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Abstract

Concentration and consolidation in production, distribution, and retailing have arguably reduced the diversity of US food supply and distribution channels, thus introducing vulnerabilities into the food system. This paper addresses the question of what can be done to make the system more resilient to shocks that can disrupt food supplies. We suggest that the interest connected to the local food movement extant in a wide-ranging set of public and private groups, as well as among a widening base of consumers, creates a unique opportunity to strengthen food system resiliency. We specifically focus on the supply and distribution systems of supermarket retailers. Supermarkets are major drivers of the modern food system, with US and global consolidation positioning grocery retailers as both oligopolistic sellers and oligopsonistic buyers of food. We discuss the opportunities and challenges to diversifying supermarket procurement and distribution through localization, and suggest that such a shift can be most successful if it is facilitated by public/private partnerships to address the logistical challenges and system changes needed. We provide an example of one such public/private partnership in the context of the work of the Center for Environmental Farming Systems (a collaboration between two North Carolina land grant universities) which has partnered with a regional supermarket to facilitate and promote the sourcing of local products. The substantive activities of the partnership—capacity-building training for growers and buyers; networking and peer-learning activities and site tours; support for MBA research teams and undergraduate internships; piloting and subsequent evaluation of novel distributional techniques—are ones that can be enacted by researchers, instructors, and advocates in partnership with

supermarkets and other food businesses to build more resilient systems of food procurement and distribution. Discussion of the project provides tangible examples of how public and private entities holding shared interests in local agriculture can partner as part of a holistic approach to diversifying and strengthening the food system.
Keywords: food system, local food, resiliency, public-private partnerships, social change, supermarkets, university

Introduction

Based on the criteria of low production and distribution costs, the US mainstream food system can be described as highly efficient. Many of these efficiencies derive from the economies of scale associated with large food producers, distributors, and retailers. However, this system has also been criticized for the negative outcomes it engenders, including environmental degradation, market exclusion of small and mid-scale producers who farm the majority of U.S. farmland, and the inadequacy of the current system to equitably provide affordable, healthy foods across the economic spectrum. Changing climatic conditions have also exposed the risks of food production concentrated in a few specific geographic areas. As a result, alternative agri-food initiatives have taken hold in the past few decades, including the localization of food production, distribution, and consumption, a phenomenon known as "the local food movement."

Corporate concentration and consolidation in food production, distribution, and retailing have arguably reduced the diversity of supply and distribution channels, thus introducing vulnerabilities into the food system. Even in the current system, however, there are locations where local food advocates, researchers, and educators can engage and

form partnerships with businesses in ways that mutually benefit both corporate systems and the alternatives that have grown in opposition to them. For example, large-scale distributors and retailers seek to localize their procurement to appeal to consumer demand and build market share at the same time that local food system proponents pursue connections to larger-scale markets to expand the benefits of local food systems to a wider range of consumers and mid-scale producers (Friedmann 2007; Mount 2012). Viewed from either perspective—enhancing business profitability, or expanding availability of locally produced food—localizing food supply chains has the potential to enhance food system resiliency by building redundancy (in the sense of system-strengthening duplication) and diversity into the production and distribution of food. Both of these hallmarks of resiliency reduce the negative effects of concentration and consolidation in food supply chains, thereby decreasing the potential for system disruption. At the same time, localization increases knowledge sharing across regions and scales by involving a wider range of businesses along the food supply chain. This enhances the capacity of the mainstream food system for learning and adaptation to local conditions.

This paper begins by considering the effects of business consolidation and centralization in the supermarket industry. We focus on this sector because of the profound influence of supermarkets on the locus of production and system of procurement and distribution of food (Gereffi 1994; Gereffi & Lee 2012; Konefal et al. 2007; Lawrence & Burch 2007). We then move to a consideration of how the local food movement can engage with the mainstream food system in ways that promote resiliency through diversification in the means of supply and distribution of food, and by setting the

stage for knowledge exchange and system adaptation. We use the Center for Environmental Farming Systems (CEFS) as an example of an organization where activities broadened from a focus solely on alternative production methods to recognition of the need to engage with the businesses and infrastructure all along the food supply chain. Finally, we provide some observations from CEFS' North Carolina Growing Together project and its experiences working with a regional supermarket chain to demonstrate how researchers, advocates and educators can engage with mainstream businesses. We conclude with a consideration of the strengths and weaknesses of the mainstream retailing system for promoting food system resiliency, and suggest that transformative change likely won't occur by solely working outside of this system, but rather by engaging with it and utilizing key infrastructure while modifying structures and processes to accommodate more resilient practices.

Supermarket Retailing in the US: Consolidation of Supply and Distribution

Supermarkets are arguably the major drivers of the modern food system, with US and global consolidation positioning grocery retailers as both oligopolistic sellers and oligopsonistic buyers of food (Harvey 2007; Konefal et al. 2007; Konefal, Mascarenhas, & Hatanaka 2005; Lawrence & Burch 2007; Sexton 2000). The concentration ratio for U.S. supermarkets, measured by the percent sales of the top four sellers (Wal-Mart, Kroger, Albertsons, and Safeway), is estimated at 42-51 percent (James, Hendrickson, & Howard 2013). The potential precariousness of relying on a few suppliers is masked by retailers' use of different store names, even though various chains are owned by the same parent company (e.g., Kroger owns chains Harris Teeter, Ralphs, and Food4Less, among others). With over 90 percent of the food eaten at home bought at supermarkets ("Retail

Trends" 2014), this means that close to a majority of food consumed in American homes is purchased from just four large retailers.

Much of the competitive economic pressure leading to consolidation in the US derives from the entrance of Wal-Mart into food retailing (Biles 2006; Gereffi & Christian 2009; Konefal et al. 2007). Wal-Mart's entry into the grocery sector in the 1990s led to an era of consolidation through mergers and acquisitions as smaller grocery chains sought to achieve the kind of economies of scale, infrastructure, control over logistics, tracking technologies, and bargaining power that allowed Wal-Mart to achieve its "everyday low prices" in grocery items (Konefal et al. 2007; Wrigley 2001). The "Wal-Martization" of the grocery sector manifests in the dominant technological, communication, and physical infrastructure of procurement and distribution, and in the related relationships and practices that characterize food markets (Christopherson 2007; Gereffi & Christian 2009). For example, the development of the supermarket industry's distribution system derives in part from Wal-Mart's early expansion strategy; the company originally targeted rural areas that lacked reliable infrastructure, and Wal-Mart opened its own distribution centers to facilitate its ability to purchase in large volumes (Lichtenstein 2009). Today, the movement of most grocery items in the U.S. is structured around this type of hub and spoke system of Regional Distribution Centers (RDC) linked via communication and logistics technologies to cost-effectively connect procurement, transportation, inventory, and sale of commoditized products. Larger supermarket chains such as Wal-Mart gain purchasing and distributional efficiency through vertical integration, meaning that they own and operate their own RDCs. Smaller chain

supermarkets and independent supermarkets more often rely on stand-alone RDCs or those owned by other chains.

Because of its high perishability and thus short shelf life, fresh produce was one of the last items to become part of the RDC system, with a structural shift from reliance on independent local and regional wholesalers sourcing produce from growers for direct delivery to stores, to a subsuming of the procurement, warehousing and distributional functions within RDCs. RDCs now procure produce directly from very large grower/shippers, enter selectively into contracts with these entities, and enforce safety and quality standards as demanded by the retailers. RDCs also manage the information systems soliciting supermarket produce orders to facilitate "just-in-time" delivery of products from the RDC to the store (Lichtenstein 2009). Consolidation and centralization has decreased the number and variety of entry points into grocery retailers, while increasing the size of RDCs (Harvey 2007; Sexton 2000). This is true for supermarket chains that are national or near-national in scope, the scores of smaller regional chains (with 10 to approximately 100 stores under one management structure), as well as independent supermarkets (those having less than ten stores under one management structure).

The impact of this change in procurement and distribution practices and shift in power dynamics from producers to retailers (and to the RDCs as the retailers' buying and logistics agents) has reconstructed sourcing strategies and buyer-vendor relationships (Gereffi 1994; Gereffi & Lee 2012). In the fresh produce market, for example, to reduce transaction costs associated with setting up and managing new vendors, and to maximize volume discounts and transportation savings, supermarkets and RDCs prefer large-scale

vendors in the form of single, very large grower-shippers, or specialized wholesalers that focus on a very narrow range of products. RDCs prefer, and have the market power to demand, produce vendors capable of delivering large quantities of product within a very narrow range of quality standards specified by the RDC to meet supermarket requirements, and enforced by the RDC through product rejection at the RDC door. Smaller growers have less financial tolerance for rejected loads of product, and are less likely to operate at a scale that can compete with large-scale producers specializing in single crops. Additionally, vendors pay fees to be established in the RDC procurement system, and typically must maintain costly certifications, such as those associated with food safety and traceability. This new grocery industry reality has vastly reduced the ability of small and mid-sized produce farmers to compete against larger growers and grower/shippers in the retail grocery chain market. As a result, the diversity of sources of produce is diminished, with much of the produce sold in major US grocery chains derived from very large fruit and vegetable operations in Mexico, California, and Florida.

The changes in retailing described here are part of larger political/economic shifts in how the global agri-food system is structured. A handful of corporations have emerged to dominate food markets, and they employ standards and other mechanisms that determine supply chain dynamics, on-farm growing conditions, and which growers can participate in their supply chains (Busch & Bain 2004; Henson & Reardon 2004; Konefal et al. 2005; Smythe 2009). These developments have also generated a substantial amount of resistance, leading consumers and Non-Governmental Organizations (NGOs) to increasingly identify demand-pull dynamics in the food system, in the form of shopper-choice, as an important leverage point for effecting more general economic and social

reforms (Freidberg 2004). In the following sections we describe the growing popularity of the local food movement and how environmental researchers and practitioners can leverage the movement to enhance the food system's capacity to buffer against and adapt to changing conditions.

Mainstream and Local Food Systems: Resiliency through Localization

The emerging popularity of local food can be understood within the context of alternative agri-food movements that aim to address the external environmental and social costs of industrialized farming methods through the development of alternative production systems, markets, and market-based mechanisms (Allen & Hinrichs 2007; Delind 2006; Feenstra 1997; Guthman 2004). The local food movement has been described as a reaction to the increasingly global and corporate nature of the mainstream food system, as well as to the perceived cooptation of the organic movement through corporate influence over the institutionalization of government standards (Delind 2006; Guthman 2007). Local food systems are seen to counter the facelessness of the mainstream food system by embedding economic transactions within the environmental and social conditions of particular places, largely by reinforcing relationships through direct marketing initiatives (Allen & Hinrichs 2007; Feenstra 1997; Kloppenburg Hendrickson, & Stevenson 1996). Proponents cite economic, environmental, and health benefits that are derived by keeping food dollars within local economies, supporting smaller-scale farms, and increasing consumer awareness of the provenance of their food (Creamer & Dunning 2012; R. P. King, Gómez, & DiGiacomo 2010). While consumers' individual perceptions of the meaning of local vary, including associations to enhanced health or environmental sustainability, the location of production remains relevant to all

definitions. Consumers tend to identify local product as sourced at no larger a geographic footprint than the state (or across state lines in the case of border communities), and often much smaller geographic niches (Brown 2003; Campbell 2011; Ostrom 2006; Thilmany, Bond, & Bond 2008).

In order to broaden access to local food and its benefits across a wider range of producers and consumers, many researchers and practitioners have called for local food systems to "scale-up," for example developing value-added supply chains or engaging with mainstream intermediaries and markets (Bloom & Hinrichs 2011; Friedmann 2007; Mount 2012). Some local food system proponents, however, question whether or not the implicit values of local food systems, and indeed their classification as an "alternative," can be maintained during this scaling-up process (Mount 2012). These criticisms highlight concerns that the mainstreaming of alternative agri-food initiatives often causes them to revert to prioritizing economic outcomes over social values, thus undermining their ability to challenge the structures within which they are embedded. This has been seen in the cases of Fair Trade and organic standards, which some claim have been coopted by corporate interests that jeopardize the standards' ability to protect and promote small and mid-sized farmers (Jaffee & Howard 2009). Other questions about the feasibility of scaling-up concern the actual ability of small-scale producers to be competitive in larger markets because, as noted in the prior section, they often lack economies of scale and infrastructural resources to keep their prices low enough to effectively compete with larger growers. Research including case studies of successful cross-scale business relationships have indicated, however, that growers, intermediaries, and consumers participate in both alternative and mainstream systems, and thus evidence

the potential for hybrid marketing and purchasing strategies that leverage both systems in order to remain viable (Bloom & Hinrichs 2011; Ilbery & Maye 2005; R. P. King et al. 2010).

The alternative agri-food movement's focus on local food and interest in "scaling up" has grown at the same time that supermarket retailers have turned to the use of differentiation strategies to achieve a competitive advantage as competition based on price lessens due to the widespread use of similarly efficient logistics systems (Busch & Bain 2004; Euromonitor 2014; Fearne & Hughes 2000; Food Marketing Institute 2012). As consumer demand for local products grows, supermarkets are increasingly interested in offering source-identified products, such as local food, in order to differentiate themselves from their competitors. This harmony of objectives and interests, if not ultimate goals and missions, provides opportunity for partnership and food system change.

The local produce procurement practices of some smaller-scale and regional supermarkets pre-date the more recent local food trend. For example, Wegmans, a regional chain with stores in five Mid-Atlantic states, developed its local produce program twenty years ago and reports that 30 percent of its produce sales during the summer months comes from products that are delivered directly to stores from local farms (R. P. King et al., 2010). In the pre-season Wegmans' produce buyers meet with local growers to determine varieties and volumes desired (R. P. King et al., 2010).

In comparison to Wegman's long-standing local procurement program, interest in local produce for national chains such as Wal-Mart is a relatively recent development, although individual stores may have been sourcing produce from nearby farms for many

years. For Wal-Mart, local produce sourcing is subsumed under its sustainability initiative, and while the company announced its local sourcing initiative in 2008, it wasn't until 2010 that it announced the specific goal of doubling its purchase of local products by 2015 ("Global Sustainable Agriculture Goals" 2010). Wal-Mart came close to achieving this goal in 2012 when it reported a 97 percent increase in sales of local produce, which translated into an increase in local from 9 to 10 percent of its total produce sales (2012 Walmart GRR). However, critics suggest that these gains don't reflect changes in Wal-Mart's procurement system, but rather their increased capacity to track same-state sales, which includes major commodities from large-scale growers (such as Idaho potatoes being sold in Idaho stores; Prevor, 2008). Research has shown that despite Wal-Mart's public commitment to sourcing local produce, making changes to its systems to accommodate smaller-scale farms and store-level procurement has been a challenge (Bloom 2013). The examples of Wegmans' and Wal-Mart's local procurement programs show how local sourcing as a procurement practice differs across supermarket chains.

Introducing localization into supermarkets' procurement systems can help to promote resiliency by introducing the feedback mechanisms that exist in direct marketing relationships into these systems, thus improving their ability to adapt to local environmental and social contexts (C. A. King 2008). Localization introduces diversity into the mainstream system, often by introducing or expanding specialty crop production into regions that have historically been dependent on a handful of commodity crops. In addition, localization expands production and knowledge sharing across different geographical and operational scales. Local food systems can promote regional self-

sufficiency, and have the potential to increase food security (the ability for all consumers to access healthy, affordable, and culturally appropriate foods in a consistent manner) while at the same time opening up more marketing opportunities for small to mid-sized growers who have been marginalized by the mainstream food system. However, research has indicated that local sourcing requires increased responsibility, autonomy, and knowledge by store-based staff in order to be successful (Guptill & Wilkins 2002). Adapting supermarket retailing systems' entrenched practices to local contexts can be challenging, and often requires deliberate partnerships to facilitate change, issues we will explore in subsequent sections.

The Challenges of Localization: The Need for Partnerships

As illustrated above, there are many challenges to localizing supermarket retailers' procurement systems, both because of the structure of those systems and the characteristics of smaller-scale farmers. In many ways, local sourcing contravenes the very strategies that led to supermarket retailers' success, including centralization of distribution systems and standardization of products and procedures across regions and between stores (Bloom 2013; Christopherson 2007; Lichtenstein 2009). In comparison, local sourcing is most successful when it is decentralized and adaptive to local contexts, criteria that can counter retailers' standardization efforts and scale-derived cost-reduction strategies.

Logistically, there are two inter-related problems intrinsic to the mismatch between the established large-scale hub-and-spoke logistics system and retailer desire to procure and sell locally-sourced food. The first is how to procure product from smaller vendors at the same low commodity pricing of the large farms and grower/shippers

selling nationally and globally-sourced product. The second issue is how to maintain the identification of the local product during the inventory cycle. Both of these issues evidence the likely higher purchase and transaction costs of dealing with small-scale, local producers. In addition, despite consumer interest in "local foods" there is little concrete evidence to confirm that consumers are willing to pay more for local product within the supermarket environment (Moser, Raffaell & Thilmany-McFadden 2011; but see Darby et al. 2006).

Nevertheless, supermarkets desire locally-sourced product to retain the loyalty of their current customers, attract their competitors' customers, and diversify their supplier base. This desire for local produce presents opportunities for advocates, researchers and educators to engage with these retailers, and to think strategically about how to overcome the challenges outlined above. Previous research has demonstrated that partnerships are key to facilitating small-scale producers' participation in supermarkets' local produce supply chains. Partner organizations such as Cooperative Extension, the USDA, and non-profit organizations often provide services such as: food safety training; funding for high tunnels and other infrastructure; organizational support to form food hubs or cooperatives; and technical assistance to help farmers understand and meet supermarkets' quality specifications (Bloom 2014; Dunning et al. 2014). For example, in the case of Wal-Mart, an agricultural cooperative of small-scale, minority farmers in Alabama has had some limited success selling to the retailer because of the facilitating activities of Tuskegee University and a third party handling company (Hill et al. 2014; Robinson et al. 2014). In comparison, research has shown that in areas where Wal-Mart does not have

active partnerships, small-scale producers struggle to navigate the company's complex bureaucracy to gain access to this market (Bloom 2013).

In the absence of partnerships that help to establish new protocols and procedures, it can be difficult for supermarket managers at the chain or individual store level to engage with local suppliers that are not linked into the existing national and global agri-food system. As discussed in the remainder of this paper through the case study of the Center for Environmental Farming Systems, agricultural and environmental professionals can play a key role in bridging differences in scale and across informational and organizational divides that separate the "local" and "mainstream" food systems.

Center for Environmental Farming Systems: Food System Change through Supply Chain Partnerships

The Center for Environmental Farming Systems (CEFS), a collaboration between two North Carolina land grant universities and the state's department of agriculture, has evolved from its origin as an organic and sustainable research facility in Goldsboro, North Carolina, to a network node connecting food businesses, academics, and non-profits across scale and silo to enact food system change. When CEFS was founded in 1995, its stakeholders were all agriculture-based, although they included both conventional and sustainable agriculture organizations. Its research units and long-term research trials were interdisciplinary and developed with stakeholder input (Mueller et al. 2006), which in itself was novel for the time and very different from traditional forms of agricultural research. This approach allowed CEFS to build bridges among conventional and sustainable agriculture stakeholders and to address complex and interdisciplinary field-based problems (Sydorovych et al. 2009; Tu et al. 2006; Zhang et al. 2005).

In 2005, CEFS expanded the breadth of its work and partnerships to include a more integrated supply chain approach with the formation of NC Choices (ncchoices.org), which is still actively engaging a variety of entities along the niche meat supply chain from producers and processors to distributors and retailers. Acting as an institutional entrepreneur to catalyze connections across the supply chain, NC Choices has significantly expanded opportunities for small and mid-scale livestock producers in the state (Gwin & Thiboumery 2014). This success is evidenced by the growth in registered farmer-meat handlers in NC from one at NC Choices' inception in 2005, to greater than 700 in 2014 (North Carolina Growing Together 2013). By addressing the information gaps faced by small and mid-scale producers as they enter retail markets, fostering collaborative relationships between producers and processors, and providing technical assistance for processors, NC Choices has used a farm-to-fork approach to build a more sustainable, diversified, and resilient meat supply chain in North Carolina.

CEFS subsequently expanded its work in North Carolina across more food systems sectors. In 2008 it launched the statewide initiative "Building a Local Food Economy in North Carolina, From Farm to Fork", which engaged hundreds of partners across the state, including agricultural stakeholders, environmental groups, local government officials, nutritionists, health professionals, economic developers, other agencies. The goal of the initiative was to develop "game changer" strategies, defined as high impact actions that could be accomplished in a 2-3 year time frame, in key areas determined by the group and predicated on continued work across an extensive array of organizations (Curtis, Creamer & Thraves 2010).

Many of the game changers have been achieved. These include the formation of a statewide legislated sustainable local foods advisory council in 2009[1]; the launch of the North Carolina 10 Percent (local) Campaign in 2011[2]; development of NC Food Corps beginning in 2011[3], the development of a Community Garden in every county in the state (funded by Blue Cross and Blue Shield of North Carolina) [4]; and a USDA/AFRI-funded project called NC Growing Together to develop models for local food supply chains.[5]

The following section returns to the discussion of grocery retailers in the food system, and details CEFS' engagement with a NC-based regional grocery chain partner through the NC Growing Together project. Through this case study we highlight the process by which a university (public) project was able to work collaboratively with a mainstream food system (private) partner to effect food system change, specifically in the procurement of fresh produce from local growers. Information in the case study is based upon the lead author's experiences working as the liaison between the university project and grocery chain partner.

Moving from the Margins to Mainstream: Strategies to Localize Supermarket Supply Chains

In late 2012 CEFS began a 5-year USDA-funded program, North Carolina Growing Together (NCGT), to integrate small and mid-sized producers (defined as operations with gross sales of less than $1 million annually) into the existing consolidated and centralized supply chains of large-scale grocery and food service businesses. One of the partners in the project is Lowes Foods Stores, a regional family-owned corporation

[1] See: http://www.ncleg.net/Sessions/2009/Bills/Senate/PDF/S1067v5.pdf
[2] nc10percent.org
[3] https://foodcorps.org/where-we-work/north-carolina
[4] http://www.ncrpa.net/?63
[5] http://www.ncgrowingtogether.org

with 98 of its 102 grocery stores located within North Carolina. Aware of the incursion of new supermarket chains into the state (e.g., Publix) and consolidation in the grocery industry (e.g., Kroger's 2014 purchase of NC-based regional chain Harris Teeter), Lowes Foods has sought to differentiate itself from these competitors by emphasizing its identity as an authentically "homegrown" and community-based retailer that strives for high levels of customer service. This focus on identity and enhanced customer service constitutes a significant shift from the company's prior focus on cost-cutting to match low-priced competitors, the "Wal-Martization" in the grocery sector as discussed above.

Lowes Foods' strategic move to distinguish itself among competitors as a homegrown business aligns with CEFS' interest in integrating small and mid-sized growers into mainstream food supply chains. Though Lowes desires authentically "local" products, it faces the same challenges as noted previously—how to locate local suppliers and how to cost-effectively procure and distribute their products within a grocery chain system built on high-volume commoditized items. Lowe's procurement and distribution structure mirrors that of other retail chains, with a centralized regional distribution center supplying nearly all of the stores' fresh fruits and vegetables. Despite the company produce manager's interest in sourcing local produce, the time investment to locate suppliers, vet these suppliers, and incorporate them into a national/global procurement system seemed out of reach.

Placement of a 2012 North Carolina State University graduating senior into a 3-month summer internship with the company acted as a "soft-start" to what would develop into a multi-year partnership built around the aforementioned 5-year grant project. The summer intern, who graduated with a self-designed major in agroecology and food

studies, was tasked with finding capable local food providers. The position morphed into a full-time position as the company's "Locally-Grown Accounts Representative," with funding for the position split equally between Lowes Foods and the CEFS' grant. This former student intern has served as a critical liaison and network bridge between corporate exigencies to cost-effectively procure local product and the longer-term project goals of building a localized food system. More broadly, the university-business collaboration is built on an overlap of interests that brought both parties to the table to work on a shared objective: localization of food production, distribution, and consumption.

When CEFS and Lowes Foods began formally collaborating at the inception of the 5-year project, the initial idea was to segregate locally-sourced and branded product as it moved through the company's regional distribution center (RDC). Both Lowes Foods and its wholesale grocery distributor Merchants Distributors, Inc., are owned by the same parent company, but operate as separate profit centers. Fifty-percent of Merchants Distributors' sales are comprised by Lowes stores, and the rest by other Mid-Atlantic grocery retailers. Segregation of local product into separate warehouse "slots" would permit product to remain source-identified throughout the procurement and distribution process; and by appearing as distinct items in the inventory system store managers could select product from an area that would be considered authentically local by their particular store clientele. During the initial meetings between CEFS, Lowes Foods, and the RDC, however, this approach was shelved: dedicating valuable space in the warehouse and adding separate item codes into the established inventory system for local products was considered too costly, especially considering the unknown supply or

demand for local products. NCGT staff recognized that further attempts to push through structural change in the warehouse procurement system under uncertain conditions and without full partner buy-in could backfire and hamper forward motion over the remainder of the project.

Instead, CEFS and Lowes Foods agreed to work cooperatively around the margins and outside of the mainstream RDC procurement/distribution system to first build steady supply and strong and consistent demand for locally-sourced products. This was accomplished with NCGT and Lowes Foods' staff facilitating relationships with local producers who could deliver fresh produce directly to stores. This facilitation took the form of "Round the Table" meetings and farm and food hub tours that allowed sometimes skeptical growers to meet face to face with Lowes Foods' representatives and ask questions on price, volume, and willingness to commit. Food hubs, the often non-profit organizations that act as intermediaries to aggregate product from small and mid-scale farmers to meet buyer volume requirements, have been important partners for their potential role in impacting a large number of smaller-scale local growers.

Product deliveries from farms and hubs to individual stores occurred first as pilots, with the process then institutionalized in the form of "Local Foods Vendor Inquiry" documents to formalize the way in which local producers could approach individual stores and become direct-store-delivery (DSD) vendors. Subsequent to this formalization, Lowes Foods developed similar local vendor inquiry documents for local egg and dairy producers. Each of these Vendor Inquiry documents is available to interested producers from individual store managers or from the project website (ncgrowingtogether.org/for-producers).

To support the nascent local-to-grocery retailer supply chains, CEFS developed web-available materials to guide producers on specific requirements, such as food safety, quality specifications, and packaging (ncgrowingtogether.org/for-producers/). At the same time, resources have been developed to guide store-manager buyers in building consumer awareness of and demand for locally-sourced products (ncgrowingtogether.org/for-buyers/). All materials are made publicly available in order to share the lessons and recommendations for local-to-retailer supply chain links with all producers and all retailers, as well as educators and advocates. Many of these materials are then used to create Cooperative Extension fact sheets to amplify their use throughout the state and more widely, and to support webinars and workshops for local and regional audiences.

Additionally, the project supports student research teams and summer interns to conduct applied research that addresses objectives shared by CEFS and Lowes Foods. For example, a summer 2014 intern built a database of farmer-vendors with photos and biographical details to be used for point-of-sale marketing. These databases were then used as part of a Community Supported Agriculture-style box program with four food hubs supplying local produce boxes to 35 Lowes Foods stores during the summer months. The databases are also being used to inform research about the potential for Lowes Foods value-added product vendors (producers of salsa, sauces, etc.) to utilize locally-grown produce in their manufacturing. The latter work is particularly interesting in that it could bring in university horticulturists to identify locally-grown produce varieties that meet the taste-profile specifications of food manufacturers. In each of these instances, project staff and CEFS network of connections across the food system work to

gather information, focus attention, and facilitate the implementation of local foods initiatives at the grocery retailer that arguably would not otherwise occur.

As the action of local sourcing becomes a normal operating practice within more Lowes Foods stores and for more grocery products, NCGT staff continue to support the development with additional student intern and apprentice experiences and applied research initiatives. An environmental studies graduate is serving a one-year apprenticeship at a local food hub that supplies product to Lowes. A university MBA student team is working to design and test marketing and merchandizing strategies for pastured meat and local seafood products in retail settings. Another team is examining the economic feasibility of food hubs to supply locally-sourced frozen bagged produce into grocery retailers. A project researcher is surveying farmers and store buyers on their perceptions of trust and commitment to identify factors key to fomenting high levels of each. With regard to direct-store-deliveries, the focus of the work with Lowes Foods described in this paper, the number of small and mid-scale vendors has grown from less than 10 in 2012 (pre-project) to over 70 in 2015, includes a much greater diversity of produce items, and now includes vendors of local eggs and local dairy products. The value of local purchasing through the direct-store-delivery program grew nine-fold over the same time period.

In all of these instances the successes of the collaboration have depended on three key factors: two willing partners, CEFS and Lowes Foods; a shared objective, increased procurement and distribution of local foods; and resources to support the building of grower capacity, grower-buyer relationships, and feedback loops across the local foods community. These resources have taken the form of staff and funding, as well as the

equally important network of relationships across the food system that CEFS has cultivated over the past decade. Without grant funding, work such as this is possible, but would rely on the time and other resources from private and non-profit partners, student internships, and cooperative extension or other agricultural educators.

While Lowes Foods and other mainstream grocery retailers are capable of creating a local foods procurement and distribution program, the risks and uncertainty of reward make it unlikely that such initiatives will be developed. University collaborations can be linchpins in catalyzing food system change by functioning as a network node between businesses, researchers, and the local foods community; and as a source of applied research, facilitated implementation of initiatives, and student skills and labor to tackle shared objectives. Regional grocery chains may be a particularly good choice for university partnerships. The authors' experiences and extant research (e.g., Guptill & Wilkins 2002) suggest that partnerships with regional, rather than national, retailers may have a better chance of achieving localization objectives due to their ability to be more flexible, adaptable, and willing to enter into collaborative relationships. Additionally, these entities may be more incentivized to use "local" as a competitive practice.

After two years of moving produce directly into stores, and thus working around Lowes Foods' RDC, the wholesale distributor has become more interested in sourcing local product. This was recently evidenced by the company's hiring of a dedicated buyer to focus on building the wholesale distributor's local program, with the buyer crisscrossing the state to meet with agricultural extension staff, growers, and food hubs. The RDC has also requested that Lowes Foods' Locally-Grown Accounts Representative and local farmers participate in its annual vendor showcase, where it features its offerings

to all its supermarket buyers. To build on this interest at the warehouse-level, CEFS supported a graduate student researcher's creation of process-flow documents for produce and meat to inform potential farmer-vendors of the process and best practices for successfully bringing local products into the warehouse system (ncgrowingtogether.org/for-producers).

CEFS experiences through the NCGT project illustrate that by supporting nascent relationships and capacity-building on both the buyer and supplier side of the supply chain, university-based projects can help businesses realize their potential to satisfy consumer demand for local produce; illustrate that local procurement is a viable business strategy; and thus bring local food into the mainstream food system.

Conclusion

Given the pressures of climate change, population growth, and the diminishing health of our natural resource base, broadening our scientific method to be more systems-based and building public-private partnerships around shared interests and objectives are two additional approaches we can employ to address the challenges to food system resiliency. In this paper, we have explored some of the possibilities for engaging the mainstream food system with local food systems, pairing localized procurement and distribution with mainstream supermarket industry infrastructure to increase food system resiliency. Facilitating mutually-beneficial partnerships as a means to localize supermarket supply chains is one way to meet the call for a "variety of agri-ecological systems that enable diversity of function at multiple scales [that] enhance ecological and community resilience" (C. A. King, 2008 p. 122).

The case study described in this paper demonstrates that researchers and educators can use consumer demand for local food as a leverage point to form partnerships with supermarket retailers to effect change. These public/private partnerships along the food supply chain are a valuable addition to traditional environmental and production systems research conducted to improve food system resiliency. Through localization of their supply chains, supermarket retailers can be better positioned to withstand shocks to the mainstream food system. Given changing climatic conditions, increasing the diversification of production areas and enhancing local and regional self-sufficiency can counter the possibility that crises in key growing areas could disrupt food supplies on a national level. As weather conditions such as drought increasingly affect California agriculture, the source of one-half of US-grown produce, diversifying production to other states and regions has the potential to reduce retailers' reliance on narrow geographic sources of product and ensure a steady supply of food for consumers.

At the same time, it's useful to consider the potential role that the mainstream food system can play during emergency events. Supermarket retailers have well-developed, efficient logistics and distribution infrastructure that can draw on diversified sources at a national level. While these systems have developed, in part, by externalizing costs and relying on an era of cheap oil, this national system may ultimately have a role to play when natural disasters disrupt supplies for one specific region. For example, Wal-Mart runs an internal Emergency Operations Center, where it tracks weather events such as hurricanes, tornadoes, and floods and the company routinely leverages its "just-in-time" distribution networks to respond to natural disasters, being among the first

organizations to provide water, food, and supplies after Hurricane Katrina hit New Orleans in 2005 (Lichtenstein 2009). Therefore, maintaining connections to a national distribution system may help to strengthen and supplement local food systems during times of crises. Likewise, introducing local and regional production into that national system improves system resiliency.

Adding local procurement practices to the operation of supermarkets as well as food service management (e.g., Aramark, Sodexo, Chartwells) and food service wholesale distributors (e.g., Sysco, US Foods) can increase system-strengthening redundancy and diversity in the mainstream food system, injecting resiliency into both national and local food networks. Enhancing adaptation to the contextual needs of different areas can be accomplished without losing the advantages that national and international distribution networks provide. Selective engagement and strategic partnerships with mainstream food businesses are one promising means to build a stronger food system.

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Conflict of Interest

The authors are unaware of any conflict of interest.

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