Cold Chain Food Distribution from the Driftless Area: Keys to Attaining Self-Reliance in the Circle City

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University of Wisconsin–Madison

Authors:
Janice M. Soriano, Jacci Ziebert, and Alfonso Morales
University of Wisconsin–Madison

Principal Investigator:
Alfonso Morales, PhD
Department of Urban and Regional Planning
University of Wisconsin–Madison

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16. Abstract **In recent years, small- to mid-scale farms have increasingly emphasized the importance of branding and establishing the appropriate identity to enter the value-added market. Farms in the Driftless Area (mostly Southwest Wisconsin) are slowly developing a regional food system and their attempts to take advantage of its strategic location in supplying abundant, quality cold chain product to the metropolitan areas, recognized as the Circle City (Chicago to the Twin-Cities). A large proportion of Circle City's food is imported from outside the Upper Midwest, while the Driftless are is capable of producing more food to meet the region's needs. Farms specialize in small-scale and organic food production, but production must increase and producers must shift from direct marketing to intermediation in order to increase food supply from the area to the Circle City. At the same time, Driftless producers should continue and enhance their sustainable production methods and experiment with producing a more diverse array of food products; both of which are important dimensions to a self-reliant food system. This paper uses analyses of Transearch and ESRI ArcGIS Business Analyst to synthesizes the supply-demand relationship of food products that the Driftless Area shares with the Circle City by quantifying the amount of cold chain food product that is transported on a regional level. This paper makes recommendations that small- to mid-scale farmers can follow to scale-up production and to enter wholesale markets by developing relationships between each other and logistics firms, and then developing and utilizing aggregation points, which reduce risk to the producers.**			
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EXECUTIVE SUMMARY

In recent years, small- to mid-scale farms have increasingly emphasized the importance of branding and establishing the appropriate identity to enter the value-added market. Farms in the Driftless Area (mostly Southwest Wisconsin) are slowly developing a regional food system and their attempts to take advantage of its strategic location in supplying abundant, quality cold chain product to the metropolitan areas, recognized as the Circle City (Chicago to the Twin-Cities).

A large proportion of Circle City's food is imported from outside the Upper Midwest, while the Driftless are is capable of producing more food to meet the region's needs. Farms specialize in small-scale and organic food production, but production must increase and producers must shift from direct marketing to intermediation in order to increase food supply from the area to the Circle City. At the same time, Driftless producers should continue and enhance their sustainable production methods and experiment with producing a more diverse array of food products; both of which are important dimensions to a self-reliant food system. This paper uses analyses of Transearch and ESRI ArcGIS Business Analyst to synthesizes the supply-demand relationship of food products that the Driftless Area shares with the Circle City by quantifying the amount of cold chain food product that is transported on a regional level. This paper makes recommendations that small- to mid-scale farmers can follow to scale-up production and to enter wholesale markets by developing relationships between each other and logistics firms, and then developing and utilizing aggregation points, which reduce risk to the producers.

INTRODUCTION

In recent years, small- to mid-scale farms have increasingly emphasized the importance of branding and establishing the appropriate identity to enter the value-added market. The regional food system has simultaneously evolved from the traditional framework that groups food resources based strictly on proximity and geographic range to the more contemporary approach that places emphasis on food resource variety and transport efficiency. A topographically and resource-rich area with a growing presence in local and regional food systems, the Driftless Area is taking advantage of its strategic location to supply abundant, quality cold chain product to metropolitan areas that surround it. However, supply chain inefficiencies and local and interstate policy conflicts challenge the surrounding metropolitan Circle City from advancing systematic regional self-reliance.

Geographical Context

Located in a quad-state region consisting of Wisconsin, Minnesota, Illinois and Iowa, the Driftless Area is composed of deeply carved river valleys formed by the absence of glaciation during the last glacial period. This hilly terrain deprives farmers of conventional farming, which requires heavy machinery and large-scale row cropping, making the land more suitable for smaller scale and perennial production. The Driftless Area remains a haven for organic, high-value, small-scale farming. The area boasts a high concentration of organic farms and an array of specialty foods such as apples, wine grapes, artisanal cheeses, and grass-fed beef.

The Circle City is a Midwestern region first identified as a coherent region by Phil Lewis,

practicing landscape architect, emeritus professor at UW-Madison, and director of the Lewis Regional Design Academy. It consists of the many metropolitan areas that encompass the Driftless Area, as shown in Figure 1. Based on its collection of natural resources and features, the close proximity of metropolitan cities of which it comprises, and the rail and highway transportation systems that connect them, it produces many and varied products, inclusive of clusters of agricultural producers, such as Organic Valley.

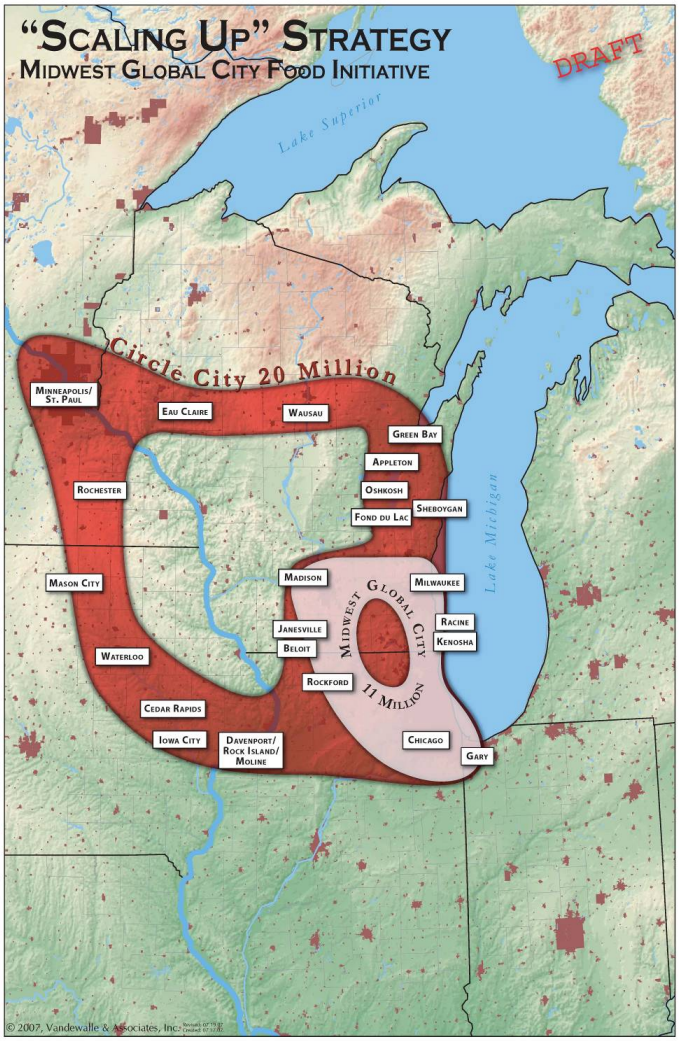


Figure 1. The Circle City
Source: Lewis, 2008.

The larger vision of this project involves three phases each elaborating on the relationship between the Circle City and the Driftless Area. Phase I detailed case studies of Driftless businesses across the food supply chain focusing on distribution while Phase II followed-up with these businesses. This latest report, Phase III, involves a more detailed examination of the Circle City and Driftless Area relationship by implementing both quantitative freight data and

qualitative assessments on practice recommendations and policy. Before proceeding, we briefly review the history of the overall project, then revisit the findings of each of the previous phases.

Maximizing Freight Movements in Local Markets: Phases I & II

Phase I

In Phase I the research goal was to evaluate whether and how freight infrastructure and movements can be utilized to more efficiently distribute local food. Driftless Area businesses (such as 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 were examined to identify a range of logistical needs and innovations related to distribution in the study area.

These case studies revealed that mid-career producers applied 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 while 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, which may offset some or all of the advantages of intermediation.

Phase I 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. Lastly, 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.

Phase II

Phase II of this research examined methods to reduce the barriers for small and medium-sized farmers seeking to begin or increase the use of intermediated distribution. Many producers at these scales are engaged in both direct and intermediated marketing. Additionally, tools that may be useful for producers seeking to scale up were examined including cost of self-distribution assessment tools and traceability technology.

In Phase II four follow up interviews were conducted with four case studies from Phase I in order to describe the ongoing challenges in distribution, organizational emergence, and how those businesses respond to those challenges. A new case study was presented of an independent, regional, mainline food distributor based in La Crosse 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. Phase II also generated maps that revealed regional patterns of business "hot spots" and "cold spots" that are areas with noticeably positive or negative relationships to agricultural enterprises.

Phase III describes opportunities for small- to mid-size farms to scale up exports. Further, it describes the spatial clustering of cold chain commodity industries. It also reviewed the potential that emerging food hubs and other collaborative methods offer to intermediated supply chain participants. Creating and comparing "hot spot" maps for different commodities provided in the Upper Midwest relative to the Driftless Area offers a rich sense of economic development opportunities in the region as a whole.

Phase III Context & Methods Employed

Self-reliance for Regional Food Systems

Supporting a regional food system is a critical component of a resilient region. Clancy (2010), argues that a regional food system must be self-reliant, rather than self-sufficient, one that recognizes that not all food needs can be produced in the region. A regional food system must verify that "as much food as possible to meet the population's food needs is produced, processed, distributed, and purchased at multiple levels and scales within the

region, resulting in maximum resilience, minimum importation, and significant economic and social return to all stakeholders in the region." The term "regional" is not rigid and can be defined in numerous ways; by political or administrative boundaries or arbitrary boundaries where regions may overlap. The Driftless Area can be defined as an unglaciated area in the upper Midwest mostly located in southwest Wisconsin, but also parts of northwest Illinois, eastern Iowa, and southeastern Minnesota.

Clancy describes four crucial dimensions to a regional food system framework: food supply, natural resource sustainability, economic development, and diversity (Clancy & Ruhf, 2010). In this case supply is in terms of the Circle City's food demands and the food demands of Driftless residents. Second, sustainable farming practices' using natural resources ensures the food supply for current and future generations. Third, a regionally focused food system enhances economic returns since it broadens marketing options for all farm sizes via alternative supply chains. Products in alternative chains tend to endure fewer transactions while marketing strategies include product differentiation that add value through its production methods (such as certifying products as organic), place-based branding, such as consumer awareness of food origin, association with place of production, or through face-to-face interaction with the farmer. Fourth, diversity in types of food grown and processed provides resiliency to the region, preserving options in the event of shocks to the region, directly, through climate change, or indirectly from changes to other regions that supply food to the Circle City. Supporting a regional food system enables resiliency, food and resource security.

With this in mind, we elected to study the Driftless Area in the larger regional context to produce a comprehensive regional view and to distinguish patterns of supply chain activities in relation to the Driftless Area as a whole. We examined a 100 mile distance buffer of the Driftless for 3 reasons: (1) 100 miles is a typical distance a person states is local (Peters et al., 2009); (2) 100 miles is the typical distance aggregation centers obtain food from local growers (Illinois, 2012); and (3) it is near (94 miles) the average distance food travels in intermediated supply chains (King et al., 2010).

Data Analysis Methodology & Caveats

We deployed two databases in our research, Transearch and ESRI ArcGIS Business Analyst. The Transearch database is a tool used by transportation planners and government agencies alike to "analyze current and future freight flows by origin, destination, commodity, and transport mode" (IHS, 2014). New data can be purchased every year as the organization or agency prefers, and at varying levels of geographic and commodity-related detail. Geographic breakdowns include but are not limited to: county, metropolitan statistical area (MSA), or BEA economic area (BEA), or state. Commodity breakdowns are provided in Standard Transportation Commodity Codes (STCC) and typically come in two or four digits, though can be provided as far as 6 to 7 digits to specific commodities within each class and subclass.

ESRI ArcGIS Business Analyst 2012 provides a national database of businesses along with employee count, annual sales volume, and an 8-digit North American Industry Classification System (NAICS code), which is a hierarchical coding system that classifies

industry type. Food production and food processing businesses within a 100 mile buffer distance of the Driftless were selected and categorized by type of food produced or handled (dairy, poultry, fruits/vegetables, or meat). Annual sales volume was log-transformed to normalize the data. Next a hot spot analysis (Getis-Ord Gi*) was performed to find locations of geographic clustering. Our analyses produced a series of hot spot and cold spot maps of each business/commodity type indicating clusters of either high gross annual sales volume or low sales volume. These maps as well as a more detailed walkthrough are provided in the appendices.

Commodity

Transearch classifies freight movements using the Standard Industrial Classification (SIC) system as opposed to the more widely used North American Industry Classification System (NAICS) code. The Standard Transportation Commodity Code (STCC) mentioned previously is based on SIC[1]. We are interested in the movement of cold-chain products because of the additional logistical challenge associated with the need to temperature control in-transit and during transfer. Cold chain products typically refer to perishable goods that must be temperature-controlled (refrigerated or frozen) to maintain its quality. For this cold chain study, only products *for human consumption* within the SIC codes preceded by "01" (Agricultural Production-Crops) and "20" (Food and Kindred Products) were considered.

[1] For more information, please refer to Railinc's "Commodity Classification Systems: A Brief Examination of Relationships from the STCC Perspective" listed under Works Cited at the end of this report.
[2] Typically, full truckload tons is the unit that measures the amount of tons that are part of a full shipment

The STCC level of aggregation provided is limited to four digits and thus prevents us from a more specific analysis of movements of individual types of commodities (e.g. apples, carrots, gouda, etc.). It also proved difficult to disaggregate the four-digit generalized commodity categories and specify which individual commodity types fell within them to the level desired. Table 1 below displays the commodities and their respective four-digit STCCs studied for this project.

Table 1. Commodity Categories by STCC-4

STCC-4	**Cold Chain Commodity**
01 xx	*Agricultural Production - Crops*
01 22	Deciduous Fruits
01 29	Miscellaneous Fresh Fruits or Tree Nuts
01 33	Leafy Fresh Vegetables
01 39	Miscellaneous Fresh Vegetables
01 42	Dairy Farm Products
01 52	Poultry Eggs
20 xx	*Food and Kindred Products*
20 11	Fresh, Chilled Meat
20 12	Fresh, Frozen Meat
20 13	Meat Products
20 15	Fresh, Dressed Poultry
20 16	Frozen, Dressed Poultry
20 17	Processed Poultry or Eggs
20 21	Creamery Butter
20 25	Cheese or Special Dairy Products
20 26	Processed Milk

Geographical Extent: Origin & Destination

- Origin - Driftless Area: Due to Transearch data limitations, the analysis of these cold chain transport relationships are limited only to *Wisconsin* counties considered to be within the Driftless Area and excludes the counties of the three other states that share portions of the Driftless. However, the 22 Wisconsin counties whose cold chain production we examined still make up a significant portion of the Driftless, comprising about 49% of the Driftless Area in acreage.
- Destination - Circle City: The Circle City could not accurately be represented by the 2007 and 2011 figures provided by Transearch. Neither the spatial extents of the Circle City MSAs, nor its cold chain movements in 2007 were equivalently defined and tracked in 2011, rendering some cold chain movements incomparable. The 2007 Transearch data used MSAs to define its spatial extents, while 2011 data used BEAs ("Bureau of Economic Analysis" Economic Areas).

The Driftless Wisconsin counties are the "origin" counties, and the Circle City BEA areas are the "destinations" as defined by Transearch 2011 listed in Table 2 below. It should be noted that the BEA system simply divides each state into several BEA "regions" named after the most dominant city within that region. Therefore, the five Wisconsin Circle City Areas listed below for the study actually comprise data associated with surrounding cities of the region as well.

Table 2. Origins and Destinations Selected for Study

ORIGIN	**DESTINATION**	
Driftless WI County	*Circle City Area (BEA)*	*State*
Buffalo	Cedar Rapids	IA
Columbia	Chicago	IL
Crawford	Davenport	IA
Dane	Madison	WI
Dunn	Minneapolis	MN
Eau Claire	Wausau	WI
Grant	Rochester	MN
Green	Milwaukee	WI
Iowa	Green Bay	WI
Jackson	Appleton	WI
Juneau	*Not included in 2011 data*	
La Crosse	Beloit	WI
Lafayette	Eau Claire	WI
Monroe	Fond du Lac	WI
Pepin	Gary	IN
Pierce	Iowa City	IA
Richland	Janesville	WI
Rock	Kenosha	WI
St. Croix	Mason City	IA
Sauk	Oshkosh	WI
Trempealeau	Racine	WI
Vernon	Rockford	IL
	Sheboygan	WI
	Waterloo-Cedar Falls	IA

Transport Mode

Transearch tracks freight movements made by truck, rail, air, or water transport, though only truck-transported, cold chain freight was considered for this study. These are measured in units of full truckload tons[2] and less-than-truckload (LTL), or partial truckload tons. Additionally, truckloads transported by private (e.g. "big box" retailers) and for-hire haulers are tracked separately. It is also important to note that Transearch does not capture the local distribution of goods to retail markets (CMAP, 2014). Similarly, Transearch is unable to specify the final destination of some LTL tons since they typically include mixed freight loads that are assumed to be handled en route over several destinations. Therefore, for the purposes of this analysis, only full truckload tons transported by for-hire haulers was considered.

First, the report will illustrate the Driftless Area's cold chain food production over the past five years and the probable efficiencies and problems these data imply. Secondly, it will address transport inefficiencies seen throughout the supply chain and will propose methods to scale-up production and distribution while highlighting federal, state and local policies that impact the future of the Driftless Area food system as a whole. Across these two measures of the Driftless Area's capacity to serve the Circle City is an important theme: that coordination and consistent relationships must also occur at multiple scales to sustain a healthy and resilient regional food system.

[2] Typically, full truckload tons is the unit that measures the amount of tons that are part of a full shipment that weighs more than 10,000 lb/load. (gforceship.com)

MEETING THE FOOD DEMANDS OF THE CIRCLE CITY

This section synthesizes the supply-demand relationship of food products that the Driftless Area shares with the Circle City. The data presented here show that the cold chain movements between the Driftless Area and the Circle City bring the Circle City closer to self-reliance. Although the two regions are by no means exclusive in their food system relationship, the amount of Driftless Area cold chain product that remains within the Circle City satisfies a significant amount of meat and dairy commodities, but weak in fruit and vegetable commodities. Vice versa, the Circle City also appears to export much of its raw cold chain product for further production and processing to parts of the Driftless Area. While this is not based on specific truckload tons aggregated by county, this can be interpreted from the freight movements and hot spot analyses mapped previously.

Value-Added Producers in the Driftless Area

The Circle City's developing relationships to the Driftless Area is attributable to proximity and to the Driftless Wisconsin's production of high-value crops and value-added products. Table 3 displays the amount of cold chain product the Driftless produces and delivers to the Circle City, in truckload tons, while Figure 2 following it portrays these numbers in terms of percentage of total U.S. production. Clearly, the region specializes in dairy – specifically dairy farm products, cheese, and processed milk – with miscellaneous fresh fruits, poultry eggs also showing significant production relative to the other cold chain commodities studied.

Table 3. Amount of Driftless Wisconsin Cold Chain Food Product Produced for Circle City MSAs (2011)

Cold Chain Commodity	Total Produced (truckload tons)
Cheese or Special Dairy Products	250,670
Poultry Eggs	76,124
Creamery Butter	39,602
Misc. Fresh Fruits	97,176
Dairy Farm Products	4,555,955
Meat Products	45,812
Fresh, Frozen Meat	41,121
Fresh, Chilled Meat	45,398
Misc. Fresh Vegetables	2,329
Deciduous Fruits	3,546
Leafy Fresh Vegetables	276
Processed Milk	201,152
Frozen, Dressed Poultry	6,578
Fresh, Dressed Poultry	6,789
Processed Poultry or Eggs	8,912

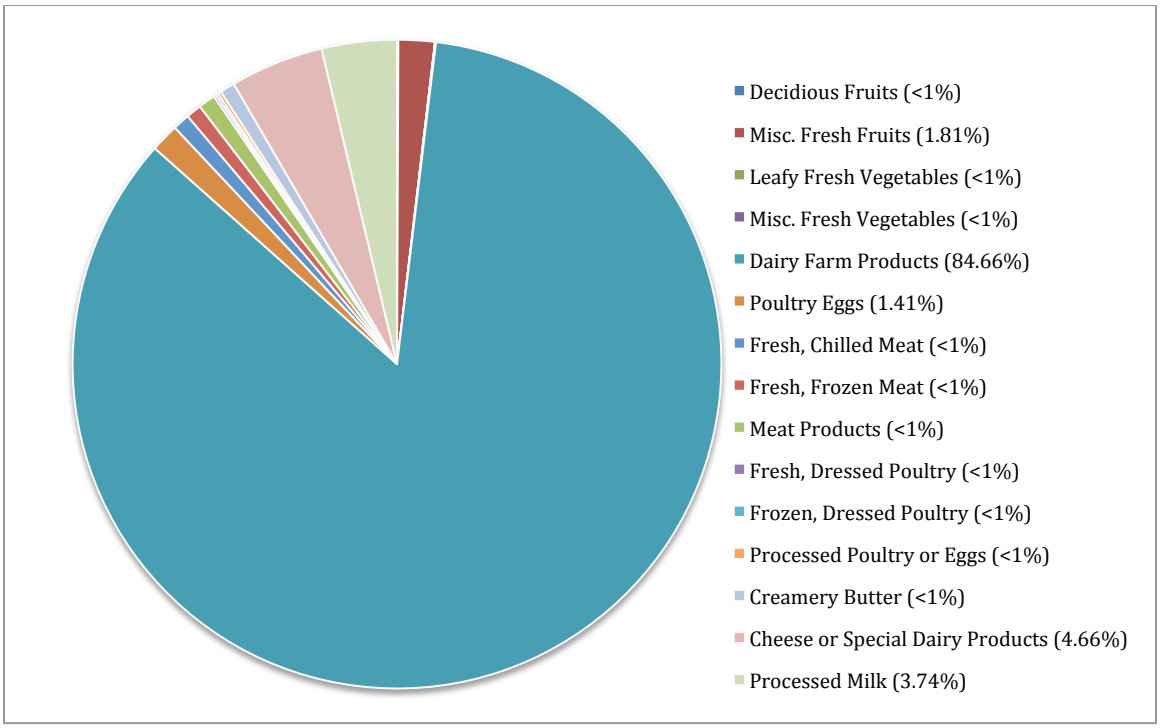


Figure 2. Makeup of Cold Chain Commodities Produced in Driftless Wisconsin Overall (in % truckload tons)

Here, we will first identify potential cold chain production trends in Driftless Wisconsin by specific commodity groups.

Fruit & Vegetable Production to the Circle City

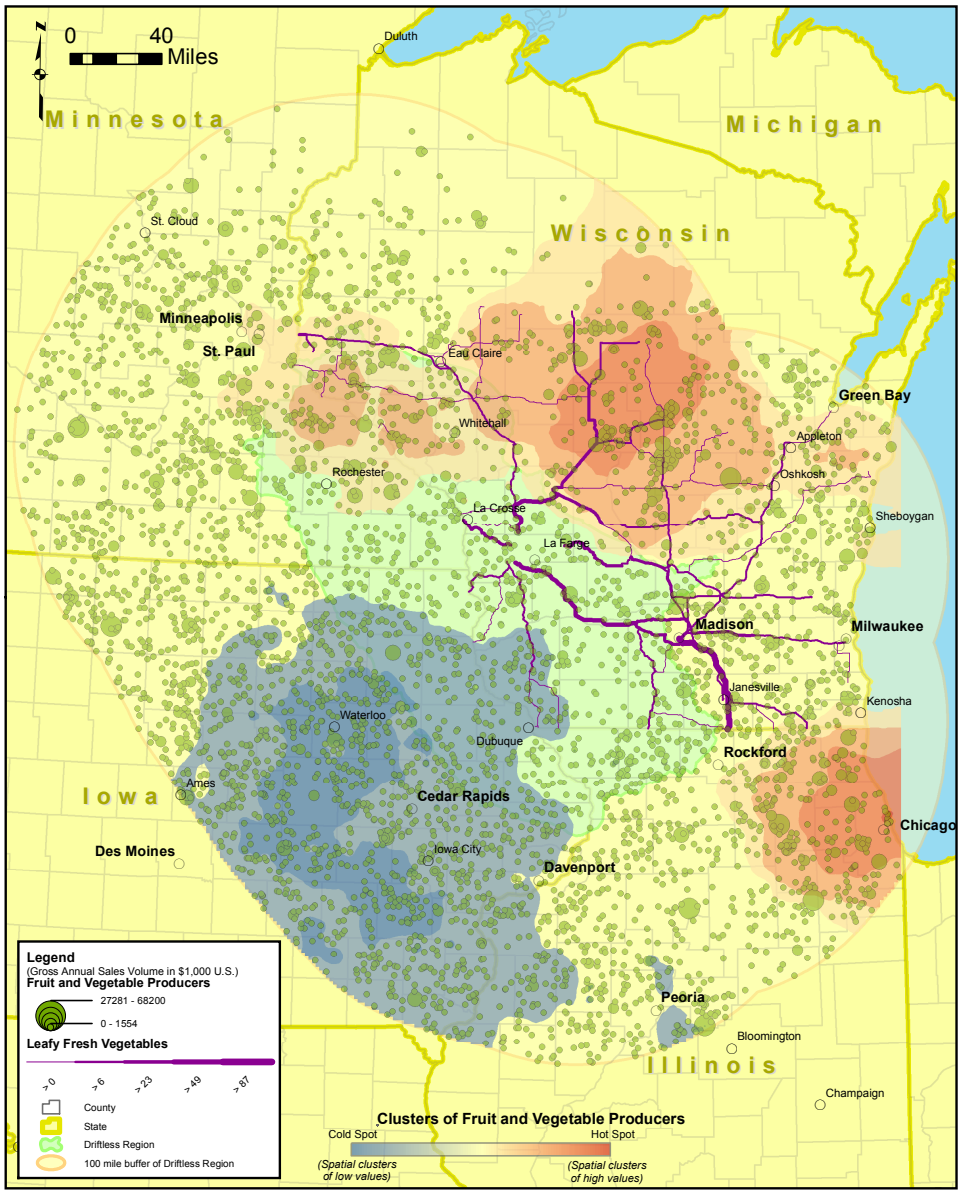
The Transearch data used is not suited to describe movements of specific types of fruits and vegetables; however, we are able to make decent inferences about more generalized fruit and vegetable groups such as deciduous fruits, leafy fresh vegetables, and miscellaneous fresh vegetables. Table 4 below shows the top five Driftless Wisconsin production counties for each of these fruit and vegetable commodities based on truckload tons transported to the Circle City.

Table 4. Top Five Driftless Counties for Fruit and Vegetable Products Delivered to the Circle City

Driftless Wisconsin County	Total Truckload Tons Produced for Circle City
Deciduous Fruits	
Vernon	519
Monroe	506
Pierce	468
Eau Claire	380
Dunn	356
Leafy Fresh Vegetables	
Vernon	173
Pierce	31
Eau Claire	11
Buffalo	9
Dunn	9
Miscellaneous Fresh Vegetables	
St. Croix	567
Trempealeau	429
Columbia	280
Dane	212
Green	154

Based on Transearch data alone, Vernon, Eau Claire and Pierce Counties were the highest producers of deciduous fruits and leafy fresh vegetables in 2011. However, a closer look at the spatial attributes of fruit and vegetable production in Figure 3 will show that these counties are close, but do not actually lie within a fruit and vegetable production "hot spot." This "hot spot," which indicates where fruit and vegetable

production is likely to be highest, exists deepest in central Wisconsin, rather than among these Driftless counties that reside closer along the Wisconsin-Minnesota border.



Sources: Food businesses (ESRI Business Analyst 2012), Freight tonnage (TRANSEARCH 2011), Food hubs and organic farms (USDA)

Figure 3. Fruit and Vegetable Production Clusters in the Driftless Area (showing only leafy fresh vegetable freight movements[3])

[3] The fruit and vegetable production clusters shown in Figure 3 will appear multiple times in the appendices, but with freight movements for either deciduous fruits, leafy fresh vegetables, or miscellaneous fresh vegetables overlaid onto them.

Similar inferences can be made about the lack of vegetable production in Driftless Wisconsin by observing Figure 4 below, where land use for vegetable production as of 2007 was not nearly as prominent in any part of the Driftless Area except for Minnesota. Figure 5, which follows, further implies that especially when compared on a state-by-state basis, Wisconsin's agricultural input *and* output has decreased since 1960.

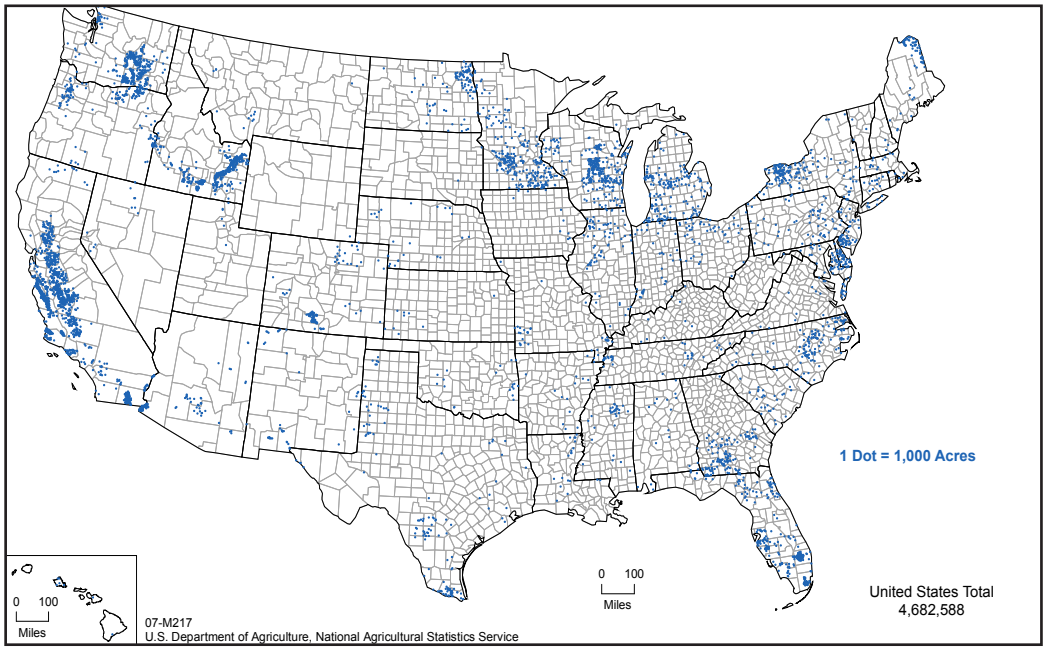


Figure 4: Land Used for Vegetables in 2007
Source: SWWRPC, USDA, 2013.

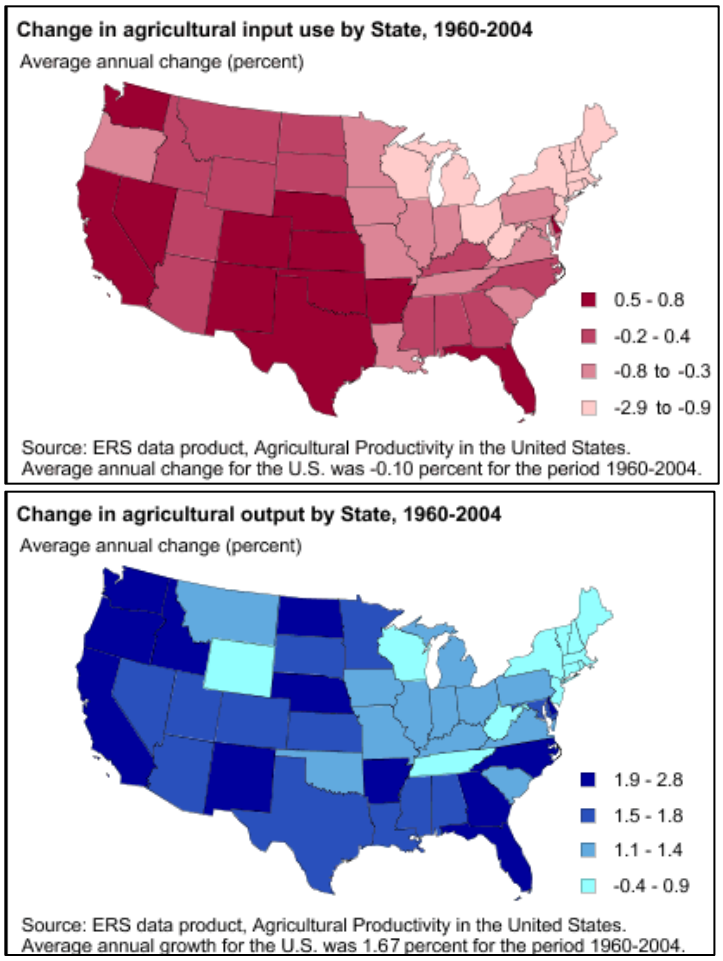


Figure 5. Change in Agricultural Productivity in the United States, 1960-2004
Source: USDA – Economic Research Service, 2013.

Fresh Meat and Meat Products

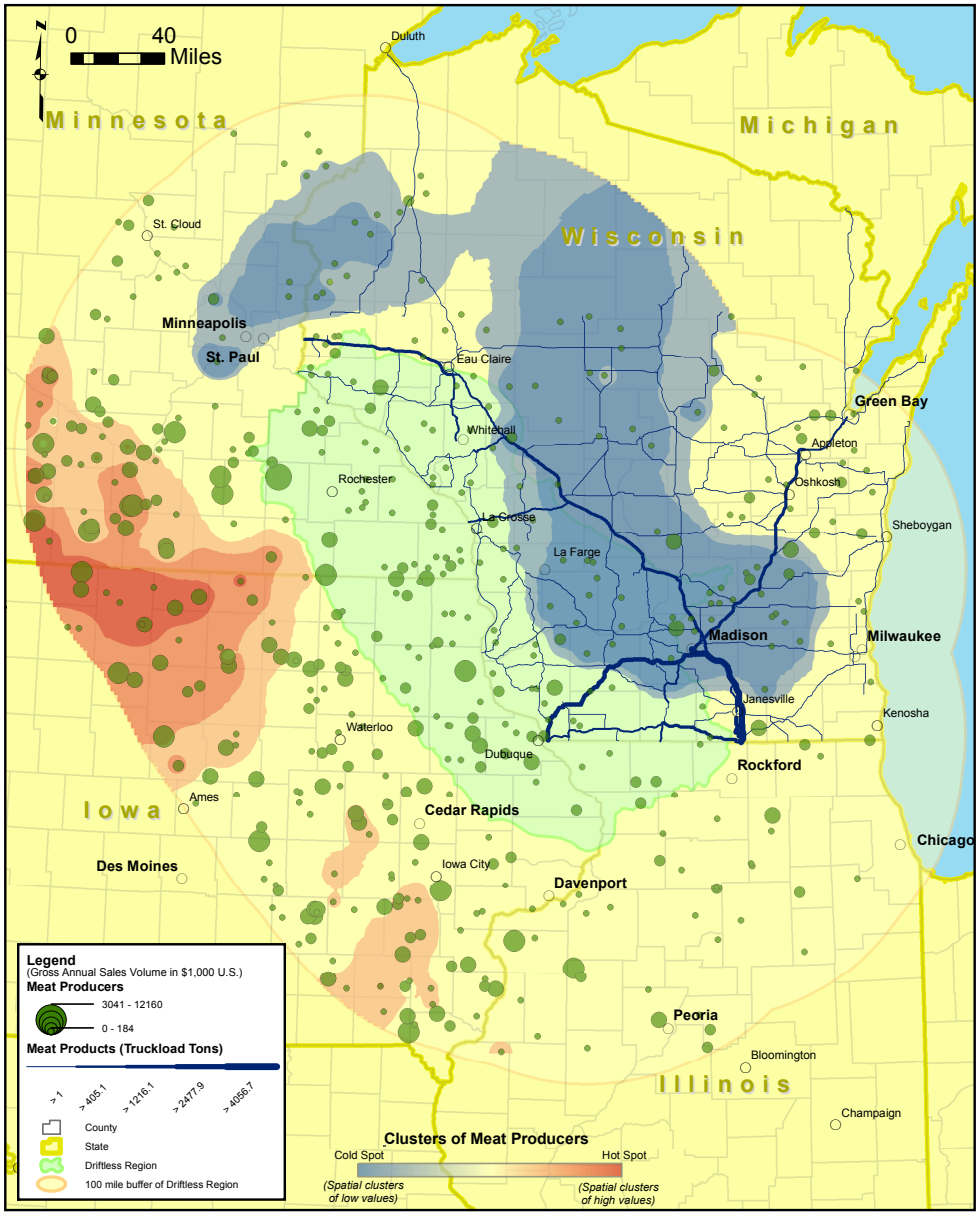
Based on Transearch 2011 data, Driftless Wisconsin counties are generally stronger producers of meat products. Table 5 below shows the top five Driftless Wisconsin production counties for each meat commodity group.

Table 5. Top Five Driftless Wisconsin Production Counties of Meat Commodities Delivered to the Circle City

Driftless Wisconsin County	Total Truckload Tons Produced for Circle City
Fresh, Chilled Meat	
Dane	20,639
Green	4,216
Trempealeau	3,390
Rock	2,868
La Crosse	984
Fresh, Frozen Meat	
Dane	16,072
Green	3,284
Rock	2,934
Trempealeau	1,433
La Crosse	430
Meat Products	
Dane	15,632
Green	3,170
Rock	2,742
Trempealeau	2,693
La Crosse	824

It is especially interesting to note that the top five counties, which predominantly reside in south central Wisconsin and along the Wisconsin-Minnesota border, remain the same despite the type of meat commodity production. A closer look at the meat commodities' spatial attributes in Figure 6 below, however, broach the debate on whether or not these counties' higher meat production is a result of a meat producer cluster. The five counties,

which find themselves in a “cold spot” on this map, appear to have a substantial amount of meat producers within close proximity, though based on sales volumes, they do not produce the same quantify as a “hot spot” cluster like the one shown in parts of Iowa outside the Driftless Area.



Sources: Food businesses (ESRI Business Analyst 2012), Freight tonnage (TRANSEARCH 2011), Food hubs and organic farms (USDA)

Figure 6. Meat Production Clusters in the Driftless Area (showing meat product freight movements only[4])

This data also appears to hold true to older implications made by the Tri-State Prospectus study completed by SWWRPC in 2007. It identified Wisconsin, Illinois and Iowa as a tri-state agricultural region that lacks fruit and vegetable production but boasts consistent meat and dairy industries. Figure 7 below, taken directly from the report, further shows

[4] The meat production clusters shown in Figure 6 will appear multiple times in the appendices, but with freight movements for either fresh chilled meat, fresh frozen meat, or meat products overlaid onto them.

this prominent meat and dairy industry in southwest Wisconsin in 2007 (SWWRPC, 2013).

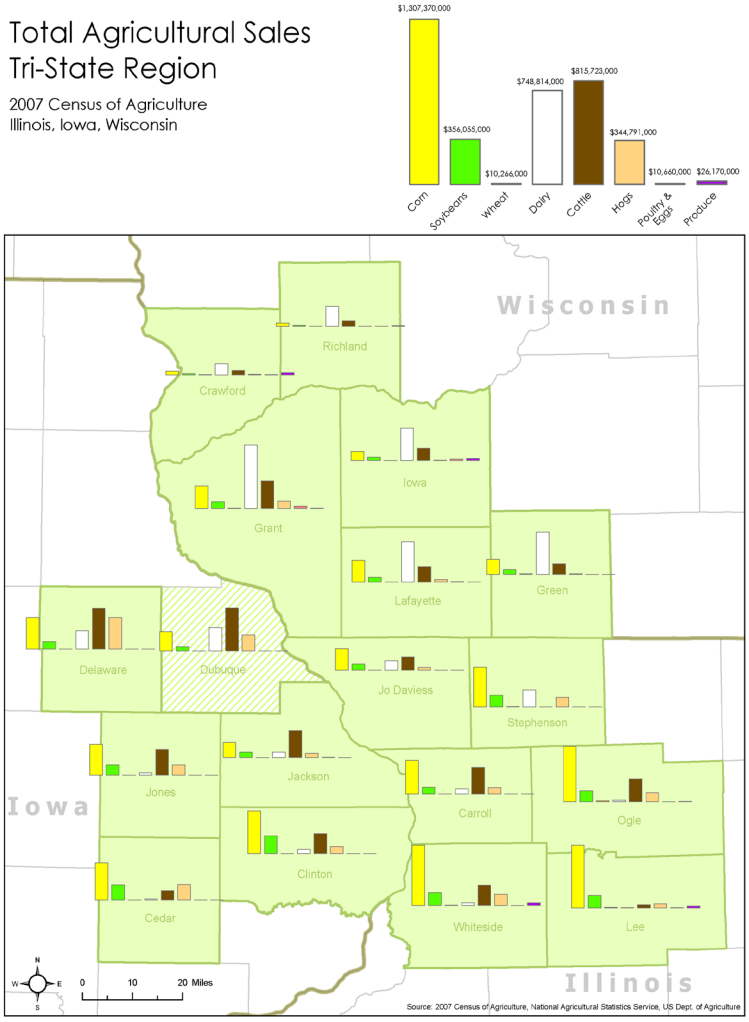


Figure 7: Total Agricultural Sales in the Tri-State Region in 2007
Source: Census of Agriculture, SWWRPC, 2013.

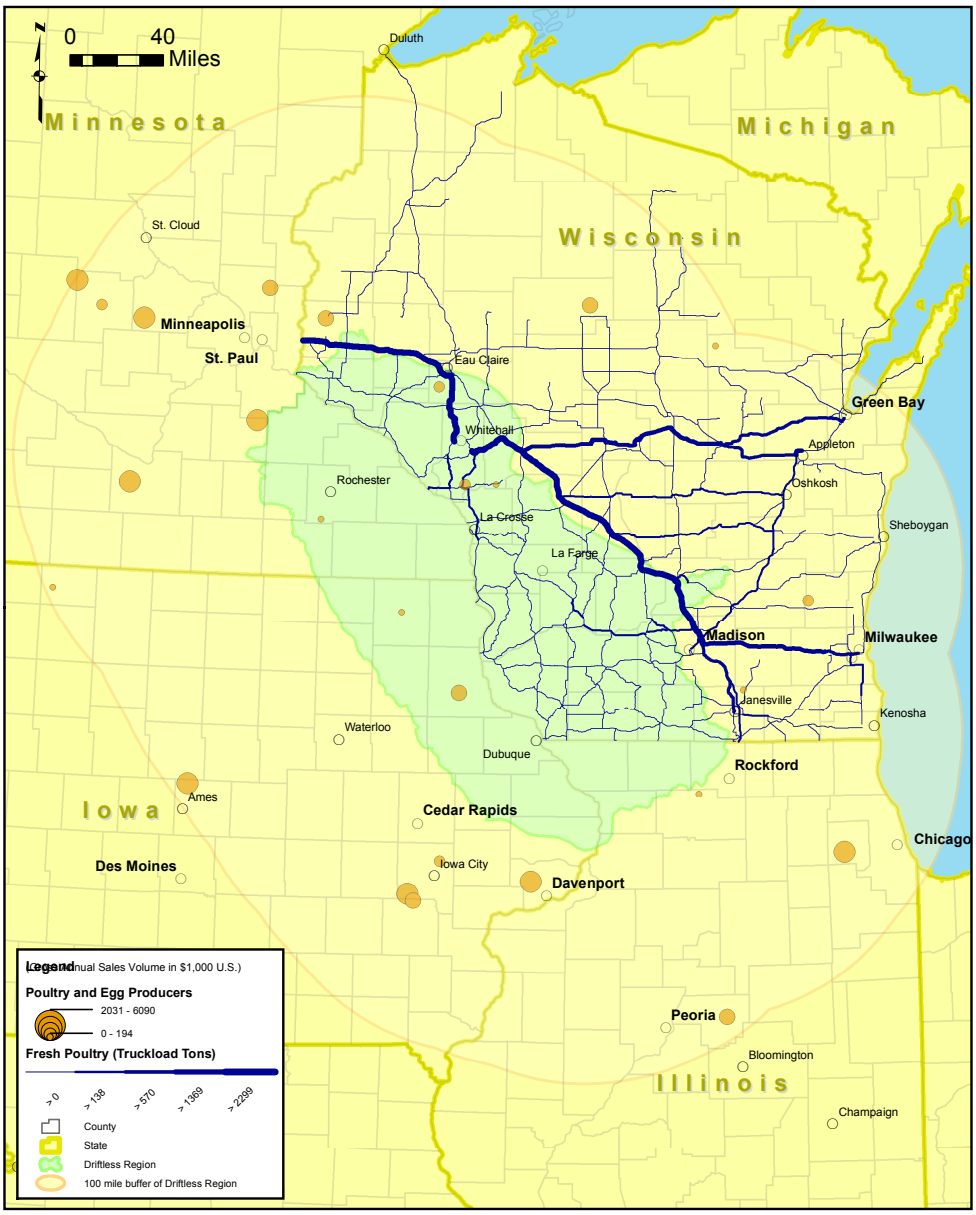
Poultry & Eggs

Driftless Wisconsin counties also generally appear to be strong producers of poultry products, though more so for its processed poultry products and eggs. Table 6 below shows the top five Driftless Wisconsin production counties for each poultry commodity group.

Table 6. Top Five Driftless Wisconsin Production Counties of Poultry Commodity Groups Delivered to the Circle City

Driftless Wisconsin County	Total Truckload Tons Produced for Circle City
Poultry Eggs	
Buffalo	13,948
Trempealeau	3,550
Sauk	1,938
Columbia	1,769
Iowa	1,674
Processed Poultry or Eggs	
Trempealeau	8,325
Rock	229
Green	109
Eau Claire	84
Dane	52
Fresh Dressed Poultry	
Trempealeau	6,330
Rock	191
Green	79
Eau Claire	60
Dane	37
Frozen Dressed Poultry	
Trempealeau	6,029
Rock	171
Green	76
Eau Claire	57
Dane	39

Trempealeau County is clearly the top producer of poultry and egg related products of the Driftless Area counties according to Transearch 2011 data.



Sources: Food businesses (ESRI Business Analyst 2012), Freight tonnage (TRANSEARCH 2011), Food hubs and organic farms (USDA)

Figure 8. Poultry and Egg Production Clusters in the Driftless Area (showing fresh poultry freight movements only[5])

[5] The poultry and egg production clusters shown in Figure 8 will appear multiple times in the appendices, but with freight movements for either poultry eggs, processed poultry or eggs, fresh dressed poultry, or frozen dressed poultry overlaid onto them.

Cheese, Milk & Other Dairy Products

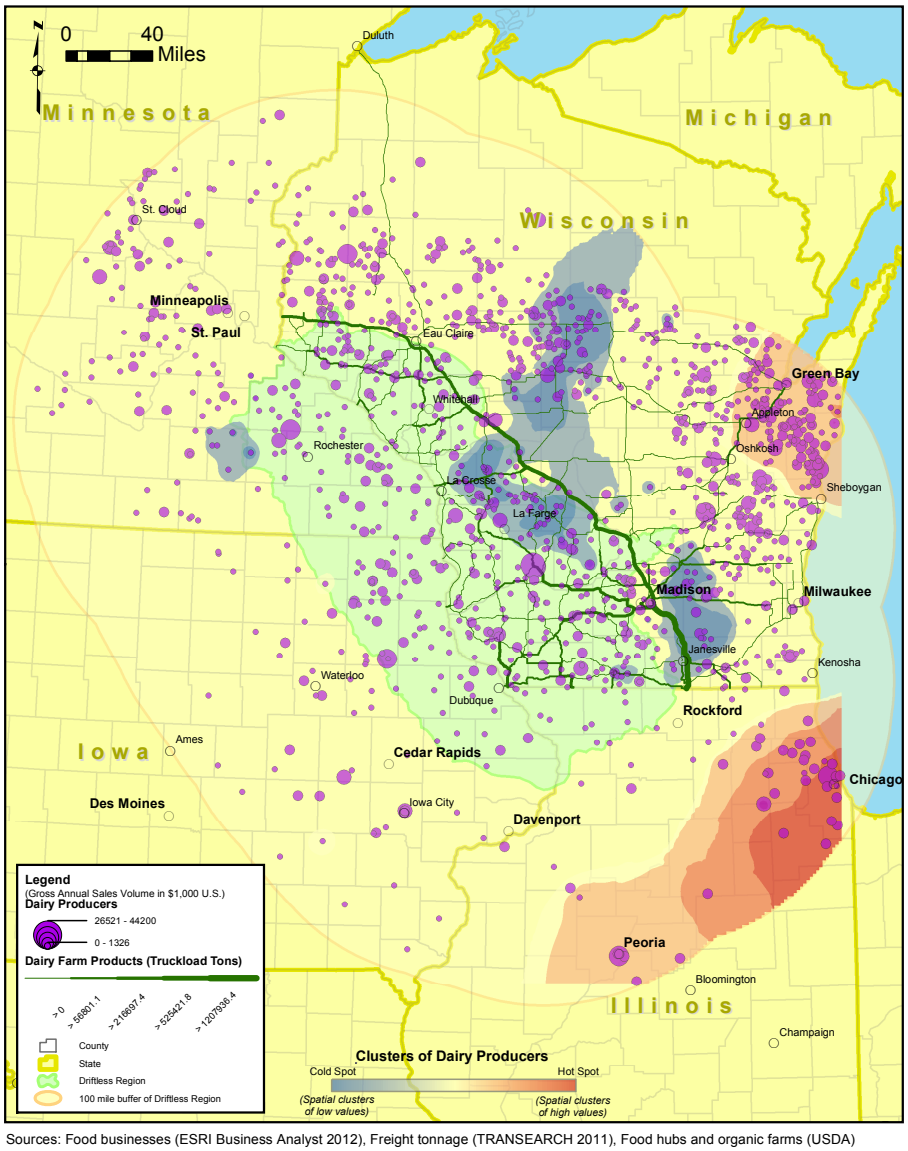
As earlier implied, Transearch 2011 data indicates that Driftless Wisconsin counties are generally strong producers of dairy products. Table 7 below shows the top five Driftless Wisconsin production counties for each cheese, milk or dairy commodity group.

Table 7. Top Five Driftless Wisconsin Production Counties of Cheese, Milk and Dairy Commodity Groups Delivered to the Circle City

Driftless Wisconsin County	Total Truckload Tons Produced for Circle City
Creamery Butter	
Dane	8,094
Richland	3,394
Sauk	3,305
-	-
-	-
Cheese or Special Dairy Products	
La Crosse	10,352
Trempealeau	10,136
Green	9,259
Lafayette	7,765
Grant	7,513
Processed Milk	
Dunn	91,737
Richland	52,672
Vernon	18,470
La Crosse	13,188
Monroe	8,588
Dairy Farm Products	
Dane	316,323
Grant	231,439
Green	154,534
Sauk	145,254

Monroe	139,927

Unlike the other commodity groups explored, the cheese, milk and dairy group do not appear to have common top producing counties shared among the different commodity types. Figure 9 below confirms this from a spatial attribute perspective, indicating a spread of "cold spot" dairy producer clusters throughout the Driftless Wisconsin area.



Sources: Food businesses (ESRI Business Analyst 2012), Freight tonnage (TRANSEARCH 2011), Food hubs and organic farms (USDA)

Figure 9. Dairy Production Clusters in the Driftless Area

(showing dairy farm product freight movements only[6])

Circle City Metropolitan Demand

We are not suggesting that the Circle City metropolitan areas should rely solely on Driftless Area products. However, the Circle City MSAs are a steady food market for Driftless Wisconsin products because of (a) the *proportion* of Driftless Wisconsin cold chain products they historically consume and (b) the breakdown of cold chain products it actually consumes.

First, Circle City MSAs appear to be the Driftless Wisconsin's top consumers in 2011. Revisiting Table 3 in the previous section, which displays the total truckload tons produced for each commodity, Table 8 below now considers the percentages of each commodity consumed only by the Circle City. The commodities are listed in ascending order of percent, indicating that the Circle City consumes an overwhelming majority of many types of Driftless Wisconsin cold chain products.

Table 8. Proportion of Driftless Wisconsin Cold Chain Food Product Consumed by Circle City MSAs (2011)

Cold Chain Commodity	Total Produced (truckload tons)	Portion Consumed by Circle City MSAs (%)
Cheese or Special Dairy Products	250,670	29.70%
Poultry Eggs	76,124	32.52%
Creamery Butter	39,602	37.35%
Misc. Fresh Fruits	97,176	46.44%

[6] The dairy production clusters shown in Figure 9 will appear multiple times in the appendices, but with freight movements for either creamery butter, cheese or special dairy products, processed milk, or dairy farm products overlaid onto them.

Dairy Farm Products	4,555,955	54.79%
Meat Products	45,812	57.01%
Fresh, Frozen Meat	41,121	61.07%
Fresh, Chilled Meat	45,398	73.56%
Misc. Fresh Vegetables	2,329	76.39%
Deciduous Fruits	3,546	83.10%
Leafy Fresh Vegetables	276	85.68%
Processed Milk	201,152	95.76%
Frozen, Dressed Poultry	6,578	96.87%
Fresh, Dressed Poultry	6,789	98.65%
Processed Poultry or Eggs	8,912	98.73%

Observing these numbers tells a particularly compelling story about Driftless Wisconsin's cold chain production relative to the Circle City's consumption trends. By listing the cold chain commodities from least to most Circle City-consumed, we are also drawing attention to commodities that are in demand at a broader geographical scope, i.e. those that are potentially in higher demand non-locally than other commodities from Driftless Wisconsin. Some of these commodities that are consumed less by the Circle City are actually among the Driftless Wisconsin's most produced commodities by truckload tonnage – cheese and dairy products, miscellaneous fruits, as well as meats. While looking at other top non-Circle City consuming MSAs was not the focus of our study, it is clear that such an analysis would be important to freight planning.

Looking at the overall makeup of Circle City cold chain consumption in Figure 10 below portrays the Circle City's *actual demand*, as opposed to how strong a consumer it is relative to non-Circle City MSAs. Just because the Circle City appears to consume a

large proportion of what Driftless Wisconsin produces does not mean this is an indicator of what it demands most. Of all the Driftless Wisconsin cold chain products the Circle City consumes, it appears to consume mostly dairy farm products, processed milk, cheese or special dairy products, fruit, and fresh meat from the region. However, as an example, it appears to consume about 86% of the leafy fresh vegetables Driftless Wisconsin products, yet leafy fresh vegetables make up less than 1% of all the cold chain products the Circle City consumes. For this and for other cold chain commodities showing such a trend in our study, this simply means that the Circle City is a strong leafy fresh vegetable market for Driftless Wisconsin, but leafy fresh vegetables make up a small portion of Circle City cold chain needs.

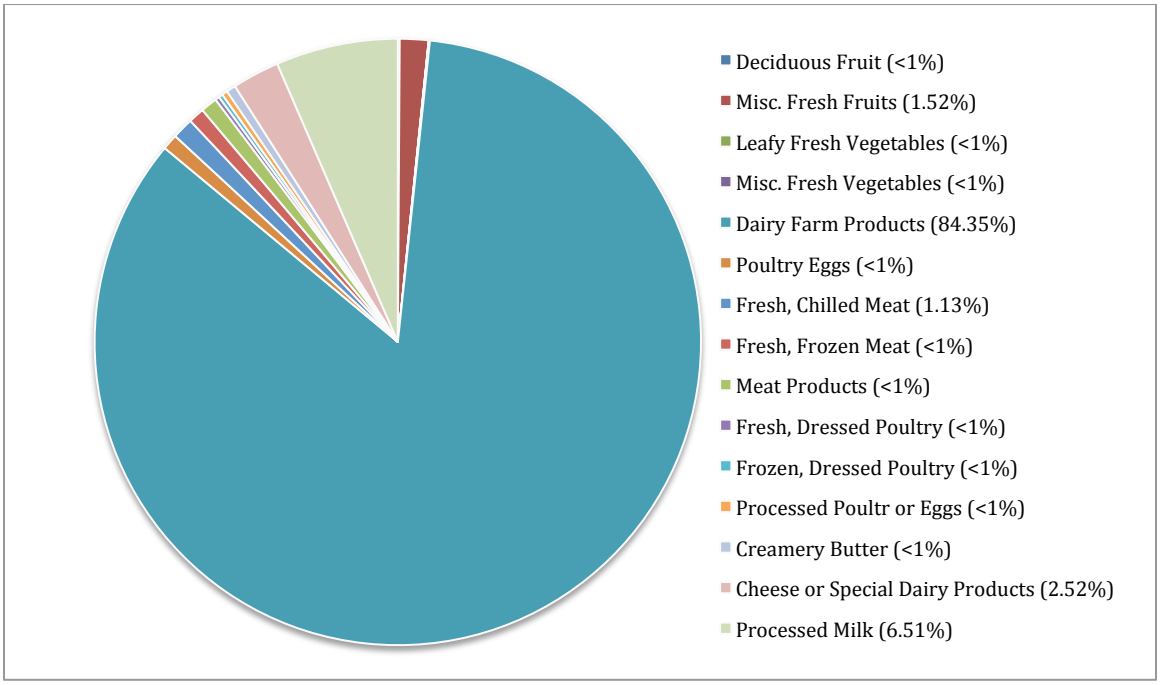


Figure 10. Total Circle City Consumption of Driftless Wisconsin-Produced Cold Chain Products

These three trends, though interesting at a general level, cannot fully be explained without closer exploration of consumption trends grouped by commodity and examined at more local level. We will now share our findings on consumption by commodity group, paying particular attention to top-consuming Circle City MSAs.

Fruits and Vegetables

According to Figures 11 and 12 below, Minneapolis is the clear top consumer of the fruit and vegetable commodities produced in Driftless Wisconsin, followed by Milwaukee and Chicago as the next biggest consumers. Observing Figure 13 as well as Figure 3 in the previous subsection, respectively, shows that much fruit and vegetable truckload tonnage is transported along Interstates 90 and 94 towards these three MSAs, despite the MSAs showing characteristics of fruit and vegetable "hot spots" of their own. This potentially indicates that Driftless Wisconsin serves an organic or other value-added product demand not otherwise met by the respective MSA's more local fruit and vegetable sources.

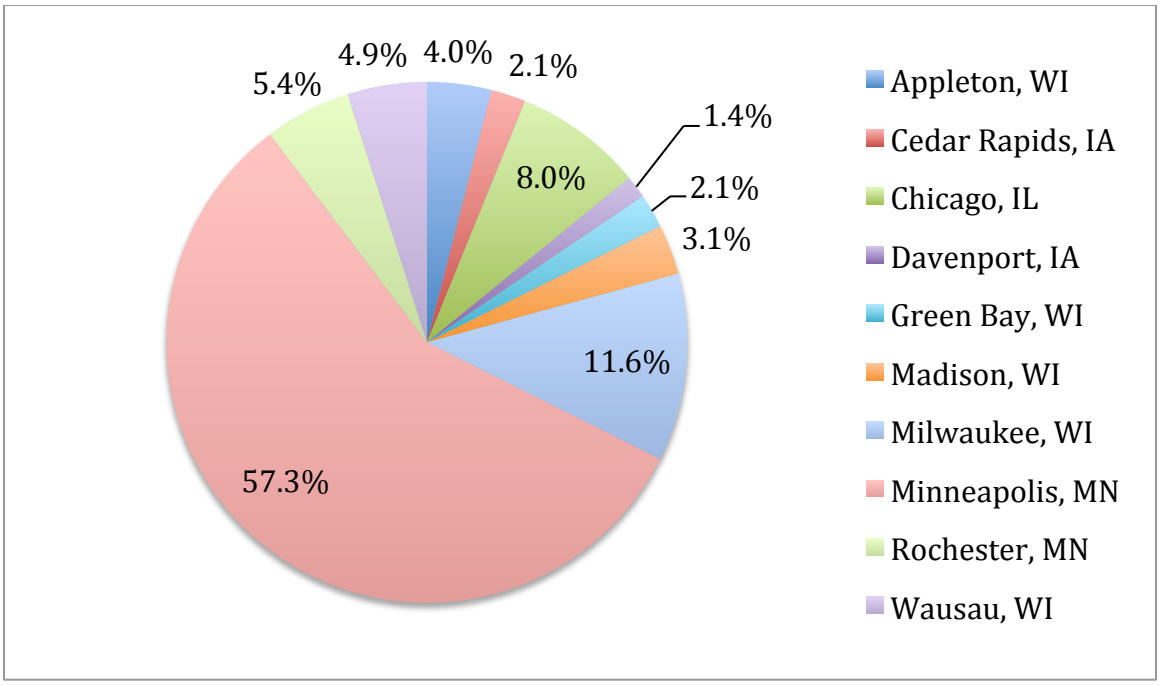


Figure 11. Consumption of Driftless Wisconsin Deciduous Fruits in Circle City MSAs (2011)

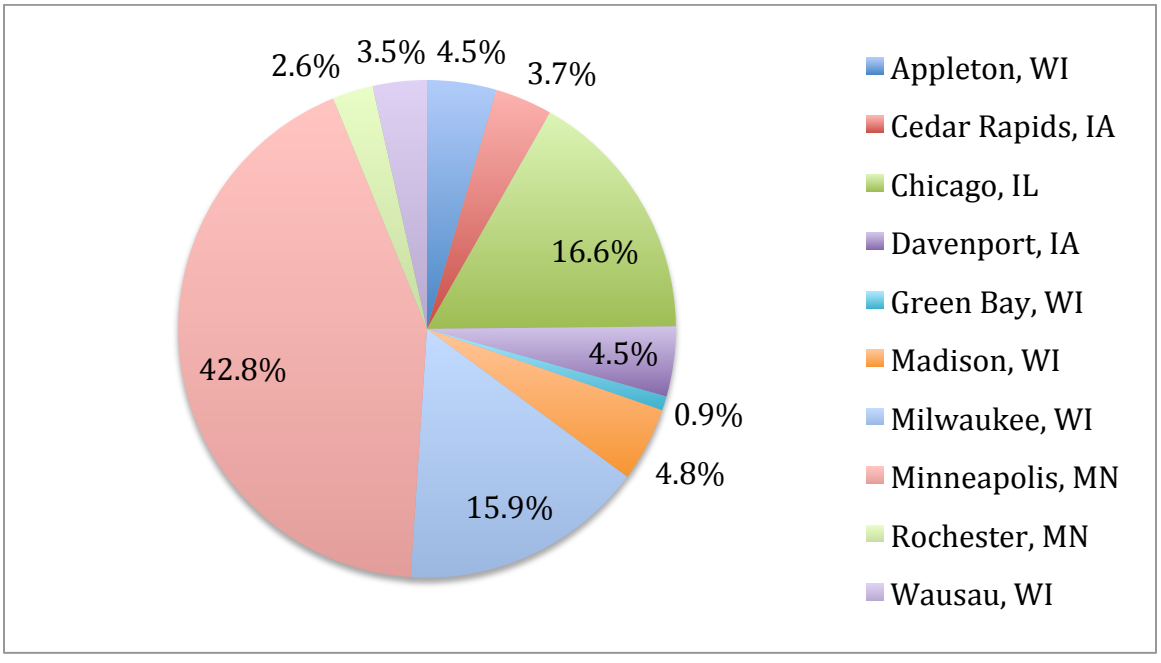
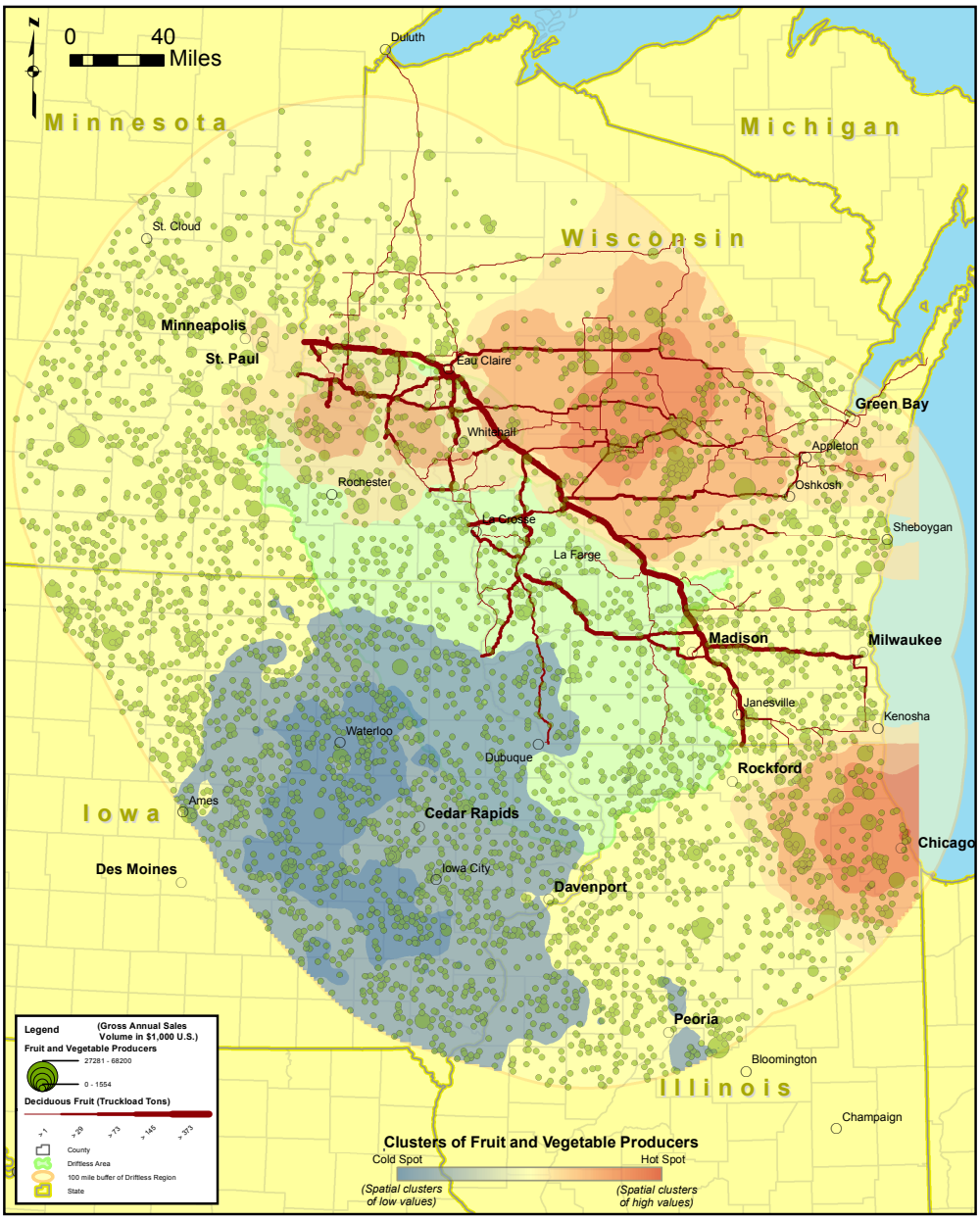


Figure 12. Consumption of Driftless Wisconsin Leafy Fresh Vegetables in Circle City MSAs (2011)



Sources: Food businesses (ESRI Business Analyst 2012), Freight tonnage (TRANSEARCH 2011)

Figure 13. Freight Outbound Tonnage of Fruit Products from the Driftless Area (shown with fruit and vegetable producer clusters)

Fresh Meat and Meat Products

Circle City trends in meat consumption in general show Chicago as the top consuming MSA, followed by Green Bay and Appleton. While Figure 14 below displays the distribution of *processed* meat products among Circle City MSAs only, the trends seen

here hold true for fresh meat commodity groups as well. The same information on those commodities can be found in the appendices of this report.

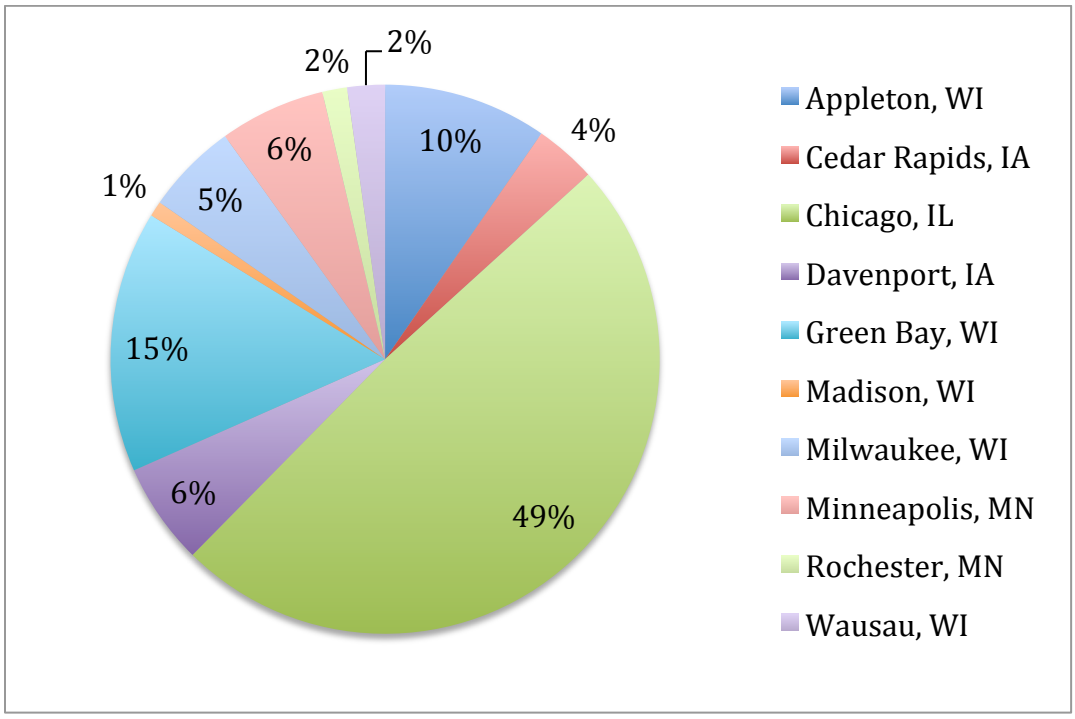
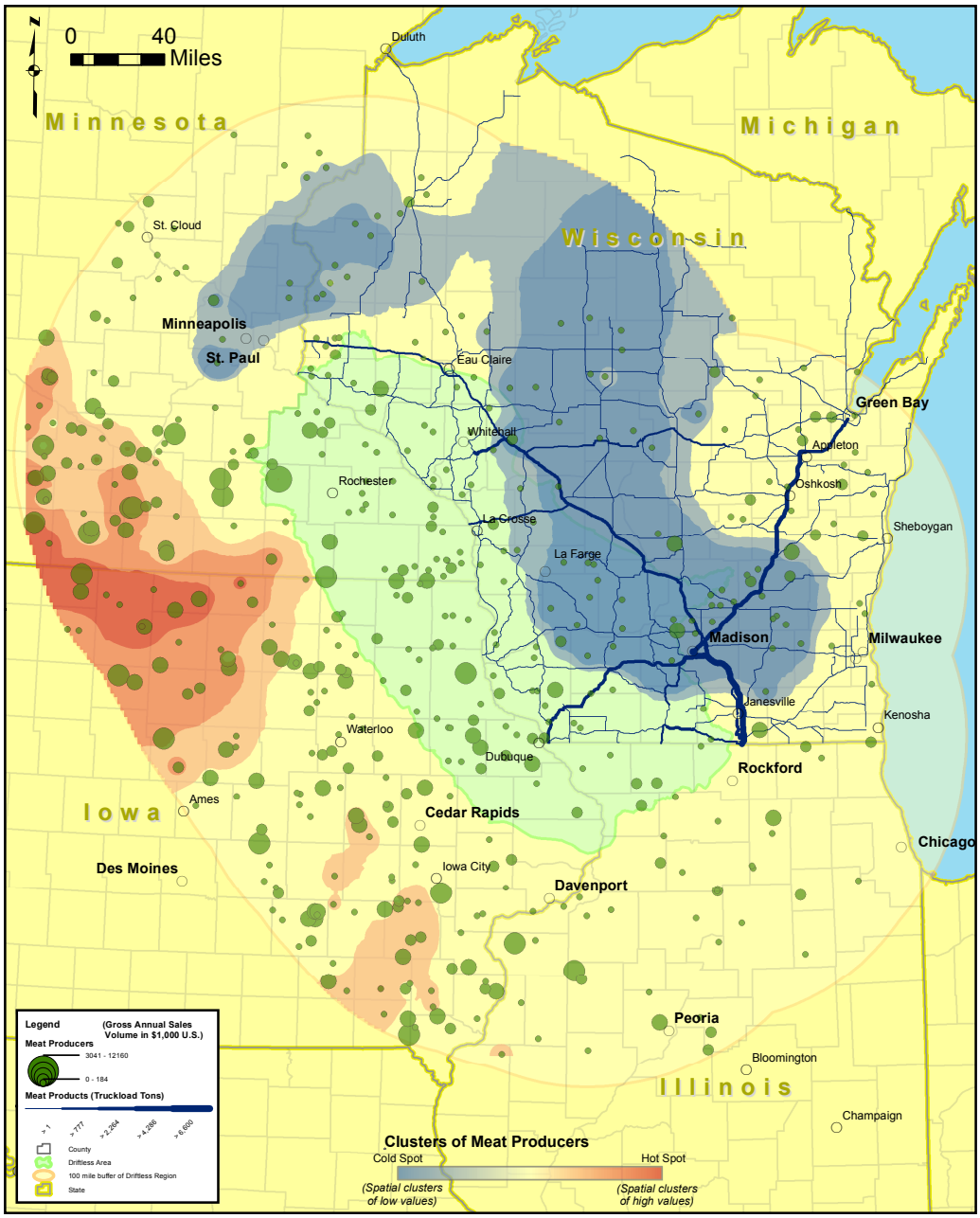


Figure 14. Consumption of Driftless Wisconsin Meat Products in Circle City MSAs (2011)

The map provided in Figure 15 below shows a spatial pattern that follows suit, with meat products originating mostly from Dane, Green, and Rock counties being transported to Chicago and towards Green Bay from Interstates I-90/94 and State Highways 151 and 41, respectively. Similar freight movements are observed in maps created for both fresh and frozen meats from Driftless Wisconsin, which can be found in the appendices. There is also something to be said about the location of meat processors, which also seems to influence meat transport especially to Chicago (identified as a meat processing hot spot) and surprisingly to Iowa MSAs despite their reportedly lower consumption of Driftless Wisconsin meats overall. These inferences can be observed from meat processor cluster maps provided in the appendices as well.



Sources: Food businesses (ESRI Business Analyst 2012), Freight tonnage (TRANSEARCH 2011)

Figure 15. Freight Outbound Tonnage of Meat Products from the Driftless Area (shown with meat producer clusters)

Poultry & Eggs

Consumption of poultry and eggs in the Circle City appears to vary, as can be seen in Figures 16 and 17 below. Figure 16 shows that the consumption of fresh poultry is fairly widespread among the MSAs, though Minneapolis and Milwaukee dominate. This also

holds true for frozen poultry products, whose consumption distribution can be found in the appendices as well. Poultry eggs, on the other hand, are mainly consumed by Minneapolis and Chicago. Though no significant poultry and egg production cluster exists within the Driftless Area, as depicted in Figure 18 below, it is noticeable that much truckload tonnage is transported along Interstate 94, which connects Minneapolis to Milwaukee. Even lesser-known State Highways 54 and 15, which run east-west towards Green Bay and Appleton, respectively, are used to transport poultry and egg truckloads.

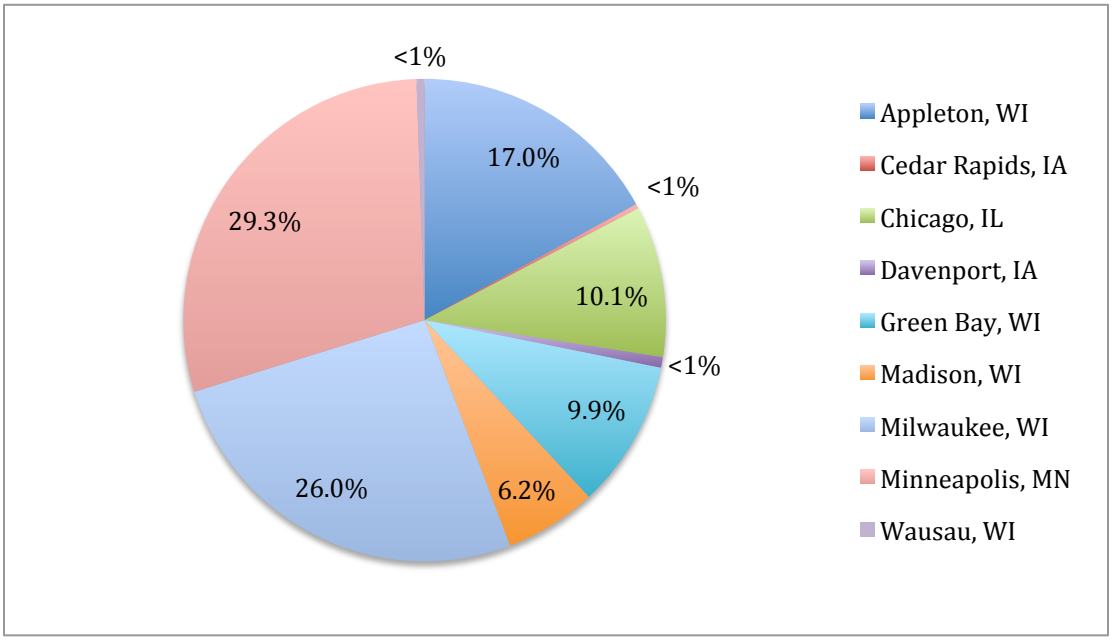


Figure 16. Consumption of Driftless Wisconsin Fresh, Dressed Poultry in Circle City MSAs (2011)

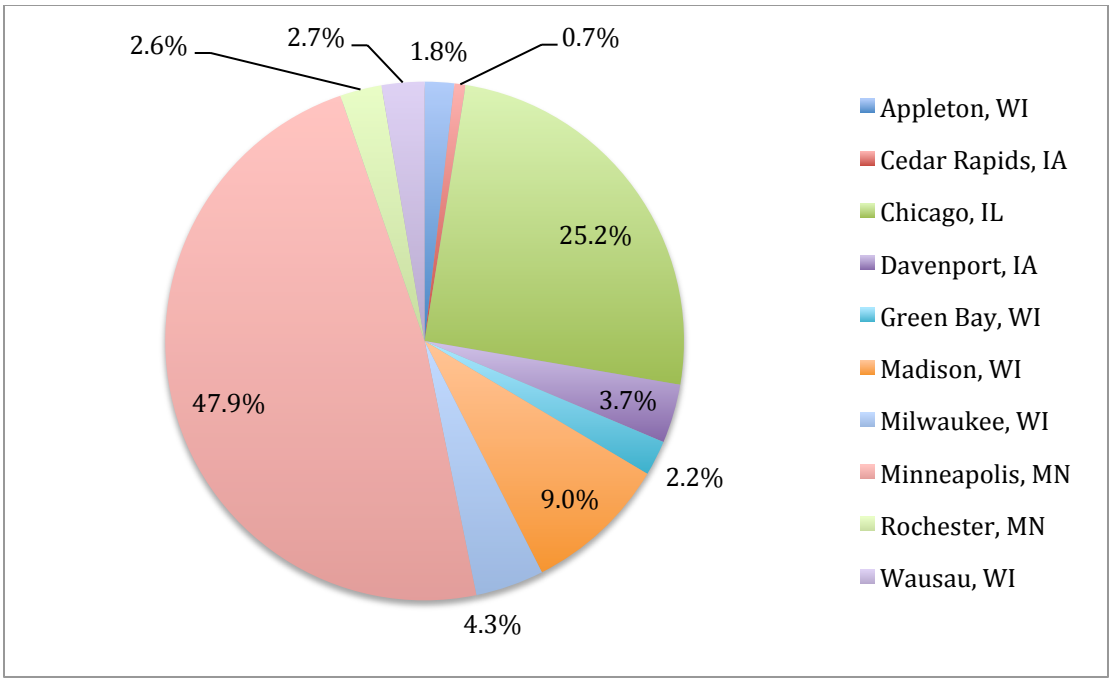


Figure 17. Consumption of Driftless Wisconsin Poultry Eggs in Circle City MSAs (2011)

Sources: Food businesses (ESRI Business Analyst 2012), Freight tonnage (TRANSEARCH 2011)

Figure 18. Freight Outbound Tonnage of Fresh, Dressed Poultry from the Driftless Area (shown with poultry and egg production clusters)

The consumption of *processed* poultry and eggs shows a completely different trend as can be seen in Figure 19. Chicago demands a much higher portion of Driftless Wisconsin-produced poultry products and eggs than any other Circle City MSA. Additionally, not all Circle City MSAs consumed processed poultry and eggs in 2011. While the Driftless Area in general still does not appear to have a significant poultry and egg processor cluster, high processed poultry and egg consumption in Chicago could be due to the processor points residing along poultry and egg-transported highways, seen in Figure 20 below.

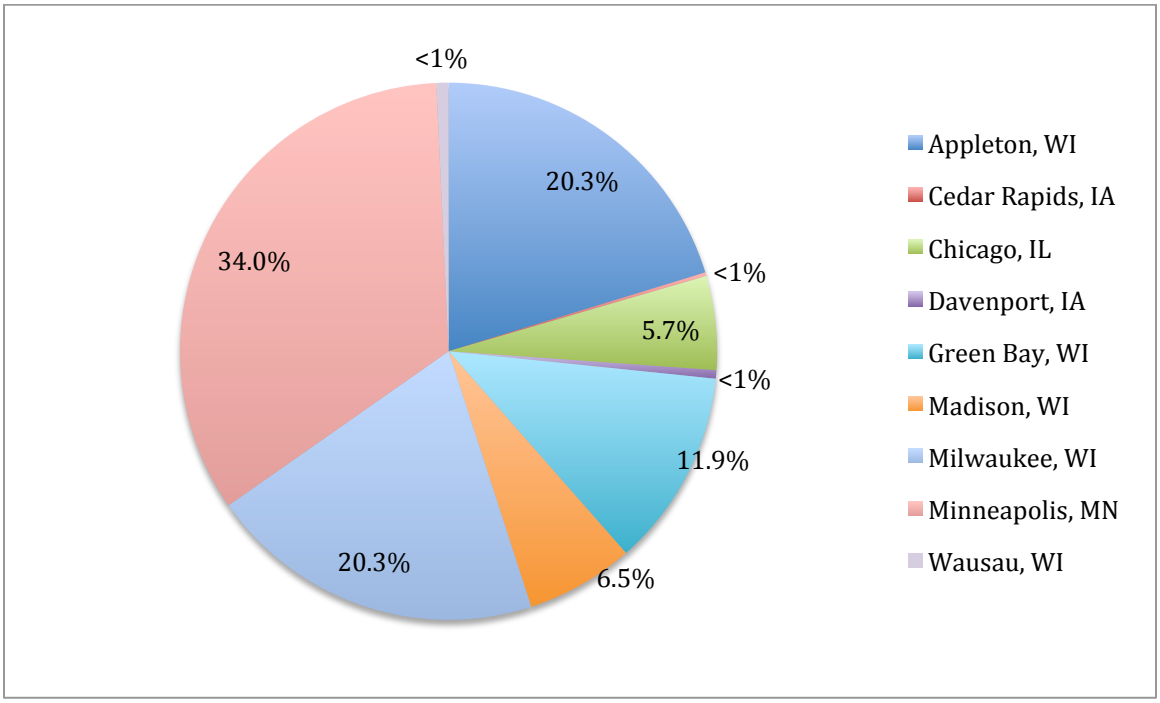
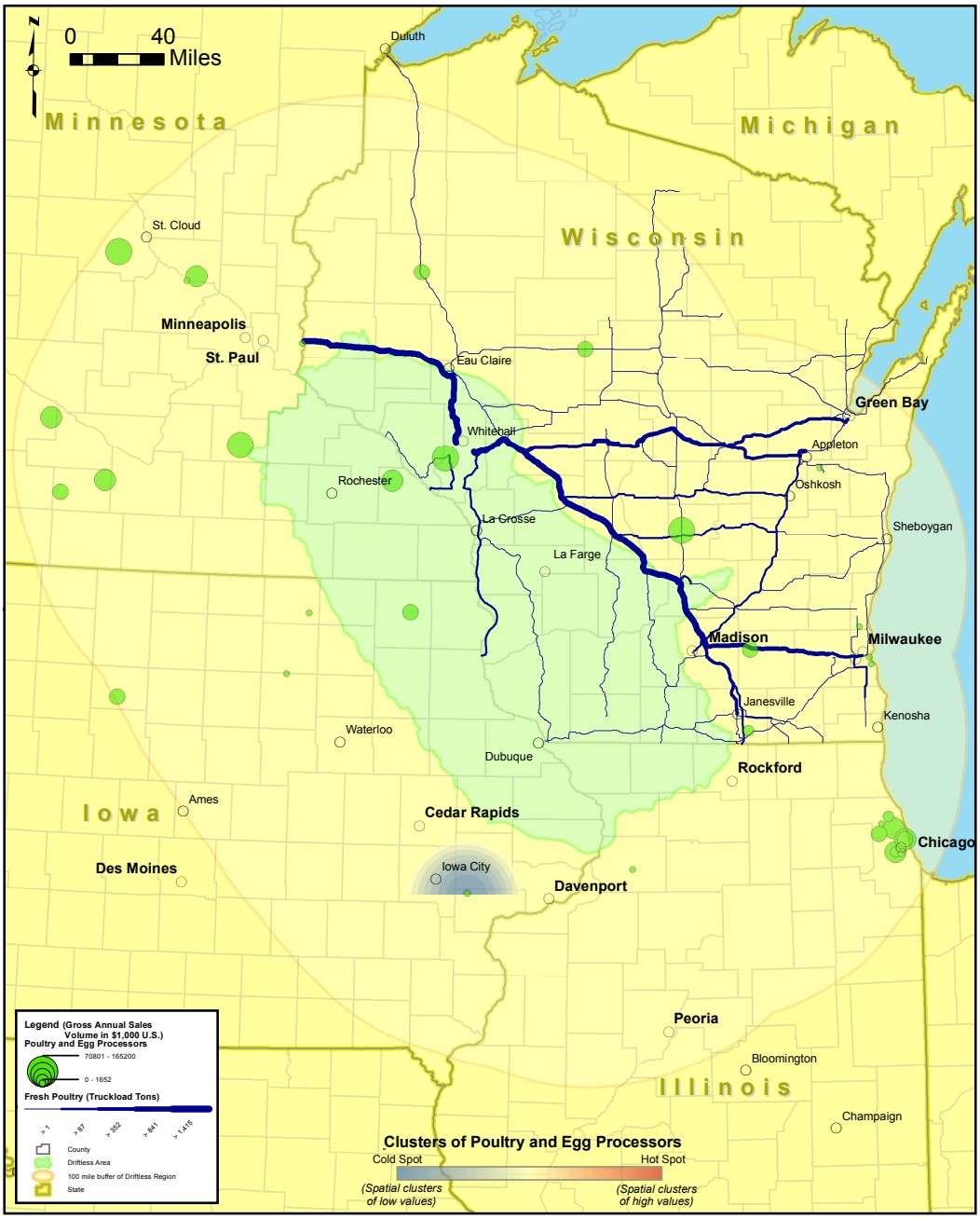


Figure 19. Consumption of Driftless Wisconsin Processed Poultry and Eggs in Circle City MSAs (2011)



Sources: Food businesses (ESRI Business Analyst 2012), Freight tonnage (TRANSEARCH 2011)

Figure 20. Freight Outbound Tonnage of Fresh, Dressed Poultry from the Driftless Area (shown with poultry and egg processor clusters)

Cheese, Milk and Other Dairy Products

Finally, cheese, milk and dairy products consumed in the Circle City proved to have varying trends associated with them as well. Figure 21 shows that the consumption of cheese and special dairy products was widespread among the Circle City MSAs, though Milwaukee consumed about ¼ of the amount produced by Driftless Wisconsin for the Circle City region.

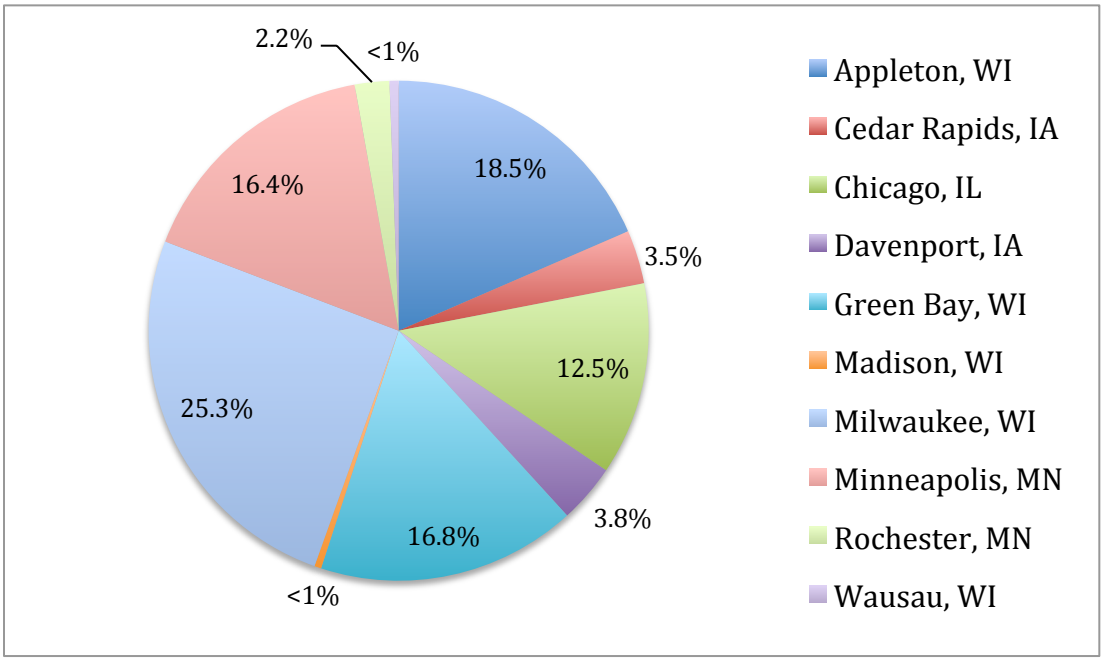
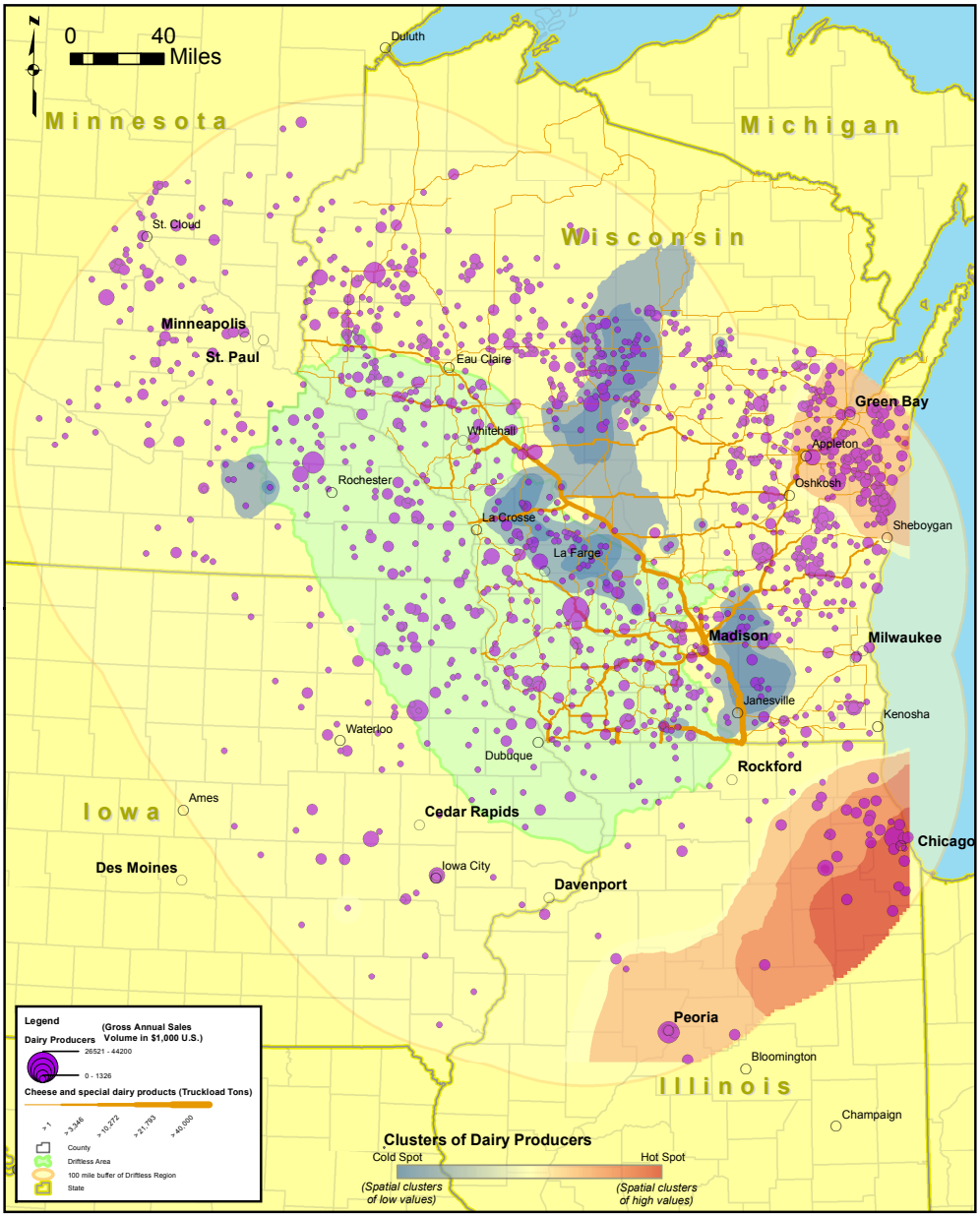


Figure 21. Consumption of Driftless Wisconsin Cheese and Special Dairy Products in Circle City MSAs (2011)

However, based on information we analyzed about top cheese producers in Driftless Wisconsin, as well as on information on freight movements portrayed in Figure 22 below, it is interesting to note a unique characteristic about the transport patterns for this commodity. Because cheese and special dairy product production, among other dairy products, is competitive in Driftless Wisconsin, the collection of producers is not considered a strong cluster and thus appears as a cold spot, while Chicago appears as a hot spot for dairy production in general.

Based on this general assessment about the presence of dairy production in the Drifltess, much of the cheese product is nearly evenly dispersed among the Circle City MSAs and therefore takes several different freight corridors, using Interstates 90 and 94 as a means to transfer out to less traveled state highways.



Sources: Food businesses (ESRI Business Analyst 2012), Freight tonnage (TRANSEARCH 2011)

Figure 22. Freight Outbound Tonnage of Cheese or Special Dairy Products from the Driftless Area (shown with poultry and egg production clusters)

This is in high contrast to consumption trends and transport patterns observed for processed milk and for dairy farm products, which shared Minneapolis as a common top consumer in 2011, seen in Figures 23 and 24 below. It is clear to see when observing the freight movements of processed milk in Figure 25, which is heaviest along routes heading towards Minneapolis and originating from central Driftless Wisconsin counties earlier identified as top milk producers. As also earlier observed, as the Driftless Wisconsin's most produced cold chain commodity, dairy farm products are also the most widely transported commodity throughout the Circle City and exhibit a similar transport trend to that of cheese products.

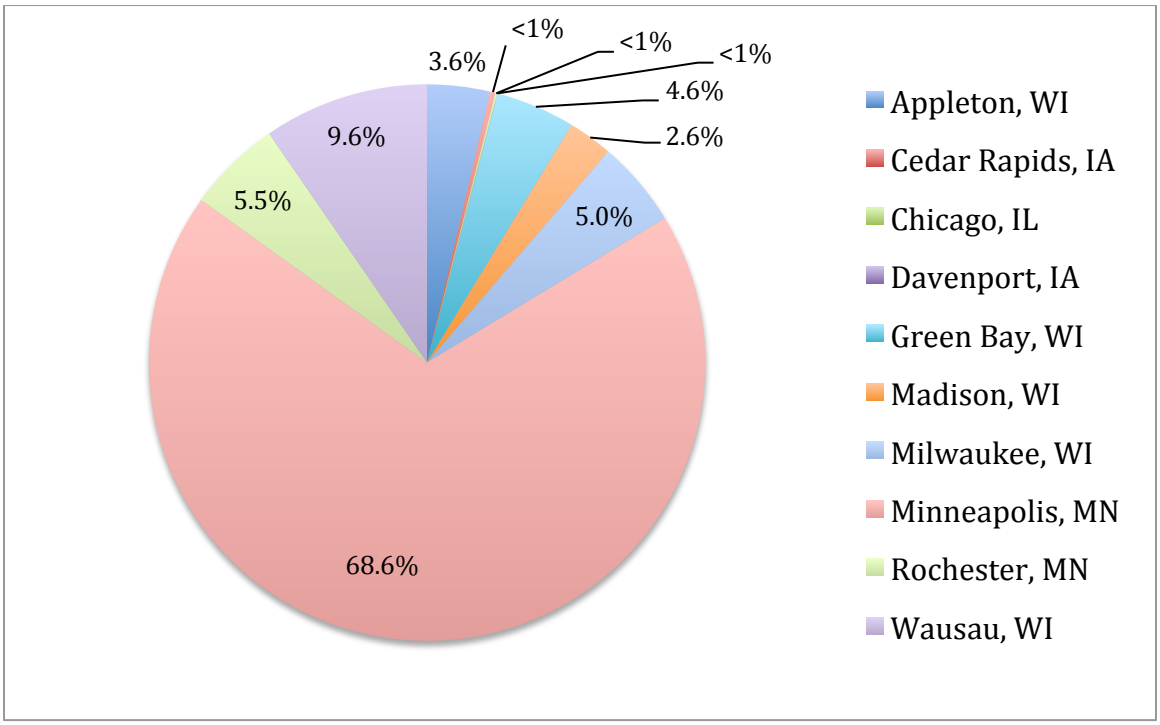


Figure 23. Consumption of Driftless Wisconsin Processed Milk in Circle City MSAs (2011)

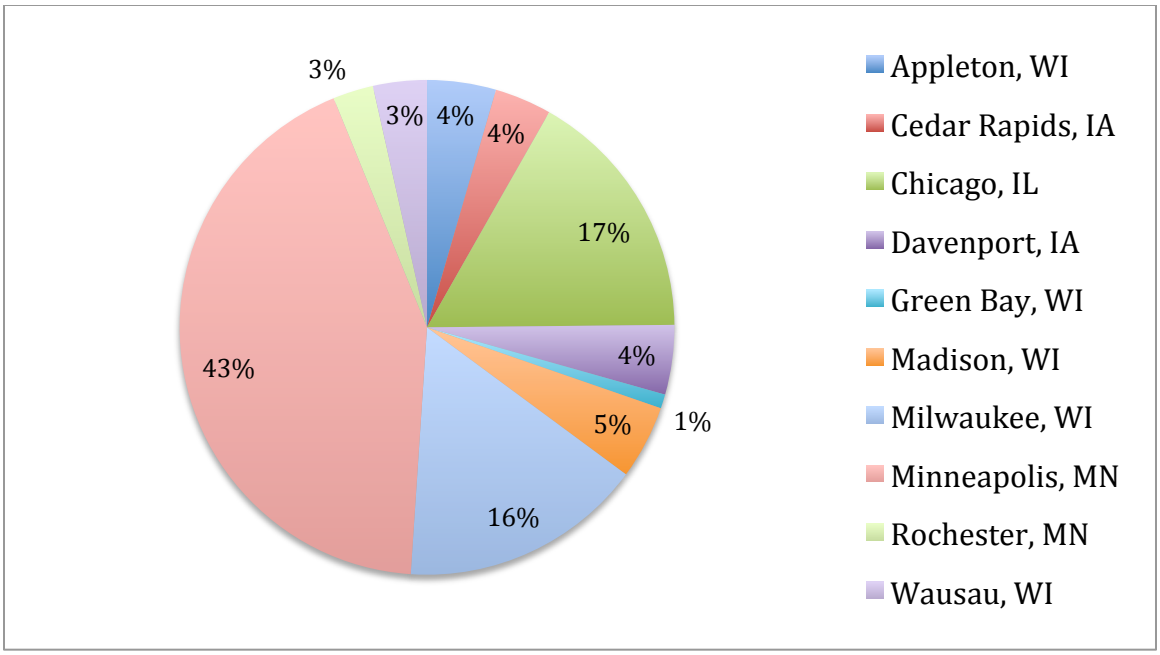
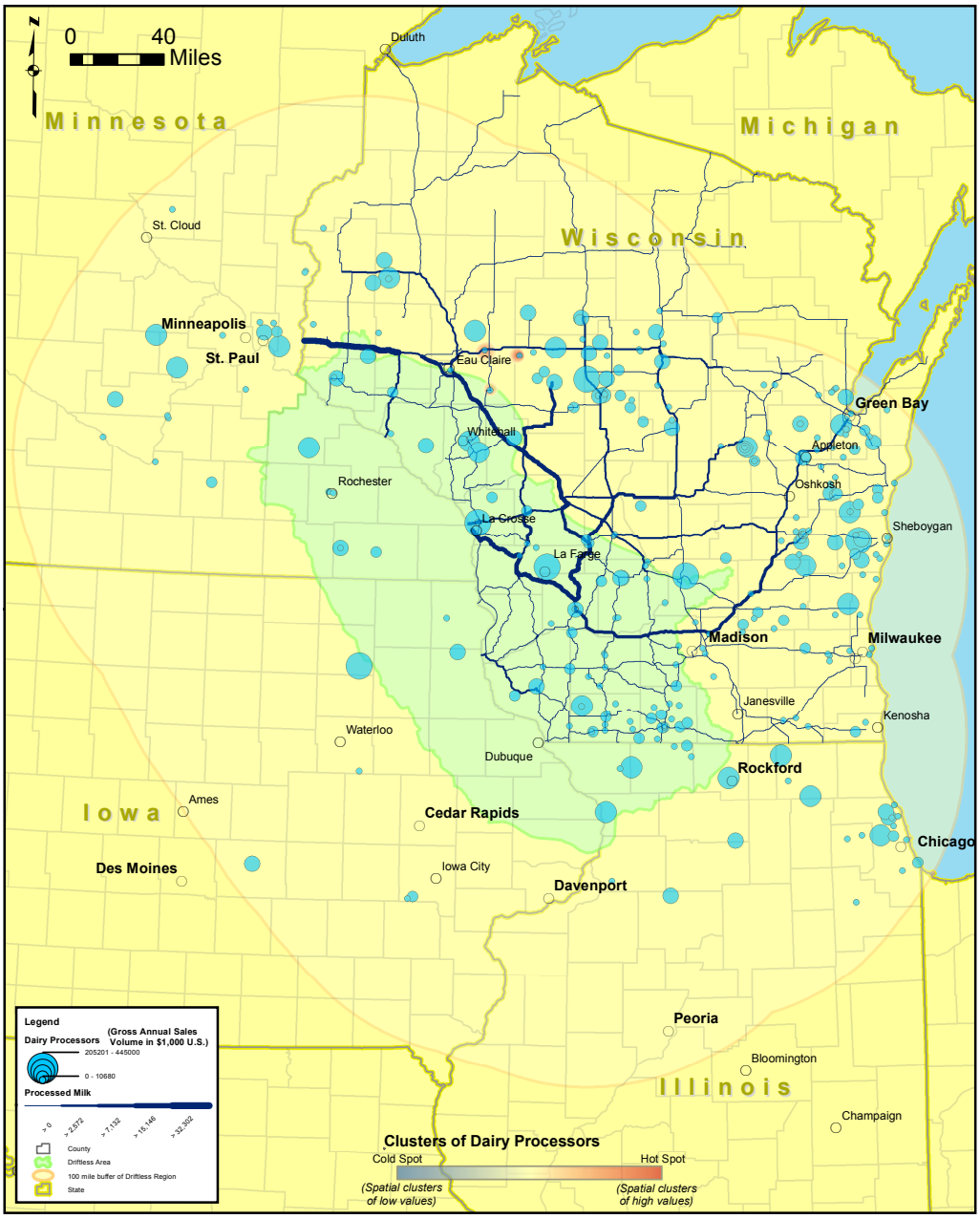


Figure 24. Consumption of Driftless Wisconsin Dairy Farm Products in Circle City MSAs (2011)



Sources: Food businesses (ESRI Business Analyst 2012), Freight tonnage (TRANSEARCH 2011)

Figure 25. Freight Outbound Tonnage of Processed Milk from the Driftless Area (shown with dairy processor clusters)

Meanwhile, Figure 26 shows Chicago as the clear top consumer of Driftless Wisconsin creamery butter in 2011. Much of the product appears to originate from central Driftless Wisconsin, then transported to Chicago along Interstate 90 despite Chicago's existing

dairy production hot spot (refer back to Figure 22). Once more, this demand for Driftless Wisconsin creamery butter could be filling a niche product demand not otherwise met by Chicago's more local options for dairy, as well as the Driftless Area's lack of a significant dairy processor cluster, as seen in Figure 27 below.

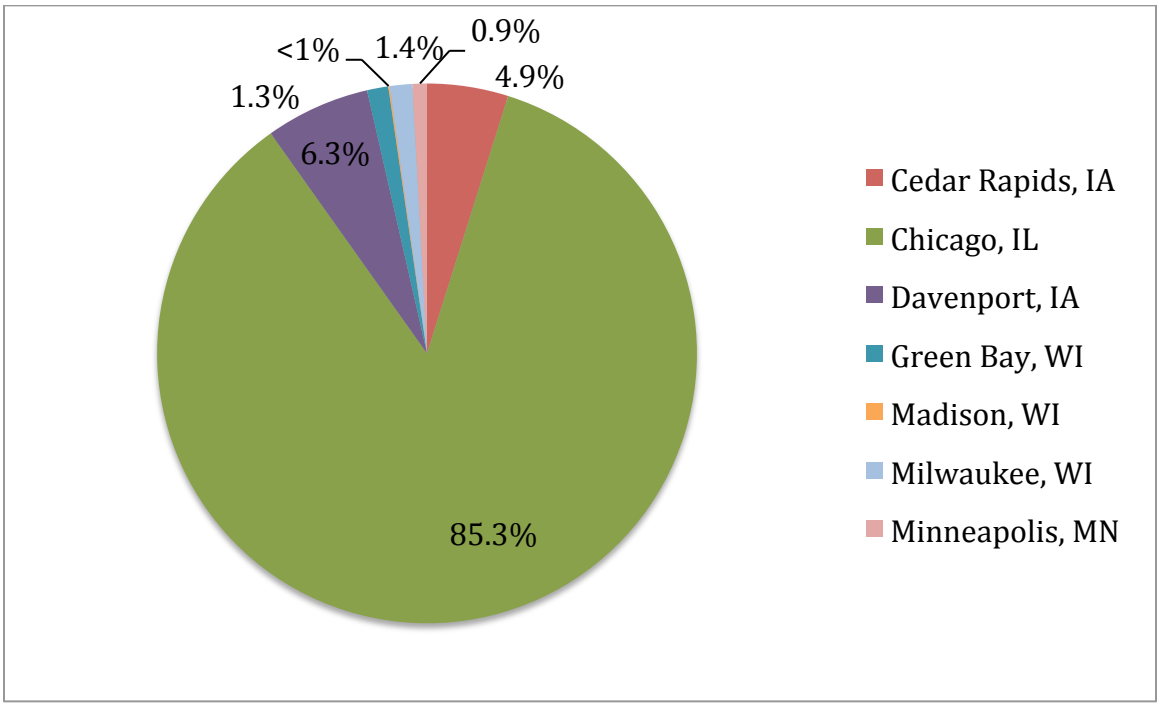
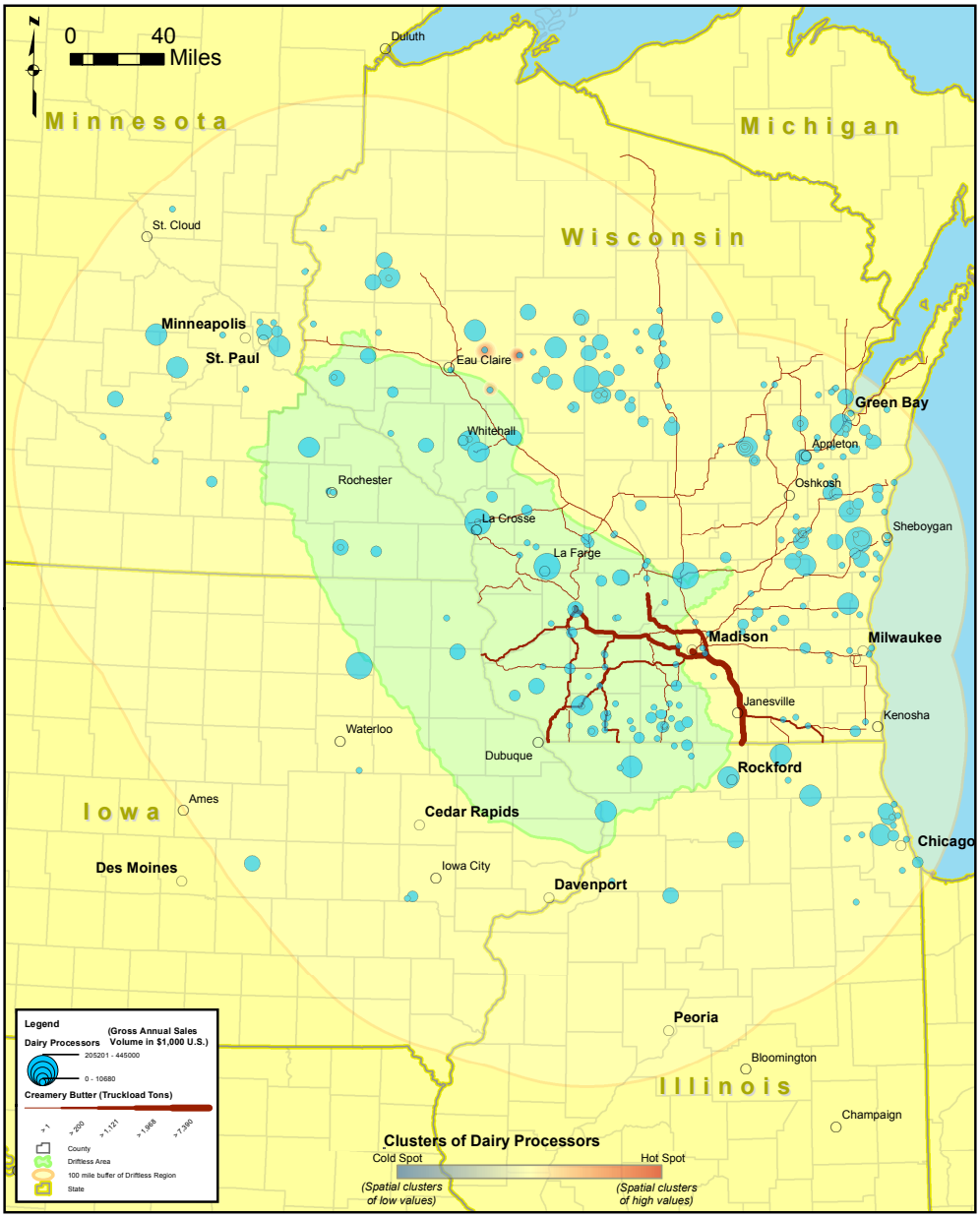


Figure 26. Consumption of Driftless Wisconsin Creamery Butter in Circle City MSAs (2011)



Sources: Food businesses (ESRI Business Analyst 2012), Freight tonnage (TRANSEARCH 2011)

Figure 27. Freight Outbound Tonnage of Creamery Butter from the Driftless Area (shown with dairy processor clusters)

This data in summation does not only look at simple production and consumption levels of cold chain food product in the Driftless Area/Circle City region. It goes further and clearly points out both the locational strengths and weaknesses of the different cold chain food networks. As stated earlier in the report, the Driftless Area appears to be the most

conducive to the production and processing of meat and dairy products as opposed to fruits, vegetables and poultry products. Still, when considering the spatial clustering of these broadly categorized cold chain products, it shows that the Driftless Area's meat and dairy sources can be better networked. First, meat production and processors are certainly present throughout Wisconsin, though they are better spatially correlated in the northeastern parts of Iowa closest to the Driftless Area. Second, dairy and cheese production is evidently high in the Driftless Wisconsin area, but is surprisingly enough better spatially related in areas closest to Chicago.

Additionally, this data considers Circle City demand of Driftless Area cold chain products in two ways: (1) the proportion of Driftless Area product consumed by the Circle City (to provide an understanding of how impactful the Circle City is to Driftless Area food production, and (2) the breakdown of products the Circle City consumes (to provide an understanding of Circle City preferences). These aspects of the Driftless Area-Circle City relationship are important to differentiate as one looks across the many cold chain products studied. For example, while cheese and dairy products are far more produced in the Driftless Area more than most cold chain products, the Circle City consumes the least of this out of the other Driftless Area cold chain products available. This is not the same story for poultry products in general, which are not nearly as abundantly produced, but are among the most Circle City-consumed of the Driftless Area's products.

It should be noted that the analysis does not consider Circle City consumption of cold chain products that are produced by other MSAs in the United States. While acknowledging that this information is important and may actually influence our interpretation of the Driftless Area-Circle City relationship, it is the intent of this report to focus on Driftless Area-specific recommendations of scaling up.

Synthesis of Production and Consumption Trends Observed in the Driftless Area & Circle City

The Driftless has the potential to meet some Circle City food needs. The regions already exhibit an interesting exchange in their relationship as much Driftless produced and processed food is actually exported from Circle City region. Even though consumers think of fresh fruit and vegetables when they think of local products, commodity-scale production of fresh produce in more northern climates is difficult since seasonality disrupts market relationships. Regional fruit and vegetable production has declined since the 1980s, becoming more geographically concentrated in southern regions such as California and Mexico where companies can grow and deliver products to market year around. This production pattern is likely to shift if drought deepens in the Imperial and Central Valleys or if new business models, e.g. cooperative models, repopulate the Midwest.

The Driftless is not a significant meat producer overall due to its lack of meat production and processing points within close proximity, as supported by the hot spot analysis; however the Circle City consumes much of the meat it produces. As seen in earlier

cluster maps, a cluster was found outside the Driftless Area in parts of Minnesota and Iowa. For USDA-certified organic livestock farms, our analysis reached a different conclusion. A large number of these farms are located on the eastern half of the Driftless while few farms are located in the previously stated hot spot. However, a hot spot analysis could not be performed on organic farms due to lack of quantitative values in the data, such as farm size and annual sales volume. Products grown in the Driftless Area utilize product differentiation strategies to promote value-added meat products, such as grass fed or organic. While the Driftless Wisconsin counties may not be a top exporter of both fresh chilled meat and fresh frozen meat to non-Circle City MSAs, they are still largely exported outside Wisconsin.

Recommendations for Scaling Up

Reflecting on the previous section, we found that the Circle City consumes a large portion of the Driftless Area's cold chain commodities, though a large proportion of the Circle City's food is likely imported from outside the Upper Midwest. Farms in the Driftless Area may specialize in small-scale and organic food production, but producers still have an opportunity to produce significantly more product to meet Circle City's demand in order to attain self-reliance as a region.

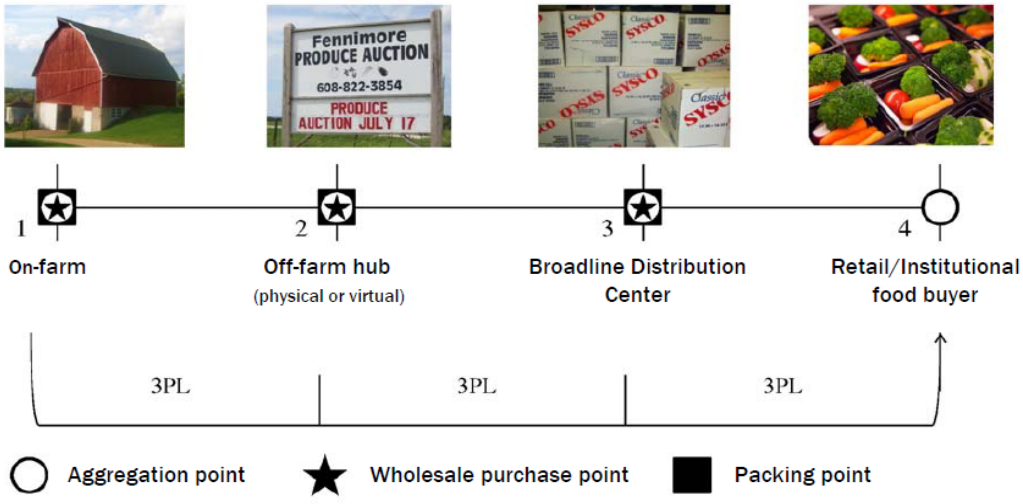
This section describes recommendations that small- to mid-scale farmers can utilize to scale-up and to enter wholesale markets. These include: exploiting appropriate aggregation points and methods to foster relationships with complementary or competing businesses. However, federal and state policies control freight funding and provide

regulations that influence the spread of cold chain food produced in particular regions. Fully recognizing the challenges a multi-state region such as the Driftless Area experiences in changing its food system, and that policies are sometimes barriers to scaling up cold chain production. Besides recognizing regulatory barriers, this section will also acknowledge specific challenges that different actors in the food supply chain may face in following our recommendations.

Exploiting Aggregation Points

A vital component for reaching wholesale markets is via aggregation, the consolidation of food products to a single location sourced from multiple producers. Aggregation can occur at multiple points along the supply chain with a motive to diversify product offerings and to achieve large volumes of a single product. Day-Farnsworth & Morales (2011) describe four types of aggregation points that can be utilized along the supply chain: on-farm, off-farm hub, broadline distribution center and retail/institutional food buyer, as portrayed in Figure 28 below. Each of these points is critical for small and medium growers to exploit in order to compete with mainstream supply chains through the expansion of market opportunities and access to buyers.

Figure 1. Aggregation Points and Distribution Paths Across the Local/Regional Food Supply Chain



Third Party Logistics (3PL) can be used to transport product between any combination of segments of the supply chain.

Figure 28. Aggregation Points and Distribution Paths Across the Local/Regional Food Supply Chain
Source: Day-Farnsworth & Morales, 2011

A characteristic of Aggregation Point 1, direct-marketing is when a farmer sells products directly to consumers without an intermediary. Food is sold usually through CSAs (community supported agriculture) and farm stands where customers can directly communicate with the farmer. While direct-marketing can lead to increase in sales by capturing additional activity sources, it is inefficient in accommodating a population's food needs. However, direct-marketing is "an impractical means of moving high volumes of local product into venues such as retail grocery stores and cafeterias because farm-direct sales typically move small quantities of product, while retail and institutional buyers would prefer to buy larger volumes from fewer suppliers" (Day-Farnsworth & Morales, 2011). While direct-marketing can be a first step for small- or mid-scale producers in entering untapped markets, producers may have no desire to increase

production or may lack the necessary funds necessary to scale-up. Other methods must drive these producers to achieve a greater scale of production.

As an alternative to direct marketing, farmers are utilizing value-based marketing by establishing an emotional connection with products to the consumer. With the rise in the local food movement, consumers are seeking products with environmental, social, or ethical values attached, stories that commodity-scale marketing often overlooks. Producers utilizing this alternative marketing strategy are usually too small to compete with large producers who are able to take advantage of an economy of scale but too large to rely primarily on direct-marketing as an output to sell products. But through product differentiation strategies, such as certifying products as organic or keeping the farm story firmly attached to the product, Driftless businesses are addressing consumer interest in values and filling a small and growing market.

An off-farm food hub, represented by Aggregation Point 2 in Figure 28, enhances opportunities for small- and mid-scale farmers seeking market expansion by providing access to a combination of facilities. Products are collected at a single location, a farm or food hub, to increase food diversity and/or volume. A food hub enables "the aggregation, storage, processing, distribution, and marketing of locally/ or regionally produced food products (Melone, 2010)." Food hubs are another method to attain sufficient volume to realize efficiencies of scale. can mean off-farm aggregation. It can also mean an urban truck hub, a coop retail store, logistics business, a van that drives food around, etc. Especially for smaller farmers, food hubs assist farmers who are especially challenged by

a lack of infrastructure, such as a warehousing or refrigeration. While direct-marketing strategies allow small farmers to emerge in retail, food hubs expand marketing opportunities and to potentially increase sales due to access to a greater number of buyers. For buyers, food hubs provide a stable place to purchase food products and to reduce transaction costs due to single point location. Unlike in traditional supply chains, food producers are considered valued business partners rather than a mere supplier strengthening relationships with producers.

At Aggregation Point 3, the supply chain is extended such that broadline distributors aggregate food products supplied by food hubs, food processors, or directly from farmers and distribute them to restaurants or institutions. A broadline distributer streamlines the supply chain by creating a single source to purchase products for buyers, avoiding inefficiencies that may occur when a buyer purchases from multiple sources. However, while local production may be limited by a shorter growing season, broadline distributors may desire a year-round supply and may not purchase food locally due to higher transportation and storage costs (Nelson et al., 2013). For small farmers partnering with a distributor broadens market opportunities but by lengthening the supply chain, diluting communication, and adding more risk to the activity, may foster tenuous relationships.

Lastly Aggregation Point 4 signifies on-site aggregation at retail outlets or institutions that may represent direct-to-consumer sales or "one-stop shopping" as the final destination (Day-Farnsworth & Morales, 2011). A buyer may prefer to buy large volumes from fewer suppliers. No single approach to aggregation will serve any one producer all

the time, but awareness of the options will help producers understand the consequences of their choices for their businesses and for relationships with business partners. We now turn to the question of our second recommendation, fostering partnerships with distributors.

Fostering Partnerships with Distributors

To maintain an independent operation, farmers could utilize intermediaries called third party logistics (3PL) where farmers contract with a freight hauler to transport products to aggregation points or to wholesale markets. Contracting these services allows the farmer to spend his/her resources into another facet of production and to increase the amount of product sold (Day-Farnsworth & Morales, 2011). Phase II (Nelson et. al., 2013) found that small-scale farmers lacked a complete understanding of their self-distribution costs and thus are reluctant to hire a 3PL. By properly understanding the cost of distribution, including how resources are split among farming tasks, farmers are better able to make sound decisions when it comes to hiring a hauler or distributor and to creating strategic supply chain partnerships.

Another approach to this logistics problem is to increase the production or processing capacity of processed foods, such as frozen or canned foods. While food processors are supply-oriented firms, these businesses tend to be located near market inputs to minimize procurement costs (Lambert et al., 2007). Yet, within the Driftless Area we find few food processors and instead find more fruit and vegetable processors located within the 100 mile buffer of the Driftless Area. They also tend to gravitate toward metropolitan areas and along major interstates, as opposed to more remote areas within this 100-mile buffer.

Lambert states that "Counties with access to agglomeration economies, product markets, transportation networks, and agricultural resources are better positioned to use food manufacturing recruitment as an economic development strategy" (Lambert et. al., 2007). We found that the Driftless lacks significant hot spots of fruit and vegetable production, which suggests the Driftless Area is not at a scale of production to attract a food processor for fruits and vegetables. After all, fruit and vegetable production must increase to attract a food processor, or an alternative business model, such as cooperative food processing should be examined.

While attracting a food processor may be impractical, on-site light processing, such as washing and packaging, incentivizes distributors to source from small-scale farms that provide these basic amenities. Furthermore, haulers could accommodate the needs of the producers, as in providing temperature-control trucking/warehousing or flexibility in load size (Bittner et al., 2011). Phase I found that the "[u]se of low-cost, low-tech storage infrastructure enables [small-scale producers] to address seasonal fluctuations in supply without making a costly investment in a permanent temperature-controlled storage unit." To minimize high upfront costs of permanent storage, the addition of temporary storage during the busy season saves on money and space (Bittner et al., 2011). Food hubs provide a step-up to expand market opportunities by creating a one-stop shop for supply chain activities ranging from on-site washing and packaging to distribution.

Hiring a 3PL for a supply chain activity may increase risk of mishandling or damage of products. Products transported by a third party reduces the growers control over product

quality which can impact the reputation of product's brand or farm identity. For instance, lettuce quality will suffer if it remains on dock for a few hours before being stored in the cooler. The producer's label is on the package identifying the operation by name and in the end the retailer and consumer judges the quality that then affects the grower's reputation. Thus, trusting relationships with distributors are crucial to producers.

Finally, challenges with cold storage requirements may arise as different products require different temperature and separate containers. Ecker's Apple Farm, located in Trempealeau, Wisconsin, is hindered from sharing storage with other producers while renting or building permanent cold storage is currently not financially feasible. To solve this dilemma, Ecker's utilizes freight containers as temporary storage during peak season (Bittner et al., 2011). Additionally, inefficiencies arise when cold chain transporters make separate trips in transporting compatible foods. Farmers or distributors could better coordinate to properly load and combine perishable and cold chain foods that are compatible in transport with each other based on required temperature, required relative humidity, emission of physiologically active gases, odor-absorbing characteristics, and modified atmosphere requirements (USDA, 2006).

Aggregation and Distribution in Policy Contexts

To ensure these recommendations are feasible for those involved federal freight policies as they relate to the transport of agriculture products must be reassessed for (1) the flexibility and practicality needed to economically sustain the seasonal demands of this industry and (2) the seamlessness of trucking practice and equipment regulations at state

borders. The agricultural community has expressed concerns over being held up to the same regulatory standards as commercial long-haul trucks that run consistently year-long. With the need for fertilizer and heavy equipment during planting season, and the intended transport of fresh farm product during harvesting season, the demand for truck transport occurs with considerable seasonal peaks. This attribute, unique to the agriculture industry, was initially acknowledged and addressed in at least one provision of the previous and current transportation bills (MAP-21), but other concerns remain. The provision that in part acknowledges this unique transportation need is the agriculture exemption to the hours of service a truck is permitted to operate. The relevant legal exemptions are as follows, according to the USDA-AMS report on Agricultural Transportation Issues in Rural Communities:

- "Drivers transporting agricultural commodities or farm supplies for agricultural purposes within a 100 air-mile radius from the source or distribution point during planting and harvest seasons, and for drivers transporting livestock feed at any time of the year" are exempt from the hours-of-service rules.
- "Temporary exemption from hours-of-service rules for drivers in response to natural disasters and disruptions in fuel supplies…"
- "Exemption from the commercial drivers license (CDL) requirement for drivers of farm vehicles used to transport agricultural products, farm machinery, or farm supplies to or from a farm within 150 miles of the farmer's farm"
- "Exemption from the minimum qualifications for drivers engaged in custom harvest operations transporting farm machinery or supplies to and from a farm, or custom harvested crops to storage or market…"

The exemption in summation clearly aids the agriculture community in times where transport resiliency is at risk. It also exempts them from the costly formalities of certifying drivers and certain vehicles that are often not affordable to small- to mid-scale farms. However, other provisions still have yet to address truck size-weight provisions that also deter multi-state agriculture efforts.

Conclusion

Clancy argues for a regional food system framework in four dimensions and it appears that Driftless Area and Circle City are poised to realize the four. The Circle City consumes an overwhelming majority of Driftless Wisconsin cold chain food produced implying that demand can only increase from there so long as quality and proximity to complementary commodity clusters remains constant. This implies that *food supply* is matching food demand. The unique agriculture practices of farms in the Driftless Area, not to mention the abundance of organic farms, implies *natural resource sustainability*. *Economic development*, is ongoing as the Driftless Area increases its reputation as an organically-producing, artisan-attracting area for niche food products. Lastly, despite the region's evident strengths in cheese, dairy and meat production, the Driftless Area still produces quality fruit and vegetable commodities that continue to fulfill Circle City demand.

Finally, utilizing aggregation points, reducing risk, and developing relationships are three key methods producers could utilize as a method to increase production to facilitate a self-reliant regional food system. These will not be successful if federal policies are not

synergistic with these goals, or if they do not differentiate between the needs of statewide initiatives and regionally or more locally-scaled needs. The transport of agricultural products, cold chain or not, is a sensitive industry that should not simply be held under the same standards as other freight commodities. By keeping open lines of communication between different agriculture stakeholders, policy analysts and policymakers from the federal down to the local level, and farmers, processors, and distributors, unique solutions can involve from the recommendations laid out in this study.

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APPENDICES

Methodology

The ESRI Business Analyst (BA) extension provides a vast database of geocoded business that includes the business name, business address, its 8-digit NAICS code, annual sales volume and employee number. For our research, food production and food processing businesses within a 100 mile buffer distance of the Driftless were selected and categorized by type of food produced or handled (dairy, poultry and eggs, fruits/vegetables, or meat). Next a hot spot analysis was performed to find locations of geographic clustering; the sales volume of each business provided a disparate value to determine areas with unusually high number of businesses. Our final output was a series of hot spot and cold spot maps displaying areas with clustered businesses of either high gross annual sales volume or low sales volume.

In further detail, businesses were first segmented into either production or processing categories determined by the business's NAICS code. To facilitate sorting, each business was assigned its 4-, 6-, and 8- digit NAICS industry title. This process of categorizing businesses was completed in Microsoft Access to ease navigation and sorting. Industry titles were reviewed and either eliminated or selected under either of our two categories: food producer or food processor. A total of 7,500 businesses were compiled and each processing and production business were further segmented by type of food product involved: fruits/vegetables, meat (cattle, pig), poultry and eggs, and dairy/cheese. This involved meticulously sorting individual industry titles either at the 4-, 6- and 8- digit hierarchical level. Businesses that involved cold-chain products were kept while

supporting businesses, such as breeding services, and businesses that primarily involved non cold-chain products, such as soybean farms were eliminated.

After data was compiled and segmented into our categories, the next step we performed spatial analysis to determine locations of business clusters. Each business possessed a quantitative value of annual sales volume which was used as a disparate measure. However, a histogram of sales volume revealed a strong positive skew, while the mean was less than twice the standard deviation: this suggests the distribution is likely skewed and a transformation was needed (Manikandan, 2010). Sales volume underwent a base-10 logarithmic data transformation to normalize the data since sales volume displayed a strong positive skew due to a high number of businesses with low sales volume in comparison to the low number of businesses with high sales volume.

To determine geographic occurrences of hot spots and cold spots, the Hot Spot Analysis tool was used to calculate the Getid-Ord Gi* statistic for each feature in each of our eight categories (production and processing businesses for fruits/vegetables, meat, poultry/eggs, and dairy). We chose an arbitrary distance threshold of 50 miles. ModelBuilder in ArcMap streamlined this entire process of our data analysis from performing the data transformation, which required adding a field and calculating the log of sales volume, to the final visual output of hot spots and cold spots. The final output was a series of maps of a raster surface displaying hot spots in red and cold spots in blue, as determined by the z-score. Areas with z-scores of between -1.96 and 1.96 were excluded from the map since these values fall within the 95% confidence interval of the

normal distribution, indicating no significant clusters exist. Evaluating the z-score output, extreme low values (cold spots) signifies that clusters of businesses with low sales volume exist, while extreme high values (hot spots) signifies clusters of businesses with high sales volume.

In addition to the business listings derived from ESRI Business Analyst, addresses of USDA-certified organic farms were geocoded. We found our BA data excluded many of them. Locations for USDA-certified organic farms were obtained from the USDA website; this data contains types of products produced, and whether livestock or handling was done on-site. With a list of over 3,100 farms in the four states of the study region, addresses were geocoded with a 98% matched rate; the remaining 2% were matched using the zip code since exact precision is not crucial for our investigation. However, a hot spot analysis could not be done since the data did not include quantitative values, such as farm size or annual sales volume. As a final output, a dot map was created which also displays location of food hubs recognized by the US Department of Agriculture.

Limitations of BA

Business Analyst obtains their data from InfoUSA, a third party data and marketing services company that derives their data from Yellow Page directories and other listings. Businesses may be unintentionally excluded, especially smaller businesses who may not desire or have the funds to advertise in such places. This is reflected by the minimum annual sales volume of "only" $170,000 for fruit and vegetable production so small farms (those with <$50,000 annual sales volume) may not be fully represented in the database.

Furthermore, a study on accuracy of food outlets as characterized by public directories, such as InfoUSA, found that data was more accurate for big box stores and in high population areas and least accurate for farm produce stands and in rural areas. Overall, the study found that "public directories seriously misrepresented the actual distribution of food outlets" (Longacre et al, 2011). Accuracy of our data may be lacking.

CFIRE

University of Wisconsin-Madison
Department of Civil and Environmental Engineering
1410 Engineering Drive, Room 270
Madison, WI 53706
Phone: 608-263-3175
Fax: 608-263-2512
cfire.wistrans.org