

Introduction to the Symposium on American Food Resilience (Part 2)

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Abstract The security of the US food supply faces unprecedented challenges due to changes in our food system and the environment during recent decades. The 27 articles in the Symposium on American Food Resilience examine the resilience of food production and distribution – the system’s ability to withstand shocks or stresses that could lead to disruption of the food supply. Four central questions provide a framework:

1. What are the main lines of vulnerability and how do they function?
2. What are leverage points for reducing the risks and improving the capacity to cope with breakdowns?
3. What is already being done by government, civil society, and the private sector?
4. What can scientists, teachers, and other professionals do through research, education, community action, or other means to make the food system more resilient?

The Symposium is in two parts. Part 1, which was published in the last issue of this Journal, laid out a conceptual framework and surveyed the problems. Part 2, which is in this issue, focuses on solutions. Paradigm shift is a major theme in Part 2. It revolves around two key ingredients:

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1. Conflict between the prevailing “industrial” paradigm and sustainability
2. The scale of food system operations, and the contribution that more resilient regional food systems can make to the security of our food supply

Concrete details are provided by case studies from New England, Ohio, North and South Carolina, and Wisconsin, where researchers or nonprofit organizations have collaborated with food system practitioners to strengthen and diversify regional food production and food supply chains. A case study from Washington applies the diversity perspective to a strategic analysis of regional capacity for disaster response. Resilience planning in Australia features strategic policy analysis with quantitative techniques such as linear programming optimization and system dynamics, which can profitably be employed elsewhere as well. Together, the Symposium articles provide a bounty of material that can be mined by researchers, teachers, policy makers, farmers, and other food system practitioners for application to their own circumstances.

Keywords Food system · Food security · Food supply · Food supply chains · USA · Diversity · Resilience · Sustainability · Regional scale · Paradigm shift · Strategic analysis · Policy

Introduction

The resilience of the American food system—its ability to withstand shocks or stresses that could lead to disruption of the food supply—is a matter of genuine concern (Marten and Atalan-Helicke 2015). While all seems well with supermarkets stocked to the brim, changes in the

food system and the environment during recent decades have created uniquely 21st century challenges to the security of the food supply—and crises that are no longer hypothetical (see for example Keppen and Dutcher 2015). It is difficult to get a clear grip on this topic because the food system is so complex, and failure could take forms never seen before. It is easy for wishful thinking to prevail, but the stakes are high.

The 27 articles in the Symposium on American Food Resilience (Marten and Atalan-Helicke 2015) explore the vulnerability and resilience of food production and distribution from a variety of perspectives, providing a bounty of material that can be mined by researchers, teachers, policy makers, farmers, and other food system practitioners for application to their own circumstances. Four central questions provide a framework for the exploration:

1. What are the main lines of vulnerability in the food system?
2. What are leverage points for reducing the risks and improving the capacity to cope with breakdowns?
3. What is already being done by government, civil society, and the private sector?
4. What can scientists, teachers, and other professionals do through research, education, community action, or other means to make the food system more resilient?

The symposium is in two parts. Part 1, which consists of 13 articles, was published in the *Journal of Environmental Studies and Sciences*, volume 5, number 3 (September, 2015). Part 2, which contains 14 articles, is in this issue. While the articles in both parts address problems and solutions, Part 1 focuses more on problems, reviewing vulnerabilities and how they can engender crises, while Part 2 focuses more on solutions.

Part 1 begins by setting the scene with a framing of the food system and its vulnerabilities (Marten and Atalan-Helicke 2015; Stave and Kopainsky 2015) and applying political-economic analysis and resilience theory to explore theoretical perspectives on resilience (Jacques 2015; Hodbod and Eakin 2015). This is followed by a review of the implications and consequences of prominent changes during recent decades: climate change (Keppen and Dutcher 2015; Lengnick 2015), consolidation of food supply chains (Rotz and Fraser 2015; Hendrickson 2015), and the decline of food storage (Fraser et al. 2015). The remaining articles in Part 1 recount experiences and lessons learned when shocks such as severe storms (MacMahon et al. 2015), nuclear-reactor disaster (Belyakov 2015), or war (Maltz 2015) have disrupted the food supply. Simulated experiences with a computer model assess the expected

impact of an influenza pandemic on food supply and suggest ways to reduce the risks (Huff et al. 2015).

The emerging significance of regional food systems

The role of regional food systems is a prominent theme in Part 2. Each article explores, in its own way, the idea of stronger and more resilient regional food systems, the benefits to be expected, and the contribution that resilient regional food systems can make to the security of our food supply. For years, alternative food system initiatives aimed at compensating for shortcomings in the mainstream food system have been associated with the local food movement. While it makes sense to address local needs with local action, local areas also have their limitations. As a consequence, alternative food system development has begun to shift in recent years to the regional scale with the expectation that a larger area can provide benefits that local areas alone cannot provide.

How realistic are the expectations associated with regional food systems? There is plenty of scope for clarification. The articles in Part 2 provide insights with regard to some critical questions:

- What does “regional” mean operationally? What is a useful basis for delineating food system regions (e.g., metropolitan areas, watersheds, climatic zones)?
- What benefits can stronger regional food systems truly offer? What are weakness and limitations of the regional scale?
- Concretely, what kinds of changes will be necessary to realize the benefits? What are the design characteristics of functional, sustainable, and resilient food systems?
- How can such changes realistically be achieved? What are obstacles in the mainstream food system, which is a product of powerful social and economic forces that have made it what it is today? What are levers for positive change?
- What can environmental and food system professionals do in collaboration with food system practitioners to facilitate constructive action?

Paradigm shift

The first four articles in this issue (Anderson 2015; Dyball 2015; Lengnick et al. 2015; Tolley et al. 2015) set the stage with conceptual frameworks that highlight the need for paradigm shift. Fundamental changes are in order to the extent there are serious shortcomings in the current system. Each article describes the prevailing paradigm for its particular take on the mainstream food system, pointing to a more sustainable

and resilient paradigm. Together, these articles provide a basis for contemplating coherent alternatives.

Anderson (2015) provides a conceptual basis for food system classification that can be helpful for many of the issues under consideration in this Symposium. The framework is based on two dimensions of food system organization:

1. The scale of a food system, extending from “fragmented” (i.e., predominance of the local scale) to global and strongly integrated
2. The breadth of signals to which the system responds, ranging from “industrial” food systems that respond primarily to economic signals to food systems that are broadly multifunctional

Anderson explains how different parts of the conceptual space formed by these two dimensions correspond to different paradigms, different ways the system functions, and different roles for knowledge. She argues that multifunctional food systems, which are more desirable from a resilience perspective, are more attainable with knowledge that is transparent and openly accessible and the knowledge itself adaptive and resilient. She presents a case study of a new governance system, the Committee on World Food Security, which is trying to generate, encourage, and use resilient knowledge.

Dyball (2015) compares food production and consumption in three metropolitan regions: Canberra, Copenhagen, and Tokyo. Only a small fraction of the food consumed in each of these regions is actually produced in the region. Most of the region’s food production is exported elsewhere, and most of the food consumed in the region is imported from outside the region. Because of the disconnect between urban food consumers and distant food sources, food choices of urban consumers can create market signals that undermine the sustainability of those distant food sources on which consumers depend. Dyball argues for a paradigm shift to “biosensitivity,” in which consumers are aware of where their food comes from in a way that leads to more sustainable choices. One way to enhance biosensitivity is involvement of consumers in their local food system. Not only will involvement directly increase the consumption of food produced in the region, it can also instill biosensitivity as consumers establish personal relationships with food producers and rethink their values and practices with regard to food procurement, food preparation, and other aspects of their food experience.

Following up on Lengnick’s (2015) contention that “industrialization” and geographic specialization of American agriculture have degraded the nation’s capacity to adapt to climate change, Lengnick et al. (2015) recommend a paradigm shift based on two fundamental changes:

1. Transformation of food production from industrial to sustainable
2. Transformation of food system geography from regional specialization to diversity within regions

They explore the resilience benefits of a nationally integrated network of sustainable regional food systems oriented to major metropolitan areas—metropolitan foodsheds—and spell out resilience design principles and performance indicators for metropolitan foodsheds. Well-established guidelines for resilience involving diversity, modularity, and a functional balance of natural and human assets can show the way. The guidelines are illustrated by success stories of resilient farms that manage a high level of diversity and integrate their products into food supply chains designed to accommodate that diversity while serving local, regional, and national markets.

Tolley et al. (2015) describe how contemporary international fish marketing and the history of federal government management of the New England fishery for cod, haddock, and flounder have led to domination of that fishery by large-scale industrial fishing operations, high volume/low value fishing that is unsustainable, decline of local fishermen who have the knowledge and motivation to fish sustainably, and recurring collapse of the fish stocks. The Fish Locally Collaborative, a decentralized network of fishermen and their communities, has promoted a paradigm shift to quadruple bottom line accounting (social, economic, environmental, and regional food system impacts), low volume/high value fishing, and consumption of lesser-known fish species to motivate more balanced and ecologically sustainable fishing. The Fish Locally Collaborative has worked for the survival of local fishermen by reestablishing viable regional marketing with “community-supported fisheries” and institutional food procurement that specifies local and sustainable catch. The problems, solutions, and insights in this story apply not only to fisheries but also to land-based food systems.

Collaborative regional food system development

The next five articles (MacFall et al. 2015; Hoy 2015; Atalan-Helicke 2015; Ruhf 2015; Dunning et al. 2015) focus on particular aspects of regional food system development, including collaboration of universities or nonprofit organizations with food system practitioners to catalyze sustainability and resilience. A common theme in the articles is the benefits to be expected from greater *diversity* in food production, processing, and distribution. However, there is more to diversity and resilience than the redundancy achieved by putting eggs in more than one basket. It is about *connections*: how diversified agriculture and diversified food supply chains are structured

and aligned and function together. Details in the articles throw light on how this works in practice.

MacFall et al. (2015) use examples of successful initiatives in North and South Carolina to show how diversity of food production and distribution can improve resilience. Carefully planned on-farm diversity using techniques such as “biointensive cultivation” can improve sustainability and resilience by increasing water-use efficiency and nutrient retention while reducing damage from pests and pathogens. A diversity of farm products then supports a more diverse and resilient regional network of food aggregators, processors, wholesalers, and retailers, improving consumer access to food by providing more choice, and expanding skilled jobs to foster economic viability. A case study of the North Carolina Piedmont region illustrates networked sharing of information about market opportunities, innovative practices, and government regulations. A South Carolina food hub demonstrates how a diverse regional network for food production and distribution can help achieve multiple goals of sustaining environmental diversity, diversifying local agricultural production, and supporting rural development. The article provides explicit guidelines for creating diversified regional food production and distribution networks.

Hoy (2015) explores mutually reinforcing relationships between “agroecosystem health,” adaptability, and resilience. Agroecosystem health—the ability of farm landscapes to meet human needs on a sustainable basis—involves not only crops, livestock, and the physical landscape but also economic and social dimensions, all of which can be assessed quantitatively. Because diversity can contribute substantially to agroecosystem health, the Agroecosystems Management Program at Ohio State University has embarked on research and outreach to improve diversity, agroecosystem health, and food security by facilitating the development of self-organizing social networks connecting farmers with local and regional food supply chains. A major goal is to support a diverse population of entrepreneurs who can launch a wide range of innovative production or food supply chain enterprises at a range of scales, including small enterprises featuring differentiated products sold through short and more localized supply chains.

Atalan-Helicke (2015) examines the vulnerability of the seed system and how seed exchange networks in civil society, business, or a combination of the two can help enhance food system resilience. Although seed exchanges are not new, strong institutional seed exchange initiatives have recently increased at local, regional, and national scales, serving not only gardeners but also a growing number of organic farmers. Seed exchange networks foster favorable conditions for the conservation of genetic resources; close the gap between plant breeding, seed provision, and cultivation; create economic value for agricultural biodiversity; build partnerships for institutional change; augment resilience to climate change with the

exchange of regionally adapted seeds; and generate opportunities for developing low-input and other innovative approaches to sustainable and resilient agriculture.

Ruhf (2015) describes collaborative initiatives of government, civil society, and the private sector in New England to increase regional self-reliance and reduce the risks of short-term or long-term disruption of food supply. The article explains how regional food system visioning, food policy councils, and regionally focused institutional food procurement have fostered markets for regionally produced food and helped improve farm viability and farming opportunities. While the New England region does not have the climate and agricultural land base to meet all the food needs of its large urban population, it does have the potential to meet a greater percentage of those needs. More land in agriculture, enhanced diversity and flexibility, supportive public policies, appropriately scaled food supply chains, the trust among food system players so essential for durable institutions and infrastructure, and cooperation among the six states in the region can all contribute to greater food security.

Dunning et al. (2015) show how connections between the local food movement and the mainstream food system can promote resilience by diversifying food production and distribution and enhancing communications across scale and function to generate local/regional feedback loops that promote adaptation. The Center for Environmental Farming Systems at North Carolina State University has established public/private partnerships to integrate regional food production into institutional food service and supermarket chains, with support for producer and buyer capacity building and horizontal and vertical supply chain networking and peer-learning. Consumer demand generated by the local food movement provides the motivation for engagement of business partners with university research and extension staff to pilot novel food procurement and distribution techniques, expanding the diversity of sources and channels through which food reaches end markets and creating redundancies that enhance food system security and resilience.

Strategic analysis for resilience

The next two articles (Miller and Solin 2015; Paci-Green and Berardi 2015) are case studies that illustrate resilience problem solving. Miller and Solin (2015) explain how environmental scientists and teachers in Wisconsin have collaborated with farmers and consumers to use structured and networked storytelling for dealing with food system challenges. This kind of storytelling can help people to comprehend their role in the food system, make them aware of their responsibility for the health of the system, and assist them to be more effective and

adaptive, thereby rendering themselves and the system more resilient. Three cases provide examples:

1. Apple farmers in the upper Mississippi Valley have used structured and networked storytelling to develop strategies for dealing with extreme weather events and engage in technical innovations such as reducing pesticide use.
2. Farmers, their food supply chain partners, and researchers in the region between Chicago-Milwaukee and Minneapolis-St. Paul have shared experiences and developed applied research questions as they embark on marketing to these metropolitan areas.
3. Storytelling has helped children to engage in discussions about agricultural ethics and develop civic management skills.

Paci-Green and Berardi (2015) describe the interruption of food supply to be expected in the Pacific Northwest after a major earthquake and accompanying tsunami that severely damage harbors, highways, and other transportation corridors. Although Western Washington is highly dependent on food imported from outside the region, regional food production has the potential to fill the food supply gap until transportation channels are restored, provided there is a regional strategy for food production, processing, and storage that stocks sufficient food on a routine basis. The strategy can be strengthened by agricultural diversification, public awareness, and government policies that support healthier diets and storage of whole grains, dry beans, and tree nuts produced in the region.

The last two articles in Part 2 (Ward 2015; Candy et al. 2015) use quantitative techniques for strategic policy analysis in support of resilience. While each article applies its methodology to a specific geographic area, the same methods can be powerful tools for resilience planning elsewhere.

Ward (2015) uses linear programming optimization to assess the potential of Adelaide, Australia, to meet its food needs with urban agriculture, using land and other resources available within the city. The optimization methodology identifies the best mix of specific crops and urban livestock to meet specific goals such as a diverse and healthy diet, lower family grocery expenses, and filling the gap in the event of a short-term or long-term shortfall in food supply from outside the region. Optimal solutions show not only how to do it but also how well the goals can be met. The same methodology can be extended to the entire region around the city to explore what foods would best be produced in the region, not only for sale outside the region but also to supply the city, and how much of the city's food consumption would have to come from outside the region.

Candy et al. (2015) use “system dynamics” modeling (Stave and Kopainsky 2015) to generate scenarios exploring how the Victoria, Australia, regional food system can be expected to respond to shocks or long-term stresses

such as drought, depletion of irrigation water, or increase in petroleum or fertilizer prices. The scenarios explore the implications of a range of policies for food system organization including:

- Alternative agricultural technologies for more resource-efficient, lower-input food production
- Government involvement ranging from strong investment and regulation in the food system to more laissez-faire policies that leave sustainability and resilience to the private sector and free market
- The scale of solutions, varying from centralized and global to decentralized and local

While the scenarios show that some policies can lead to serious deterioration of future food supply, they also point to strategies with promise for adapting to and dealing with the challenges.

Conclusion

What can we take away from all the articles in the Symposium on American Food Resilience to guide research and action? An article addressing this question will be in the next issue of the *Journal of Environmental Studies and Sciences*.

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