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Achieving Scale Strategically: Understanding Freight Flows in Regional Food Supply Chains

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The past several years have seen a rising interest in all things sustainable, from energy efficient homes and vehicles, to alternative energy sources, to increasing focus on recyclable and renewable material usage. This trend has also been accompanied by an increased examination by consumers of where our foods come from and how it reaches us. Decades of globalization have drastically altered supply chains. Along with consumer goods, the distance in that food travels to reach its markets has grown exponentially, and stressed freight transportation systems. This research will identify how the local food supply and distribution systems function in the Upper Midwest States and suggests ways that regional food transportation movements can become more efficient and retain and enhance other values.</td></tr>
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Introduction

Phase I review

In Phase I of this project, our research goal was to “evaluate whether and how freight infrastructure and movements can be utilized to more efficiently distribute local food.” The concept of efficiency was discussed in terms of the opportunity to increase the resiliency of the food system at a regional scale through the lenses of economic, social, and environmental performance. The main questions asked were, “What are the opportunities and strategies available to maximize these benefits in local food distribution?” & “How can existing supply chain research and strategies inform this question?”

To answer these questions, Bittner et al. (2011) conducted case studies in the Circle City region, an area that extends from the Twin Cities in Minnesota through southwest Wisconsin and northeast Iowa into the Chicago metropolitan area. With one exception, the profiled supply chain participants are located in or near the Driftless area that is situated along the west edge of the Circle City region. These case studies examined businesses (producers, haulers, distributors, and an institutional food service provider) operating at different production scales and offering different product mixes within local and regional food supply chains. This was done in order to identify a range of logistical needs and innovations related to distribution in the study area.

The case studies from Phase I showed that small-to-medium size farms rely almost exclusively on farm vehicles or truck freight services provided by hauling or aggregation businesses. Rail freight is not employed in wholesale food supply chains except at large, commodity scales and is most likely when moving bulk shipping containers. There is no indication from any of the case study participants, or other professionals we interviewed that this will (or should) change in the near future. In Wisconsin, agricultural shipping containers hold “primarily distiller's grains (an ethanol production co-product), and both specialty and commodity-grade corn and soybeans” much of which is for international export (personal communication, J. Petty – WI DATCP, June, 2012). Petty notes that about one-half of U.S. containerized bulk shipments of agricultural goods originate from Wisconsin. Suffice it to say, as population density reaches a critical mass, regional rail and barge freight for food products may emerge as a viable innovation, as it has in Indiana (Dick 2013) and Paris (Todd 2012).

As might be expected, farmers engaged in direct marketing tend to view transportation as a necessary farm task, rather than assuming that transportation could be a service for contract. Over time, these farmers may shift their approach to transportation services, relying first on relationships that they have already established. The Phase I case studies revealed that mid-career producers use multiple distribution solutions, rather than relying on a single method. Producers cooperate by hauling goods for each other and by sharing access to distribution. Certain buyers may favor specific haulers. And some haulers may not be able to provide the services required by the farmers, such as marketing the full value of their specific product by keeping the farm story intact through the supply chain. Any distribution decision must take into account the distances between production areas, and the distance between production and the freight haulers, processors and aggregation facilities further along the supply chain. Distribution is more

than a matter of the time and money required to move product between locations. Distribution arrangements beyond simple hauling agreements often impose a set of legal and financial terms, as well as scheduling practicalities, that may offset some or all of the advantages of intermediation.

Phase one of this research also noted that farmers sometimes maintained ownership of their product even as the chain between field and table lengthened and at other times sold their product into a specific wholesale marketing chain. Distribution methods reported by producers included:

- Selling direct-to-the-consumer through farmers' markets, on-farm stores and community supported agriculture (CSA).
- Delivering direct from farm to grocers, restaurants and/or schools.
- Employing outside haulers to deliver product to aggregation facilities such as wholesalers and packing houses. This may involve renting refrigerated or freezer trailers for on-farm cold storage.
- Arranging for product pick up by wholesalers and packing houses.
- Delivering direct from farm to aggregation facilities.
- Sharing truck space between farms, or "piggybacking" product onto trucks whose routes pass near to a farm or packing house location. Piggybacking may require the producer to haul product a short distance to a point along a truck's route.

Finding the most cost effective hauling and distribution options is not the only marketing consideration for producers. Like larger operations, small to medium-sized farms are concerned with how the customer perceives the value and quality of the product offered. When direct marketing, farmers have an opportunity to obtain immediate feedback from customers, form personal relationships, and solve some problems more quickly than might be done in mainstream supply chains. These personal relationships are one of the hallmarks of direct marketing, and one of the most compelling reasons for a producer to opt out of contracting with outside hauling and distribution services. For some farmers, direct marketing is a lifestyle choice.

Selling through a farmers' market or on-farm store may provide a better bottom line for some producers. However, farms that choose to direct market exclusively are unlikely to grow into large-scale operations. As King et al. (2010) state, "While farming operations often can scale up by expanding their land base and capital and labor resources, it is more difficult to scale up a marketing enterprise that is predicated on direct, personal relationships with customers" (7).

Phase II research

The follow up interviews done for Phase II confirm that choosing between available marketing options is an ongoing necessity. Ecker's Apple Farm, Driftless Organics, Grass Run Farms and Keewaydin Organics have all made changes to their hauling and aggregation arrangements since we last interviewed them due to fluctuating weather and marketing opportunities. In fact, with Driftless Organics and Keewaydin Organics we see the natural emergence of a regional food hub involving multiple businesses with common business objectives and sustainability values in mind.

Phase II of this research examines methods to reduce the barriers for small and medium-sized farmers seeking to begin or increase the use of intermediated distribution. These barriers to "scaling up" include:

- The difficulty of knowing the cost of self-distribution and how it compares to the cost of hiring outside distribution.
- The need for supply chain communication strategies that approximate the face-to-face contact found in direct-to-consumer marketing such as Farmers' Markets and Community Supported Agriculture (CSA).
    - This is related to maintaining the individual farm identity from the production of food to the end-consumer, a process that helps to explain why a particular farm has something special to offer.
    - It is also useful for resolving problems, responding to customer requests, and establishing an Internet presence.
- The complexity of achieving efficiencies in distribution without the economies of scale available to large supply chains.

Phase II section organization

In Section 1, we discuss tools that may be useful for producers seeking to scale up. These include cost of self-distribution assessment tools, traceability technology methods and a general matrix of technology.

In Section 2, we offer follow ups to four case studies from Phase I that describe ongoing challenges in distribution, organizational emergence, and how those businesses respond to those challenges. There is also a new case study of an independent, regional, mainline food distributor based in La Crosse, Potato King, that describes that company's focus on quality and efficiency, and how that relates to the opportunity for small to medium-sized local producers seeking to scale up.

In Section 3, we discuss concepts related to barriers and opportunities for small to medium-scale producers seeking to scale-up from direct marketing. It should be kept in mind that many producers at these scales are engaged in both direct and intermediated marketing. We relate the opportunity for scaling up to export-based economic theory and the spatial clustering of industry. This section closes with a review of the potential that emerging food hubs and other collaborative methods offer intermediated supply chain participants.

In Section 4, we use maps generated by the Food Systems Profile project that reveal regional patterns of business "hot spots" and "cold spots" that are areas with noticeably positive or negative relationships to agricultural endeavor. Comparing these hot spot maps for the Upper Midwest with more detailed maps of relative density in the Driftless area may offer a richer sense of economic development opportunity in the region as a whole. For an initial representation of agricultural activity by supply chain participant in the Driftless area, please see the density maps and accompanying text available in Appendix B of this report.

Section 1: Tools for scaling up

Tracking the cost of distribution for small farmers

> Having a proper understanding of the cost of distribution is a critical component to creating partnerships and contracting delivery services. Driftless Organics' ability to pinpoint costs and savings under different delivery scenarios helps it make sound business decisions. (Bittner et al., 2011)

This section looks at several tools designed to help farmers decide whether to "scale up" into intermediated supply chains based on the relative expense of self-distribution. There are two main benefits for producers that may accrue through an intermediated supply chain. First, intermediation may reduce marketing expenses and/or relieve the farmer of tasks that take time away from the main goal of raising crops. Second, working with outside hauling or distribution may increase the amount of product sold by opening up new markets for the farmer. The assumption here is that the increase in total product sales and the money saved by eliminating transportation and sales tasks will result in higher net profits, even when the farmer receives a smaller percentage of the final sale price.

Farmers may be uncertain whether hiring outside services will improve their bottom line. Contracting for hauling or distribution without knowing the cost might result in lower net revenues. King et al. (2010) describe this concern in their case study of Nature's Fountain Farm. Owner Scott Frost sells blueberries to the New Seasons Markets, a small Portland supermarket chain. New Seasons encourages farms to use the supermarket's pick-up services, so farmers may concentrate on production. However, Frost has calculated all costs related to self-distributing his blueberries and prefers to drop off product at New Seasons rather than paying their fee. In doing so, he also experiences greater flexibility in scheduling his product for market, and the supermarket is willing to handle this delivery arrangement. Producers who understand the net marketing costs of each distribution option are better able to weigh the tradeoffs associated with employing outside marketing services.

Frost also asked New Seasons for a higher product price than they pay other suppliers. This request was based on bulk rates Frost receives at farmers' markets, but it is unclear if he took his costs for transportation, labor and other transaction costs of selling at farmers markets into account. New Seasons agreed to a higher rate for a limited time. Direct marketing allows the producer greater flexibility in pricing as long as the consumer is willing to pay. However, intermediated supply chains, even those where the producer delivers the product, involve "middle-men." Inserting a grocery store between producer and consumer means the costs associated with marketing increase and profit from sales must be shared along the chain. If lengthening the supply chain raises the product price too high relative to consumer demand, the supply chain becomes ineffective. This creates a pressure for the producer and/or retailer to take a smaller share of the final sale. While Frost's decision to charge New Seasons a higher price may have been a reasonable decision, so too was New Season's hesitation to continue paying that price.

Breaking down the specific costs associated with different distribution methods increases the ability to assess the potential risks and rewards of “scaling up”. Determining the cost of self-distribution is not just a matter of tracking the producer’s individual costs such as vehicles, fuel, labor, and insurance. The distribution task shares these tools with other farming tasks, making it difficult to determine the cost of a specific tool per task. It is similarly difficult to say how much time is used for actual marketing purposes. Farmers who deliver produce during the span of a day may also perform other farm errands, fulfill family obligations, or visit friends. This can be an efficient approach to accomplishing multiple goals, but it makes assessing marketing and distribution costs complex. Consequently, making a gut decision about distribution methods may or may not be based on actual costs of doing business. It may also be difficult afterward to determine which factors contributed to business success or failure.

As mentioned earlier, there are valid reasons why a farmer may prefer not to employ outside services for marketing their produce, although they may not be expressed in so many words. Rink DaVee, is a small-scale producer who also facilitates the distribution of food to restaurants and institutions through his aggregation business, Green and Green. We asked him whether small farmers are interested in assessing their cost of self-distribution. He observed:

> Most farms I know, including my own, often don't do a good job of assessing marketing costs and don't want to really know the answer since it would not give us the answer we ‘want’ to hear. Running a small farm is a lifestyle and so assessment tools often don't fit. The fact is that real distributors don't have a hard time knowing what it cost them to ‘stop’ the truck for a delivery - which is why they have minimum [charges]. (personal communication, September, 2011)

Some producers are interested in a dedicated tool that calculates the cost of self-distribution and helps to estimate the cost of marketing through outside hauling and distribution. Ideally, this tool would be in the form of software where the user enters costs and revenues from direct marketing. If an outside hauling or distribution service is being considered, data for that example is entered in a similar way. The program then estimates the cost of self-distribution versus the other options being explored. If the net revenues associated with the new option do not improve the bottom line enough to justify a change in marketing method, then that option probably won’t be pursued. A possible exception to this occurs when marketing labor is reduced through intermediation, thereby allowing effort to be directed to other tasks without additional labor cost. Another exception is when revenues are projected to improve by using the new method, but do not justify making the required changes to lifestyle.

Currently available cost of distribution tools

At this point in time, there is one dedicated tool that measures the cost of self-distribution through direct marketing versus other methods. **The Farm to School Distribution Cost Template** (Holcomb & Vo, 2011) is available as an Excel spreadsheet from the Oklahoma Farm to School website. It tracks the cost of fuel, maintenance, tires, depreciation and trip labor as broken down by specific product types. For each product, this tool calculates both the average cost of distributing each unit in a specific delivery load, and the net revenue (“farm gate” margin) after

distribution. The Oklahoma Template can also calculate the cost of distribution to a wholesale warehouse, or to an intermediary such as a smaller distributor or packinghouse. This tool assumes that the farm performs initial delivery of product even when working with these outside partners.

Although useful, the Oklahoma Template has limitations in what it can measure. It does not track marketing costs associated with farm labor such as packing and processing, or the cost of miscellaneous supplies used to market through a specific channel. The cost of insurance and complying with regulations required by supply chain partners, law or statute is not included in calculations. Multiple spreadsheets (or sheets within a spreadsheet) are necessary to track multiple product types. This requires the spreadsheet user to decide how to organize different product combinations when comparing distribution options. Although the Oklahoma tool was developed to facilitate Farm to School sales, it is widely applicable for other situations with minor modifications.

The Land Stewardship Project (LSP) in Minnesota has converted the Oklahoma Template into printed form for the use of farmers attending cost of distribution workshops. Like the original spreadsheet version, each form is dedicated to the costs of a specific type of marketing and for a specific crop (e.g. direct marketing distribution costs for Watermelon). For those farmers who use the kitchen table and a calculator method for figuring costs, this may be a familiar process.

There are at least two other tools which do part of the task of determining cost of self-distribution, or could do so with modification. **Veggie Compass – Whole Farm Profit Management** (Munsch & Claypool, 2012) is a spreadsheet tool developed at the University of Wisconsin. Veggie Compass is designed as a total farm solution for calculating expenses by crop and by market, and can be used for “what if” scenarios. The Veggie Compass team is exploring options to make record keeping even easier by developing a smart phone application.

While Veggie Compass is not specifically designed to aid farmers in deciding whether to enter intermediated supply chains, its related capabilities include:

- allocating the cost of fueling and maintaining a delivery truck across different marketing channels;
- tracking unit sales of specific crops across marketing channels;
- tracking costs of production and on-farm packing by specific crop;
- tracking farm profit and loss by market channel.

The Ag Decision Maker is a website hosted by Iowa State University with a wide range of documents and tools designed to aid farmers in making decisions related to crop planning, marketing and other aspects of farming. Their **Marketing Outlet Analyzer**, is a spreadsheet tool that provides a way to outline costs associated with different marketing options. This tool does not break costs down in the detail that the Oklahoma Template does, although it does offer an input for the cost of supplies associated with specific market channels (Chase, 2010). The Iowa tool sets a budgeted marketing cost figure and compares that to the actual cost of marketing through a specific market channel. This tool may be particularly useful for farms that have generalized “whole

farm" cost and revenue data at the ready, but do not have easy access to the more detailed information necessary for using a program like Veggie Compass.

Traceability technology in small scale food supply chains

Sustaining relationships between modest-scale producers and consumers

In direct marketing situations such as Farmers' Markets or Community Supported Agriculture (CSA), the producer and the consumer meet face to face. One of the benefits of this direct connection is the opportunity for the producer to quickly address customer concerns. This connection is reduced or eliminated when producers hire an outside partner for hauling or distributing their product. Farmers can no longer directly describe crop varieties, growing methods and business philosophy to consumers. Farmers also loose the direct feedback from their customers. Each additional link in the supply chain between the producer and the consumer increases the likelihood that specific information will be diluted, inaccurate or lost. Farmers looking to scale up their operations from direct marketing to intermediated supply chains understand this risk, and may decide against entering wholesale markets as a result.

Traceability technology uses mobile devices to scan Quick Response (QR) codes or RFID tags for tracing products along supply chains and over the Internet. While this technology can improve inventory and food safety along agricultural supply chains, it also has the potential to enhance customer knowledge of farmers and their products, and restore direct customer feedback in longer supply chains. It does this by providing customers the opportunity to scan the same codes used by producers and distributors to gain additional information about the food for sale, and connect via websites with producers and processors.

Quality control along the cold supply chain

Reputations are a way for consumers "to deal with a complex world in an efficient way" (Woerkum & van Lieshout, 2007). Being well known is a good thing for producers until product quality declines. A bad reputation can easily affect the long-term viability of the producer's business. This risk is diluted in situations where the product from multiple farms is aggregated as one distributor brand name. In those situations, it is the distributor's reputation that is at risk. However, all of the producers will still feel the economic impact of reduced consumer demand because of suboptimal product quality.

Producers can limit the risk of disappointing customers by tracing their product as it travels through intermediated supply chains. This is particularly true of longer supply chains and those that rely on refrigeration to keep product at its best. As the chain lengthens, there are more points where product quality and timeliness of delivery can be negatively affected. Traceability is useful to haulers, aggregators and distributors for the same reasons. Information important to each of these participants includes:

- Did the hauler pick-up and deliver on time, and was the product transported carefully and at the correct temperature?
- Did the aggregator/distributor store the product appropriately and arrange for further transport services in a timely fashion?

- If the product was processed and/or packaged off-farm, was this done according to standards?
- In those cases where the producer delivered product directly to the aggregator or distributor, was it delivered on time and in the expected condition?

These concerns relate directly to the ability of supply chain participants to determine the details of product flow. If a problem occurs, traceability makes it easier to know how the distribution process went wrong. For that reason, it is increasingly common for distributors to require that their suppliers provide traceability records (Gloy, 2007). Mainstream producers and distributors have traditionally traced their products primarily through the use of UPC and other simple bar codes, sometimes in combination with printed production codes. Almost all mass produced retail products have printed UPC codes (Seideman, 1993).

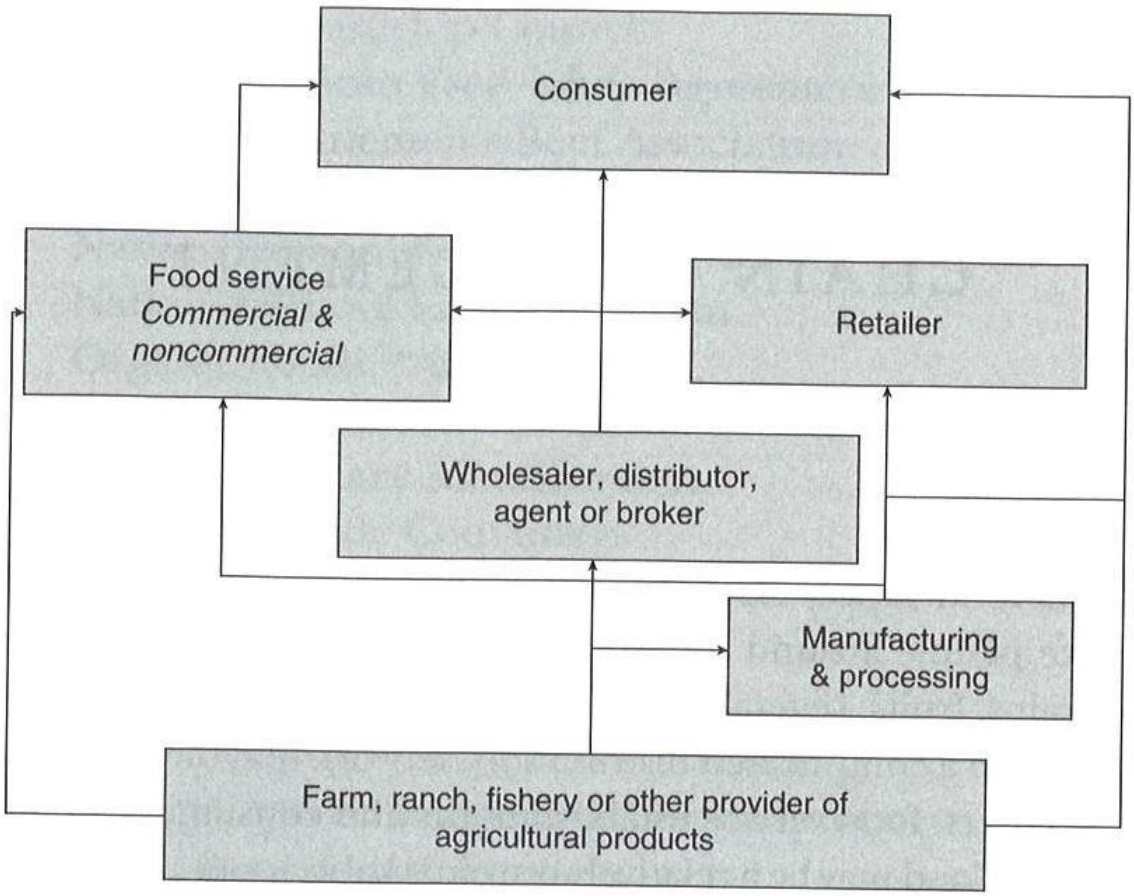

Figure 1 An intermediated food supply chain (Pullman and Wu 2012)

Traceability and food safety

Traceability is useful for more than marketing outreach, consumer education and inventory control. It also provides a way to tie the outbreak of food borne illness back to the source. For example, assume there is a public health issue involving contaminated lettuce sold in the produce section of a chain of stores. Successfully tracing the product

backward along its supply route through the use of QR codes used for inventory may determine the source of contamination. This also serves to protect the supply chain businesses that are not liable for the public health risk. In the case of highly processed, multiple-sourced foods, full tracing of the contents may prove very difficult. In the case of single-sourced local foods, this tracing is more likely to be conclusive, although more expensive. Distributors who work with small-scale producers are increasingly requiring some degree of traceability (Diamond, 2009; King, 2010). A good inventory system employing technology such as QR codes provides a way to do this efficiently

Traceability technology enhances the flow of information along supply chains

Traceability provides a way to determine the path and timeliness of an agricultural product's movement through a supply chain, from production all the way to its retail or institutional sale. This traceability may be accomplished with the simple alphanumeric lot number (or production code) like those that have been used for decades on food packaging. It may also be communicated through the use of UPC barcode symbols, or the more recent and increasingly common two-dimensional (2D) bar codes.

There are technological drawbacks to the first two of these tracing methods. Production codes are not designed for scan-ability and convey very limited information that may not be understood by the consumer. The most commonly found bar code, linear UPC symbols, are scan-able making the inventory process easier along the supply chain, but are limited to 20 numerals (0-9) for conveying data. By comparison, 2D codes that are also scan-able have the capacity to hold much larger amounts of detailed information. The Quick Response (QR) code is the most successful example and the one most familiar to consumers (Roberts, 2008).

http://www.gs1us.org/Portals/0/images/barcodes/UPC-A.gif http://en.wikipedia.org/wiki/QR_code

Figure 2 UPC and QR Code Examples

Consumer demand informs product supply through traceability technology

Most consumers purchase their food at the end points of long, mainstream supply chains and are accustomed to identifying packaged food products by reading the label. A primary benefit of direct marketing is the ability of a consumer to learn more about the food they purchase by directly engaging with the farmer. A consequence of a longer supply chain is that it is harder to tell the farm story. In recent years and before QR codes became widespread, the quickest way for consumers to obtain additional product information was to search for the product online, and hope the corresponding company or third party website had the information needed.

Fresh produce is frequently merchandised in bulk bins without packaging or in unmarked carry containers. This bulk produce may also be individually labeled with text or bar codes. When fresh produce is prepackaged, the label often shows production and/or UPC bar codes much like other food products. These codes do not always inform the consumer information about the food inside. Additionally, the product may have been aggregated in a facility from several different sources making it essentially impossible to know where the food originated. Products sold through mainstream supply chains increasingly have QR codes printed on the packaging. When scanned using a smart phone or other mobile device, these QR codes have the capability to provide large amounts of detailed information to the consumer (Interview, A. Gutierrez, 11/15/2011). While this could be a direct result of the smart phone "reading" the QR code, it is more common for the code to link the consumer's phone to a company website where they can access product information, promotions, or provide customer comments.

QR codes have a high rate of adoption and are used extensively in newspapers and magazines, on posters and storefronts, on retail shelves and packaging, on websites, and in emails. A primary reason for the success of QR codes is that the consumer perceives it as less intrusive than other advertising technologies.

> The key is that mobile barcodes are a pull technology, a permission-based way for a consumer to engage with an advertiser or medium. This is a very important attribute since there is a great deal of consumer angst and regulatory concern about intrusive mobile marketing: mobile barcodes are a world away from pushing unsolicited spam. (Roberts, 2008)

A push-based technology indicates that a company is trying to create demand, while a pull-technology serves an existing demand.

QR codes and local food

Farmers can also benefit from offering the customer information about where their food originated and its unique qualities. This may take the basic form of package or shelf labels to tell the consumer who grew their food and where. This origin (sense of place) information is the basis for local foods appeal. In some cases, the origin information reveals the actual farm where the food was produced. If the produce was aggregated with other product, the origin information is usually less specific reflecting only the region or group of producers that sourced the produce. This level of information may be enough for the consumer.

As with mainstream products, local foods with QR codes can be scanned for information by any consumer possessing an appropriately equipped mobile device. The QR code may direct the consumer to a webpage describing the farm where the food originated, or in the case of aggregated food, the region where it was produced. Information such as the variety of produce, growing conditions and philosophy of the growers can be offered giving the consumer additional motivation to buy that particular local brand. This connection to the Internet has the potential to greatly enhance communication between business and consumer.

When the farm's webpage is hosted by, or linked to the website of a distributor, that partner in the supply chain gains exposure as well. This web presence can be extended to supply chain partners such as haulers, aggregators and other producers partnered in the same supply chain. A "family" of brands and supply chain partners emerges, along with a story of local food production that may be more appealing than that of mainstream provision. This is also an example of cooperation between partners in a supply chain who in other circumstances might be competitors (and perhaps still are), thereby creating greater opportunity for all. Sharing a supply chain and the associated distribution identity may also benefit those producers offering nearly identical products.

This limited form of competition in a supply chain is sometimes known as "co-opetition". Competitors within an industry each deal with a range of similar issues. Each participant in a supply chain employing co-opetition has something to offer int eh way of solutions for common issues. Gnyawali and Byung-Jin (2009) document strategic alliances between competitors are growing in importance and are associated with businesses seeking to innovate and manage complex products. The problems identified by locally-oriented supply chains will differ from those of larger food chains. Regional supply chains are unlikely to face the same logistical issues faced by large scale supply chain participants, yet the principles of co-opetition remain appropriate to many scales, and to relationships between scales. Gnyawali and Byung-Jin observe:

> "The importance of co-opetition seems to be even greater in the context of Small and Medium-Sized Enterprises (SMEs). As technological battles have intensified and technologies have become more complex, SMEs face numerous challenges such as rising R&D costs, high risk and uncertainty in technological development, as well as a lack of resources to pursue large-scale innovation projects" (309).

The analogous situation for small to medium agricultural producers is found in adopting and sharing the costs of those scale appropriate technologies that support communication with consumers and enable traceability in the supply chain. QR codes provide a plausible technology for doing so.

When managed skillfully, traceability technology provides a more effective connection between producers and consumers than do non-interactive labels and shelf tags. These lines of communication make the businesses associated with a product more real to the consumer. When the product is local agriculture, the message can emphasize the place, taste and unique qualities of the food offered. At its best, traceability may help the farmer tell the farm story to consumers, although feedback from the consumer to the producer is now reliant on their use of the Internet.

Online QR tracking programs (not to be confused with the general subject of traceability) provide businesses a way to determine if they are using QR codes effectively. These programs allow the business to create statistics such as:

- number of people scanning their products;
- type of products scanned most often;
- identify the most popular website pages.

Some products are scanned more frequently than others, but sell more slowly. This provides the business with a marketing puzzle to solve. Is it the product, its packaging,

or the information derived from scanning the product that is limiting sales? QR tracking programs need not be intrusive for the consumer if accompanied by a sound privacy policy.

Businesses with considerable in-house expertise can manage the programs that track the effectiveness of QR codes. Others will rely on one of many online services to do this, for a service charge. The ability to count scans verifies whether QR code use is increasing customer awareness of products and services. Some tracking services can help users differentiate the type of media (newspaper, shelf tag, product sticker, display screen) where a code was scanned, thereby indicating the most effective medium for linking story to product. While getting into QR coding may be relatively inexpensive, using QR capabilities to the fullest and tracking its effectiveness could be too time-consuming for smaller supply chain participants. Appendix A supplies a list of websites that offer QR code related services. The Grass Run Farms case study in Section Two of this report illustrates these issues.

The Radio Frequency Identification (RFID) option

RFID is a traceability technology that offers many of the same benefits as QR codes, at a scale suitable for wholesale buyers, rather than retail consumers. Generally, these tags or stickers have a small coil of antenna embedded and are scanned for radio frequency instead of the optical recognition used by barcodes. This has a couple important advantages. RFIDs do not require line of sight. Many work just by waving a reader near the items to be scanned. The right combination of tags and reader allows simultaneous scanning of multiple items such as an entire pallet of goods (Sato, 2011). This saves time during inventory, and lessens the likelihood of user error.

RFID technology also comes with some disadvantages. QR barcode technology is usually cheaper, “A typical barcode label costs about $0.02, whereas an RFID tag label can costs upwards of $0.10 or more depending on quantity” (Sato). While QR codes are in widespread use by consumers, the ability to read RFID tags is incorporated into relatively few smart phone devices (Interview, A. Gutierrez, 11/15/2011). This may change over the next few years.

Some RFID tags can be “rewritten” to convey new information while others are only written to once. QR codes cannot be rewritten. This limitation is not necessarily a major drawback for communicating with the consumer. Website content linked to QR codes can be changed to meet the needs of businesses and their customers. While RFID is not a popular consumer technology, Wal-Mart, J.C.Penney’s and other businesses have instituted large-scale implementation of RFID in their supply chains (Roberti, 2011). However, the affordability of RFID is scale dependent, and is not yet cost effective for smaller businesses in food supply chains. RFID may become a solution that works well for medium scaled aggregators who seek to manage inventory, and perhaps, convey the story of regions rather than individual farms.

Traceability improves inventory processes, and supply chain communication

Large-scale supply chain participants often use handheld inventory devices to scan QR codes or RFID tags as product moves from one part of the supply chain to another. This information is transferred to an inventory database that provides a nearly continuous

picture of product flow and interruptions (Interview, A. Gutierrez, 11/15/2011). When all partners in a supply-chain have access to product flow data, this creates an environment of information transparency with the emphasis on efficiency and cooperation, rather than competition. The question for intermediated supply chains is whether the benefits are significant enough to justify the expense. This is a matter of scale. The greater the product flow, the greater the likelihood that a traceability system will be cost effective. Improved customer communication and efficient inventory management may encourage direct market producers to join intermediated supply chains, but only when the overhead associated with new systems do not consume considerable time and money.

Section 2: Case studies on local food freight

Ecker's Apple Farm: building complex marketing relationships for maximum profitability

Ecker's Apple Farm is an apple orchard that distributes apples and honey as well as value added products such as pies and caramel apples. Ecker's also run a farm store that sells their products and complimentary items from local partners. Ecker's plans for 2012 included offering "Pick Your Own Blueberries" by appointment, a small peach crop, and selling apple mini doughnuts onsite, emphasizing direct-to-consumer marketing. Extreme weather in 2012has reduced their apple crop considerably. Accordingly, Ecker's juggles allocation of their apple supply based on securing the best price possible while maintaining important relationships with their supply chain partners.

Ecker's direct-markets the majority of their apples. They also use two Minnesota wholesale packinghouses, Wescott Agri-Products of Elgin and Pepin Heights of Lake City, to market and distribute approximately 20 percent of their apple crop regionally. Ecker's also works with Just Local Foods a distributor out of Viroqua, WI. These aggregation businesses pick up unprocessed product from the farm. Ecker's apples are then aggregated with apples from other farms. In the process, the individual Ecker's brand identity that has been successfully built up through direct marketing is lost. Working with outside distribution increases the farms' revenue, but does not increase customer awareness of Ecker's apples. Ecker's also supplies apples for Farm to School sales that they wash, grade and pack on-farm.

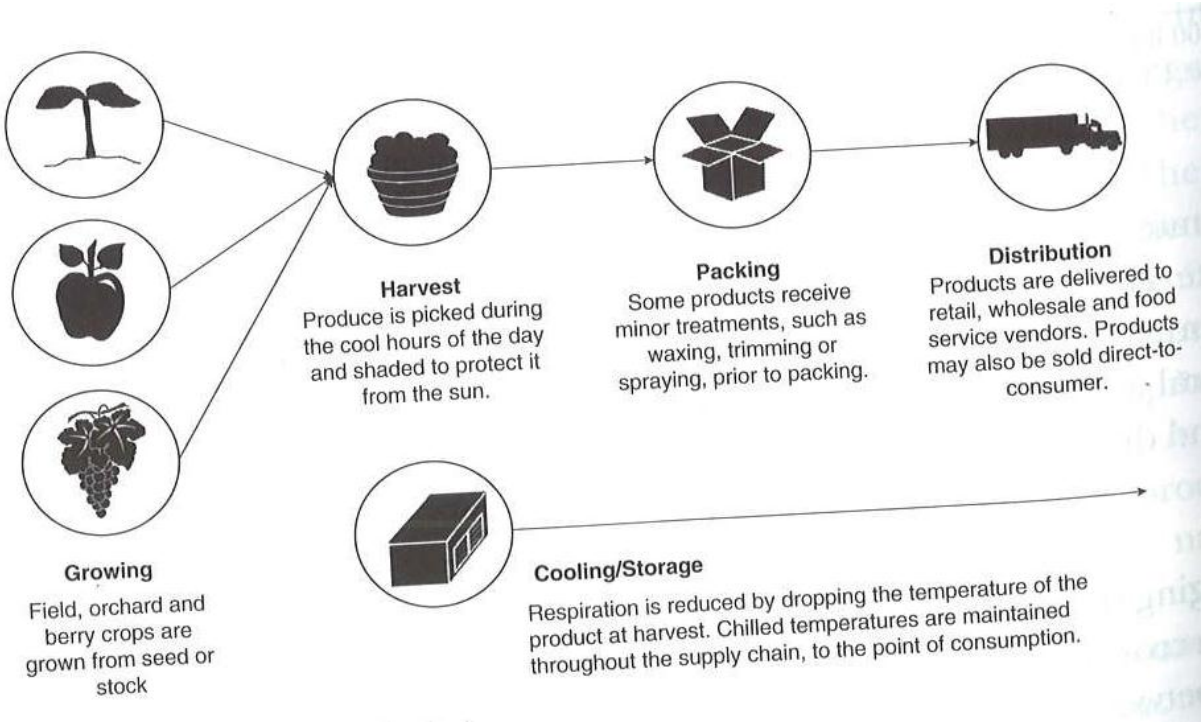

Figure 3 US Fruit Supply Chain (Pullman and Wu 2012)

Owning trailers to move their wholesale product would not be cost effective for Ecker's orchard. In past years, a local trucking company, Hilton Trucking was hired to transport a rented refrigerator trailer (reefer) from their property to the packinghouses once it was filled with apples. This year, the apple crop is not large enough to require renting a reefer, although there should be enough to stock the farm's retail store. Once production is back on track, Ecker's intend to have the packing houses pick-up apples directly from the farm to save the cost of renting a reefer and to transfer the product ownership (and risk) further down the supply chain . Using a hauling service or renting a trailer insulates the farm from additional expense in the event that a truck or trailer breaks down, jeopardizing the cold chain. It is imperative that fruit farmers have on-site cold storage. In addition to refrigerated storage, Ecker's has three residential freezers for storing pies, as well as a rented freezer trailer that is dedicated to pie storage.

There have been big changes in Ecker's Farm-To-School business over the last two years. The schools Ecker's works with now want all food suppliers to purchase a $5 million insurance policy. This can be a prohibitive expense for small operations. Sara Ecker notes that schools are looking to economize food costs while instituting different accounting practices:

> 2010 was our first year with Farm-To-School. Our door-to-door delivery meant that we were in the schools at least weekly to drop the boxes. We also included information sheets on each of the varieties. In 2011, two major changes occurred. The inclusion of our education services in the price of each box was eliminated and schools set up educational events as a separate charge. This was meant to keep the cost per box down for the schools. Some classrooms were

> able to attend farm tours, but none of the schools chose to set up demonstrations for additional costs.

Ecker's is interested in maintaining a relationship with students and educators, not only to cultivate business for their farm, but also to participate in the educational process, "In 2012, we may post online videos through our website and Facebook so interested schools can follow us through the harvest. We may also choose to volunteer our time and set up at lunch/recess times to slice fruit and connect with students." This helps to sustain the local connection between producers and their customers.

An additional complexity of school sales is found in hiccups between wholesalers and schools. If an order comes in late to the wholesaler, a product similar to that ordered may be substituted. This may mean that apples other than the agreed upon Ecker's apples end up going to the school. The quality of the product may be lower, and the reputation and market presence of Ecker's apples can be affected by this substitution. Beginning in 2011, Ecker's began to use Reinhart Foodservice to distribute farm washed, sorted, and packed fruit to school clients. Ecker's apples are now a special order item at Reinhart's so that unwanted substitutions can't occur by accident if orders come in late.

Participating in intermediated supply chains introduces additional risk along with opportunity. Ecker's has invested in food-grade plastic bins for use as hauling containers in an effort to maintain high food-safety standards. Although these bins are reusable and relatively durable, "They are expensive and can be easily damaged or misplaced along the distribution chain. We will continue to use them and educate those along the chain of their advantages and special handling needs."

Although Ecker's does not have a computerized system for tracking sales and inventory, they expressed interest in a smart phone enabled bar-code system to perform those tasks if that proved to be an affordable investment for their relatively small operation. Ecker's uses QuickBooks to track accounts receivable. Inventory is recorded on paper and uploaded into spreadsheets. Eventually, Ecker's would like to have a comprehensive software program to handle inventory while providing improved traceability. Desired information from this process would include: source of product, market differentiation by product, detailed customer information, and the product selling price. From the point of production, Ecker's would like to label produce at least down to the box level (bushel). Currently, produce is labeled down to each 18-bushel bin. Ideal labeling content for an 18-bushel bin would include: the date and location apples were picked, who picked, and the fruit variety. This level of record keeping would enable closer to real-time inventory, help determine where problems occurred, and inform pre-season planning.

Ecker's uses a mix of face-to-face contact, advertising, and a business website to reach customers. The website is updated for key events through the season, but is not a major point of contact with customers. Sara Ecker estimates the farm is contacted approximately once a week through the site. Sara Ecker is aware that they would benefit by increasing customer awareness of their products:

> In 2011, to improve our customer connection, we paired with a local winery to do a 2-sided coupon so customers to each venue could receive a discount on a

> caramel apple or glass of wine. We also utilize local radio ads and place ads in the Winona Daily News for events on the farm. Expanding our customer connection needs to be a goal of ours moving into the 2012 season.

In a normal season, Ecker's sells approximately 20% of their product through wholesale channels and 80% through direct marketing. She estimates that the cost for Ecker's to wash, pack and assume other direct marketing tasks is similar to the cost associated with contracting a distributor/packing house to do the work. That makes direct marketing more attractive than wholesaling from a bottom line point of view. Even so, Ecker is quick to point out that businesses like Reinhart's and Just Local with their competent staff and open lines of communication have proven essential for distributing Ecker's product, particularly in years with high yields. Extreme weather dramatically impacted many fruit growers in 2012 and Ecker's was no exception. This had a noticeable effect on the percentage of fruit Ecker's sold wholesale and it underscored the need to build food supply chains resilient to change.

Grass Run Farms: A farmer-built aggregation business

Grass Run Farms (GRF) sells grass-fed beef and "fresh air" pork and is owned by Ryan and Kristine Jepsen. Distribution for GRF is a complex undertaking, a situation stemming from the geographic range where slaughter facilities, processors, distributors and customers are located. Kristine Jepsen describes the challenge of routing meat shipments efficiently:

> We try always to analyze which products are going where and eliminate product back/forth. Ground beef produced at our grinder in Minneapolis should not need to go back to Madison to get picked and delivered to end customers in the Cities. Some transport decisions are within our control; some are not, depending on when product leaves our possession. In general, we do a pretty good job of keeping product as local to the end market as possible, a goal that's usually most cost-effective.

Historically, the small volumes moved by GRF mean that delivery expenses run high. This lack of efficiency informed GRF's decision to cease self-distribution. In recent years, this led to a contract with the Twin Cities-based Edina Couriers that picked up product from GRF's warehouse and delivered it to locations in Illinois, Iowa, Minnesota and Wisconsin. However, meat production in general is a low profit margin industry, and shipping product via less-than-truckload (LTL) freight results in a high cost of shipping per pound. This made it necessary for GRF to take bids for hauling from multiple carriers, and to consider alternatives for storing their product. GRF then contracted with cold storage facilities in Omaha and the Twin Cities, where cross-docks for designated meat distributors are located.

> Right now we contract a complex LTL route with Perishable Distributors of Iowa (PDI) each week to get product from kill to further processors and warehouses. This route includes backhauling products that were further-processed the week prior. Once product is at each distributors' designated pick-up point, it becomes their possession in distribution to the end customer. Our distributor in Madison

> sometimes holds products, though more of a cross-dock than full-on storage, now that they're purchasing all their inventory from us by purchase order.

Despite the expense, Jepsen's view of shipping costs is tempered by years of experience in production and distribution, "Our cost per pound of distribution to the end customer is quite high, but our sophistication of relationship with our main distributor makes it reasonable—after all, we've done it all ourselves in the past, and we understand their challenges and overhead."

This ties into one of the biggest challenges GRF faces as a specialty meat company, that of creating productive relationships with new supply chain partners. Turning over distribution of its products entailed finding a business that shares GRF's dedication to quality, natural products. GRF hadn't grown large enough until last year to attract the attention of mainstream distributors. Large distributors prefer to pick and choose the cuts of meats they handle, but this is not necessarily the way things work in the grass-fed beef business where product supply is relatively scarce. Even though some aspects of their supply chain are settled, it continues to be a challenge for GRF to fully distribute all parts of each carcass, thereby increasing net revenues and limiting waste.

GRF acquires new customers each week separate from those accounts that are handled by their primary distributor. Some of these customers, especially those with multiple locations, arrange their own distribution by brokering deals that reduce hauling costs. In these cases, the customer pays for distribution. In other situations, GRF's cost of distribution is figured into the price paid for by the customer.

The infrastructure for small to mid-scale meat distribution is a limiting factor for producers. Meat is more heavily regulated than non-meat products meaning there are fewer independent processors available to handle meat properly. This represents a barrier for small-scale meat producers seeking to establish and maintain a livestock operation. The pressure to grow is immense, because large-scale operations can arrange more cost efficient hauling and distribution relationships. This pressure to grow also makes it necessary to understand the cost of distribution, something that may be less imperative for small-scale crop operations. Kristine Jepsen observes, "For producers, it boils down to the question, which markets are you servicing and why?"

GRF and its partners have begun to implement electronic scanning inventory systems to more efficiently track inventory. For the present, they still collect and manage inventory data from distributors through the use of manual tally counts and excel spreadsheets. This system works fairly well because GRF runs a lean distribution inventory with few boxes of product requiring storage from week to week.

While GRF's website currently provides a modest connection to their customers, Jepsen believes that GRF's capability in that area, as well as the ability to manage and sell inventory online will continue to grow:

> Customers read our website as a point of verification of our story and product attributes, but it is not a primary means of communicating with them. We rely on point of sale to corroborate our product quality and sourcing narrative. We did just launch retail fulfillment through our website, and that has provided a useful outlet to our fresh inventory. Overages can be routed to fulfillment for very

> effective direct shipping to online customers. In the coming year, I expect to contribute to and flesh out our Facebook page and blog as a means of staying current with interested customers and explaining more of what we do in our industry.

GRF has partially adopted QR code technology for use in labeling product, but has not found a cost effective way to incorporate additional functions into their inventory system. Scale limits the ability of small to medium scale producers to fully integrate this technology. Kristine Jepsen describes the practicalities:

> We have QR codes on our retail labels as a branding tool. They are not a tracing mechanism right now, due to cost of printing unique label inventories and managing the QR code assignments themselves. It may be possible to get processors to adopt QR image printing technology for case labels of products, an innovation that would require weekly or even daily management by both GRF and the production house.

Ninety percent of GRF's inventory is in primal cuts – the basic sections from where steaks, roasts and other subdivisions are cut - that their wholesale customers render into smaller cuts further along the supply chain. The remaining ten percent of products are distinct cuts and are labeled with generalized QR codes. It is currently too expensive to create QR codes for individual cuts. The key for producers working at the scale of GRF may be to grow, and to have supply chain partners willing to develop shared printing and networked inventory resources. In GRF's case, growth might cause greater amounts of product to be located in one place, consequently making labeling and traceability of individual cuts feasible. Whether this could happen at a scale that is local or regional is difficult to say. Beyond this, Kristine Jepsen feels that consumer use of QR codes on food products hasn't reached a high rate of adoption, based on the limited customer feedback in the markets they serve. Fewer than ten people have left comments related to using QR codes through the GRF website. Jepsen feels that the use of an online tool such as Google Analytics would help to determine the marketing effectiveness of using QR codes by tracking how frequently their products are being scanned. QR codes might also be effectively combined with coupons or other incentives that are part of the consumer's increasingly digital purchase experience.

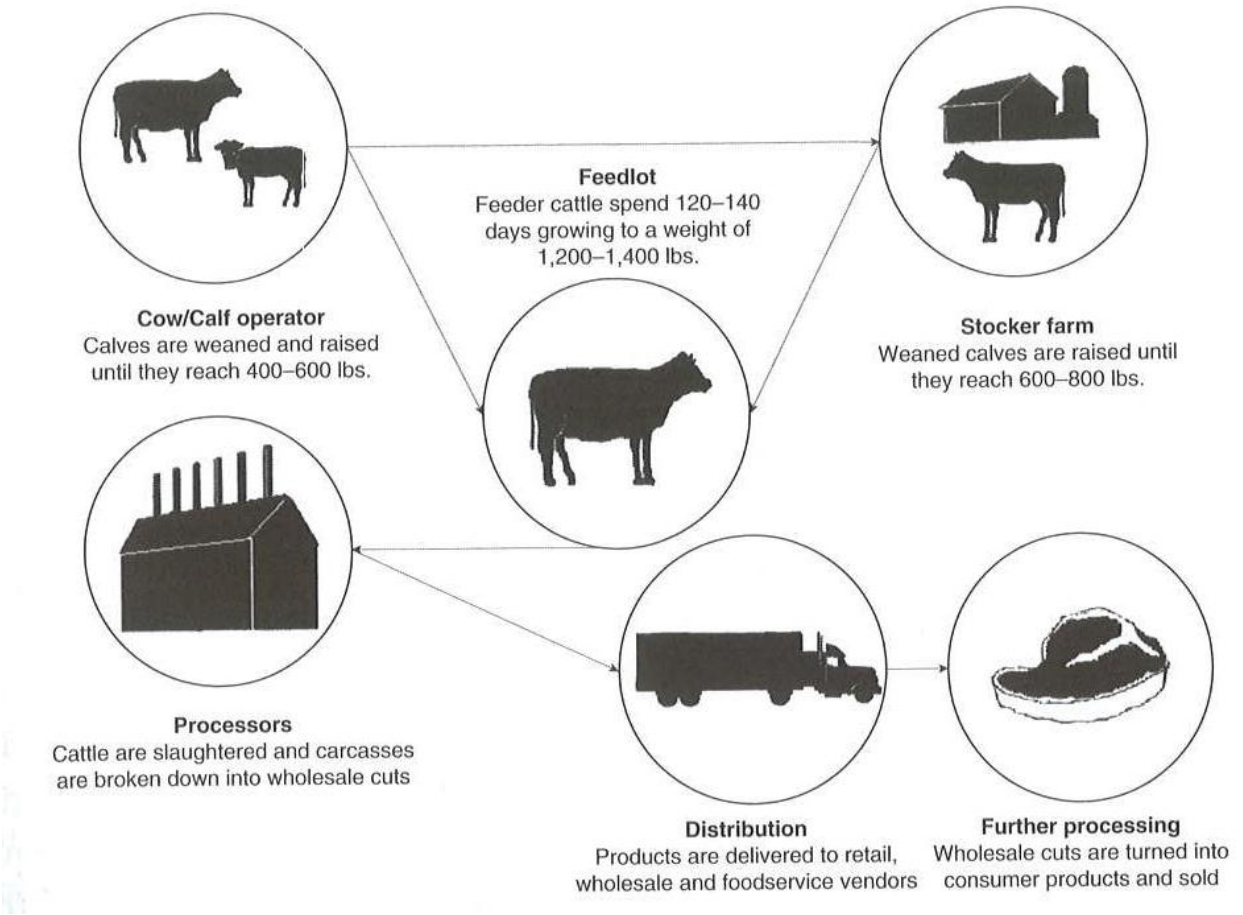

Figure 4 US Beef Supply Chain (Pullman and Wu 2012)

An emerging food hub: Driftless Organics, Keewaydin Organics, Harmony Valley and Just Local Food

There is an emerging set of business relationships in the Driftless area with like-minded vegetable growers that forms the basis for aggregating product at a scale to meet wholesale buyer needs. The Driftless region is home to a high concentration of organic farms, with relatively little infrastructure for fresh vegetable wholesaling. While organic dairy farms have enjoyed the proximity to dairy processing in this region, as evidenced in the success of Organic Valley, organic vegetable growers have been quietly building their production know-how and investing in business infrastructure to enter the wholesale organic market. By working together, these businesses have reached critical

mass and are serving the regional market with fresh, local organic vegetables.

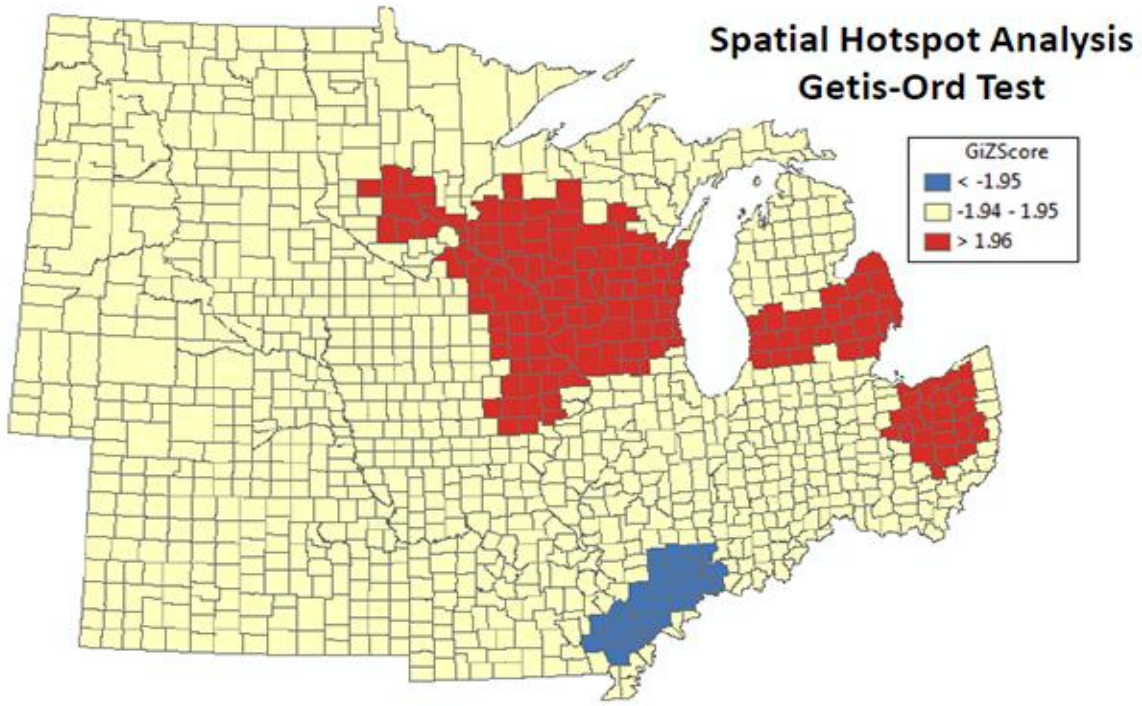

Figure 5 Hotspot analysis of the number of farms with organic production in the Upper Midwest, 2007.[1]

Driftless Organics grows and sells a variety of vegetables with potatoes as its main wholesale crop. They also raise sunflowers for culinary oil, contract out for pressing and bottling, and then market under the Driftless Organics label. The company's distribution area for vegetables is primarily southern Wisconsin and the Twin Cities, and their sunflower oil is distributed throughout the Upper Midwest. In addition to Community Supported Agriculture (CSA), farmers' markets, and farm-to-school programs, Driftless Organics sells to retailers, wholesalers, and restaurants. CSAs represent 50% of Driftless Organics' sales. Customers can also order beef products from Driftless Organics' partner **Big River Beef** through the CSA program or directly by email. Driftless Organics has recently begun to grow grain that it sells to local bakeries through farmers' markets.

Driftless Organics employs a creative mix of distribution and hauling strategies to reach its customers cooperating with neighboring **Star Valley Flowers** on weekly distribution runs. Once a week from June through December, Driftless Organics loads its 16 foot truck with produce that it delivers to several CSAs, one wholesaler and multiple retail clients in the Twin Cities area of Minnesota. It piggybacks flowers for Star Valley to a wholesaler in that market. They may partner with Star Valley to deliver product to Chicago. This shared efficiency cuts in half the number of trips required for these businesses to service the Twin Cities, and is a promising relationship for future markets.

[1] Hotspot analysis maps courtesy of Laura Brown, University of Wisconsin-Extension; Steven Deller, University of Wisconsin- Madison, Department of Agricultural and Applied Economics; and Anna Haines, Center for Land Use Education, University of Wisconsin–Stevens Point. www.foodsystems.wisc.edu/index.php

Driftless Organics also drops off product at nearby **Harmony Valley** farm which provides aggregation and distribution services for them. In conversation with Andrea Yoder, we learned that Harmony Valley began serving as a cross dock for a number of smaller vegetable farms in 2006, and now helps distribute a number of processed products from the region, including cheese, coffee, fermented vegetables, maple syrup and jams and jellies. Harmony Valley notes that aggregation location is only one factor that dictates the viability of an aggregation point. Facilities and staff are two others. Their dock may not be on a major thoroughfare, but they are able to staff their loading dock for pick up at any hour, a convenience for haulers who manage often unpredictable drop off and pick up schedules. **Edina Couriers** transports some of these products from Harmony Valley to **Co-op Partners Warehouse** in St. Paul, Minnesota where it is then distributed to metropolitan area stores. For more on the values-based business relationships with **Coop Partners Warehouse** see case studies in Day-Farnsworth 2011, and Stevenson 2013. Edina piggybacks small shipments for Driftless Organics to markets, including Madison and Milwaukee, that otherwise would be impractical. Harmony Valley also acts as a hub for Driftless Organics products that are sold to **Whole Foods Market**. Whole Foods Market is a vertically integrated retail chain with its own distribution trucks that have added Harmony Valley as a back hauling partner. Empty trucks traveling from the Twin Cities are filled with product from the Harmony Valley aggregation point, and then travel to Munster, Indiana, where Whole Foods Market maintains its regional warehouse. This arrangement reduces the cost of distribution considerably for farms and processors in the region and represents the farthest distance regional product travels. The products sold to Whole Foods Market are labeled with various brands and sold in regional stores with their stories intact.

Driftless Organics has also been working with **Keewaydin Organics** to market produce under its **Just Local Food** label. While the amount of product Driftless Organics sells through Keewaydin Organics is currently small, the two businesses have a mutually beneficial relationship based on informal distribution. Keewaydin Organics may have need for a bit more product, or Driftless Organics may have more than is needed to fill orders. This on-the-fly arrangement between supply chain partners reduces product loss through waste, and helps to retain customers through reliable provision. Keewaydin Organics helps producers maintain a degree of connection with customers by listing source farms on the Just Local Food label. The organic certifier that Driftless Organics uses would like them to incorporate lot numbers as part of invoicing, and provide an inventory spreadsheet for sunflower oil to ease the certification process.

Driftless Organics has not incorporated logistics or inventory technology into its operation, due in part to the variety of its hauling arrangements. Their website personalizes the farm story with history and profiles of the people who work there. Driftless Organics provides an online CSA form that makes it easy for customers to sign up, and is connected to a database that tracks when and where deliveries will be made. Their site also provides links to the CSA newsletters that are regularly released June through December. These newsletters describe the contents of current CSA boxes, offer opportunities to buy non-CSA produce, and shares farm anecdotes and recipes. While Driftless Organics participates in intermediated distribution, they also communicate effectively with their direct market customers through the Internet.

During the slow season, **Keewaydin Organics** has the ability to haul product in one of their three fully refrigerated vehicles. During the busy time of year, Keewaydin Organics delivers only to Madison and Milwaukee, and uses Edina Couriers to haul product to Minneapolis and Chicago. Keewaydin Organics also piggybacks on Organic Valley deliveries through Nottestad Trucking and looks for similar opportunities when possible. Keewaydin Organics owner Rufus Haucke values both quality local production and innovation. About a quarter of his 20-acre organic farm supplies his CSA business while the other 15 acres is distributed through wholesale markets. Keewaydin Organics LLC aggregates organic produce from 60 producers for distribution. When we spoke in 2010, Haucke was developing a system of hauling product by smaller trucks to a regional aggregation point, and using larger trucks to provide interstate and large market hauling. The process would be reversed when delivering to the larger, urban markets that comprise 95% of Keewaydin Organic's business. Where possible, product would be cross-docked for efficiency and hauled by smaller trucks to CSA drop-off points, groceries, restaurants and institutions.

Haucke's aspiration to transform his business into an aggregation facility and cross-dock products has since become a reality. Haucke's aggregation business, **Just Local Foods**, is now one of three businesses located in the **Food Enterprise Center** in Viroqua, Wisconsin. Just Local Foods shares space in this food hub with partners such as **LuSa Organics**, a producer of organic bath and body products; and the Fifth Season Cooperative, with member-owners including local food producers, processors, distributors, buyers and the workers who supply the labor. There is also a new commercial kitchen that will be available for local businesses seeking to create value added products. These businesses work together to create a commercial space based on similar values such as local business, organic production and fair trade.

Keewaydin Organics, like other businesses interviewed for this report, is concerned with maintaining a personal relationship between customer and business. Their business model is based, in part, on transparency, meaning that the customer knows who is producing the food or can readily discover the story. Face to face interaction between producer and customer may be low-tech, but it is also effective. When supply chains get longer, and products from many sources are aggregated, new technology is needed to sustain the story. Haucke understands this.

Haucke has been working to implement a software system that will provide real-time inventory and purchasing histories for his business, and others that work at a similar scale, "I personally think that the local food world is screaming for a system to be developed, and yes, there are systems being developed, but they are being developed by people outside of the industry and that is leading to products that aren't quite right." Haucke is finding it challenging to oversee the creation of this software in a way that is affordable and leaves time for his other responsibilities. A solid inventory software system scaled for local supply chains would open the door for considering traceability options such as QR codes. Cooperative infrastructure ventures like the Food Enterprise Center in Viroqua have the potential to concentrate resources at the necessary scale for local producers, distributors and processors seeking to make investment in this type of innovation more cost effective.

Potato King: A case study of regional logistics, independent distribution and implications for local food

Our research team thought it would be informative to find out how a mature, independent, regional distribution business sets priorities and achieves efficiency in food supply chains. We attended a tour and discussion group about supply chain logistics at Potato King, a distributor based in LaCrosse, Wisconsin, that delivers to regional markets and sources globally.

Keith Herlitzke and his two brothers now manage the family business started by their father in 1961. Herlitzke's dad was working for Trane Company in LaCrosse when he started to regularly purchase potatoes direct from a local grower's roadside stand about 150 miles north of LaCrosse. His neighbors expressed interest in buying these potatoes for their families, so Herlitzke began picking up extra to distribute in his community. Over time, Potato King grew from a self-constructed root cellar operation into a mid-size, independent, full-line distributor with the addition of several produce types, many sourced from California. Potato King grew further and introduced an increasing number of products, most of which found a healthy demand from their buyers.

In addition to the three Herlitzke brothers, four of their children also work at Potato King. The family-run business expanded the sourcing of its produce to include the southern United States, as well as global sources, making it a local example of global food distribution to regional markets. Potato King contracts with 80-85 stores and 150 accounts, distributing a full line of fresh foods to southeast Minnesota, Madison, the Fox River Valley, and north across Michigan's Upper Peninsula. Potato King picks up and delivers all products it sells, delivering every day of the year except Christmas and New Year's. Potato King is a family business with a strong commitment to the local community and its employees. Herlitzke is committed to Potato King as a values-driven business emphasizing honesty, fair prices, on-time delivery and a customer-oriented attitude. This is reflected in the way the company has responded to customer needs. Year round availability of seasonal produce has become increasingly important for Potato King's clients, primarily wholesale buyers from independent supermarkets. Knowing this, the company made it a point to look for opportunities to expand product lines in response to requests for locally out-of-season and otherwise unavailable products. A byproduct of this philosophy was an increased ability to fill gaps in demand when less flexible competitors dropped out of the marketplace. Potato King now lists thousands of SKUs for products from around the world. Greater amounts of produce are imported when seasonality limits availability from suppliers in Florida, California, Georgia, and Philadelphia. Potato King imports bananas through Freeport TX ports, and foods from China and Indonesia through a Central Los Angeles warehouse. Mexico is also a source of produce for Potato King.

Potato King's customers are the driving force behind the company's growth. Supermarkets and groceries had complained of insufficient freshness of product from previous suppliers. Those distribution companies relied on outside trucking, but the produce was not reliably fresh and problems with driver fatigue and reliability resulted in late deliveries. The trucking of semi-freight is a business known for high driver turnover, a problem that makes it difficult for businesses to achieve consistent quality and

timeliness. Herlitzke emphasizes that in the long term, Over-The-Road (OTR) trucking often fails to provide the driver with incentive to deliver in a timely fashion. Drivers know that they may end up waiting for their next load, therefore experiencing considerable downtime between hauls. Boredom, frustration and lack of opportunity sap the motivation of affected drivers.

This knowledge motivated Potato King to develop its own hauling business in a way that reduces driver fatigue and maximizes the freshness of produce. Delivery schedules are made as regular as possible, and back-hauls are actively sought to decrease downtime and increase efficiency, both in labor and fuel. This active management of the hauling task reduces stress on the driver, who more often can predict what they need to do and when. Drivers have dependable incomes, feel respected, and consequently are invested in providing the customer satisfaction that Potato King considers the primary indication of success. Partner drivers (husband/wife teams) have become increasingly important to Potato King. Partnered teams are able to alternate driving shifts. This reduces trip times and downtime, and allows husbands and wives to see more of each other.

Driver training is a key component to success in distribution. Potato King's good reputation in the trucking community provides them with a better pool of drivers than most companies. Word of mouth attracts applications from drivers even at those times when Potato King is fully staffed. Potato King, however, still checks online driver records to verify the quality of all driver applicants. Herlitzke reports very low driver turnover, far lower than the industry average.

Potato King's regular use of back-hauling could be termed complimentary hauling, because it is less about the direction the truck is moving, and more about the availability of space in the truck, and whether hauling another company's product would interfere with providing great service to Potato King's clientele. Potato King has regular complimentary hauling relationships with City Brewery clients, Organic Valley, Kroger, as well as various cheese producers and paper companies located in the Fox River Valley area. Potato King targets dropping off complimentary loads close to the producers/suppliers from where they source. This happens frequently when Potato King sources produce from California. Potato King will transport any product suitable for their trucks as time and space allows.

Potato King's trucking business continues to grow with the company fleet now numbering 70 tractors and 90 trailers. Potato King uses modern truck technology, including computerized logs of trailer temperature that provide improved precision and verifiable proof of quality control. Potato King uses this technology to adjudicate disputes over delivered quality, because they don't want to take ownership of a rejected load. Potato King has also moved to consistent use of 53' trailers that is now the industry standard and is the size necessary for supplying most supermarkets. Potato King ships only to supermarkets and groceries. Institutions proved difficult to supply efficiently due to non-standard package sizes that did not stack well on pallets.

Variations in state trucking regulations are not a big problem for Potato King, with the exception of California. Herlitzke notes that California regulations change more often than in other states, are not consistently enforced, and make less sense to him than

regulations in other states. The Federal standards for diesel emissions apply in most states, but not in California where a stricter standard applies. An example of this is found in the rules for trailer cooling units. Once a cooler engine is seven years old, it must be replaced or rebuilt, an expensive proposition. This applies whether the refrigeration unit has been operated for 10,000 hours or 1 hour. The anti-idle law is also problematic because drivers and produce both need protection from extreme temperatures, whether the truck is in motion or stationary. This tension between environmental and freighting concerns is frustrating to Herlitzke who says that Potato King is happy to be “carbon foot print compliant”, and “smart way certified”.

Weather is a key risk factor throughout the food supply chain. For example, Potato King purchased and distributed 7000 cases of sweet corn in 2010; only 5000 cases were moved during the cool, rainy year of 2011. By mid-August of 2012, 9000 cases were distributed with an additional 1000 cases a real possibility. There is always a huge regional demand for watermelon, a crop dependent on ample water supply and sourced primarily from the south. Rain events can hasten or slow watermelon availability and it is Potato King’s marketing staff who communicates these ebbs and flows to retail clients, encouraging them to feature abundant crops and warn them of likely shortages. The sales room buzzes with phone conversations that communicate real-time, in-field conditions while managing customer expectations.

Like weather, climate impacts produce availability. The Upper Midwest has a shorter growing season than most other regions in North America, but consumers demand fresh produce 12 months of the year. Most buyers contract and receive produce from states with longer growing seasons well before Wisconsin’s produce is harvested. Consequently, Potato King sources most of its product from out of state. Georgia sweet corn growers expected a bumper crop in 2012 and this influenced how Potato King promoted product. Northern California is the #1 source of produce distributed throughout Wisconsin, whether by Potato King or another company. Produce sourcing moves geographically in tune with regional growing seasons. Delano Farms is a large California producer, packer and marketer that supplies Potato King with table grapes for six months of the year, then Potato King staff sources grapes produced in Chile.

A primary logistical problem with local supply relates to the need for quickly cooled and transportable produce like tomatoes and strawberries, preferably before local gardeners harvest. Local product often is not grown to withstand transportation, hasn’t received the same level of post-harvest care, and is usually available at the height of the season. Therefore, local products may not be as robust and won’t compete well with out of state commercial product. The primary local products Potato King does transport are squash, sweet corn, peppers and pumpkins. Local potatoes provide viable distribution opportunities for Potato King, but the elevation and climate in Idaho and Colorado produce potatoes with a higher specific gravity that are denser and store better than Wisconsin potatoes. In Herlitzke’s experience, Wisconsin potatoes only compete well with that of other regions when they are closer to the final destination and sold closer to harvest. Herlitzke notes that organic sales don’t appear as strong in Fox Valley markets and those of the Upper Peninsula of Michigan relative to other markets.

Freshness is another key to Potato King’s success. Dole is Potato King’s biggest partner on the supply side. Dole supplies Potato King with fresh cut products such as

prepared salad greens. Potato King insists on very fresh produce for maximum shelf life. This means that Dole produce is picked fresh daily, the coleslaw is processed the night before, and the product is picked up between 1 and 3 am on Thursdays from Salinas Valley, arrives Sunday at Potato King in LaCrosse, and is in stores by that Monday. Potato King routes their trucks around weather, rather than pushing through along the shortest routes. This may increase freight times, but does not leave then vulnerable to long weather delays. Because of this, Potato King has a perfect on-time delivery record for the past two years.

Potato King has 45 employees working in the warehouse, and 125 employees total, with the facility filled near capacity 2 days/wk. Potato King's warehouse turns over 75% of product twice a week. Over 1800 cases of salad are sold every week. Herlitzke states, "If even as many as five cases of salad are not sold in a week, then I know there's a problem." He also notes that Potato King's grower partners are so good at sorting and grading that Potato King is able to repack and rebrand onions efficiently for regional sales. Potato King is an example of a large regional distributor that understands the components of its success: quality, reliability and timeliness.

Their success, however, makes Potato King and other independent mainline distributors of comparable size and organizational structure a poor fit for disaggregated small producers due to issues of seasonality, transportability and scale. Potato King responds to the expectations of the independent supermarkets that make up the bulk of its clients, and is therefore oriented toward delivery efficiency, availability of product, and standard product lines. For Potato King to source product from many small-scale local producers who are tied to seasonal production would require Potato King to complicate its existing relationships and supply chains. This helps us to better understand the importance of product aggregation and packing for smaller local producers interested in intermediated distribution.

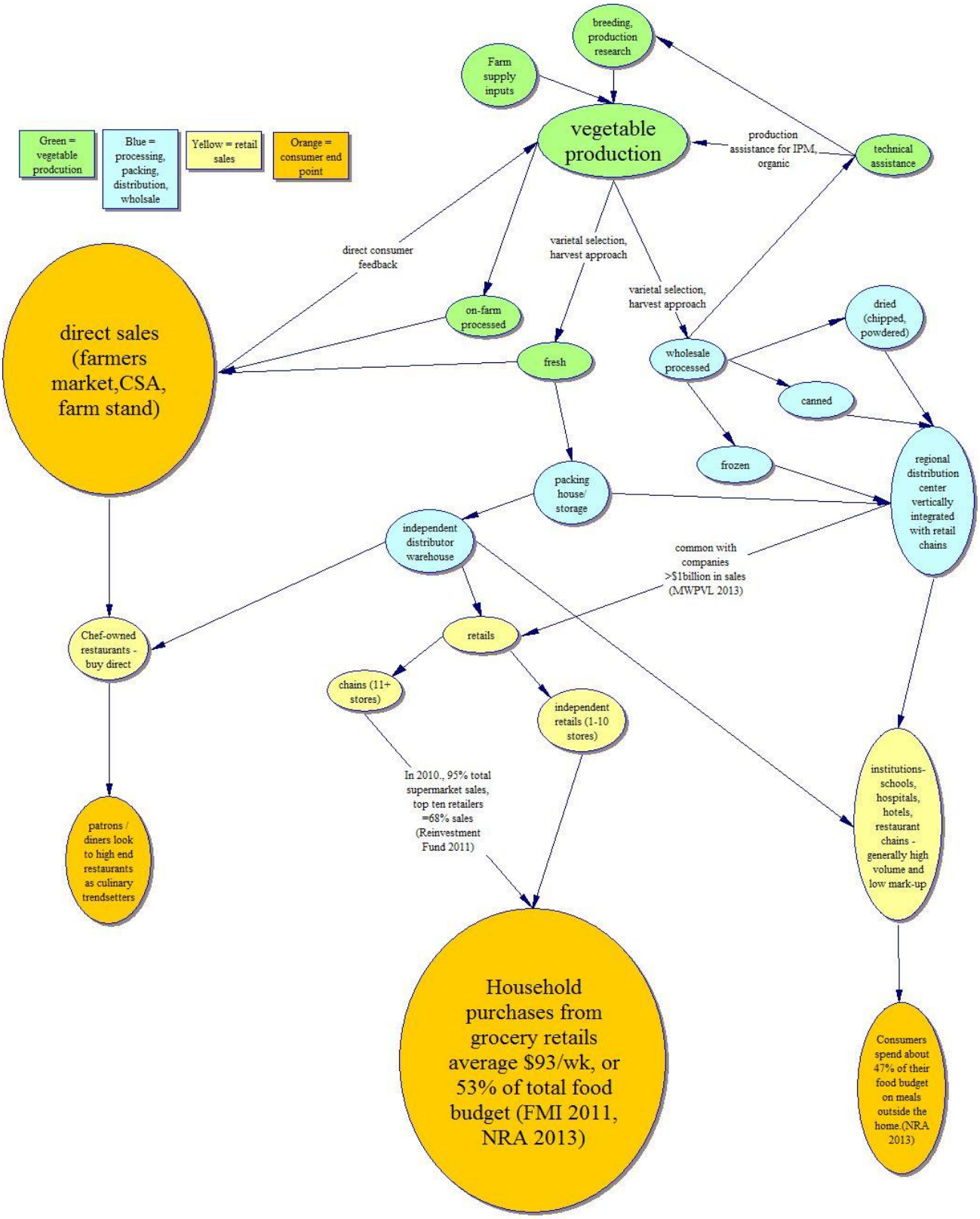

Figure 6 Extended food supply chains for vegetables, including direct and intermediated markets, processing and fresh markets.

Section 3: Discussion of concepts with literature review

Opportunity in local food sales | Farm scale and marketing channels

To understand the constraints that affect the efficient distribution of local food by small to medium-sized farms, it is helpful to have working definitions for farm size, and to know in which marketing channels local food is typically sold. Farm size categories differ by type and mix of product grown (dairy, vegetables, meat, animal feed, fiber, bioenergy, etc.) and geographical context (such as irrigated desert, central plains, flood plains, foothills, etc.). Marketing channels are equally complex, dependent on processing requirements (washing, sizing, packaging, controlling temperature, cutting, etc.), business relationships maintained over time, and size of market (single store, store chain, restaurant, school district, etc.). This complexity makes it hard to define what is meant by a "local food supply chain". The distance food travels to market or the geographic boundaries within which it is sold rarely capture the complexity within local food supply chains (Martinez, 2010). Yet, local food has a story that differentiates it. It is about the places where it is grown; how it is grown, the lives of the people who grow it, and the way consumers connect to that knowledge (Johnson, Cowan & Aussenberg, 2012).

Low and Vogel (2011) define local food as that sold in two of three marketing channel types: direct-to-consumer (farmers' markets/roadside stands/on-farm stores/CSAs), and intermediated (direct-to-grocer/restaurant or through a regional distributor). The terms direct-to-consumer and direct marketing are essentially interchangeable. The third channel, mainstream, is considered large scale, conventional in nature and not local. Low and Vogel define farm size in the following manner:

- Small Farms are those with less than $50,000 in gross annual sales.
- Medium-sized farms are those with gross annual sales between $50,000 and $250,000.
- Large farms are those with gross annual sales of $250,000 or more.[2]

With these gross definitions in mind, Low and Vogel describe the distribution of local food by tracking farm size against degree of participation in direct-to-consumer and intermediated marketing channels. Low and Vogel's analysis of data from the USDA's 2008 Agricultural Resource Management Survey (ARMS) reveals that large farms were 5 percent of all farms reporting local food sales, but accounted for nearly 70 percent of total local food sales, and 92 percent of intermediated local food sales. Large farms are the dominant suppliers of local food in intermediated supply chains. Diamond, Barham and Tropp (2009) describe the similar situation of very large farms in conventional supply chains, and the resultant economic and cultural effects:

> Historically, farmers have been "price takers" when they deal with mainstream markets such as wholesalers, terminal markets, mainline food service

[2] It is important to note that Low and Vogel provide no differentiation between large and very large farms and chose to use gross annual sales as opposed to net farm income. They have also defined scale in economic terms across production sectors, rather than making distinctions between sales from various production categories. For instance, a high value product such as beef may not easily compare with a lower value food product like sweet corn.

> distributors, or brokers—i.e., they exert little control over the prices of their goods. Such price-sensitive market outlets tend to favor farm enterprises that produce large quantities of undifferentiated agricultural commodities at low cost. The consumers who purchase these goods also tend to be relatively "passive" buyers, for the most part neither aware of nor interested in how or where their food was produced. (3)

This helps to explain why the national and global marketing channels, and other intermediated supply chains that may be similarly organized, may not appeal to farmers with a commitment to values such as community, environmental conservation, and local economic development. Participation in formal supply chains does not guarantee a satisfactory bottom line, environmental protection, or meaningful social relationships.

Diamond et al. (2009) emphasize that farms outside traditional supply chains may find success when operating at the smaller scale of direct marketing. There the connection between farmer and buyer is personal, as well as practical. These consumers are often more interested in knowing the origin of their food and ascribe value to differences from conventional product. In the direct market, consumers are clear in their desire for products that are organic or sustainably-farmed. Consumers see value in products that are authentic, traditional and innovative (Weiss 2011). These commonly held values or preferences give producers the opportunity to distinguish themselves from the mainstream.

Although translating this sense of shared experience and higher quality to intermediated supply chains is challenging, choosing to participate in that marketing channel can be financially rewarding. Low and Vogel (2011) observe that local food sales for all farm sizes were higher when selling exclusively through the intermediated channel. This indicates opportunities for small to medium-size farms to increase sales in the local foods market through the intermediated channel. However, small farms were approximately ten times more likely to sell exclusively through the direct-to-consumer channel than solely through the intermediated channel, and roughly three times more likely to sell exclusively direct-to-consumer than through both channels. As Martinez (2010) notes, "the incentive of smaller farmers to expand and become more efficient is diminished as more time is spent off farm performing additional entrepreneurial activities such as marketing at farmers' markets" (23). It is also common for small farmers engaged in direct marketing to supplement their income through both off-farm jobs and on-farm work that is unrelated to local food production such as marketing forest products or producing alternative energy (Martinez). This do-it-yourself, diversified approach is an integral part of farming lifestyle for smaller farms. The additional income from these supplementary endeavors may offer financial stability for a farm business, yet leave little time to explore intermediated marketing opportunities.

The importance of location | Proximity and other factors

Low and Vogel (2011) performed statistical analysis of 2002 & 2007 Census of Agriculture, 2000 U.S. Census, and county-level data sources to reveal where farms with higher local food sales are likely to exist. The results suggest location is the dominant factor in determining demand for direct-to-consumer sales, and that metropolitan areas with ample land for agricultural production are the best locations for

small local food farms. There was not enough data to determine whether this was also true of intermediated local food sales.

Small farms located near the major markets they wish to supply will experience shorter hauling distances. Accordingly, these farms partially compensate for the advantages large farms have in distributive economies of scale. Low and Vogel note that 50% of small local food farms are located in metropolitan counties, and 30% are located adjacent to metropolitan counties (12). Larger local food farms, however, are more likely to be located in counties that are remote from metropolitan areas. Metropolitan areas may lack sufficient amounts of open and contiguous agricultural land to support larger farm operations. Large farms tend to be well integrated with intermediated supply chains and the associated economies in distribution. It may be important for large local food farms to maintain these efficiencies, rather than pay a premium to locate production near metropolitan areas.

There is also the question of whether direct-to-consumer marketing of local foods stimulates local economies, and under what circumstances. Export-based economic theory emphasizes that exporting goods from an area of production brings otherwise unavailable revenue back to that area. Theoretically, more money will then be spent in the local community thereby improving the overall local economy. Much like the uncertainty found in defining local food, it is difficult to define the minimum distance required to define a good as an export. Kozub (2011) notes that local agriculture by definition would not create exported goods, because the product is consumed near where it is produced. However, Kozub observes that the very uncertainty of what local or regional food means and where the boundaries between regions are located suggest that these goods may still be exports with some degree of economic benefit accruing to the locality. Certainly, we can expect that farm goods produced in rural areas and purchased by neighboring urban consumers has the potential to support rural economies. Similarly, if rural areas add product value through telling the product's story or through processing, the value may accrue to the rural area.

Deller and Brown (2011) examined the 2008 Agricultural Resource Management Survey data to determine whether local food marketing produces local economic benefits. As in the work of Low and Vogel (2011), some types of analysis could not be done for intermediated marketing so the authors performed statistical analysis solely on the direct-to-consumer channel. Deller and Brown tentatively conclude "Most of the statistical evidence suggests that there is no relationship between local foods and community economic growth and development" (3). Deller and Brown caution that this analysis is preliminary, and that some types of direct sales such as those to restaurants, groceries, schools and hospitals could not be tracked. The ability of those types of direct sales, as well as intermediated local food sales to improve local economies requires further study.

In some circumstances, it is practical for small to medium-sized producers to haul food over a much greater distance. This may be to a farmers' market, but is very likely to involve a set of deliveries to restaurants or retail stores, and the producer may also be acting as a distributor for other farms (D. Parr, personal communication, September, 2011). However, producers who hope to find additional customers within specific urban markets do not always achieve and maintain an adequate customer base. Farmer and

small-scale distributor, Rink DaVee has observed that producers who deliver direct to businesses over longer distances tend to “do it for a short period and then move onto something else.” This can be considered in terms of the case studies area. From the mean center of the Driftless area, it is approximately 150 miles to the Twin Cities, and roughly 200 miles to Chicago. The real world distance along roads is greater. Ideally, any load of food travelling these distances should be fairly large to cover the significant investments of fuel and time. Some Driftless producers are very close to a major market, e.g. producers located in western Dane County. The distance for these producers to Madison is quite possibly shorter than the 30.7 mile average that producers reported travelling to a farmers’ market (Low and Vogel, 2011). However, much of the farmland in the Driftless is located far enough away from major markets to make self-distribution an expensive proposition. Intermediation may be the only efficient method for most farmers interested in transporting food to relatively distant markets. Traditionally, this would be done through an aggregation facility such as a packinghouse, specialty or mainline distributor. Producers who know their cost of self-distribution are most able to gauge the value of using one of these aggregation services.

There is another cost consideration for some producers in the Driftless area. Much of the land topography is hilly and therefore highly erodible and challenging to farm, especially with machinery. While the average Driftless farm is not small, the most easily cultivable land is often broken into smaller sections that would not interest large-scale farming operations. Cohee (1934) writes, “Only on extensive ridges or in a wide valley will a farm consist entirely of level land; more frequently it will be partly level and partly hillside” (244). Hillside farming plots must be carefully managed due to erosion concerns with some crops such as corn presenting a greater risk of soil loss.

Access to markets | Retailer and distributor motivation

Clark, Inwood & Sharp (2011) produced a study examining barriers to scaling up for local fruit and vegetable producers in Ohio. One of the challenges involved is in finding retailers willing to work with small local farms. Large-scale retailers participate in conventional distribution through supply chains that have well-established relationships with large farms. This approach to business is not just about obtaining favorable product price for the retailer, it also reflects the necessity of securing predictable and adequate flows of product into supermarket chains and other stores with large customer bases. Significantly, when retailers, distribution and production elements are integrated within a vertically integrated business structure, small producers are essentially excluded from participation in the supply chain.

Small farms may not grow enough produce to enter into a marketing relationship with a retail supermarket chain. If a supermarket chain requires a range and quantity of produce to supply several stores, the fact that a farm can supply enough of certain products for one of those stores is not necessarily compelling. Large chains seek the advantage of sourcing from fewer suppliers because it simplifies inventory and communication with supply chain partners (USDA, 2011). Packinghouses and distributors help small and mid-scale farms successfully market to those large groceries

and supermarkets actively seeking local product. Independent groceries and regional mid-size chains show greater interest in buying produce directly from small and medium-sized farms (Clark et al., 2011). These retailers show greater flexibility in sourcing produce and tend to have greater autonomy at the individual store level. Even so, they are likely to purchase greater amounts of fresh local produce when it has been aggregated.

Predictable and efficient product flow is just as important to large distributors as it is to large retailers. Nick McCann of the Iowa State University (ISU) Extension works as a business consultant with local farmers in northeast Iowa (personal communication, July, 2012). McCann sees his job as matching farm production to demand by moving local products out of the six-county region. McCann works mostly with the "serious" growers – those working hard to market their products.

> It's about growing their market, getting better gross margin. The major constraint for these producers is in entering the market. People say, we'll buy all you can if you produce it, but this is not always true. The large systems are not buying a lot of local foods. It's related to the risk of allocating shelf space in stores to perishable products from unfamiliar sources.

Small and medium-sized farms cannot depend on being distributed by large distributors even during peak production. Clark et al. (2011) note that the size of distributors in Ohio has an inverse relationship with the percent of foods locally sourced during the height of growing season. Large distributors are likely to purchase locally produced food only when doing so lowers their transportation and storage costs.

All large distributors that responded to the surveys of Clark et al. also require third party certification, something not always required by mid-sized distributors. Large retailers also require suppliers to be fully certified in terms of food safety. Even those retailers who make an effort to form relationships with local farmers want inventory and distribution to be reliable and efficient. The upshot of these tendencies produces a pressure for small and mid-scale farmers to pay for third-party certification, and to consider solutions such as inventory/traceability software and labeling systems. Together, these processes increase the reliability and predictability of product flow through supply chains, and allow participants to better respond to food safety issues. These services may be available through intermediation, but small and mid-scale farmers will usually be required to adapt their operations to handle some aspects of certification and traceability. Those producers who participate in intermediation so they can focus on production and pre-season planning, rather than marketing, may view these requirements as unnecessary complications.

There is little upside for large distributors to offer a hand to producers looking to "scale up" into intermediated supply chains. Clark et al. (2011) note that the large scale distributors in their study are "least likely of all distributor respondents to indicate they would be willing to work with the Ohio Department of Agriculture to develop, maintain, and grow relationships and markets with Ohio farmers" (32). This contrasts with medium-sized distributors who are very willing to work with farmers. At the other end of the scale, very small distributors are less likely to collaborate with farmers. Large distributors appear to see no advantage in working through logistics with producers that

supply smaller quantities, while very small distributors often lack the resources to dedicate to producer development (34). Clark et al. conclude that “Small and medium-sized farmers are searching for market access; distributors are looking for market viability; and the mid-level store is looking for competitiveness” (35). Intermediation through mid-scale distributors holds the most promise for small to medium sized producers seeking to enter new markets.

The key, as Clark et al. (2011) see it, is in avoiding oversupplied market categories, making effective use of available resources, and achieving economies of scope. Economy of scope is found in diversification. In our context, it refers to the idea that a facility that distributes one type of food product may work well to distribute many others, thereby reducing the cost of distribution across the range of products. Similar considerations apply to businesses that focus on hauling, cold storage and packing. Diversification also supports the marketing of niche foods by providing products that are less likely to be oversupplied.

The concerns of large-scale distribution suggest the future concerns of successful medium scale distributors. As product quantities increase, so does the pressure on distributors to buy greater percentages of that product from fewer suppliers and in a way that limits freight cost (King et al., 2010). This creates a reality check for medium-scale distributors who will have to manage the tension between the overall efficiency of large scale, conventional distribution, and retaining the small to medium-scale producers who have contributed to their success. This decision is also influenced by the cultural values of these independent businesses in the supply chains. The principles of growth, profit, and reliability are commonly held by supply chain participants at all scales, but may be superseded at smaller scales by other values such as preserving a traditional rural lifestyle, conserving soil and water quality, keeping revenue from agricultural production in the community, and maintaining close relationships with consumers.

This raises the long term question of whether small to medium-sized producers who participate in intermediated supply chains can bring other values to their supply chain relationships and realize some efficiencies of scale. For smaller farms to successfully participate in conventional supply chains they need to aggregate product and develop values-based relationships with supply chain partners.

Performance of intermediated supply chains

King et al. (2010) compared the performance of direct-to-consumer, intermediated and mainstream supply chains in several U.S. markets. Across different product types (apples, blueberries, salad mix, beef and milk), King et al. found that all of the producers that were engaged in direct marketing, and some of those that were part of intermediated distribution, obtained a higher percentage of the final consumer price than producers that supplied mainstream supply chains. Small producers may expect higher revenues per unit through direct marketing when compared with other methods. However, small farms that direct market are also less likely to track their actual marketing costs making it difficult to determine whether they could improve their bottom line by joining an intermediated supply chain. As King et al. note:

> Producers in most local supply chains (and all of the direct-market chains) assume greater responsibility for the supply chain functions (e.g., processing, distribution, and marketing…Whether or not producers are financially better off in local supply chains depends on the volume of sales, the size of the price premium they receive, and the degree to which they can perform additional supply chain functions cost effectively. (67)

King et al. (2010) note that the distance food travels (food miles) and fuel usage (per hundred weight) varies widely in mainstream supply chains meaning these chains are not always the most fuel-efficient. This indicates that the superior fuel economy observed within intermediated supply chains partially compensates for the economies of scale available to mainstream supply chains. King et al. also note that while the number of food miles travelled is low in direct marketing, the fuel usage per hundred weight is generally higher than in intermediated and mainstream supply chains. This inefficiency is due to the smaller scale of production, and the smaller load capacities of vehicles associated with farms that rely on direct marketing. By being more efficient, producers marketing through intermediated supply chains may experience a better bottom line than those selling direct. This improved bottom line is likely to be dependent upon selling greater amounts of product when using intermediation. At the same time, increased production of specific crops tends to mean fewer varieties of crops are grown. Curbing on-farm diversity can mean that a farmer takes on greater risk. This risk can be reduced when producer and distributor work together to plan the quantity and diversity of crop production thereby making product flows more predictable and wasted product less likely.

Small and medium scale distributors struggle to meet the needs of wholesale buyers while minimizing the cost of freight. This is related to the need to use labor efficiently and to fill trucks to capacity. Nick McCann of the ISU Extension describes a non-intuitive solution one of his clients found for this problem (personal communication, July, 2012).

> One meat distributor knew some stores that received weekly meat deliveries were running out of product, something made more complex by the need to provide the right mix of specific cuts of meat for each store. Even though it increased his transportation costs, the distributor decided to deliver a half-truck twice as often. Product supply improved, and average sales through those retail outlets eventually doubled. The delivery cost also went up less than anticipated, because the distributor no longer had to use expedited hauling services to correct product shortages in the retail stores.

King et al. (2010) also stresses that the inability of many local farms to provide year-round product availability is a barrier to entering some markets. Consequently, large-scale producers in California, Florida and other locales with long growing seasons play an integral role in mainstream and intermediated supply chains. Farms that grow storage crops such as potatoes, onions and apples can extend their sales for months after harvest. However, some local storage crops have shorter shelf lives than out of state varieties, limiting the ability of local producers to compete directly with large-scale production. The shelf life of potatoes, for example, ranges from 56 to 140 days, a difference that greatly affects inventory planning for warehouses and retailers (Bachmann & Earles, 2000). The impact of short growing seasons can also be lessened

by using preservation techniques such as drying, canning and freezing or raising fruits and vegetables using season extension methods such as hoop houses. Even with these methods, producers remain dependent upon favorable weather conditions and adequate marketing opportunities.

Collaborative solutions to enhance distribution

Agricultural business partnerships are collaborative efforts. Different stakeholders, each with a particular set of skills and motivations work with each other, either toward a common goal or to accomplish individual goals. These relationships exist in all marketing channels and at all scales of production and distribution. They are based on trust, experience and performance. Some of the stakeholders in these relationships are employees who work for pay, but largely do not determine how business is organized and conducted. Other stakeholders are farms who supply product for wholesale markets and who rely on brokers to market for them. These farms may have little choice about the type, quality or scheduling of the products they supply. Although many small and medium-sized producers operate at a scale smaller than the mainstream channel because of barriers to participation in mainstream agriculture, others do so willingly. For some farmers, the intermediated channel represents the only marketing option where financial goals and personal values achieve an acceptable balance.

The long-term viability of local food as an intermediated product is likely to depend on establishing an authentic definition of local. Johnson, Cowan and Aussenberg (2012) address the risk that any product or shelf label that touts a popular marketing quality whether it be local, organic or natural, may be no such thing. “The lack of a universally agreed-upon definition […] does raise questions about ‘what is a local food’ and may also provide opportunities for fraud in the marketplace with the sale of foods that are marketed as ‘local’ when they cannot be determined to be local” (4). It may not be possible to say precisely what local food is, but it is important to define what it is not.

Local food in sufficient quantities to meet growing urban demand requires robust and resilient regional food systems with the infrastructure necessary to support independent farms. A 2011 USDA report on the feasibility of establishing a food hub in California’s North Coast region observes:

> Marketing messages around local food do not always denote an actual commitment to sourcing from small, sustainable, regional producers, and the existing food system is still largely structured to reward centralized production and long distribution chains. Actually bringing significant quantities of product from small and mid-size family farms to larger local markets remains a structural challenge. (5)

Ongoing distribution of local food beyond that of direct marketing requires the investment of resources at a regional scale. Food hubs offer a promising method to achieve the right mix of supply chain efficiency, marketing savvy, and local authenticity needed to provide this support. Very often, there are a number of “allied” businesses working together to share expenses and resources through the common location of the food hub.

In this way, food hubs are regional responses to inadequate opportunities for aggregation and distribution at local and regional scales, and are a way for small to mid-scale supply chain participants to achieve some of the logistical efficiencies of conventional distribution. Day-Farnsworth and Morales (2011) note that mid-level aggregation shows the need for an "improved post-harvest handling infrastructure that would allow for better quality control through centralized grading and packing facilities and more efficient transport." This improvement requires hiring managers with the ability to coordinate multiple elements of a food supply chain. Food hubs often provide warehouse, cold storage, and office space. These facilities are likely to offer advertising and certification assistance, as well as informational services. Hubs may also include kitchen space that may servce as a business incubator, where small businesses may prepare value-added foods or engage in light processing such as washing, cutting and peeling.

Food hubs can be organized as public or private entities, as for-profit or non-profit businesses, and in single owner, multi-owner or cooperative forms (DCPDD, 2011). Consequently, financing options and availability for food hubs vary greatly. Food hub creation can be facilitated by securing public funds in the form of government loans, grants and/or Tax Incremental Financing (TIF) strategies (Day-Farnsworth & Morales).

Viewing food hubs as a type of economic cluster

Economic cluster theory offers an alternative view to the idea of the export-base theory mentioned earlier. Kozub (2011) explains that cluster theory, "stems from a geographic analysis of economic activity, which shows critical masses of firms in particular places that enjoy unusual competitive success in a particular field" (8). While this does not refer to the physical scale of food hubs, it can be used to consider the potential for agricultural production and distribution within regions. Unusual competitive success in our context means the ongoing viability of small and medium-scaled producers and their supply chain partners in an economic system that confers competitive advantage to large scale production and distribution.

Day-Farnsworth and Morales (2011) advocate the identification and fostering of "food clusters," regions that contain not only food producers, but also the allied industries that support the production and distribution of food throughout the supply chain. These clusters are distinguished by the variety and quality of the foods available, the type of value-added products offered, and the cultural/social values exemplified. In this way, the identity of a growing region is described along with the infrastructure needed to support it. Economic opportunities become evident through the identification of the need for specific supporting businesses that provide jobs, and the establishment of a regional food "brand." Food clusters with successful food hubs provide models for creating hubs in areas with similar agricultural potential. This potential is represented by the presence of agricultural producers, processors, wholesalers, warehouses, freight services and to some extent, retailers and other consumers. The potential for a successful food hub is also indicated by the presence of underutilized production capacity and underemployed workforce.

Kozub offers a compatible description of potential in, “clusters are characterized by continual investment in a shared skilled labor pool, the manufacture of particular equipment, the presence of specialized service providers, and other infrastructural needs, within an approximate geographic boundary” (8). Food hubs can be viewed as a purposeful and geographically concentrated point of aggregation within a cluster. The presence of a successful food hub may encourage additional clustering of related businesses. Porter (2000) observes, “Clusters suggest that a good deal of competitive advantage lies *outside* companies and even outside their industries, residing instead in the locations at which their business units are based” (16). Clusters, however, appear as likely to occur “naturally,” as to be formed through specific planning efforts.

King et al. (2011) note, “Presence of a strong industry that distributes nationally or internationally does not necessarily help create an infrastructure of knowledge and services that facilitates the development of local food supply chains” (65). This presents a challenge for guaranteeing the success of a regional food hub based on agricultural potential, and raises the question of whether mainstream agriculture’s physical assets contribute to clusters in a way that benefit locally and regionally based supply chains.

This encourages us to expand the scope of what might be considered an allied business. In some regions, food hubs may need to be envisioned more broadly as “agricultural hubs” drawing in partners from the livestock feed and forest products industry. This seems like a small intuitive leap to make in regions where produce, grain and meat farmers often possess skills that are useful in other agricultural industries. In a challenging economy, even this scope of collaboration may be too limiting. Other industries that are not as closely related, but have similar needs for resources, infrastructure and municipal services may make good partners. The resulting hubs might then be considered “rural business campuses.” This relates to our discussion of clustering. Successful clustering is not just about material flows between entities, or even the opportunity to share costs and resources. It is also about sharing innovation and culture. Relevant questions include:

- What is the threshold level of participation needed from producers, haulers and aggregators to create a working agricultural cluster?
- How much cooperation is needed between allied businesses in order to create synergies in cost and resource sharing?
- What are the best methods for encouraging innovation and the exchange of ideas?

As with many planning endeavors, it may be difficult to convince diverse stakeholders to work toward a common goal. It will be necessary to show support for the idea of food hubs from the private sector. Barham et al. (2012) describe how private food supply chain businesses are adjusting to the demand for local food and the specific needs of local agriculture:

> Because food hubs are largely defined by a set of business practices and not by any one legal structure, several produce distributors and wholesale markets are adjusting their operations to meet their customers’ demand for source-identified local and regional products—essentially turning their businesses into regional food hubs. It is within the context of these shifts in the formation of strategic

> partnerships and the transformation of business practices that the greatest potential for systems to change in local and regional food economies can and will occur. (2)

The motivations that drew these aggregation businesses and their supply chain partners together can be adapted to promote agricultural hubs or rural business campuses that seek the benefits of economic clustering. These collaborative hubs will not necessarily be very large enterprises; the primary motivation is to achieve efficient and sustainable supply chains or sometimes webs of relationships. For these supply relationships to be successful, the needs and self-determination of rural communities must be balanced with the needs of urban markets. Some people will gladly participate in a collaborative hub, some will have no wish to change their lifestyle, and others will have no compelling need to make that change.

Section 4: Hotspot analysis

To get a better sense of regional supply chain economic potential, we generated maps using the University of Wisconsin-Extension's Food Systems Profile project of agricultural hot and cold spots in the Midwest. This project provides an overview of existing data across a broad scope of food systems activities, documents how key indicators are changing over time, and serves as a baseline for community leaders and educators to identify opportunities for growth or expansion in regional food systems. Data for this profile was accessed from existing secondary data sources including the US Census of Agriculture and the United State Department of Agriculture. Where data are available, users can create county-level maps for a local view of food systems data.

The Food Systems Profile project easily generates maps from existing data sets, revealing patterns of business "hot spots" and "cold spots"; that is to say, regional areas with statistically significant positive or negative relationships to food supply chain businesses, from cheese manufacturing and breweries, to farms that sell directly to consumers or directly through CSAs. To test whether the patterns observed in simple mapping are "statistically significant" as opposed to random, economic geographers conduct a *hotspot analysis*. While there are numerous tools for hot spot analysis, the one that is perhaps most widely used is the Getis-Ord spatial statistic. Comparing these hot spot maps for the Upper Midwest with more detailed maps of relative density in the Driftless region, we can get a richer sense of economic development opportunity in the region as a whole.

Our research team took a deeper look at Driftless area counties by creating density maps. For an initial representation of agricultural activity by supply chain participant in the Driftless area, please see the density maps and accompanying text available in Appendix B of this report.

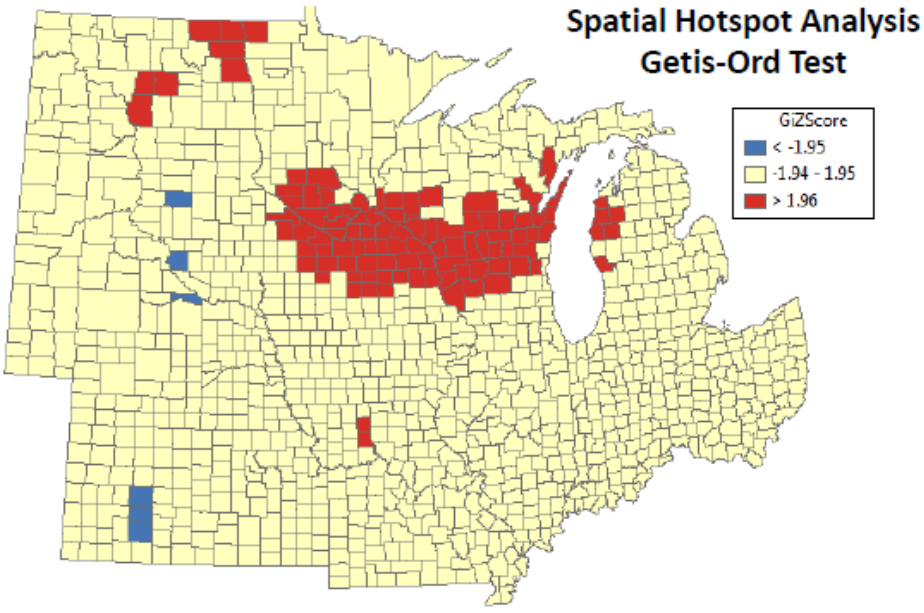

Figure 7 The hotspot analysis for vegetable, melon and potato farmers per 10K population, 2007, in the upper Midwest.

Figure 7 shows potential for economic development around vegetable production throughout southern Minnesota, central Wisconsin, and a few counties in Michigan. Not only is there potential for production, this may also prove to be a good region for vegetable processing.

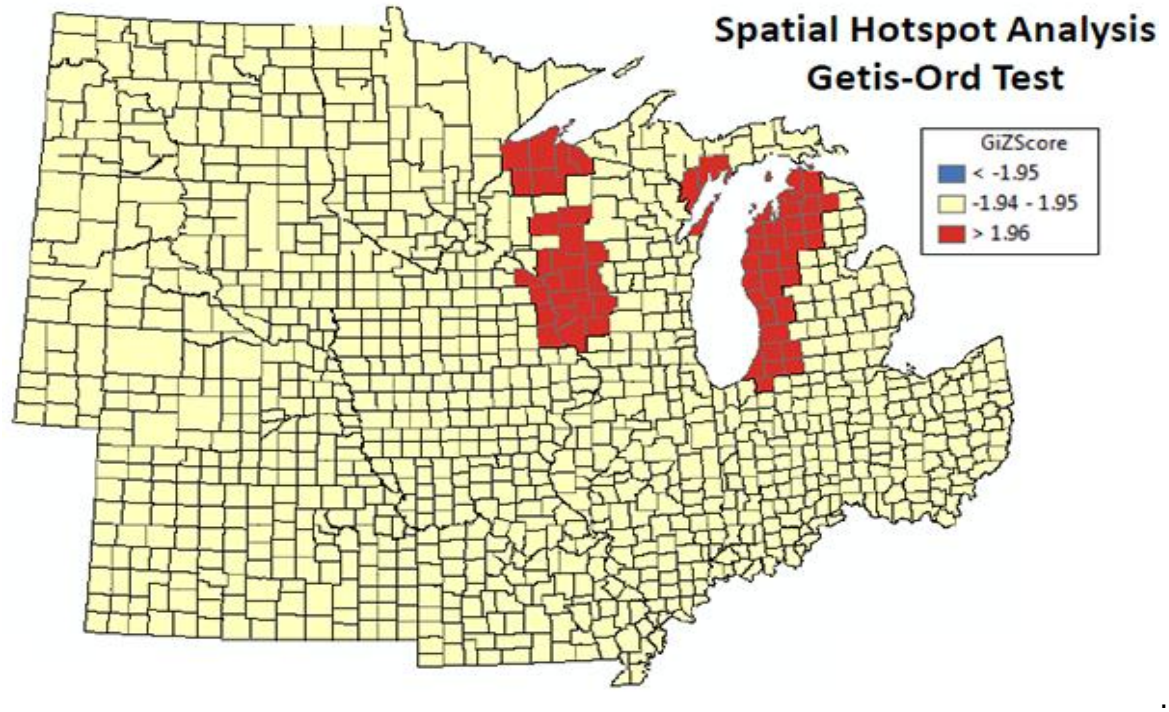

Figure 8 The hotspot analysis for the number of fruit, nut and berry farms per 10K population, 2007

Similarly, there is potential for growing more wholesale fruit, nut and berries along the Great Lakes shores and along the upper Mississippi River valley. There are already growers serving a wholesale market, with some infrastructure for packing, processing and distribution.

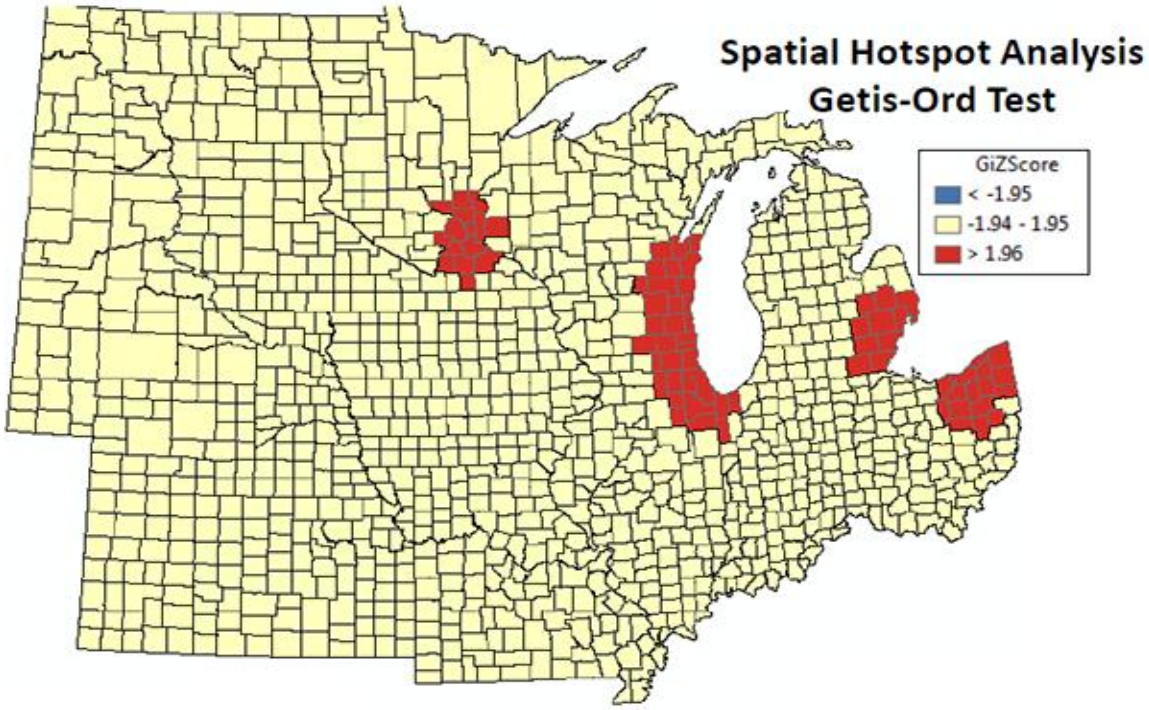

Figure 9 The hotspot analysis for processors in the upper Midwest.

Figure 9 illustrates that processing tends to concentrate in urban areas. The Twin Cities, the Milwaukee-Chicago corridor, and Detroit are upper Midwest hotspots. Rural areas could potentially develop processing infrastructure, adding value to products that could build the rural economy and retaining processing waste closer to farms for composting.

Transportation implications

In talking with transportation planners about this work, a valuable insight emerged: that much of the current work underway with local food systems transportation is about developing relationships and logistics at a regional scale. It is these "new" logistics, some which we've described here, that will impact and inform the development of transportation infrastructure in the mid-term. This raises questions that are largely organizational or technological in nature:

- What does a regional – scale food system look like? What aspects are independent of size and what are aspects are scale-dependent?
- What is necessary to support regional logistics?
- How can values around rural economic development and environmental conservation be balanced with efficiencies of scale?
- Are there assistive technologies in packaging and tracking that could combine to develop new ways of moving food to markets?
- Are there non-traditional partners for getting food to market?

- How can choices made in regional logistics contribute to creating a “green” transportation system?
- What does green transportation infrastructure look like?
- How do we communicate green transportation in the supply chain as another means for adding product value?
- How well do current road and rail networks support the transportation of food at all scales?
- Are there well-developed distribution and processing options for maintaining the cold chain at small and medium scales? Is there shared capacity with large scale supply chains?

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Works cited

Appel, K. (2008). Chefs Collaborative Regional Food Infrastructure Project. Retrieved from http://chefscollaborative.org/wp-content/uploads/2009/03/public-summary-final1.pdf

Bachmann, J., & Earles, R. (2000). Postharvest handling of fruits and vegetables. Retrieved from https://attra.ncat.org/attra-pub/summaries/summary.php?pub=378

Barham, J., Tropp, D., Enterline, K., Farbman, J., Fisk, J., & Kiraly, S., U.S. Department of Agriculture, Agricultural Marketing Service. (2012). *Regional food hub resource guide*. Retrieved from website: http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5097957

Bittner, J., Day-Farnsworth, L., Miller, M., Kozub, R., Gollnik, B., (2011). *Maximizing freight movements in local food markets*. Madison: National Center for Freight & Infrastructure Research & Education.

Brown, L., Deller, S. and Haines, A. (2011). Mapping local food indiators for the North Central States. Retrieved from http://www.foodsystems.wisc.edu/resources

Brown, L., Deller, S. and Haines, A. North Central Region County Food Systems Profiles Portal. Retrieved from www.foodsystems.wisc.edu/index.php

Chase, C. (2010, May). Evaluating marketing outlets using whole-farm records. Retrieved from http://www.extension.iastate.edu/agdm/wholefarm/html/c5-32.html

Clark, J. K., Inwood, S., & Sharp, J. S. (2011). Scaling-up connections between regional Ohio specialty crop producers and local markets: Distribution as the missing link. Retrieved from http://www.ngfn.org/resources/ngfn-database/knowledge/Scaling_Up.pdf

Cohee, M. H. (August 01, 1934). Erosion and Land Utilization in the Driftless Area of Wisconsin. *The Journal of Land & Public Utility Economics, 10,* 3, 243-253.

Dane County Planning and Development Department, (2011). *Southern Wisconsin food hub: Feasibility study* (HR-101111)

Day-Farnsworth, L., McCown, B., Miller, M., & Pfeiffer, A. (2009). *Scaling Up: Meeting the Demand for Local Food.* Madison, WI: University of Wisconsin Extension Ag Innovation Center and University of Wisconsin Center for Integrated Agricultural Systems. Retrieved from http://www.cias.wisc.edu/wp-content/uploads/2010/01/baldwin_web_final.pdf

Day-Farnsworth, L., & Morales, A. (2011). Satiating the demand: Planning for alternative models of regional food distribution. *Journal of Agriculture, Food Systems, and Community Development.* Advance online publication. http://dx.doi.org/10.5304/jafscd.2011.021.020

Deller, S., & Brown, L. (2011). Local foods and community economic growth and development. Informally published manuscript, UWEX, University of Wisconsin, Madison, WI

Diamond, A., Barham, J., & Tropp, D. (2009). *Emerging Market Opportunities for Small-Scale Producers: Proceedings of a Special Session at the 2008 USDA Partners Meeting.* Washington, DC: United States Department of Agriculture, Agriculture Marketing Service. Retrieved from http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5076556

Dick, G. (2013 May 21). “Green Express to Freshen Hoosier Farmers Portfolios”. Inside Business. Retrieved from http://www.insideindianabusiness.com/advanced-manufacturing.asp?ID=3028&Detail=True

Food Marketing Institute (2011). Grocery Shopper Trends. Retrieved from http://www.fmi.org/research-resources/supermarket-facts/weekly-household-grocery-expenses-2011

Gloy, A. (2007). *Evaluation of distribution channels as a market expansion barrier to New York's perishable product producers*. Original manuscript, Cornell University, Ithaca, NY, Retrieved from http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5066849

Gnyawali, D. R., & Park, B.-J. R. (July 01, 2009). Co-opetition and Technological Innovation in Small and Medium-Sized Enterprises: A Multilevel Conceptual Model. Journal of Small Business Management, 47, 3, 308-330.

Gutierrez, A. (2011, Nove 15). Interview by D.A. Nelson [Personal Interview]. State of RFID technology.

Holcomb, R., & Vo, A. (2011). Farm to school templates: Tools for participating producers and schools. Retrieved from http://www.okfarmtoschool.com/resources/fts-distro-foodsafetymanual/section3-FTS-templates-2.pdf

Johnson, R., Cowan, T., & Aussenberg, R. A. Congressional Research Service, (2012). *The role of local food systems in u.s. farm policy* (R42155). Retrieved from http://www.fas.org/sgp/crs/misc/R42155.pdf

King, R. P., Hand, M. S., DiGiacomo, G., Clancy, K., Gomez, M. I., Hardesty, S. D., Lev, L., & McLaughlin, E. W. (2010). *Comparing the Structure, Size, and Performance of Local and Mainstream Food Supply Chains* (ERR-99). Washington, DC: United States Department of Agriculture, Economic Research Service. Retrieved from http://www.ers.usda.gov/publications/err99/

King, R.P., and Stevenson, G.W. (2013) Values-based food supply chains: Coop Partners Warehouse Retrieved from http://www.cias.wisc.edu/wp-content/uploads/2013/04/cooppartnersfinal041813.pdf

Kozub, R. (2011). *Evaluating a strategic framework for regional food supply chains: Using economic development theories to analyze the merits of "local foods" in rural economies*. Unpublished manuscript, Urban and Regional Planning, University of Wisconsin, Madison, WI.

Low, S. A., & Vogel, S. United States Department of Agriculture, (2011). *Direct and intermediated marketing of local foods in the United States* (Economic Research Report Number 128). Retrieved from http://www.ers.usda.gov/media/138324/err128_2_.pdf

Martinez, S., & United States. (2010). *Local food systems: Concepts, impacts, and issues*. Washington, D.C.: U.S. Dept. of Agriculture, Economic Research Service. Retrieved from http://www.ers.usda.gov/media/122868/err97_1_.pdf

MWPVL. (2013) The Grocery Distribution Center Network in North America. Retrieved from http://www.mwpvl.com/html/grocery_distribution_network.html

Munsch, J., & Claypool, R. (2012). Veggie compass: Tools. Retrieved from http://www.veggiecompass.com/tools/

National Restaurant Association (2013). Facts at a Glance. Retrieved from http://www.restaurant.org/News-Research/Research/Facts-at-a-Glance

Porter, M. E. (January 01, 2000). Location, Competition, and Economic Development: Local Clusters in a Global Economy. *Economic Development Quarterly, 14,* 1, 15-34.

Pullman, M. & Wu, Z. (2012). Food Supply Chain Management: Economic, Social and Environmental Perspectives. Routledge: New York.

The Reinvestment Fund (2011). Understanding the Grocery Industry. Retrieved from http://www.cdfifund.gov/what_we_do/resources/Understanding%20Grocery%20Industry_for%20fund_102411.pdf

Roberti, M. (2011, Nove 2). U.S. apparel retailers drive RFID adoption. RFID Journal, Retrieved from http://www.rfidjournal.com/article/view/8918

Roberts, B. (2008, Febru 22). Mobile barcodes 101: Understanding mobile barcodes, http://www.gomonews.com/mobile-barcodes-101-understanding-mobile-barcodes/. Retrieved from http://www.gomonews.com/mobile-barcodes-101-understanding-mobile-barcodes/

Sato America Inc. (2011). Basics in RFID (white paper), Retrieved from http://www.satoamerica.com/Images/Users/WhitePaper/WP_BasicsinRFID_B.pdf

Seideman, T. (1993, Spring). *Barcodes sweep the world*. Retrieved from http://tonyseideman.com/Bar_Codes.pdf

Todd, S. (2012, March 19) “Supermarket delivers by river”. Lloyd’s Loading List. Retrieved from http://www.lloydsloadinglist.com/freight-directory/searcharticle.htm?articleID=20017946724&highlight=true&keywords=supermarket+delivers+by+river&phrase=#.UcnEj3eB7rc

U.S. Department of Agriculture, (2011). *Establishing an aggregation & marketing center for California’s north coast: A USDA rural development feasibility study*. Retrieved from http://caff.org/wp-content/uploads/2011/08/CAFF_Study.pdf

Weiss, A. S. (2011, Winter). *Authenticity.* Gastronomica p.74-77

Woerkum, C. M. J., & Lieshout, I. M. (May 22, 2007). Reputation management in agro-food industries: safety first. *British Food Journal, 109,* 5, 355-366.

Appendix A: Additional sources for information on QR codes.

Helpful web articles for understanding the use of QR codes:

Fuld, A. (2013, January) *So qr codes didn't die, here's how to make them effective*. Retrieved from http://www.visualead.com/blog/2013/01/so-qr-codes-didnt-die-heres-how-to-make-them-effective/

Keffer, C. (2011, Augus 18). *Tracking qr codes in google analytics: Easy as pie*. Retrieved from http://www.lunametrics.com/blog/2011/08/18/tracking-qr-codes-google-anaytics/

There are many online applications for creating and managing QR codes. The cost for using the applications and other services range from free to one-time or subscription pricing. The web addresses below provide a sample of what is available with many offering tips for use:

http://azonmedia.com/qrcode-generator

http://beqrious.com/qr-code-generator/

http://www.beetagg.com/en/beetagg-qr-generator/

http://www.mobile-barcodes.com/qr-code-generator/

http://qrcode.kaywa.com/

http://qrickit.com/qrcode_tracking.php

http://www.qrstuff.com/

(This site offers webpages with a large amount of QR code information)

http://www.scanlife.com/

(Also see http://www.scanlife.com/trend-reports for data about QR adoption)

Appendix B: Creating Maps of Supply Chain Participant Density

In Appendix B, we present maps that show the relative density of supply chain participants within the Driftless area. All maps found here were made using ArcGIS software. Although the datasets are not identical, it is possible to compare these relative density maps with the maps generated through the University of Wisconsin-Extension's Food Systems Profile project (Section four: hotspot analysis). Those maps show relative hot and cold spots of agricultural supply chain activity in terms of the Upper Midwest region of the United States. This suggests the potential for agriculture to provide economic development opportunity in the region as a whole. It should be noted that the maps found in this appendix are a first step toward describing spatial densities of agricultural supply chain participants.

The maps included with this report are broken down into several categories based on overall food production, type of food production, as well as other types of supply chain participation in the Driftless area:

- Area Producers (All Types except Nuts)
- Fruit and Vegetable Producers
- Dairy Producers
- Meat Producers
- Grain & Other Producers
- Alcoholic Beverage Producers
- Truck Freight
- Processors
- Warehouses
- Wholesalers

In these Driftless maps, it is the representation of relative densities that is important, more so than the total number of participants. This is because a map that shows the density of fruit and vegetable producers will be based on different absolute values than a map representing other types of agricultural producers. This is also true of maps showing the density of supply chain participants such as processors, wholesalers and warehouses. While this means these Driftless maps are not directly comparable with one another, we can make some tentative inferences. Areas with greater densities of certain types of production should correspond to the reasons why farmers choose to raise specific crops or livestock (e.g. topography, soil qualities, distance to markets, and availability of aggregation and processing facilities).

The density maps below reveal areas possessing concentrations of several types of supply chain participants. Side by side comparison of the differing density patterns found in these maps sometimes reveal "stacked" concentrations of supply chain activity.

These stacks may mean that plentiful local producers are already well connected to supply chain partners, or it could mean that there is an opportunity to connect a diffusion of producers with existing aggregation and processing services. The presence of many producers in an area, but few haulers, processors and aggregators suggests the potential for new distribution opportunities, whether through the creation of an independent business or a cooperatively organized food hub. The effectiveness of this kind of inference is limited by the coarseness of some data. A distributor that handles tomatoes may also handle potatoes, apples and green beans. It is less likely that same distributor also handles meat, dairy and grain products if operating at a small scale. The distributors with the most comprehensive range of products tend to be large and conventional in nature. Many supply chain participants also fill multiple roles in the chain (e.g. freight, warehouse, and distribution), but may be present in the data as a single participant category. Once general agricultural clusters are detected, it would make sense to describe the presence of specific crops through existing supply chains in those same localities.

Processors often specialize in one broad food category such as corn or wheat. The presence of several grain processors in one county, therefore, may not suggest an immediate synergy with nearby participants in a meat based supply chain, except as that grain is intended as a source of feedstock. However, if we extend the concept of allied businesses to include supply chain participants that are not very similar to each other (i.e. that operate at different scales and scopes), there may be synergies available if those businesses work together to manage costs and resources.

In order to map the relative geographic density of supply chain participants in the Driftless area, we first created several categories of participant types. These types are: producers, truck freight, processors, warehouses and wholesalers. Within producers, we created the subtypes: Fruit and Vegetable, Dairy, Meat, Alcohol, and Grain & Other. We then built a kernel density surface from points representing the supply chain participant type being examined. Using this method, each point in the study area influences surrounding cells in the same manner as any other point. This is modified by the kernel equation that looks at the distance each cell is from each point before assigning density values to cells. We used a kernel density radius of 24 km that will likely capture many active points, although the effect of kernels upon points is reduced as distance increases. This relates to the question of how far producers will travel to deliver to their customers. Low and Vogel (2011) note that farmers travel an average of 30.7 miles (49.41 km) to farmers' markets. This can be related to our radius of 24 km. A farmer willing to travel roughly 48 km to a farmers' market may be willing to deliver product half that distance to a supply chain partner (or pay for a pick up by that partner).

There is also the question of whether each supply chain participant should affect the mapping of density in the same way. For each data point within a participant type, there is an associated sales volume that is roughly proportional to the amount of product that participants move through a supply chain. We chose to have participants with higher sales exert greater influence on the density surface than those with lower sales. As such, we could positively weight the contribution of each participant in relation to the density surface by their sales volume. However, we did not want to under-represent the importance of smaller-sized participants in the supply chain. In order to lessen the

impact of participants with larger sales volumes on the kernel density, we used the square root transformation on the sales volume. This transformation moves all of the weighted values closer together decreasing the range of values. Moreover, it reduces large sales volume values by a greater proportion than smaller ones, to such an end that it captures the greater effect of large participants without allowing their presence to dominate that of small to medium-sized participants. For some of the participant data, the sales volume listed was zero. In these cases, we set the weight to 1 in order to ensure a nominal contribution by every data point to the density surface.

Large-scale supply chain participants contribute to the possibility of distribution by drawing greater political support for infrastructure investment in the form of roads and municipal services. There may also be untapped potential for synergies between differently scaled supply chains. King (2011) observes, “The local supply chains studied do not currently rely on infrastructure developed for a national industry or other local supply chains. Building ties to such supply chains may increase product volumes and reduce per unit costs as demand for local food products grows” (v). As mentioned earlier, however, King goes on to state that the presence of large scale agriculture, “does not necessarily help create an infrastructure of knowledge and services that facilitates the development of local food supply chains” (65). It is also important to note that a farm (or processor, distributor etc.) may be large, without being a national or globally scaled operation.

The active presence of producers and other supply chain participants at a mid-scale suggest the potential for enhancing the distribution of local foods at a scale below the mainstream channel. This would not be true in an area that contains only very large scale supply chain participants. Further mapping work might separate each participant type by a scale classification to allow better analysis.

The mapping methodology we used for this project has several limitations. While highly useful, the ESRI Business Analyst data is likely to have a significant number of data point omissions and duplications. Businesses and their locations change over time. The transformation we used to weight Sales Volume can be improved upon by more rigorously relating the scale of supply chain participants to weight. There are edge effects in the map data due to the boundary of the Driftless area. Any agricultural supply chain participant that lies outside the study area and within 24 km of the boundary would affect real world supply chain densities inside the study area, but were not factored into our analysis. An example can be found when examining the Wisconsin county of St. Croix that shows high relative density in five of the maps below. How would that change if kernel density analysis did not end at the boundary?

The visual analysis we offer for each density map should be replaced by more precise descriptions of density. Individual maps are set up to show relative densities based on standard deviations. The lowest density of a participant type (e.g. Processors) is indicated by a very light blue color. Each increase in the darkness of the blue color represents density values within the next standard deviation. Not all maps have the same number of divisions (either 3, 4 or 5). In the real world, knowledge of the actual number and scale of processors, the type of processing done, and the associated business models would all be crucial for assessing supply chain activity. There are more producers than there are other supply chain types. This can be seen in the greater

amount of lighter shades of blue in maps of non-producer types. Similarly, there are relatively few Alcoholic Beverage producers than of other types.

We did not create a comprehensive map showing total density of all supply chain participants. Such a map wouldn't make much sense without understanding what was being produced, and the support services were available for moving, processing and storing product along the supply chain. Obtaining an on-the-ground narrative from localities that show clusters of agricultural activity would add a qualitative component for verifying the potential represented here. It would also be helpful to relate areas of high participant density to primary transportation networks, population density, employment level and relevant economic development programs. This brings us to the primary limitation of these density maps. It is difficult to show supply chain activity with great specificity without parsing the data much more closely than done here. The notes below the density maps list the areas within counties that show higher densities. Hopefully, these first steps in mapping agricultural activity in the Driftless area will suggest better approaches for future work.

There are two additional maps included with the density maps:

- A general map of the Driftless area with counties, as defined by the American Viticultural Area Petition for the Upper Mississippi River Valley. This petition describes the geological, historical, and cultural aspects of the region that support its recognition as a unique production region. The full petition is available on-line at http://www.scribd.com/doc/57221797/Upper-Mississippi-River-Valley-AVA-Petition-1
- A map that shows the relationship of the Driftless area to primary roads within a 250 mile radius of the area's geographic (mean) center. This road network looks at three different aspects of road connectivity.
    - Roads within the Driftless
    - Roads from 0 to 24 kilometers beyond the Driftless area. This corresponds roughly to half the average distance farmers are willing to travel to farmers' markets (Low & Vogel, 2011).
    - Roads that are at least 24 kilometers outside the Driftless and less than 400 kilometers (approximately 250 miles) from the mean center of the Driftless. This shows the distance and position of external urban areas and major markets relative to the Driftless area.
    - All distances are straight line and not reflective of actual road distances travelled. Improved maps would take the network distance of road travel into account to produce more accurate estimates.

Driftless area map geographic data sources

http://dai.northeastiowarcd.org/,

http://www.nationalatlas.gov/

http://www.census.gov/geo/www/cob/

Driftless map errata:

Map Scale = 1:5,097,095.

Kernel density output cell size = 500m.

Figure 10 The four state Driftless area and individual counties.

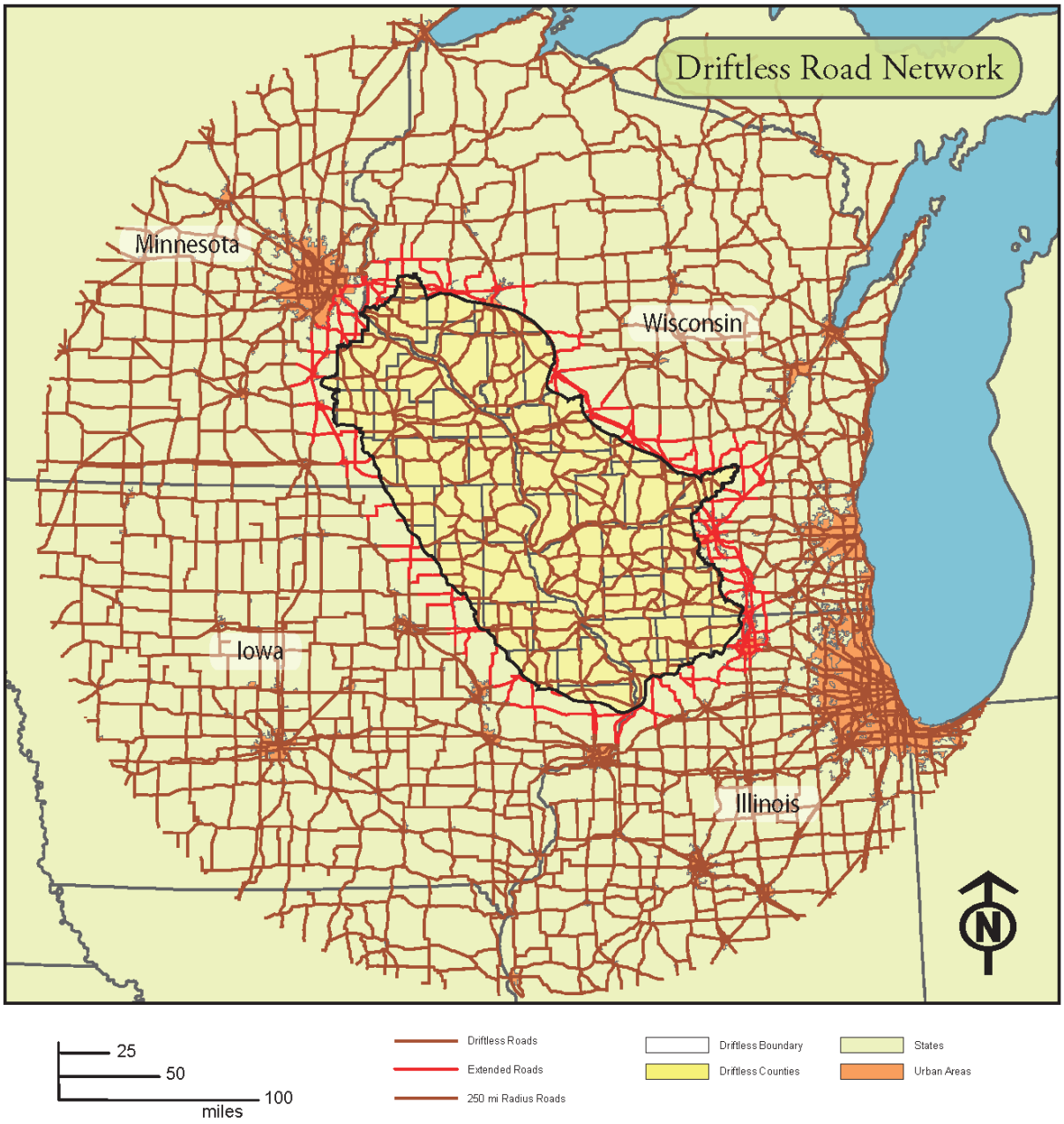

Figure 11 Primary roads in and near the Driftless.

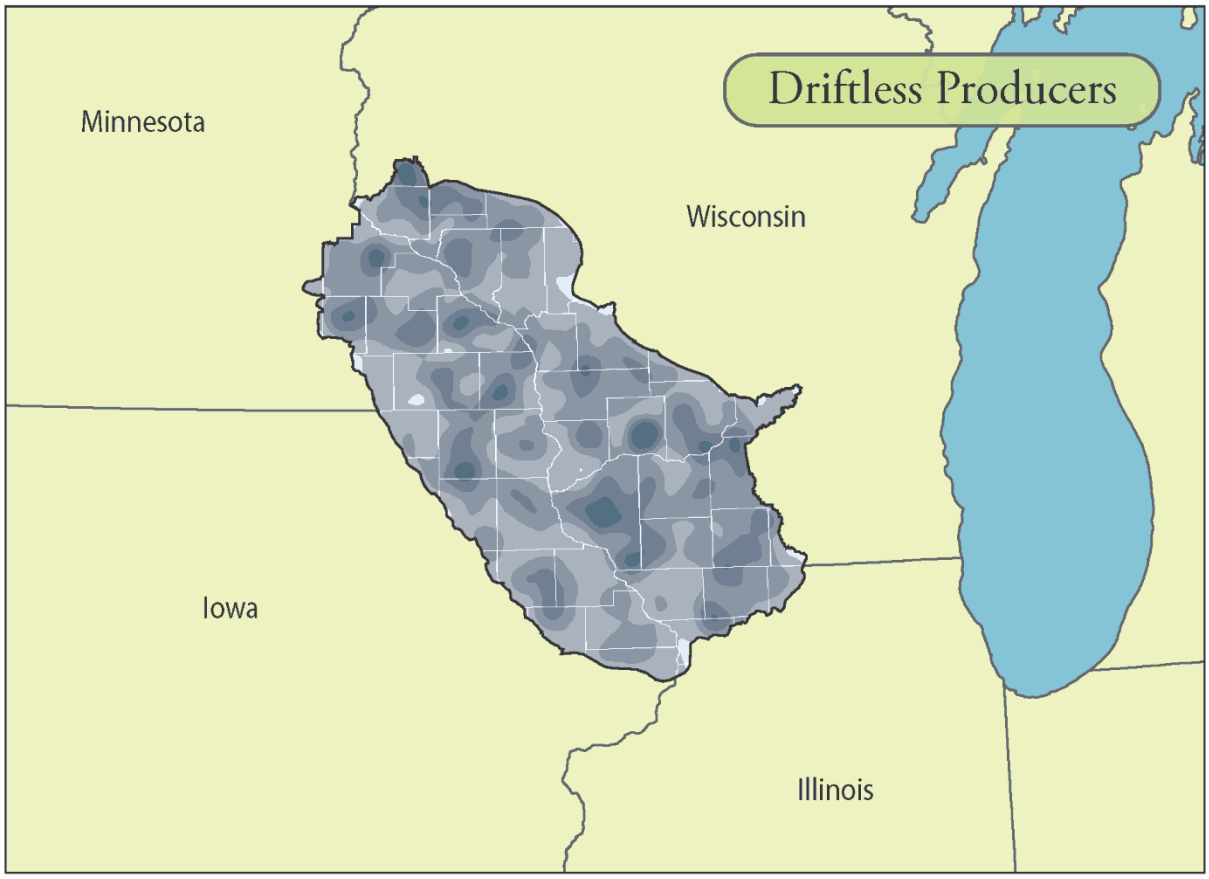

Figure 12 The relative density of all Driftless area producers (all types except nuts)

Counties with higher producer densities

- In Illinois: NW and SW Stephenson and N Carroll
- In Iowa: E Delaware, Central and S Winneshiek
- In Minnesota: Dodge, Central Fillmore, E Central Goodhue, Houston, E Olmsted, and Central Winona
- In Wisconsin: NW Buffalo, N Dane extending northwest into Sauk; S Dunn, Central and S Grant, Green, SE Monroe, NE Pierce, SE and Central Richland and St. Croix.

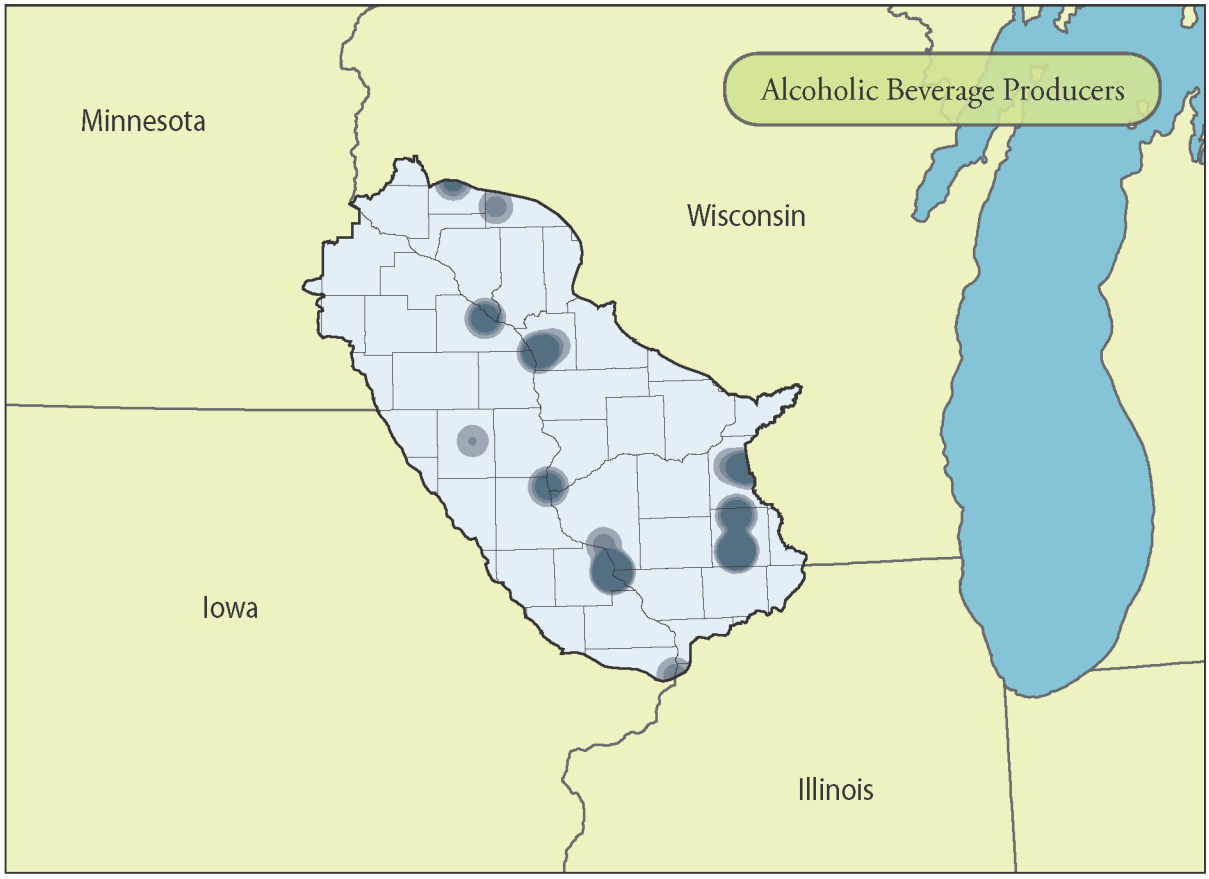

Figure 13 The relative density of alcoholic beverage producers in the Driftless area.

Counties with higher alcoholic beverage producer densities

- In Illinois: N Whiteside
- In Iowa: NE Clayton, E Clinton, and E Dubuque, Central Winneshiek
- In Minnesota: NE Houston, E Olmsted, and E Central Winona.
- In Wisconsin: Central Dane, Central Dunn, W Eau Claire, Green, S Grant, and Central and SW La Crosse

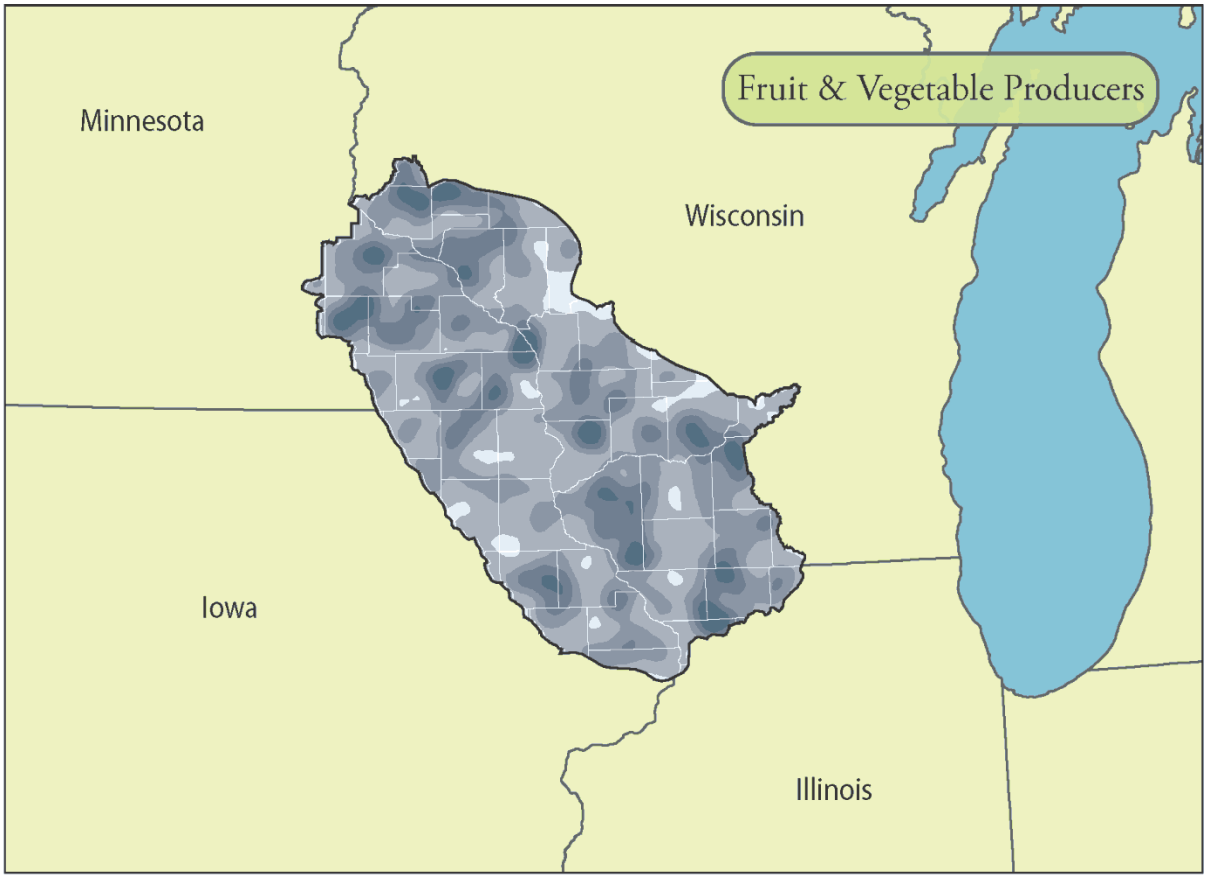

Figure 14 The relative density of fruit and vegetable producers in the Driftless area.

Counties with higher fruit and vegetable producer densities

- In Illinois: W Stephenson into Carroll
- In Iowa: Delaware, N Jackson into S Dubuque, and N Winneshiek
- In Minnesota: Central Goodhue, Dodge, SE Winona, Fillmore, N and W Houston, Olmsted
- In Wisconsin: Buffalo, NE Crawford, NE Dane into Central Sauk, Dunn, W Eau Claire, Grant, NW and SW Green, W La Crosse, and N Pierce into St. Croix, Central Vernon

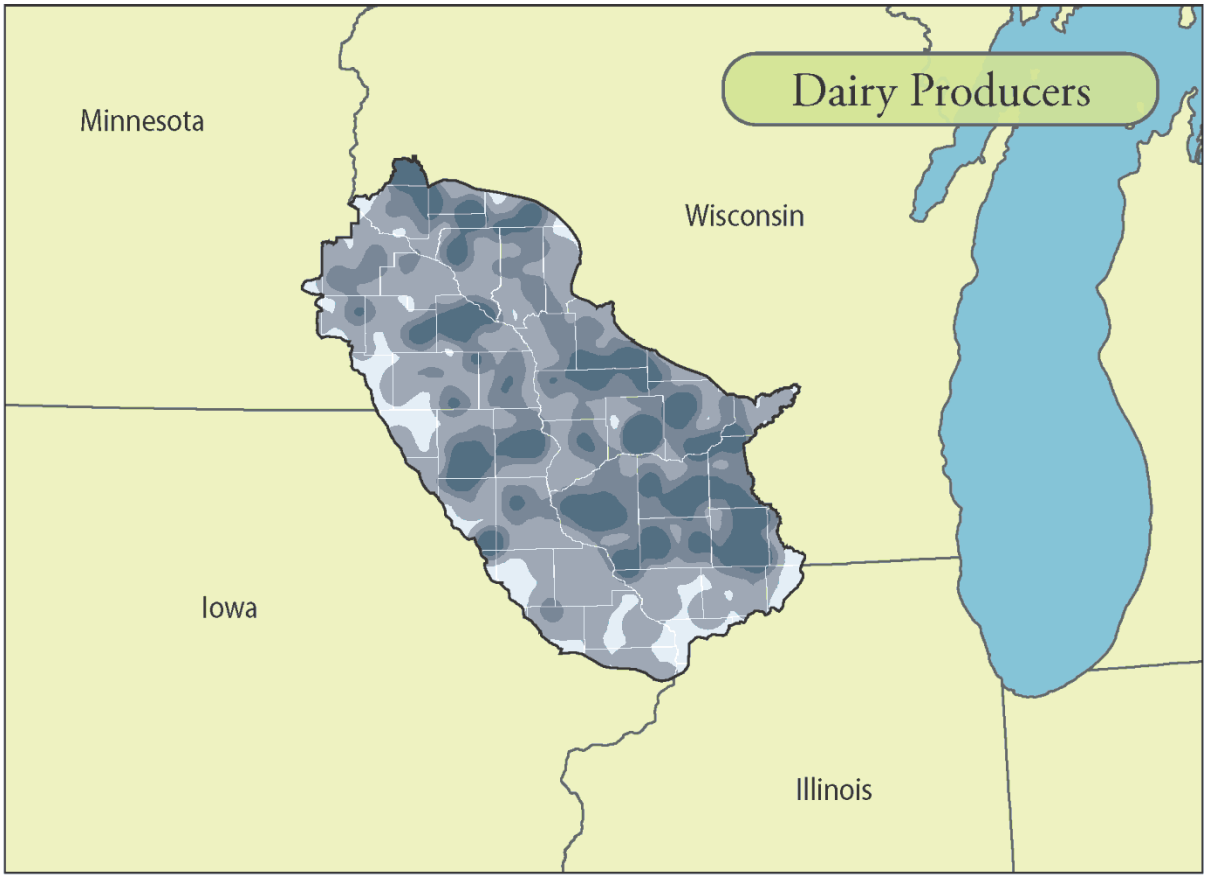

Figure 15 The relative density of dairy producers in the Driftless area.

Counties with higher dairy producer densities

- In Illinois: NW Jo Daviess, and NE Stephenson.
- In Iowa: Allamakee, Central Clayton, N and S Fayette, N Central Jones, Winneshiek
- In Minnesota: NE Dodge, NE and SE Fillmore, Central Goodhue, Central Houston, E Olmsted, Winona
- In Wisconsin: NW Buffalo, Central Crawford, Dane, Dunn, S and Central Eau Claire, Grant, Green, Iowa, Lafayette, Richland, N Pepin, NE Pierce into St Croix, Central and S Monroe into N Vernon, E and Central Richland, Sauk

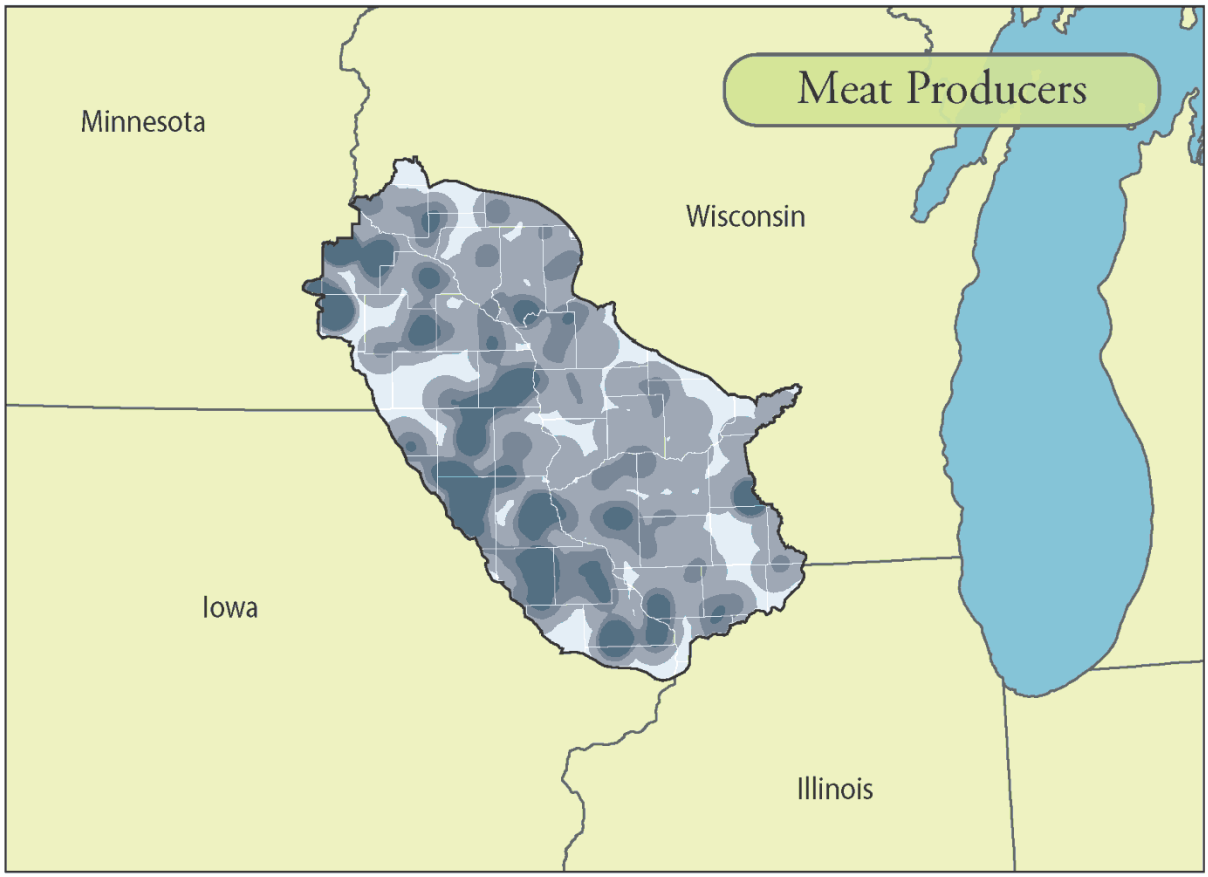

Figure 16 The relative density of meat producers in the Driftless area.

Counties with higher meat producer densities

- In Illinois: SW Jo Daviess, SW Stephenson into N Carroll
- In Iowa: SW Allamakee, Chickasaw, Clayton, Delaware, Dubuque, Fayette, S Central Howard, Jackson into N Clinton, N Jones, Winneshiek
- In Minnesota: NE and Central Dodge, SE Fillmore, Goodhue, Houston, E Olmsted, Wabasha, S Central Winona
- In Wisconsin: S Central Dane, E Central Grant, N edge of La Crosse, E Pierce into W Pepin, S Trempealeau

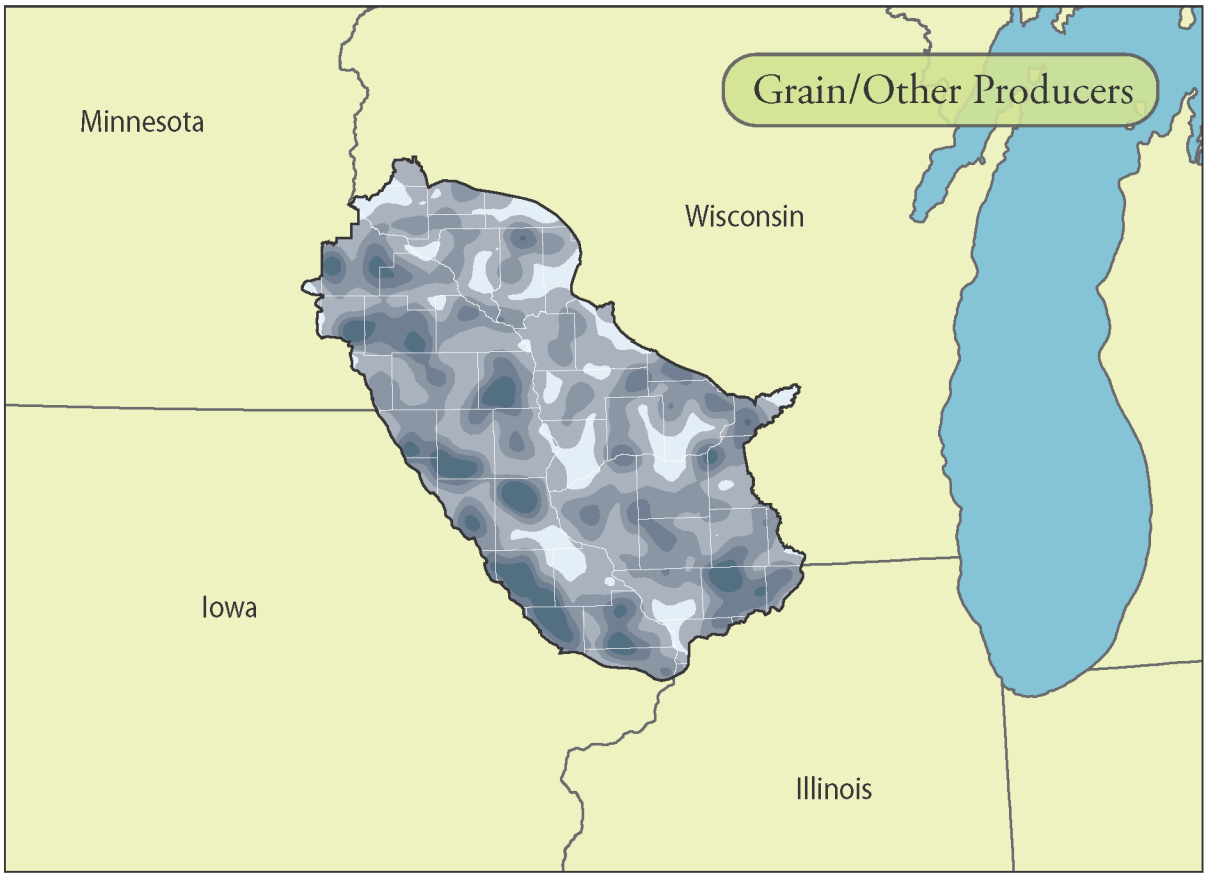

Figure 17 The relative density of grain and "other" producers in the Driftless area.

Note this is not grain produced for exclusively for human consumption, but also includes grain produced for animal feed, biofuels or other processing markets. Counties with higher grain and/or "other" producer densities

- In Illinois: Stephenson into NE Carroll, Winnebago
- In Iowa: Central Allamakee, Buchanan, N Clayton, Delaware, S Central Fayette, S Howard, N-to-S Central Jackson into N Clinton, Jones, S Winneshiek
- In Minnesota: SE Dodge, E Central and W Central Goodhue, Houston, Olmsted, W Wabasha, N Winona
- In Wisconsin: NW Dane, Three areas within Grant, SW Green, SW Iowa, Juneau, Lafayette, W Richland, N Trempealeau, E Vernon

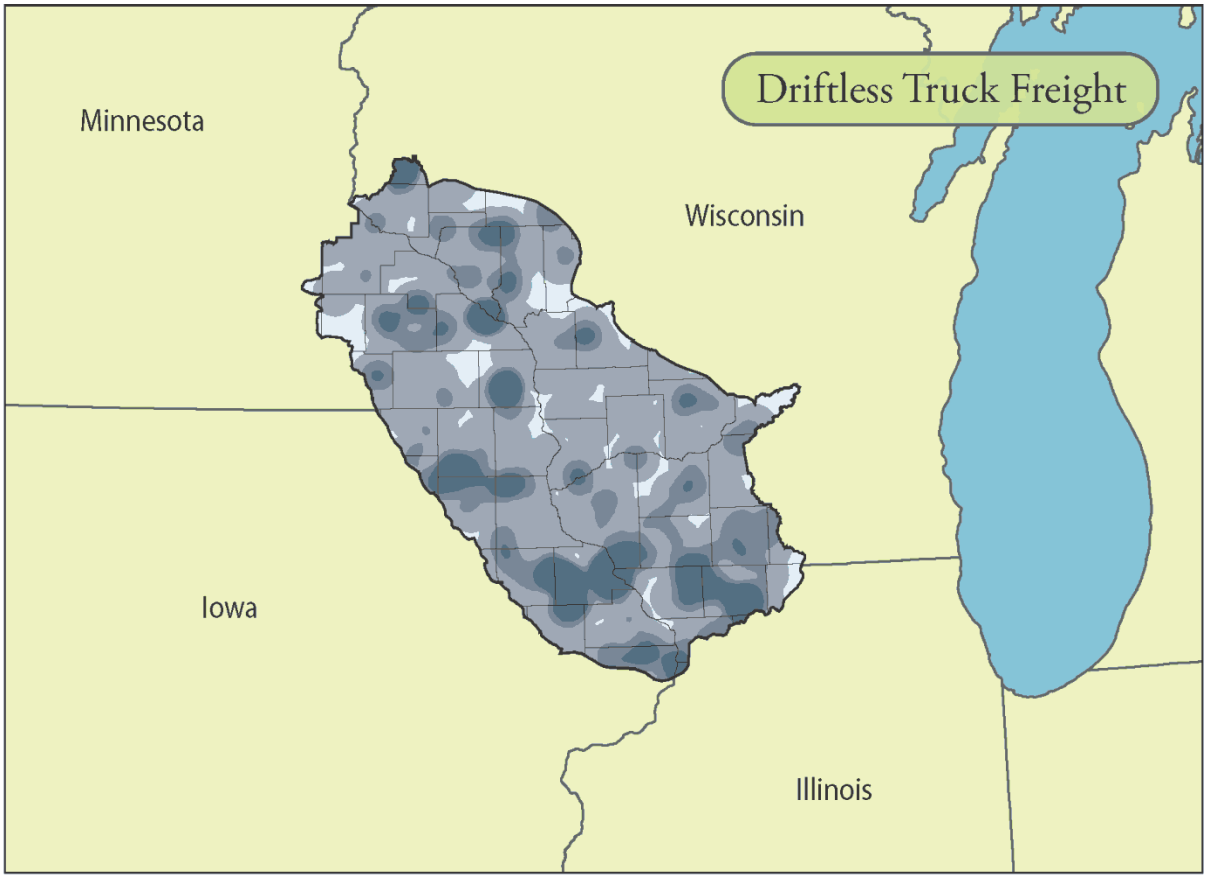

Figure 18 The relative density of truck freight in the Driftless area

Counties with higher truck freight densities

- In Illinois: E Jo Daviess, Stephenson, Whiteside into S Carroll
- In Iowa: NW Clayton, Clinton, E and NW Delaware, Dubuque, N Fayette, N Jones, S Winneshiek
- In Minnesota: Central and S Houston, Central Mower, Olmsted, E Central and W Winona
- In Wisconsin: S and NE Buffalo, S Grant, Green into NW Rock, E Central Iowa, SE Lafayette, W Central Monroe, N Central Sauk, St. Croix, W Trempealeau

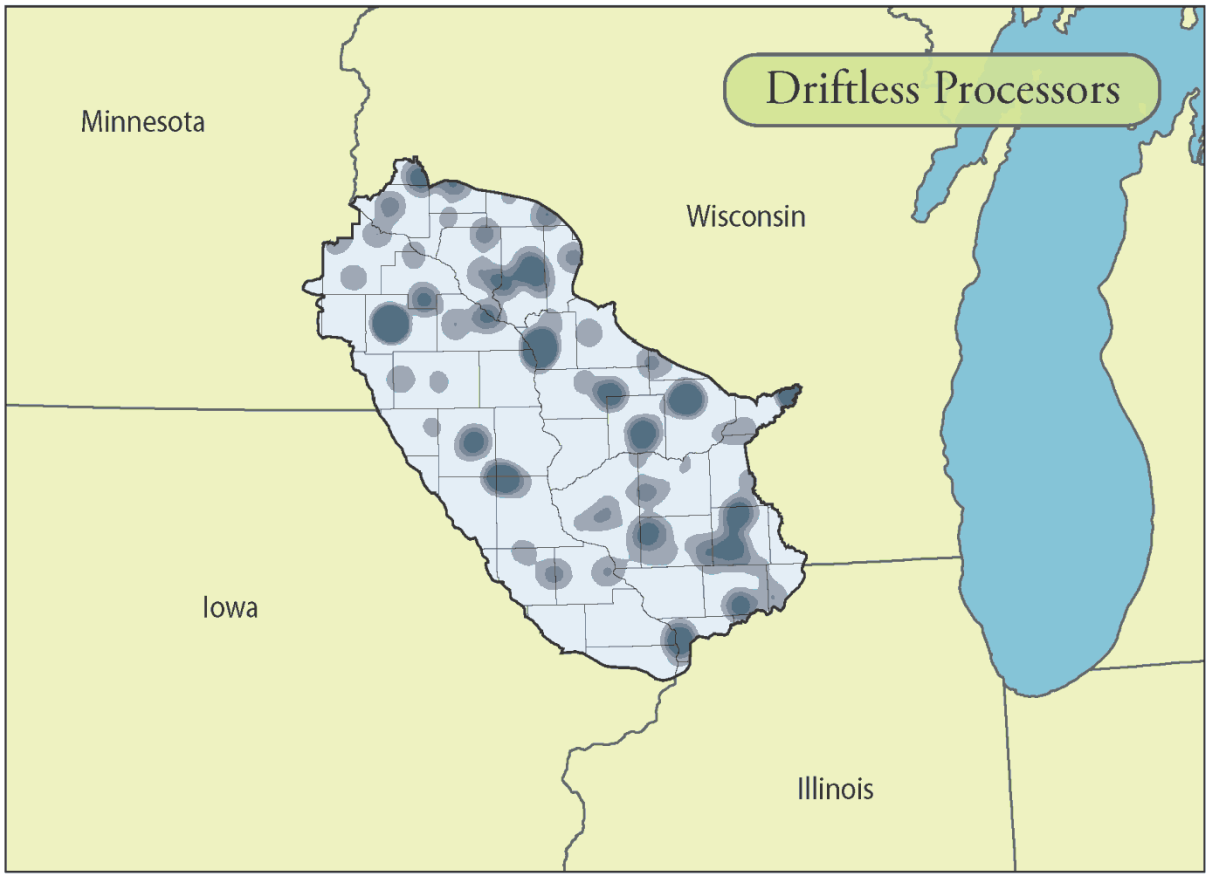

Figure 19 The relative density of food processors in the Driftless area.

Counties with higher food processor densities

- In Illinois: W Carroll, S Stephenson
- In Iowa: NW Clinton, SW Jackson, Central Winneshiek, Noticeable cluster near nexus of Allamakee, Clayton, Fayette and Winneshiek.
- In Minnesota: W Central Olmsted, S Wabasha, E Central Winona
- In Wisconsin: SE Buffalo, NE Columbia, E St. Croix, N-to-S Central Green, NW and SE Lafayette, Central and SW La Crosse, Central and S Richland, N Sauk, Central Trempealeau, Central Vernon

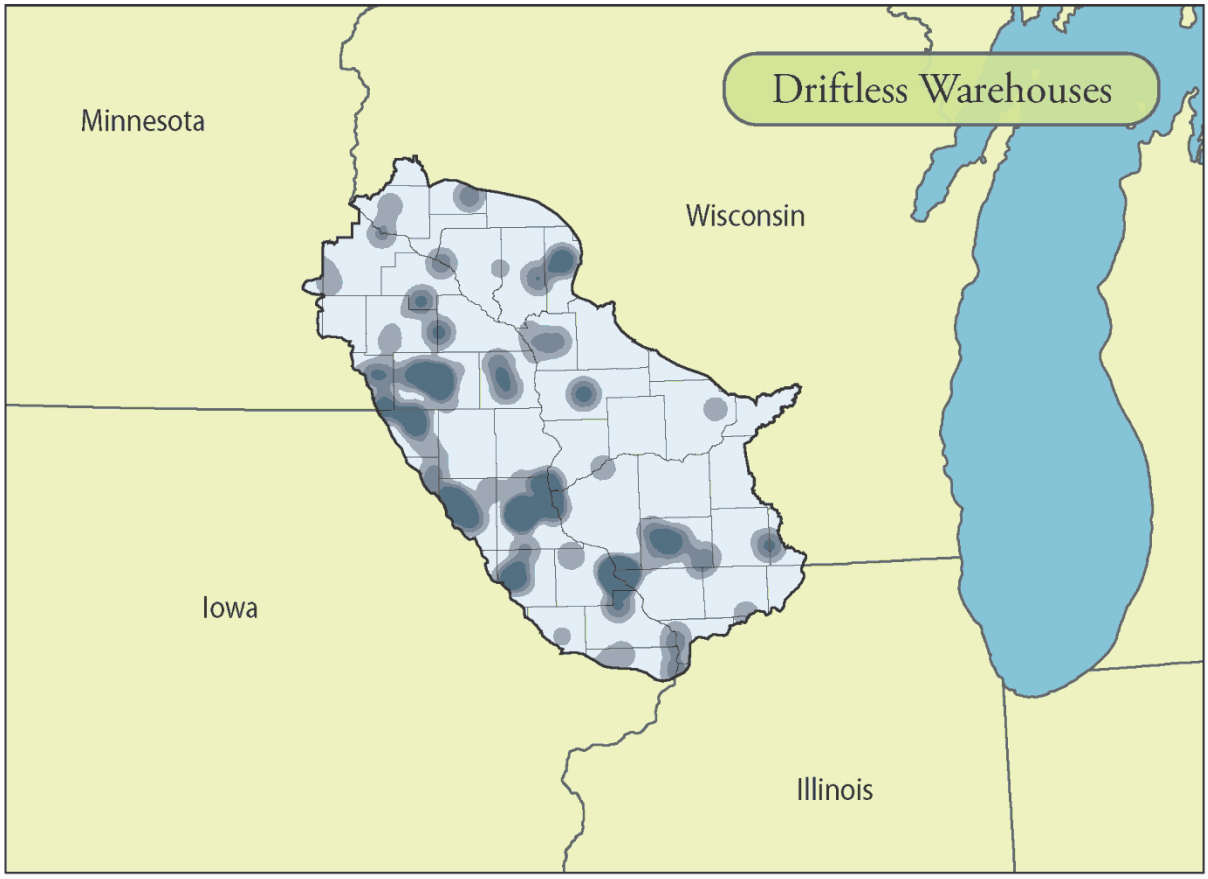

Figure 20 The relative density of food warehouses in the Driftless area.

Counties with higher food warehouse densities

- In Illinois: W Carroll, NW Jo Daviess
- In Iowa: NE and Central Clayton, E Clinton, W and Central Delaware, E Dubuque, SW and Central Fayette, N Howard, E and N Central Jackson,
- In Minnesota: Central Fillmore, Central Houston, Mower, E Olmsted, S Wabasha, W Winona
- In Wisconsin: W Buffalo, W Crawford, E Dunn, S and W Grant, E Green, W Jackson, Central La Crosse, Lafayette, W Rock, S Pierce, E Central Trempealeau, Central Vernon

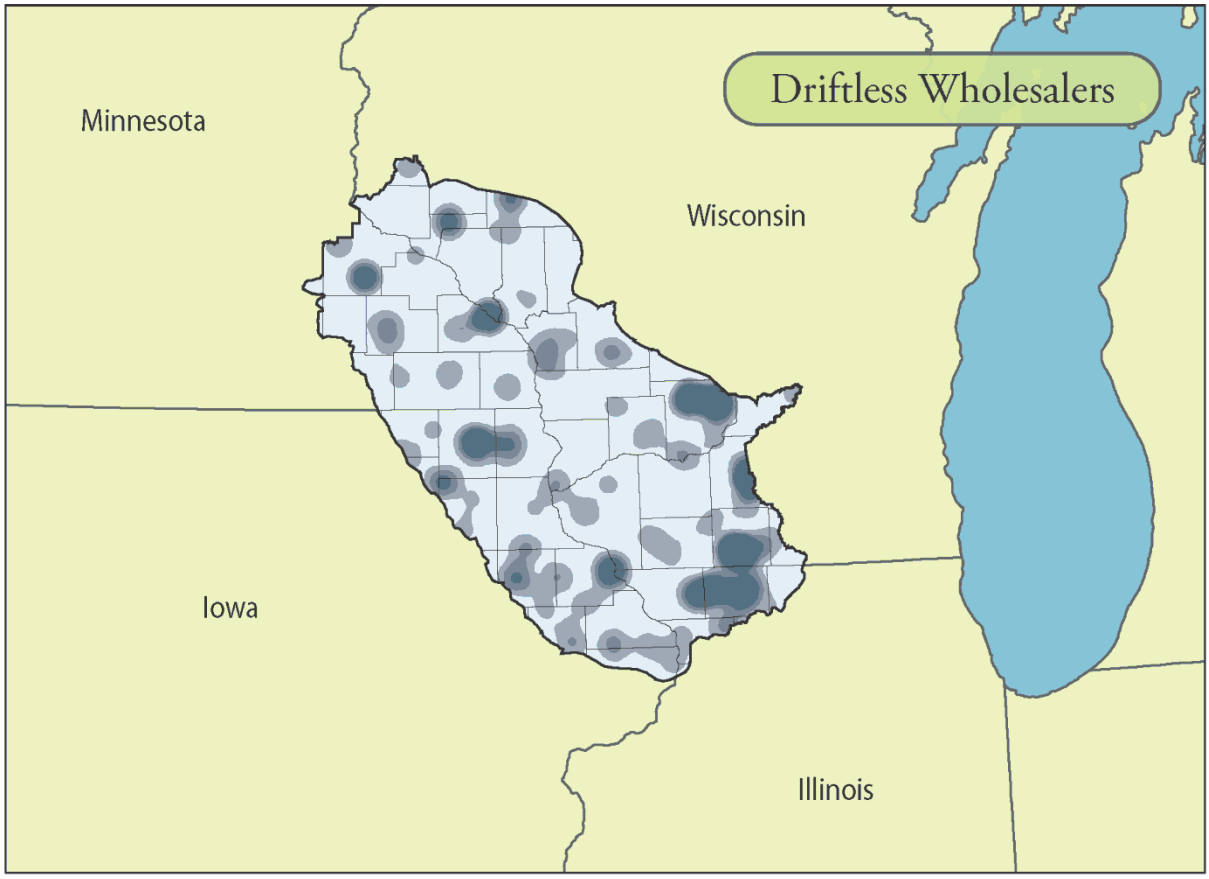

Figure 21 The relative density of food wholesalers in the Driftless area.

Counties with higher food wholesaler densities

- In Illinois: E Jo Daviess, Stephenson
- In Iowa: W Delaware, E Dubuque, NW Fayette, Central Winneshiek into Central Allamakee
- In Minnesota: S Goodhue, W Central Olmsted, E Central Winona
- In Wisconsin: Central Dane, Central Eau Claire, S and Central Green, SW and Central La Crosse, S Central Monroe, Central Pepin, N and E Sauk

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