4 Assessing food systems as complex adaptive systems

Conceptual views and US applications

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Using a complexity approach can simplify

Scholars have long noted that paying close attention to complexity can simplify both assessment (Holling, 2001) and implementation (Holland, 2006). Four decades of professional practice through a non-profit research and consulting firm have confirmed this. Our partners are often community-based food system leaders who seek us out because, as they engage in systemic change efforts, they find that conditions are so complicated, and the multitude of options open to them so vast, they are unsure how to prioritize action.

Engage residents as systems experts

The central role of the food system assessor in this setting centres upon *engaging local residents as experts on local systems*, learning how they view the assets and weaknesses of their community, and understanding the potential solutions that are either emerging, or being stifled. This places the researcher in the position of *co-constructing* knowledge and potential policy frames (Blay-Palmer et al., 2018; Chapter 12, this volume). As an analysis is formed, the process aims to help build the capacity of local food system leaders to identify key systems levers, and to make strategic plans to move them during implementation. Developing systemic theories of change, local leaders can define indicators of progress that cut across issues that are often separated by disciplinary divides.

To date, this approach has been adopted by 140 regions in 40 states, 2 provinces, and by 4 Native American tribes (Crossroads Resource Center, n.d.). In each case, time-series economic data from public sources were used to illuminate changing dynamics in the local context. Where resources allowed a more in-depth approach (n=24), close interviews with wise practitioners helped uncover core system dynamics. Two examples later in this chapter will illustrate this approach.

Viewing food systems as complex adaptive systems (CAS)

Researchers often attempt to break down food systems into their component parts for analysis (Folke et al., 2005; Aubin et al., 2013; Koopmans 2017).

Yet, this ultimately proves difficult to defend. Folke et al. (2005) argue that the goal of adaptive management should not be to seek ‘detailed knowledge of parts of the system, but improved understanding of the dynamics of the whole system’ (p. 445) (Chapter 2, this volume). Aubin et al. (2013) caution that static indicators must be combined with more dynamic measures. As he analyses four different approaches to complexity, Koopmans (2017) notes that in certain contexts it is more important to analyse the *potential for change* in a system, rather than analysing the system itself in meticulous detail.

Moreover, focusing solely on a given food system is incomplete. Morin (2008) finds that *any* system co-produces itself in relation to its external environment, drawing energy from that environment, and manifesting autonomy and emergence within that context. Moreover, he adds that any definition of a system is inherently a mental abstraction created by an observer, and thus intimately connected to the world view of that observer. Morin (1992) further suggests that the term ‘system’ is generative to new ways of thinking that essentially lead to a ‘*paradigm of complexity*’ (p. 6, emphasis added): a fundamental approach that calls for the observer to self-critically reflect on her knowledge as she engages a system (Chapters 2, 3, 5, 6, 7, 8, 9, 10, & 12, this volume). This requires ‘thinking that is capable of unifying concepts which repel each other and are otherwise catalogued and isolated in separate compartments’ (Morin, 2008, p. 81). He considers the paradigm of complexity to be ‘a bold challenge to the fragmentary and reductionist spirit that continues to dominate the scientific enterprise’ (Morin, 1992, p. 1). He adds that ‘[c]omplex thinking is not omniscient thinking ... It is always local, situated in a given time and place’ (Morin, 1992, p. 97).

Food systems are constantly evolving in response to changing demands by society (Collona et al., 2013). Holling (2001) defines the term ‘sustainability’ as ‘the capacity to create, test, and maintain adaptive capacity’ (p. 390). This, of course, implies that our approach to assessing sustainable food systems must itself be adaptive.

While several scholars have approached food systems as complex (Stevenson et al., 2007; Aubin et al., 2013; Prosperi, 2015; Allen & Prosperi, 2016; Allen et al., 2018; Blay-Palmer et al., 2018), fewer have examined complex food systems as adaptive (Heffernan, 1999; Meter, 2007b, 2010; Swanson & Bhadwal, 2009; Nelson & Stroink, 2013; Stroink & Nelson, 2013; Prosperi, 2016).

Defining complex adaptive systems

One pioneer in the complexity field, John Holland (2006), defines complex adaptive systems (CAS) as ‘systems that have a large number of components that adapt or learn as they interact’ (p. 1). Holland (1992) adds, ‘[t]hese systems change and reorganize their component... parts to adapt themselves to the problems posed by their surroundings... From the

standpoint of those who wish to understand and control these systems they constitute a moving target' (p. 18). Aubin et al. (2013) point out that static indicators 'do not take into account the adaptation and resilience of the systems studied' (p. 216).

This has profound impacts for analysts. The measurements one takes on a given food system at time *a* may be outmoded by time *b*, just a few weeks or months later. Indeed, the fundamental dynamics may have shifted even before measurements are compiled (Holland, 1992; Flood, 1999; Chapter 12, this volume). The basic nature of the entity may have changed so much that the measurements hold limited meaning, as explained below.

Consider the 2012 Census of Agriculture (US National Agricultural Statistical Service, series), which assembled data on US farming during one of its economic peaks. While census takers were gathering their tallies, grain prices were abnormally high (see Figure 4.1), fuelled by speculators who invested in commodity markets after suffering losses during the global housing finance crisis, as well as by strong demand for corn ethanol. This, in turn, meant that meat prices rose, since livestock are fed grain. By the time the 2012 counts were released in early 2014, conditions had changed substantially. The speculative bubble had burst. While corn producers in the US Midwest had earned a profit of US\$129 per acre (€44 per ha) in 2012, they experienced a net loss of US\$93 per acre (€32 per ha) in 2014 (ERS, Corn Production Costs and Returns, series). This is not to say the 2012 data were invalid. It does suggest that interpretation must take the changing nature of the system into account – in this case how a commodity economy that had brought rewards to producers rapidly shifted to one that created losses.

Food systems are especially prone to change in this emergent era. New industries have cropped up, for example, delivering prepackaged food portions to consumers who feel they are too busy to shop for themselves (e.g., www.blueapron.com) (Meter & Goldenberg, 2017). Thousands of small and large firms have entered the market (e.g., Amazon Fresh at www.amazon.com), while long-standing businesses have failed (Chasan & Burgdorfer, 2009; Bonato, 2016).

Four stages of the adaptive cycle

Scholars have found patterns in how systems change. Authors (Holling, 2001; Gunderson & Holling, 2002) identify four stages in the adaptive cycles of natural and human systems: exploitation, conservation, release, and reorganization. An adaptive cycle, Holling (2001) argues, 'embraces two opposites: growth and stability on the one hand, and change and variety on the other' (p. 392). In the first phase, new order is created out of chaotic conditions, sparking growth. During the second phase, the system's ability to efficiently control processes has the consequence of diminishing

its capacity to adapt to change. Pressures for change mount, releasing latent energies. After this period of restructuring, resources begin to coalesce in new ways, creating a new cycle of growth. In all four phases, uncertainty abounds, either within the system itself or its external context.

Stroink and Nelson (2013) analyse five food system initiatives in Northern Ontario using this framework. Although they view the mainstream food system as positioned at the height of the conservation cycle, moving towards a rigidity trap, with local food initiatives as the release of resources creating change and innovation, they also caution that ‘progression through the cycle is not necessarily sequential’ (p. 7). They further note ‘when a system will move in and through each phase cannot always be predicted, and a shift from one phase to the next is gradual and perhaps only identifiable after the fact’ (p. 8). Finally, they add,

[k]nowing where an organization lies on the adaptive cycle may allow us to understand the context of its challenges and to leverage interconnections for growth, but it does not allow us to predict with any accuracy what shifts or developments are likely to occur in the future, as these remain the emergent outcome of many complex interactions.
(p. 26)

Moreover, as Holling (2001) posits, in a complex system adaptive cycles are nested across levels of scale in what he calls a ‘panarchy’ (p. 398). This suggests that any given system may exhibit qualities of any of the four adaptive cycle stages at different levels at any point. His practical concern is that ‘actions that would be appropriate at one phase of the cycle might not be appropriate at other phases’ (p. 402).

Order interacts with disorder

Adaptive systems are not totally chaotic. Multiple authors state that the generative and emergent properties of complex systems derive from the interactions between order with disorder (Montouri, 2008; Morin, 2008). These create leverage points. Holland (2006) notes that ‘all CAS that have been studied carefully exhibit lever points – points where a simple intervention causes a lasting, directed effect’ (p. 6). This is because the ‘complexity of living systems of people and nature emerges not from a random association of a large number of interacting factors rather from a smaller number of controlling processes’ (Holling, 2001, p. 391). It is just such leverage that offers hope to local food systems leaders amid massive global economies. Yet Holland (2006) also cautions, ‘[t]here is no theory that tells us where or how to look for CAS lever points’ (p. 6). That means that subjective factors, such as imagination, pattern recognition, intuition, and educated insight, prove useful (Morin, 2008). As Holling (2001) states, ‘[w]e are always left with best judgments, not certainties’ (p. 391).

'Wicked problems,' or 'problem situations'?

Adaptation presents food system leaders with ongoing issues that are unlikely to attain a clear resolution. Two planners, Horst Rittel and Melvin Webber (1973) are credited with coining a term for this: a 'wicked problem'. They point out that casting complicated situations as 'problems' grew out of scientific methods that attempted to divide complex issues into components. However, they caution, '[t]he classical paradigm of science and engineering – the paradigm that has underlain modern professionalism – is not applicable to the problems of open societal systems' (p. 160). They further explain that this paradigm has been 'dominated by the pervasive idea of efficiency' that was not appropriate for work in societal systems (p. 158; see also Australian Public Service Commission, 2007).

Rittel and Webber (1973) add that in a quest to identify all of the major agents in societal systems, or to understand in a mechanistic manner how these operated, analysts often overlook 'the most difficult discussion of all: "What *should* these systems do?"' (p. 157, original emphasis). The supposed ideal of a cybernetic planning system, including 'statistically monitoring those conditions of the publics and the systems that are judged to be germane [and] feeding back information to simulation and decision channels' (p. 159) is fundamentally impossible to create. They conclude, '[w]e all know that such a planning system is unattainable ... It is even questionable whether such a planning system is desirable' (p. 159).

Rittel and Webber (1973) further state that 'there is no definitive formulation of a wicked problem ... The information needed to understand the problem depends on one's idea for solving it ... The problem can[not] be defined until the solution has been found' (p. 161). Now, 45 years later, this could be put slightly differently, in part because they also state that 'social problems are never solved' (p. 160). Rather they are complex, ongoing issues (Flood, 1999; Chapters 1, 2, & 12, this volume).

Rittel and Webber (1973) add that no 'wicked' issue can even be *understood* without considering *all* of the potential solutions ahead of time. Our professional practice suggests that such complexity cannot be addressed until one has sufficiently constrained one's own view of the system by setting boundaries for the analysis as well (for example, by establishing geographical limits, knowing one's purpose, clarifying one's world view, or defining a clear focus for activity). Once these are defined, it is possible to identify specific patterns of emergence reflecting these choices.

Rittel and Webber (1973) further state that even the quest for an overarching method for addressing complexity might be illusory. Since there is 'no ultimate test of a solution to a wicked problem' (p. 164), there is no way of knowing all the repercussions of an action taken today. Nor are there 'criteria which enable one to prove that all solutions to a wicked problem have been identified and considered' (p. 164). Thus, in addressing the wicked problem of assuring food access for low-income residents while upholding farmer income, Nelson and Stroink (2014) conclude 'it was

important to nurture connectivity that was not predefined by existing structure or imposed by outside leaders' (p. 10) in order to allow new approaches to emerge.

Each setting is unique

Rittel and Webber (1973) further caution that 'each wicked problem is essentially unique ... every situation is likely to be one-of-a-kind ... [therefore] one should not try to cure symptoms: and therefore one should try to settle the problem on as high a level as possible' (p. 165). Yet higher-level solutions cannot overlook local realities. As Morin (2008) states, complex thinking 'is always local, situated in a given time and place' (p. 97). Rittel and Webber (1973) add,

[s]ocial science has simply been unable to uncover a social-welfare function that would suggest which decisions would contribute to a societally best state. Instead, we have had to rely upon the axioms of individualism that underlie economic and political theory, deducting, in effect, that the *larger-public* welfare derives from summation of individualistic choices. And yet, we know *this* is not necessarily so, as our current experience with air pollution has dramatized.

(p. 168)

They conclude that

in such fields of ill-defined problems and hence ill-definable solutions, the set of feasible plans of action relies on realistic judgment, the capacity to appraise 'exotic' ideas and on the amount of trust between planner and clientele that will lead to the conclusion, 'OK, let's try that'.

(p. 164)

Flood (1999) goes on to state that

[t]he idea of systemic thinking ... is to develop whole appreciation ... [which] may be achieved only through wide ranging discourse about the relevance of optional organisational structures *in each local context*, local in space and time ... People must be allowed to decide for themselves.

(p. 72)

Flood (1999) adds, citing C.W. Churchman, 'systemic thinking (i.e. learning) begins when you see through the eyes of another' (p. 69).

If earlier scholars highlighted the uniqueness of each context, later work has added an emphasis on examining each situation through a diverse set of viewpoints, as well. Moreover, there are multiple valid approaches to working systemically. As Midgley (2007) points out, the very complexity of

adaptive systems means that a complex variety of tools is useful, often in different phases of the same work. Even schools of thought or methodologies that became displaced by newer approaches may prove critically useful, and become refined, long after they have been discarded as ‘obsolete’.

As a result, addressing persistent, complex food system issues in community contexts requires methodologies that tap into residents’ immersed knowledge of place, both offering and creating opportunities to better understand recurring patterns they experience in their local context (Chapters 2, 3, 6, 7, 8, 9, & 10, this volume). Defining the complexity of food systems as a ‘wicked problem’ does not transcend the narrowness of defining ‘problems’ as if they were external conditions to be solved. Rather a CAS approach suggests that we are all – professionals are community members alike – immersed in complex settings. We need to embrace the complexity of systems, reach out to those with different viewpoints, learn from each other, and keep an eye out for changing conditions. In paying close attention to unique local conditions, we have found that often broader societal dynamics are illuminated as well.

Avoiding reductionism

Given the ongoing nature of complex social concerns, Aubin et al. (2013) clarify that ‘[t]he challenge facing assessment is thus to take full account of this systemic complexity without breaking it down into different parts, which would cause it to lose its interaction characteristics’ (p. 200). Folke et al. (2005) add, ‘[a]daptive governance systems often self-organize as social networks with teams and actor groups that draw upon various knowledge systems and experiences for the development of a common understanding and policies’ (p. 441). Similarly, Viljoen and Wiskerke (2012) place strong emphasis on network-building initiatives (see also Chapter 3, this volume). Kania and Kramer (2011, 2013) also place strong emphasis on self-organized networks. They conclude that no single ‘backbone organisation’ is essential for collective impacts; networks can effectively coordinate in decentralized manners (Meter, 2014). Folke et al. (2005, citing Ostrom, 2005) add, there is a ‘need to view all policies as ongoing learning experiments that need to be monitored, evaluated, and adapted over time’ (p. 447). As Morin (2008) puts it, ‘[d]on’t forget that reality is changing, don’t forget that something new can (and will) spring up’ (p. 57).

Methodological frameworks

The approaches we have developed are essentially geared to assisting people who are inside a complex adaptive system to better understand, *from their diverse viewpoints and unique context* (Chapters 1, 2, 3, 6, 7, 8, 9, 10, & 11, this volume) how systems function and are adapting, sufficient to allow them to act without being paralysed by the complexity they experience. It

is our aim to assist local practitioners to build their own capacity to self-organize within changing environments.

In our practice, we are invited in by a core of local leaders who have raised money to engage us. During our negotiations, we insist that local stakeholders define the issues to be addressed (Savin-Baden & Major, 2013; Hay, 2016).

Our approaches are asset-based (Kretzmann & McKnight, 1993; Goldman & Schmalz, 2005). We avoid doing ‘needs assessments’, since ‘needs’ discussions often do not move beyond what is lacking. We begin by learning what local leaders have already done, and asking what capacities the community already has, then identifying gaps and capacities they would like to strengthen.

We make one further distinction, viewing our approaches as *systemic*, rather than *systematic*, in nature (Flood, 2010). *Systematic* approaches strive for a comprehensive overview of a given system, often couched in hopes of modelling systems behaviour by considering all of the known elements of the system with quantitative rigor. As Rittel and Webber (1973) noted above, this is often impossible in a complex and adaptive environment. Rather, these methods strive to identify *systems dynamics*, including patterns of emergence, and specific attractors (Williams, 2005), as defined below.

We define *emergence* as unexpected patterns of complexity that result from simpler processes, but could not be predicted from the rules followed in the less complex process (Flood, 1999; Meter, 2007b; Stroink & Nelson, 2013). Rotmans and Loorbach (2009), citing De Haan (2006), distinguish three types of emergence: discovery, mechanistic, and reflective. The second is more structured than the first. In the latter type, ‘observers are among the objects of the system, and have some reflective capacity, which enables them to observe the emergence they produce’ (p. 3). Flood (1999) considers spontaneous self-organization to be a specific form of emergence. *Attractors* are patterns, clusters of energy, or resource flows that tend to create stability among disorder, and that may provide the backbone for lasting systems change (adapted from Eoyang, 2004; Meter, 2007b).

Participative research processes

Our approach to research in collaboration with community partners draws upon elements of Participatory Action Research (PAR), though it differs from more carefully constructed academic efforts. Cornwall and Jewkes (1995) identify four types of PAR: *contractual*, in which people are asked to participate in projects selected by researchers; *consultative*, in which people are consulted before interventions are made by outsiders; *collaborative*, referring to projects initiated by researchers, but carried out in collaboration with local people; and *collegiate*, in which researchers and residents work together as colleagues with different skills to offer. They add, ‘[w]hat is distinctive about participatory action research is not the methods, but the methodological contexts of their application’ (p. 1667). They also focus

considerable attention on the attitudes researchers bring with them, and their willingness to affirm the perspectives of local actors.

We operate almost entirely within the ‘collegiate’ realm. Although we are often handed considerable power by our clients in framing a research project, we do so to address concerns that the community has raised. As Cornwall and Jewkes continue, ‘[t]hrough a process of mutual learning and analysis, which takes part throughout research rather than at distinctive stages, people are brought into the research as owners of their own knowledge and empowered to take action’ (p. 1670).

Yet our research process is often not collective in the ways that Baum et al. (2006) pursue. Often, rather than placing people in a room together in an effort to devise group analysis, we typically interview people privately, one-by-one. People typically offer more searching insights if they are speaking privately, reflecting on actions they have taken or observed in an exercise of praxis (Friere, 1972) (to understand the benefits of participatory research see Chapters 2, 3, 6, 8, 9, & 10, this volume).

Baum et al. (2006) note that ‘[t]he observer brings an impact on the phenomena being observed and brings to their inquiry a set of values that will exert influence on the study’ (p. 854). We certainly make every attempt to enter each community discussions with limited preconceptions, mindful of Rocheleau’s (1994) suggestion that

[w]e have also found that there is no single best, fixed land use ‘package’ for any given region or group of people, but rather a vast array of principles and components that can be constantly recombined, tested, and modified to suit changing social, economic, and ecological conditions for individuals, households, communities, and nation-states.
(p. 5)

Rocheleau further cautions (1994) that ‘[s]ome of our best data and insights are transmitted through stories, a professional oral tradition, and through the skills of our trades’ (p. 9). This also applies to lay observers. Citing Hope and Timmel (1984), Rocheleau (1994) adds that ‘[f]armers, herders, and forest dwellers may benefit substantially from a combination of historical analysis, consideration of possible futures, and qualitative comparison of existing practice’ (p. 13; see also Chapters 1 & 12, this volume).

Another way to ensure that multiple perspectives are given full consideration is to integrate mixed methods into the research process. Shorten and Smith (2017) point out that ‘[p]urposeful data integration enables researchers to seek a more panoramic view of their research landscape, viewing phenomena from different viewpoints and through diverse research lenses’ (p. 74). In this way, groups of people consulting multiple data sources of data are more likely to embrace diverse sets of insights (Chapter 3, this volume).

Irwin (2008) reminds that quantitative and qualitative data are not distinct categories of data, they provide ‘different *dimensions* of unitary problems... We need to keep under reflexive and critical scrutiny the categories we use to

organize our thinking and order our data’ (pp. 415–416, original emphasis). She continues, ‘we do not properly understand the nature of people’s values and subjective orientations if we do not understand the contexts in which they hold meaning’ (p. 420).

Methodological tools

Time-series data

Time-series data are very valuable in identifying patterns over time (Rocheleau, 1994; Eoyang & Berkas, 1998; Aubin et al., 2013). These have turned out to be the key quantitative tool in our work, although surveys are also important for generating site-specific data. For work in the US, we draw heavily upon data from the US Bureau of Economic Analysis (BEA). These data are especially useful because they focus on income flows and do not take a position regarding production systems, programmes, or specific issues. Rather, they are intended to assist municipal leaders to understand local conditions. They provide annual county-level estimates of population, employment, personal income, and transfer payments, and are the only national source of annual local farm income data. Moreover, BEA data are reported for each county in the US for each year from 1969 to the present. They can readily be aggregated to provide income estimates for multi-county regions, including those that cross state boundaries.

Many similarly useful secondary data sets are available in the US, Canada (StatCan), the European Union, and elsewhere, but detailed local-level data can be difficult to locate in many countries. In the US, the Bureau of Labor Statistics Consumer Expenditure Survey, The Federal Census, and the Centers for Disease Control and Prevention health data have been highly useful in connecting farm income to demographic, food consumption, and health risk factors. Multiple data sets are also provided by the US Department of Agriculture (USDA), including the Census of Agriculture (which does include county-level acreage, production, sales, and other data in five-year increments); and state and national production and marketing data from the Economic Research Service (ERS), the Agricultural Marketing Service (AMS), and the Agricultural Resource Management Survey (ARMS). We also draw heavily upon GIS data from a number of public agencies for mapping land use, water features, topography, and transportation routes (Thilmany McFadden et al., 2016).

Limits to data and interpretation

BEA data do have limitations. They are not raw counts, but rather estimates modelled by professionals with access to considerable computing power, drawing data from a variety of sources. This means county-level data may reflect estimates drawn from state, regional, or national level averages. However, BEA correlates these to primary business filings so we have found

that local data reflect local conditions fairly well. As with any time-series, often the patterns and trends depicted are more meaningful than the specific data points.

Interpretation should also be performed with care. There have been many structural changes to the farm economy since 1969. Far fewer farmers are in business now, and the level of technology is far more intense. BEA time-series data portray the farm sector as a whole. While this is important to know, fine-grained calculations require additional data sets in order to better understand how conditions compare across time.

A further limitation is that most national secondary data sets show primarily the workings of large-scale farms and the commodity industry, not trends in community food production (Goldenberg & Meter, 2019). These broader trends do strongly affect those producing food for nearby consumers, influencing the cost of land, availability of labour and other farm inputs, opportunity costs, and a host of other concerns, but once again it is important to interpret what is shown carefully. Until comprehensive and accurate data sets (or suitable proxies) are compiled covering community food production, these broader sets will be the best available. Importantly, time-series data often show that the commodity economy is not as robust as people imagine (see Figure 4.1). This often fosters a *destructuring* (Nelson & Stroink, 2013) of the assumptions that community members make about the mainstream food system, as the next section discusses.

A century of US farming

One example will demonstrate what time-series data can portray. In Figure 4.1, more than 100 years of US farm income and production expense data are shown. In this case, to consider the national context, we refer to USDA Economic Research Service data (taken from ERS Farm Income and Wealth Statistics), which show longer trends than BEA data. Included are (a) cash receipts; (b) production expenses; and (c) net cash income (cash receipts less production expenses – a measure of the profitability of producing crops and livestock) for all farmers in the US, from 1910 to 2018. These data have been adjusted for inflation using the US Federal Reserve Bank's consumer price index (CPI) (US Federal Reserve Bank of Minneapolis, n.d.) and are presented in 2018 US dollars.

The unadjusted data show long-term increases in both cash receipts and expenses. Yet richer insights emerge after adjusting for inflation. Visible in Figure 4.1 are several periods of prosperity for the US farm sector: (a) the 'Golden Age' of 1910–1914 when the US dominated global commodity markets and living costs were low, still viewed as the standard for farm prosperity, but followed by sales spurred by the First World War; (b) the period during and immediately after the Second World War when war-time and recovery-era sales and new technology combined to boost farm income; (c) the OPEC oil crisis of 1973–1974, when the US sold massive

Figure 4.1 Adjusted Net Cash Income for US Farms, 1910–2018.

Source: US Economic Research Service Farm Income Balance Sheet data. Public domain. Adjusted for inflation using US Federal Reserve Consumer Price Index.

shipments of grain to the USSR in order to retrieve its currency; and (d) the global housing debt crisis of 2008–2011 when speculators' bidding up the price of grains and rising ethanol use conspired to create a commodity price bubble.

What this chart shows, then, is that the only truly prosperous periods for US agriculture were due to either long-lost global market power (a) or to external shocks (a–d). Overall, net cash income trended downward, reaching lower levels in 1983, 2000, and 2018 than during the Great Depression (1932). Given the considerable importance of federal subsidies, tax incentives, and infrastructure investments to encouraging long-distance commodity trade, this is a stark reality. Moreover, each bubble led to further decline – not to lasting prosperity for the farm sector. More fundamentally, farmer investments in substantial new productivity (ERS, Agricultural Productivity in the US, series) yielded little return.

What this chart does not show is that off-farm income has increased dramatically over the past century (ERS, Farm Household Income and Characteristics, series). So, while farm families may have acceptable incomes (Gardner, 2002),

especially if they purchased land a generation or more ago, they increasingly earn this off the farm – not by actually producing commodities. In fact, ERS now calculates that US farmers lose more than US\$60 per acre planting corn (ERS, Corn Production Costs and Returns, series). Each of these trends shows adaptive cycles within the prevailing commodity economy, a context that creates considerable uncertainty despite federal efforts to stabilize.

Since key insights like these can be drawn from readily available public data sets, we often wonder why so many analysts overlook them. The patterns that local practitioners recognize in these secondary data sets often serve as a starting point for further critical reflection on the part of both researchers and community members.

Interviews with wise practitioners

This leads to the most essential qualitative tool: interviews with ‘wise practitioners’. These are people well immersed in their context, who have gained special insight, or who are especially articulate in taking a broader view of the issues at hand (Meter, 2007b). They intimately know the issues that people face on the ground, and yet they also take a position that is broader than their personal self-interest. As Flood (1999) states, they have ‘learned inside feedback structures’ (pp. 68–69), self-reflective and also responsive to those around them.

The most informed have also engaged in thoughtful reflection about their own mental frameworks (Flood, 1999; Morin, 2008). In short, they are able to ‘see the world through the eyes of another’ (Flood, 1999, p. 63). Often their own efforts to change prevailing power dynamics offer them rich insight into systems dynamics, including how a system pushes back against change (Maretski & Tuckermanty, 2007; Nelson & Stroink, 2014). Often the most informed practitioners are generalists, rather than specialists (Rocheleau, 1994; Flood, 1999; Meter, 2007b; Morin, 2008; Stroink & Nelson, 2013; Chapter 11, this volume).

Farmers, low-income residents, and other marginalized food system stakeholders are deeply cognizant of complexity. They recognize they hold limited power in making conditions better, and have often experienced potent resistance from prevailing systems. This pushback illuminates critical system dynamics (Meter, 2007b). Speaking primarily of culturally embedded knowledge in ecology, but also with clear application to social systems, Folke et al. (2005) argue that

[k]nowledge acquisition of complex adaptive systems is an ongoing, dynamic learning process ... It comes as no surprise that knowledge of ecosystem dynamics and associated management practices exists among people of communities that, on a daily basis and over long periods of time, interact for their benefit and livelihood with ecosystems.

(pp. 445–446)

One central challenge is to identify the most informed wise practitioners to interview. In our practice, we ask a group of local food system leaders to select the best people to interview based on a collective sense of which people have: (a) done the most to build the food system that embodies a more sustainable future; or (b) hold the most penetrating insights into how community foods efforts have played out in the past.

If the members of the group that make such a selection trust each other well, and keep an open mind to the broader purpose of the study, essential system dynamics and levers for change may easily be revealed from a relatively small number of interviews (about 15), unless the context is especially conflicted. In particular, primary producers (farmers, fishers, processors, etc.) often hold the most informed insights about broader aspects of the food system since their point of view is both pragmatic and immersed, and also informed by cultural roots. Independent business owners or managers may also hold a solid sense of local tradition that balances their attention to markets. Similarly, low-income residents or others who are marginalized often know more about systems dynamics than those who are in power, because they have confronted social systems and witnessed the resistance (Friere, 1972; Meter, 2007b; Morin, 2008).

Additional interviews may also be essential to fully account for diverse viewpoints, or for credibility's sake. We often discover that key practitioners have been overlooked by the local leadership team. Ideally, no key player, industry sector, nor any key philosophical position taken within the community should be excluded. Several clients have also pointed out that unless local people are directly quoted in a food system assessment, civic leaders will have limited interest in the results. This may reflect a cynicism about modelled, or academic, analysis, but it also expresses political pragmatism as civic leaders respond to constituents.

Essentially, this interview process asks those who have extensive experience in the food system's complex adaptations – its emergent patterns and its attractors – to identify the 'levers' that would best move the system. Since these systems levers are expressed in the words of local leaders, the public often understands them readily. Yet practitioners' views are not always accurate, so the quantitative data compiled and the professional experience of the analyst both play key roles in ultimately defining which levers would move the system to fulfil the local initiative's purposes at the current stages of the adaptive cycles. Those community members who implement the systemic strategies selected will further refine this analysis over time, and may come to reject the consultants' views. As systemic work in a complex adaptive setting, the main importance is that professionals and community members learn together, and that local stakeholders define and select from the options of strategic choices. As stated above, it is the trust and openness developed in this relationship, more than the data provided or the models applied, that will make the critical difference.

Developing strategic direction

Avoiding needs assessments, we often use a SWOT (Strengths, Weaknesses, Opportunities, Threats) framework. We always begin with asking about ‘strengths’. We commonly will list these attributes of the local food system anonymously to separate personalities from concepts. We look for clues that will suggest a vision for systemic change, rather than pointing to a specific programme (Morin, 2008). Often these SWOT depictions also suggest systems levers, identify emergent properties and attractors, or help us understand how comprehensive local perspectives on the prevailing food system may currently be.

Setting up a food system assessment

There are two key decisions that must be made to begin an assessment of a complex adaptive food system. In our practice, we ask local partners to make these determinations. The first decision is to make the purpose of, and audience for, the study explicit. The second is to define a specific geographic scope. Often these two decisions must be made iteratively. As noted above, these two decisions both frame and limit the analysis of the system, clarifying which elements of the system will take priority (for other approaches, refer to Chapters 2, 8, & 9, this volume).

Make the purpose and audience explicit

In our initial agreement, we specify that one of the purposes for the assessment is to build the capacity of local residents to strengthen and manage their own initiatives. Further, we ask the client what they hope to accomplish with our final report. Do they seek a document that can sway commissioners in one particular county? Is the purpose to expand regional food trade within a 32-county region? Is the purpose to explore the feasibility of a specific business opportunity? Each potential purpose suggests its own approaches, inquiry, and methods.

One important distinction we are increasingly making is to suggest that a project’s purpose be set as building ‘community-based food systems’ (CBFS), not just ‘local’ or ‘regional’ systems. For years, the concept of ‘local food’ has been diluted by practitioners who define it to mean whatever they can conveniently deliver to their customers in a way that will not invite too much scrutiny. We have come across definitions of ‘local’ that range from ‘within my township’ to ‘anywhere we can drive within 24 hours’. Such mileage limits are easy to co-opt, while building social capital is what provides a competitive advantage to community foods efforts (Goldenberg & Meter, 2019).

We define CBFS as *systems of exchange that strive to bring farmers and consumers into affinity with each other* (Heffernan, 1999; Maretski &

Tuckermanty, 2007; Stevenson et al., 2011; Wiskerke & Viljoen, 2012), for the purposes of building health, wealth, connection, and capacity (Meter, 2003, 2007b).¹ This definition views culture as a meta-purpose integrating a community's attention to the other four purposes, and serving as the central vehicle through which people agree to share certain rituals – including food – that connect them to place, and regenerate social memory (Folke et al., 2005). Folke et al. (2005) define 'social memory' as 'the arena in which captured experience with change and successful adaptations, embedded in a deeper level of values, is actualized through community debate and decision-making processes into appropriate strategies for dealing with ongoing change' (p. 453). At a more abstract level, Morin (1992) calls for 'face-to-face contact' between the observer and the system to be observed, and points out that culture 'provides the paradigms which permit and require' (p. 10) acts of distinguishing.

Indeed, using the very term 'community-based food system' points to the complexity of the discussion because community is complicated. It appears to be easier to simply count food miles or define a rigid geography. Yet a complexity focus also heightens opportunity for success, in our experience. It assumes that an effectively self-organizing community will pay attention to water, soil, and air quality for the sake of human health. While this is an implicit promise of democracy (Putnam, 1993; Lyson, 2007), such care is not always in force. Moreover, the weight of prevailing economic infrastructure in the US operates to frustrate the possibility of community-based enterprise (Meter, 1990; Heffernan, 1999), so this focus invites learning about negative feedback loops.

Define geographic boundaries

The second key question is to define the geography that the assessment will cover. This is inherently a local decision in the case of a local food initiative (Lynch et al., 2015; see also Chapter 9, this volume). It is also an arbitrary one. The *only* geographic boundaries that are not arbitrary are island or watershed boundaries, because these are determined by ocean frontage or the peak elevation of the surrounding landscape. Many work with a seemingly parallel concept of a 'foodshed', defined by Kloppenberg et al. (1996) as 'streams of foodstuffs running into a particular locality, their flow mediated by the features of both natural and social geography' (p. 12). Yet boundary decisions are complex, because the distance food can conveniently travel is determined as much by the presence of freeways, bridges over waterways, warehouses, and airports as by topography. Thus, the term 'foodshed' is a useful metaphor, if it is not taken too strictly.

For simplicity in regional identity, data gathering, or writing policy it may be useful to work within county or state boundaries, yet food systems routinely transcend such distinctions. Moreover, many regions contain big discontinuities in arable land. The key is that the boundaries should reflect

the scope of the current or proposed food system, rather than bureaucratic or organizational lines.

In general, we find that the ‘best’ geography is the one in which the client has a mutually respectful dialogue established with key food systems leaders. If the geography is smaller than a US county, this makes secondary data sets less useful, but primary data can still be compiled. If the region is defined as a larger area to enlarge the number of potential consumers, the questions become: how far does your trust extend? If you called a meeting, who would actually show up? Who would think it is too far to drive?

Once these two elements are clear, and the boundaries of the systemic view have adequately been set, the focus has been clarified enough that it is possible to identify emergent properties, attractors, and systems levers. After initial consideration, we propose a set of activities to the client, and they decide whether this is a good match for their needs.

Using the community capitals framework

We believe this approach is quite consistent with the work of Cornelia and Jan Flora, who in particular have developed and applied a ‘community capitals framework’ that lists human connectivity as one of seven forms of capital including natural, human, cultural, financial, built, and political (Flora & Flora, 2004; Chapter 3, this volume). Economic flows integrate across all of these capitals (Morin, 2008), as does social capital. Over time we have placed stronger focus on the need for strong social capital to create a resilient community economy (Goldenberg & Meter, 2019). Holling (2001) adds that ‘connectedness ... determines the degree to which a system can control its own destiny’ (p. 394). Folke et al. (2005) continue, ‘[s]ocial sources of resilience, such as social capital (including trust and social networks) and social memory (including experience for dealing with change) are essential for the capacity of social-ecological systems to adapt and shape change’ (p. 444).

Connecting to sustainable food systems work

This CAS approach overlaps considerably with other sustainable food systems work. The challenge in each community setting is for self-organizing activity to align itself with its environmental context to accomplish sustainability goals. This suggests that data providers should provide solid measures to inform strategic discussions that must inherently address very unique local conditions.

Global and national data sets covering the panoply of sustainability concerns are essential for informing these local systemic initiatives. On the other hand, if global data initiatives are designed as an effort to limit local decision-making, or to unify efforts across geographies, they may interfere with community-based efforts to move systems levers that are profoundly rooted in place (Morin, 2008).

Channelling results into a workplan

As outsiders seeking to define processes that are inherently internal to a specific community, and most visible to those who live inside the context, and as researchers who hope to build the capacity of our partners, our work converting research insights into practical workplans can be a precarious process. The basic insight to keep in mind is that there is no magic single answer. Nor can success in a complex adaptive food system be understood by referring only to a single measurement, because doing so distorts the complex interactions within the system and leads to harmful consequences (Midgley, 2007). Moreover, implementation in an adaptive system involves trade-offs between competing forces. Holding a complex set of purposes may help encompass these potential tensions. Keeping a complexity paradigm at the forefront of the work, it is possible to address systems levers and emergent change, while placing a lower priority on other critical concerns (see Chapters 2, 3, 8, & 9, this volume).

Typically, the proposed strategy is itself complex. We often compile a list of perhaps 5–8 proposed action steps, knowing that each one suggests pushing one or more ‘levers’ to create systemic change. As just one example, we often suggest that local leaders build greater trust and form stronger collaborations, assuming that stronger social capital will foster greater resilience (Meter, 2012; Meter, 2016; Meter & Goldenberg, 2018; Goldenberg & Meter, 2019).

Discrete progress in moving one of these systems levers may result in larger impacts over time, but may simply evoke resistance. If community members recognize their own wisdom in the systems levers that have been identified, however, they are in a solid position to ride through these uncertainties. Still, offering complex choices may feel debilitating to some community initiatives that seek simple solutions.

Measuring success using linked indicators

Having defined systems levers, and making a strategic assessment of which ones to push at the present time, measuring success is cast in different terms. To identify levers is essentially to begin to define a *systemic theory of change*. That is to say, a theory of change that: (a) takes into account the adaptive dynamics of prevailing food systems, and (b) measures whether systems levers have actually been moved, and if so, (c) whether this has shifted system dynamics. When issues are highly linked – as they always are in a CAS – systemic indicators should also express these linkages. For example, building social connectivity can become a foundation for economic and health improvement (Lynch et al., 2015; Goldenberg & Meter, 2019).²

One of the key systems dynamics that has been identified in regional farm and food economy studies is that the prevailing food system is structured to extract wealth from urban low-income areas and rural communities in

the US (Goldschmidt, 1978; Meter, 1990; Meter, 2007b) as well as globally (Stevenson et al., 2011). Finding local systems levers that will effectively reverse this extraction is an exceptional challenge (see Chapters 5 & 11, this volume). Yet operating a community foods initiative without addressing these structures strategically runs the risk of deepening the extraction (Meter, 2007b).

Implementation of the plans

Tragically, implementation in the US is frequently stalled by a combination of factors: years of partisan stalemates have reduced the budgets available at the local level for communities to act on their own behalf. Federal aid to municipal governments has been cut, and political discourse even at the local level has become polarized. Many citizens have opted to reject public investment of any kind.

We try to define the most comprehensive strategy possible, based on what seems right to do to move a community towards its community foods purposes. Typically, this means that leaders will make use of the data and the recommendations for years to come, adapting their strategies as conditions change.

Impacts of CAS assessments

Two studies stand out as exemplars of the utility of taking a complex adaptive view. First, when the Indiana State Department of Health commissioned an assessment of the Indiana food system so the agency could better learn how to effectively intervene to promote better health, our interviews documented that state policy was focused on exporting food globally, rather than meeting the needs of state residents (Meter, 2012). Meanwhile, state residents who were creating community alternatives were marginalized. The report presented these community-based food initiatives *as an emergent quality of the prevailing food system*, rather than as a separate cluster of activity. This, of course, is consistent with Holling's (2001) 'release' cycle. This framing made it very difficult for political leaders to deny their presence without rebuffing their own constituents. Moreover, quantitative data showed that while Indiana farms exported more than US\$8 billion of wholesale commodities, the state's consumers purchased an estimated US\$14.5 billion of food items sourced outside the state each year. This comparison deepened the discourse about food in Indiana. That is to say, our research identified two central systems levers: challenging the notion that Indiana 'feeds the world', and questioning whether the state benefited economically by attempting to do so.

Raising these questions deepened the discussion of food and agriculture in Indiana. Rural legislators seized on the amount of food the state imported

each year (Indiana Rural Caucus, 2012). The head lobbyist for the Indiana Farm Bureau called this report his ‘bible’ (White, 2014). The state’s land-grant university moved to hire a local foods coordinator.

That report’s recommendation to invest in strengthening community foods networks was adopted in a second study by economic developers in an 11-county region of Northeast Indiana (Meter, 2016). In this case, one systems lever was ensuring that food leaders adopted a single definition of ‘local food network’. Ultimately, our analysis brought economic developers into stronger engagement with issues of poverty and farm business development (Goldenberg & Meter, 2019). Thus, they began to embrace emergent farm business networks, and deepened their view of network-building as a path forward. Thus, the state Health Department initiative influenced efforts to build social capital in two settings (see Chapter 11, this volume).

In turn, advances made in Indiana impacted other states. Northeast Indiana’s embrace of network-building helped inspire the Maricopa County (Arizona) Food Systems Council to commission a study to show how community foods activity was building social and commercial networks in the Phoenix metro region. Our report (Meter & Goldenberg, 2018) documented the growth of community networks, and also noted how these contributed to local economic multipliers. Our social network maps showed that food buyers played a significant role in building social capital in the region, often more centrally than farmer organizations or non-profits. This network-building approach has been embraced by both the local food systems council and by civic leaders.

Limitations of this approach

The approach outlined here does not satisfy those who want easy answers or a simple formula they can follow (for more about complexity approaches, see Chapters 2, 3, 5, 6, 8, 9, 10, & 11, this volume). Those who seek such a linear answer operate in a different reductionist sphere, perhaps because they are not ready to embrace the complexity of the communities where they work. Our experience is that when people opt for simpler, more linear approaches, greater dysfunction is often created.

Our focus on economics could also appear too narrow. Yet for better or worse, economics is the language the US typically uses in making key policy decisions, and *is* how societies value the trade-offs between competing environmental and social goals. Like any other discipline, of course, economics is itself a complex adaptive system, yet its role is also somewhat unique. As Morin (2008) writes, ‘The economic dimension contains the other dimensions and there is no reality we can comprehend with a single dimension’ (p. 46). Our approach endeavours to create an economic language that helps explain a broader reality and embraces positive change rather than deepening exploitation.

Adaptive approaches posit questions to be addressed through ongoing reflection, but do not offer definitive solutions. While identifying systemic levers and emergent properties may help simplify assessment, this does not mean that food systems become simple. As Morin (1992) sums it up: '[c]omplexity cannot be simplified' (p. 11). But using a complexity paradigm may well show a more concise path for local leaders to address convoluted challenges for decades to come.

Notes

- 1 The careful reader will note that this formulation addresses Rittel and Webber's call to define a purpose for a system. Moreover, as a *system* of purposes, it is itself a complex adaptive system attuned to consideration of CAS dynamics. The concept of Community-Based Food Systems certainly also reflects Lyson's pioneering work (Lyson, 2004).
- 2 Some approaches for defining and using linked indicators are covered in Meter (1998, 2007a, p. 183).

References

- Allen, T. & Prosperi, P. (2016) Modeling sustainable food systems. *Environmental Management*. 57, pp. 956–975.
- Allen, T., Prosperi, P., Cogill, B., Padilla, M., & Peri, I. (2018) A Delphi approach to develop sustainable food system metrics. *Social Indicators Research*. 36(1), pp. 3–19. Available at: <https://doi.org/10.1007/s11205-018-1865-8>.
- Aubin, J., Donnars, C., Supkova, M., & Dorin, B. (2013) A critical panorama of methods used to assess food sustainability. In: Esnouf, C., Russel, M., & Biracs, N. (Eds.) *Food system sustainability: Insights from duALIne*. Cambridge: Cambridge University Press.
- Australian Public Service Commission (2007) *Tackling wicked problems: A public policy perspective*. Report available at: <https://www.apsc.gov.au/tackling-wicked-problems-public-policy-perspective>.
- Baum, F., MacDougall, C., & Smith, D. (2006) Glossary: Participatory action research. *Journal of Epidemiology and Community Health*. 60, pp. 854–857.
- Berkes, F., Folding, J., & Folke, C. (2000) Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications*. 10, pp. 1251–1262.
- Blay-Palmer, A., Santini, G., Dubbeling, M., Renting, H., Taguchi, M., & Giordana, T. (2018) Validating the city region food system approach: Enacting inclusive, transformational city region food systems. *Sustainability*. 10, p. 1680.
- Bonato, G. (2016) New titans on the block: ABCDs lose top Brazil grains spot to Asian rivals. *Reuters*, 23 March.
- Chasan, E. & Burdofer, B. (2009) Pilgrims pride exits bankruptcy under JBS deal. *Reuters*, 28 December.
- Collona, P., Fournier, S., & Touzard, J. (2013) Food systems. In: Esnouf, C., Russel, M., & Biracs, N. (Eds.) *Food system sustainability: Insights from duALIne*. Cambridge, Cambridge University Press.
- Cornwall, A. & Jewkes, R. (1995) What is participatory research? *Social Science and Medicine*. 41(12), pp. 1667–1676.
- Crossroads Resource Center (n.d.) *About us*. Available at: www.crcworks.org.

- De Haan, J. (2006) How emergence arises. *Ecological Complexity*. 3(4), pp. 293–301.
- Eoyang, G.H. (2004) *Complex adaptive systems (CAS)*. Battle Creek, MI, W.K. Kellogg Foundation.
- Eoyang, G.H. & Berkas, T.H. (1998) *Evaluation in a complex adaptive system*. Circle Pines, MN, Human Systems Dynamics Institute, p. 2010. Available at: http://www.academia.edu/830274/Evaluation_in_a_Complex_Adaptive_System_April_30_1998.
- Fabricius, C. & Koch, E. (Eds.) (2004) *Rights, resources and rural development: Community-based natural resource management in southern Africa*. London, Earthscan.
- Feenstra, G. (1997) Local food systems and sustainable communities. *American Journal of Alternative Agriculture*. 12, p. 1.
- Flood, R.L. (2010) The relationship of ‘systems thinking’ to action research. *Systemic Practice and Action Research*. 23(4), pp. 269–284.
- Flood, R.L. (1999) *Rethinking the fifth discipline: Learning within the unknowable*. London, Routledge.
- Flora, C.B. & Flora, J.L. (2004) *Rural communities: Legacy and change* (2nd ed.) Boulder, CO, Westview Press.
- Folke, C., Colding, J., & Berkes, F. (2003) Synthesis: Building resilience and adaptive capacity in social-ecological systems. In: Berkes, F., Colding, J., & Folke, C. (Eds.) *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. Cambridge, Cambridge University Press, (pp. 352–387).
- Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005) Adaptive governance of social-ecological systems. *Annual Review of Environmental Resources*. 30, pp. 441–473.
- Friere, P. (1972) *Pedagogy of the oppressed*. Harmondsworth, Penguin.
- Gardner, B. (2002) *American agriculture in the twentieth century: How it flourished and what it cost*. Cambridge, MA, Harvard University Press.
- Goldenberg, M.P. & Meter, K. (2019) Building multipliers rather than measuring them: community-minded ways to develop economic impacts. *Journal of Agriculture, Food Systems, and Community Development*. 8(3), pp. 153–164.
- Goldman, K.D. & Schmalz, K.J. (2005) ‘Accentuate the positive!’ Using an asset-based mapping tool as part of a community health needs assessment. *Health Promotion Practice*. 6(2), pp. 125–128.
- Goldschmidt, W. (1978) *As you sow: Three studies in the social consequences of agribusiness*. Montclair NJ, Allanheld, Osman.
- Gunderson, L.H. & Holling, C.S. (2002) *Panarchy: Understanding transformations in human and natural systems*. Washington, DC, Synopsis published by Island Press.
- Hay, I. (2016) *Qualitative research methods in human geography*. Oxford, Oxford University Press.
- Heffernan, W. (1999) *Consolidation in the food and agriculture system*. University of Missouri-Columbia, Report to National Farmers Union, 5 February.
- Holland, J.H. (1992) Complex adaptive systems. *Daedalus*. 121(1), pp. 17–30.
- Holland, J.H. (2006) Studying complex adaptive systems. *Journal of Systems Science and Complexity*. 19, pp. 1–8.
- Holling, C.S. (2001) Understanding the complexity of economic, ecological, and social systems. *Ecosystems*. 4, pp. 390–405.
- Hope, A. & Timmel, S. (1984) *Training for transformation*. Volumes 1–3. Harare, Mambo Press.
- Indiana Rural Legislators’ Caucus (2012) *Meeting at State Capitol in Indianapolis*, 18 January.

- Irwin, S. (2008) Data analysis and interpretation: Emergent issues in linking qualitative and quantitative evidence. In: Hesse-Biber, S.N. & Leavy, P. (Eds.) *Handbook of emergent methods*. New York, Guilford Press.
- Kania, J. & Kramer, M. (2011) Collective impact. *Stanford Social Innovation Review*. Winter. Available at: http://www.ssireview.org/articles/entry/collective_impact.
- Kania, J. & Kramer, M. (2013) *Embracing emergence: How collective impact addresses complexity* (pp. 36–41). Available at: http://www.ssireview.org/pdf/Embracing_Emergence_PDF.pdf.
- Kloppenborg, J., Hendrickson, J., & Stevenson, G.W. (1996) Coming into the foodshed. *Agriculture and Human Values*. 13(3), pp. 33–42.
- Koopmans, M. (2017) Perspectives on complexity, its definition and applications in the field. *Complicity: An International Journal of Complexity and Education*. 14(1), pp. 16–35.
- Kretzmann, J.P. & McKnight, J.L. (1993) *Building communities from the inside out: A path toward finding and mobilizing a community's assets*. Chicago, IL: ACTA Publications. Available at: <https://www.amazon.com/Building-Communities-Inside-Out-Mobilizing/dp/087946108X>.
- Lynch, J., Meter, K., Robles-Schrader, G., Goldenberg, M.P., Bassler, E., Chusid, S., & Austin, C.J. (2015) *Exploring economic and health impacts of local food procurement*. Minneapolis, MN, Crossroads Resource Center; Chicago, IL, Illinois Public Health Institute. Available at: www.crcworks.org/EHimpacts.pdf.
- Lyson, T. (2004) *Civic agriculture: Reconnecting farm, food, and community*. Medford, MA, Tufts University Press.
- Lyson, T. (2007) Civic agriculture. In: Hinrichs, C.C. & Lyson, T.A. *Remaking the American food system*. Lincoln, NE, University of Nebraska Press.
- Maretski, A.N. & Tuckermanty, E. (2007) Community food projects and food system sustainability. In: Hinrichs, C.C. & Lyson, T.A. *Remaking the American food system*. Lincoln, NE, University of Nebraska Press.
- McIntosh, R.J. (2000) Social memory in Mande. In: McIntosh, R.J., Tainter, J.A., & McIntosh, S.K. (Eds.) *The way the wind blows: Climate, history and human action*. New York, Columbia University Press, pp. 141–180.
- Meter, K. (1990) *Money with roots*. Minneapolis, MN, Crossroads Resource Center. Available at: www.crcworks.org/roots.pdf.
- Meter, K. (1998) *Neighborhood sustainability indicators guidebook*. Minneapolis, MN, Crossroads Resource Center. Available at: www.crcworks.org/guide.pdf.
- Meter, K. (2003) *Food with the farmer's face on it: Emerging community-based food systems*. Battle Creek, MI, W.K. Kellogg Foundation. Available at: www.crcworks.org/fface.pdf.
- Meter, K. (2007a) Linked indicators of sustainability build bridges of trust. In: Maida, C.A. (Ed.) *Sustainability and communities of place*. Oxford, Berghahn Books, pp. 183–200.
- Meter, K. (2007b) Evaluating farm and food systems in the U.S. In: Williams, B. & Imam, I. (Ed.) *Systems concepts for evaluation*. Point Reyes, EdgePress of Inverness, pp. 141–160.
- Meter, K. (2010) Letting food systems emerge: How do we measure progress in an emergent system? *Journal of Agriculture, Food Systems, and Community Development*. 1(1), pp. 23–26.
- Meter, K. (2012) *Hoosier farmer? Emergent food systems in Indiana*. Minneapolis, MN, Crossroads Resource Center. Available at: <http://www.crcworks.org/infood.pdf>.

- Meter, K. (2014) Co-ops and collective impact. *Journal of Agriculture, Food Systems, and Community Development*. 4(3), pp: 11–14. Available at: <http://dx.doi.org/10.5304/jafscd.2014.043.014>.
- Meter, K. (2016) *Northeast Indiana Local Food Network – Phase 1 Report*. Minneapolis, MN: Chicago IL, Manheim Solutions. Available at: <http://www.crcworks.org/innetworks16.pdf>.
- Meter, K. & Goldenberg, M.P. (2017) *Hawai'i food for all*. Minneapolis, MN, Crossroads Resource Center. Available at: <http://www.crcworks.org/hifood.pdf>.
- Meter, K. & Goldenberg, M.P. (2018) *Building community networks through community foods*. Minneapolis, MN, Crossroads Resource Center. Available at: <http://www.crcworks.org/azmaricopa18.pdf>.
- Midgley, G. (2007) Systems thinking in evaluation. In: Williams, B. & Imam, I. (Eds.) *Systems concepts in evaluation*. Point Reyes, EdgePress of Inverness, pp. 11–34.
- Montouri, A. (2008) Forward: Edgar Morin's path of complexity. In: Morin, E. (Ed.) *On complexity*. Cresskill, NJ, Hampton Press.
- Morin, E. (1992) From the concept of system to the paradigm of complexity. *Journal of Social and Evolutionary Systems*. 15(4), pp. 371–384.
- Morin, E. (2008) *On complexity*. Cresskill, NJ, Hampton Press.
- Nelson, C.H. & Stroink, M.L. (2014) Accessibility and viability: A complex adaptive systems approach to a wicked problem for the local food movement. *Journal of Agriculture, Food Systems, and Community Development*. 4(4), pp. 191–206.
- Prosperi, P., Allen, T., Cogill, B., Padilla, M., & Peri, I. (2016) Towards metrics of sustainable food systems: A review of the resilience and vulnerability literature. *Environment Systems & Decisions*. 36, pp. 3–19.
- Prosperi, P., Moragues-Faus, A., Sonnino, R., & Devereux, C. (2015) *Measuring progress toward sustainable food cities: Sustainability and food security indicators*. Cardiff, Cardiff University School of Planning and Geography. Available at: <http://sustainablefoodcities.org/getstarted/developingindicators>.
- Putnam, R.D. (1993) The prosperous community: Social capital and public life. *The American Prospect*. 13(Spring), pp. 35–42. Available at: http://www.prospect.org/cs/articles?article=the_prosperous_community.
- Rittel, H.W.J., & Webber, M.M. (1973) Dilemmas in a general theory of planning. *Policy Sciences*. 4(2), pp. 155–169.
- Rocheleau, D.E. (1994) Participatory research and the race to save the planet: Questions, critique, and lessons from the field. *Agriculture and Human Values*. Spring–Summer, pp. 4–25.
- Rotmans, J. & Loorbach, D. (2009) Complexity and transition management. *Journal of Industrial Ecology*. 13(2), pp. 1–13.
- Savin-Baden, M. & Major, C.H. (2013) *Qualitative research: The essential guide to theory and practice*. London, Routledge.
- Shorten, A. & Smith, J. (2017) Mixed methods research: Expanding the evidence base. *Evidence Based Nursing*. 20(3), pp. 74–75.
- Stevenson, G.W., Clancy, K., King, R., Lev, L., Ostrom, M., & Smith, S. (2011) Midscale food value chains: An introduction. *Journal of Agriculture, Food Systems, and Community Development*. 1(4), pp. 27–34.
- Stevenson, G.W., Ruhf, K., Lezberg, S., & Clancy, K. (2007) Warrior, builder, and weaver work. In: Hinrichs, C.C. & Lyson, T.A. (Eds.) *Remaking the American food system*. Lincoln, NE, University of Nebraska Press.

- Stroink, M.L. & Nelson, C.H. (2013) Complexity and food hubs: Five case studies from northern Ontario. *Local Environment*. 18(5), pp. 620–635.
- Swanson, D. & Bhadwal, S. (2009) *Creating adaptive policies*. International Development Research Centre. New Delhi, Sage.
- Thilmany McFadden, D., Conner, D., Deller, S., Hughes, D., Meter, K., Morales, A., Schmit, T., Swenson, D., Bauman, A., Goldenberg, M.P., Hill, R., Jablonski, B.B.R., & Tropp, D. (2016) *The economics of local food systems: A toolkit to guide community discussions, assessments and choices*. Washington, DC, US Department of Agriculture Agricultural Marketing Service.
- US Agricultural Marketing Service (AMS). US Department of Agriculture. Available at: <https://www.ams.usda.gov/>.
- US Bureau of Economic Analysis (series). US Department of Commerce. Regional Economic Accounts. Available at: <https://www.bea.gov/regional/index.htm>.
- US Bureau of Labor Statistics (series). US Department of Labor. Consumer Expenditure Survey. Available at: <http://www.bls.gov/cex/home.htm>.
- US Center for Disease Control and Prevention (series). Behavioral Risk Factors Surveillance System (BRFSS). Available at: <https://www.cdc.gov/brfss/index.html>.
- US Economic Research Service (ERS) (series). *Agricultural Productivity in the U.S.* US Department of Agriculture. Available at: <https://www.ers.usda.gov/data-products/agricultural-productivity-in-the-us/>.
- US Economic Research Service (ERS) (series). *Agricultural Resource Management Survey (ARMS)*. US Department of Agriculture. Available at: https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Ag_Resource_Management/.
- US Economic Research Service (ERS) (series) *Corn Production Costs and Returns per Planted Acre, excluding Government payments, 1996–2016. Data for the Heartland (central Midwestern states)*. US Department of Agriculture. Available at: <https://www.ers.usda.gov/data-products/commodity-costs-and-returns/>.
- US Economic Research Service (ERS) (series) *Farm Household Income and Characteristics*. US Department of Agriculture. Available at: <https://www.ers.usda.gov/data-products/farm-household-income-and-characteristics/>.
- US Economic Research Service (ERS) (series) *Farm Income and Wealth Statistics*. US Department of Agriculture. Available at: <http://ers.usda.gov/Data/FarmIncome/finfidmu.htm>.
- US Economic Research Service (ERS) (series). *Food Consumption Data*. US Department of Agriculture. Available at: <http://www.ers.usda.gov/data/foodconsumption/>.
- US Federal Reserve Bank of Minneapolis (n.d.) *Consumer Price Index, 1913 – present*. Available at: <https://www.minneapolisfed.org/community/financial-and-economic-education/cpi-calculator/consumer-price-index-and-inflation-rates-1913>.
- US National Agricultural Statistics Service (series). *Census of Agriculture*. US Department of Agriculture. Available at: <http://www.nass.usda.gov/census/>.
- White, B. (2014) Comments to State of Indiana. Indiana Grown Commission. 17 September. Indianapolis, IN.
- Williams, B. (2005) Soft systems methodology. Report for the Kellogg Foundation, Battle Creek, MI. Available at: www.bobwilliams.co.nz/ewExternalFiles/ssm.pdf.
- Wiskerke, J.S.C. & Viljoen, A. (2012) Sustainable urban food provisioning: Challenges for scientists, policymakers, planners, and designers. In: Viljoen, A. & Wiskerke, J.S.C. (Eds.) *Sustainable food planning: Evolving theory and practice*. Wageningen, Netherlands, Wageningen Academic Publishers.