be considered resilient. Researchers conducting another study found that when people are connected and share information, communities and LFS became more resilient (McDaniel et al. 2021). However, more research investigating the connections between social capital, community resilience and LFS resilience would be valuable (Green et al. 2019).

We observed that natural capital was viewed differently by representatives of different organization types. Institutional stakeholders saw these capitals as strong, while for-profit and non-profit stakeholders only described weaknesses for them. Climate change and a lack of consumer understanding of and support for local foods were also frequently referred to as weaknesses by non-profit and for-profit stakeholders alike. Interviewees also indicated that increasing access to land was a central concern, especially in urban and near-urban areas where land prices and development potential are high. The struggle to access land is a systemic challenge at a national scale in the U.S. and discrimination based on race, ethnicity and gender has produced land ownership inequities that can be seen at every level to this day (Hinson and Robinson 2008; Horst and Marion 2019). Farm laborers have also primarily been non-white (62%) and Hispanic (80%) (Horst and Marion 2019). These farm workers have experienced inequitable wages and exposure to harmful work environments (e.g., those that occurred during the COVID-19 pandemic) (Weiler et al. 2015; Klassen and Murphy 2020). Interviewees associated with both non-profit and for-profit groups spoke about producer passion and resilience during the pandemic as a great strength in human capital. However, farmers that focus primarily on passion and not profitability may come from a privileged position based on land inheritance and knowledge that may at the same time perpetuate social inequity within the LFS.

Current government policies also reduce the resilience of the LFS primarily through unequal support and lack of risk-sharing. Urban food systems, as representative of LFS in the U.S., have been shaped by discriminatory federal disinvestments (e.g., redlining, Nelson et al. 2022). In addition, groups of individuals responsible for formulating policies that govern the LFS often do not reflect the demographics of the area. In research on LFS in New Mexico, researchers found similarly unequal representation with white and high-income individuals holding power (with implicit support by local government agencies) (McDaniel et al. 2021). Some participants identified a lack of political support in particular as a weakness for the LFS. This is a common critique of city planning in the U.S. which historically did not include plans for urban food systems. Current plans still frequently do not prioritize efforts to improve food equity (or food justice as per Horst et al. 2017).

Visions for future food systems

Interviewees representing local food stakeholders expressed that a better future LFS would include changes in infrastructure, values-based markets and a transition in food culture to support behavior changes. These three themes align with

a food system transformation framework where the operational model, governance and social setting were found to be interrelated (Vieira et al. 2019). Pursuing one or two of the three themes would probably not produce intended improvements because without appropriate infrastructure, values-based markets and social/cultural capital, the chances of system transformation would be limited.

Lack of effective political infrastructure to support the LFS could negatively impact equity and resilience in our study area. Locally, city zoning and land-use choices that favor development (and an increase in the tax base) have made it difficult for some producers to continue table food production in the city. Non-profit interviewees also indicated that food system policies across scales did not effectively address food waste or food security issues. Much LFS waste could be avoided by aligning policy with a local agenda and community action (Treutwein and Langen 2021). Involving diverse LFS stakeholders could also support development of more effective local policies and enhance behavior changes in support of LFS. For example, Feagan (2007) found that connecting producer and consumer groups in a community can benefit LFS. For the food system as a whole, policies that better represent local growers, support regional and diverse supply chains, and enhance local food access could better support LFS equity and resilience (Clark and Jablonski 2022).

Federally, consistently including local food programs and incentives in the Farm Bill is essential to implementation of LFS in the U.S. (Dimitri and Gardner 2019). Policy incentives and funding to support supply-chain development (such as food hubs for aggregation and distribution) within local and regional food systems would enable programs like "Farm to School" to be more effective and would begin to provide producers with opportunities to move into a more profitable mid-scale production environment (Feenstra and Hardesty 2016). Policy and behavior changes indicated by interviewees included equal support for conventional and table food producers, and creating specific new opportunities for table food producers. Federal incentives are in place for conventional production of corn and soybeans to reduce both costs and risks – providing similar support for table food producers would increase equity and resilience in the LFS. A study focusing on developing countries found that policies related to small-scale farming require continuous change to be successful which could also prove to be important to support small-scale production in our study area (Hazell et al. 2010).

There were divergent views expressed by participants about what requirements for physical infrastructure in a future, more robust LFS would be. One view emphasized the importance of seasonal production and consumption which would require both technical and cultural shifts, while the other view included year-round produce production relying primarily on a technological shift. Producing fresh fruits or vegetables year-round in many cities in the northern hemisphere could produce a large environmental burden. A life cycle assessment study in Boston and New York City found that high-yield heated greenhouse production had 267% to 369% higher greenhouse gas emissions and 108% to 239% more non-renewable resource depletion compared to tomatoes produced conventionally outdoors (Goldstein et al. 2016). Most interviewees agreed that processing infrastructure is a critical component of a better future food system. The lack of processing limits opportunities to transform local perishable fruits and vegetables into a year-round local food source. Balancing infrastructure goals to include both technological and cultural shifts could support LFS growth without sacrificing the objective of increasing sustainability.

Value chain development is also essential for future LFS since current local production is small scale and misaligned with growing wholesale markets. The lack of mid-scale producers is a national phenomenon across the U.S. despite environmental and social benefits that could accrue (Lev and Stevenson 2011; Esquivel et al. 2021). In addition, the majority of Iowa producers sell table foods through direct-to-consumer markets which have not expanded in recent times. In comparison, wholesale markets have recently grown up to 10% (Enderton et al. 2017). Researchers reviewing farmer use of intermediated market channels found that 66% of local food sales in 2015 were through these channels, although there is uncertainty about resiliency for an increasing number of non-profit food hubs providing some of these regional market channels (Dimitri and Gardner 2019). Values-based markets could provide new opportunities for connecting institutional buyers and other agri-food enterprises with mid-scale table food producers (Lev and Stevenson 2011). This is particularly important to address current scale misalignment between producers and markets.

Many participants articulated the need for a cultural transition to support behavior changes for improving the LFS. In the wake of the COVID-19 pandemic research has emerged examining challenges to both resilience and equity, particularly as it relates to food insecurity, food worker welfare and migrant food workers (Klassen and Murphy 2020). Elements of a cultural shift that supports more resilient and equitable LFS include improved connections and trust between producers and consumers (social capital) and changing food purchasing behaviors with an emphasis on LFS engagement. In another U.S. Midwest study, researchers found that social capital in an LFS was weakened by lack of trust and divided goals (Glowacki-Dudka et al. 2013). Our study highlighted the importance of cooperation and relationships within the community and between producers and consumers. A variety of models for behavior change, including collaborative community-supported agriculture and collectively developing midscale food value chains have been proposed and

could support the development of a better LFS in the future (Lev and Stevenson 2011; Flora et al. 2012).

Study limitations

This study's limitations include the small total number of respondents (n = 10), which could have impacted on the diversity of perspectives represented. Although a strong effort was made to increase the sample size and particularly participation of underrepresented subgroups, the relatively small number of for-profit (n = 3) and institutional (n = 2) participants compared to non-profit (n = 5) participants could have also influenced findings. In an effort to achieve more inclusive participation across sub-groups, the option for interviews including ten of the twelve survey questions was offered. This could have had an impact on the richness of qualitative data collected in those interviews (n = 3). Data analysis was conducted using predetermined themes based on the Community Capitals Framework and investigator LFS expertise to develop interview questions and code responses. Conducting this study in one city and choosing a study site with a small LFS also limited the total number of participants eligible to include in this study. Future research could include larger sample sizes, analysis using grounded theory or alternative theoretical frameworks and comparison across different urban areas. While there are limitations to this study based on the small number of respondents, we present our findings as an exploratory introduction of LFS equity and resilience in the face of pandemic upheaval; it is our hope that future research can expand on our initial findings.

Conclusions

The dedication of producers and leaders in the local food system (LFS) is a key strength that kept it operating under pre-pandemic conditions. Our examination of equity and resilience in the LFS uncovered three major themes: limitations for food access, lack of land access, and unequal power access. Overall, the LFS in our study area was perceived as more equitable than resilient. Resilience was not as integrated in participant perspectives but became more visible during the COVID-19 pandemic. Resilience was also increasingly related to climate change because it may make it more difficult for farmers to produce food and may become more important in the future. The small size of the entire LFS in our study area is a significant challenge that has been compounded by a lack of physical and political infrastructure for the entire local food supply chain. Future LFS could be improved by additional infrastructure, development of values-based markets and behavior changes through increasing regard for the cultural values of local food by consumers, agri-food businesses, and institutions. Participants reported both collaboration and territorialism between organizations in the LFS. Incorporating social and cultural capital into LFS plans could help to support physical, technological and political changes needed to improve LFS equity and resilience, now and in the future.

Appendix 1 Local urban food system interview protocol

Tiffanie Stone, Erin Huckins & Janette Thompson
June 29, 2021

Structure

Explanations to introduce sections, Numbered questions, [additional probing questions in brackets].

Introduction

Our purpose for this interview is to understand equity and resilience of the local food system in Des Moines, IA. We will be asking you questions about your role in the local food system, the organization you work with and about your perspectives on equity and resilience. We are interested in your observations from both before and after the pandemic.

This interview will take approximately 90 min. Your information will not be shared outside of our research team and other trained staff who will assist in transcription at Iowa State University. We ask permission to record this interview for transcription and future analysis, is this okay with you?

All participants will be interviewed based on the same set of questions. The information from this interview will be anonymously summarized along with those provided by other participants to be disseminated in academic literature, local governmental agencies, to inform the team's research project. You do not need to answer any question you do not want to. You can stop the interview at any point. If you need a break at any point or need a question explained, please let us know.

Background

I'd like to begin today by learning a little bit more about you, your organization, and your role in the local food system before Covid-19. We will ask you about changes due to the pandemic later in the interview.

1. Could you describe the organization you work with? [If not explained: what is your role within the organization? What is your organization's role in the local food system?].

Pre-covid local food system

2. From your perspective, what were strengths of the local food system in Des Moines before the pandemic? [Can you think of any other strength? Could you tell us more about…].
3. What were challenges of the local food system in Des Moines before the pandemic?
[Can you think of any other challenges? Could you tell us more about…].
4. Has your organization made changes to reduce challenges for people in Des Moines to access local food before the pandemic*?* If so, how?

[**If yes**, how successful have these efforts been? Are there additional groups of people that you are still struggling to reach? Why do you think they are difficult to reach?].

[**If no**, are there people in your target population who your organization may not be currently reaching? Does your organization have the capacity and resources to expand services?].

Post-covid local food system

Now, we want to transition to questions that help us understand how the pandemic may have impacted your organization.

5. How has your organization adapted to changes caused by the pandemic?
[How could the adaptability of your organization be improved? Have there been changes in demand for local food from consumers in Des Moines? How difficult were these changes to make? How lasting do you think these changes will be?].
6. How could your organization improve equity for the people you serve?
[Are there changes outside your organization that would need to happen to enable this change?].

Local food equity & resilience

Now, we would like to hear more about your views on equity and resilience in the local food system in a general way.

7. How equitable do you think the local food system in Des Moines is currently?
8. How resilient do you think the local food system is currently?
[How has your experience with local food during the pandemic impacted your view of local food system resilience?].
9. What changes to policies and behaviors would make the local food system more equitable?
10. What changes to policies and behaviors would make the local food system more resilient?
[Do these changes vary or are they consistent across household/community/neighborhood?].
11. What is your vision for a better local food system in Des Moines?
[How could the Des Moines food system be more equitable? How could the Des Moines food system be more resilient?].
12. Are there other Des Moines organizations (not people!) working in this area that we should be sure to include in this series of interviews?

Appendix 2: Local urban food system interview codebook

Tiffanie Stone, Erin Huckins & Eliana Hornbuckle.
July 6, 2022.

Codebook structure

Includes **codes in bold:** followed by definitions of the codes, followed by *example codes/quotes in italics.*

Codes

Natural capital: resources that exist in the natural world (e.g., land, air, water, soil, biodiversity, weather, energy resources, waste) and their accessibility, it is an environmental account that can enhance the quality of life for residents.

"I think our biggest challenge is we have is our climate."
"not everyone can just grow a garden, like not everyone even has access to green space with their apartment. So thinking through that lens about the recommendations and things that you're kind of spearheading leave people out."

Cultural capital: includes habits and attitudes, worldviews, values, ethnic/racial diversity, and spiritual beliefs. Can have a unifying potential dominated by "majority" voices undervaluing and excluding "minority" voices. (e.g., seed saving, growing/obtaining culturally appropriate foods, working with their family in the garden, learning about culture through food).

"But people just have a really hard time, I don't know, fitting in, actually making sales at the Downtown Farmers' Market. And I don't know why. Again, there are lots of reasons why that could be the case, I'm not saying it's all because of non-equity."

Human Capital: Individual wellbeing enhancing self-determination—includes leadership capabilities, knowledge, and skills of community members (e.g., healthy eating, mental and physical health, learning about agriculture, skill building/education, comfort in nature) Some studies only use undergraduate degrees to measure.

"Hunger has no zip code. And so I'm very, very passionate about that. It's something that I'm going to keep working on."
"So, we're trying to educate people because honestly in Iowa, if you want to eat greens in the summer, you can't grow lettuce in the summer. It's too hot. So you transition to amaranth or more of the greens that need to be cooked."

Social capital: Connections or bonds between community members and civicness includes mutual trust, reciprocity and shared future. Includes bonding (interaction within a group/community e.g., farmer to farmer) and bridging (community to community e.g., farmer to community).

"Then from the outside perspective, it does feel equitable to me. But maybe because from my inside perspective, I know these resources exist. It's just helping people connect with them."

Political capital: an account of who has power or connection to power and thus the ability to change community norms and values into rules and regulations for distributing all capitals, more institutional than organizational.

"And even farmers who are renting land and they can't even get a long-term lease, and that the people... Like the City of Des Moines canceled a lease on a farmer this year. And there's no way for people to get ahead, to get land, it's out of reach."

Financial/Economic capital: Money and access to funding that is internally or externally generated (e.g., poverty rate, business partnerships, reduced food spending, grants, individual assets).

"We have been resilient, but when I step back and look at our program, it's like it's not super resilient, we are entirely dependent on grant funding, pretty much. And if a grant fell through, I don't know what we would do. And we're secure for about three years from now."

Built/Engineered capital: infrastructure from communication systems to water systems and their accessibility for all (e.g., processing facilities, refrigeration, transport, grocers/restaurants).

"I think there is not access to transportation especially local foods people can't find them. So I think that's probably something that needs to be expanded upon."

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