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Identifying Spatial Clusters within U.S. Organic Agriculture

By

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Abstract: The market for organically produced products has experienced rapid growth in recent decades; however, this growth has not been distributed evenly across the country instead concentrating in certain regions. Employing measures of spatial concentration and association we identify those counties in which organic production is clustered or represents a proportion of the agricultural economy greater than what would be expected by national trends. Results show that spatial clustering of organic agriculture does exist based on data from the U.S. Census of Agriculture on organic farms, acreage, and value of sales. Counties with the largest location quotients for organic production were most often located in the western U.S., especially California, Washington, and Oregon, the Great Plains states, New England, and in some cases, select counties within Mid-Atlantic States. Organic production clusters as measured by the local Moran's I statistic followed a similar pattern, clustering primarily in the western U.S. with additional High/high clusters found in the Great Plains, upper Midwest, and areas of New England. When these values were adjusted to represent organic agriculture's share of a county's total agriculture, central cluster counties were most likely to be found in New England. Results describing the correlation between organic support establishments and production within identified clusters suggest that organic operations in California and New England may be following different marketing strategies that promote or reduce the likelihood of identifying input-output relationships within these clusters.

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Identifying Spatial Clusters within U.S. Organic Agriculture

Society's concerns over the state of U.S. food production have led to the exploration of new, alternative, and more sustainable agricultural practices. Organic agriculture, in particular, has received attention as a potential solution to the problems spurred by current industry practices. Started in the 1940s and 50s as a response to the impacts of an increasingly industrialized agriculture, today's organic operations strive to maintain the ecologically oriented spirit of the past while simultaneously increasing the economic vitality of farming operations and providing consumers with a highly desirable product.

Federal regulation, increased awareness of U.S. Department of Agriculture (USDA) organic standards, consumer perceptions of organic foods as healthier and safer, and greater availability in conventional retail stores has helped fuel rapid growth in this profitable segment of the agricultural economy (FAS 2005). A 2004 Organic Trade Association (OTA) survey of 300 companies showed that U.S. organic food sales in 2003 totaled $10.4 billion, up 20.4 percent from 2002, continuing growth trends of between 17 and 21 percent since 1997 (OTA 2005). Organic food sales increased from 1.6 to 1.9 percent of total U.S. food sales between 2002 and 2003 (OTA 2005). In addition to domestic markets, producers have been able to take advantage of a strong export market, which generated between $125 million and $250 million in sales in 2002. OTA survey respondents expected sales to remain strong, forecasting average annual growth of 18 percent between 2004 and 2008 (OTA 2005).

Although production has increased, the pace of conversion from conventional to organic cropland currently trails the growth of organic sales (FAS 2005). The result has been an organic trade deficit, with the U.S. importing $1.5 billion in organic products (Organic Monitor 2006). The lack of supply of many organic products combined with increasing demand from U.S.

consumers will likely provide a valuable opportunity for market entrance for many new farmers and established farmers considering conversion to organic practices. As evidence that entrepreneurs perceive the economic potential of organic farming, the number of certified organic operations increased from 6,592 in 2000 to 6,949 operations in 2001 (FAS 2005). Certified organic acreage increased from 1.35 million acres in 1997 to 2.34 million acres in 2001, an increase of seventy-three percent (Greene and Kremen 2003).

Despite high demand and increasing market access adoption of organic practices has not occurred at a uniform rate across the nation. Increased management costs, certifying costs, the risks of converting a farm operation, and a lack of knowledge combined with a steep learning curve have, in some areas, limited organic conversion (Greene and Kremen 2003). Organic cropland has been largely concentrated in the in the Northeast, Upper Midwest, and Western U.S. Nine states, mostly in the South, showed decreases in certified organic farmland between 1997 and 2001 (Greene and Kremen 2002). The concentration of organic acreage and producers in certain regions of the U.S. seems to indicate that some form of clustering is present within the industry, and that factors exist which make organic agriculture more apt to survive and grow in some regions rather than others. From a regional science point of view, organic farms appear to be under the influence of "centripetal forces" that tend to concentrate and encourage economic activity in the form of agglomeration economies or economic clusters.

The idea of encouraging competitiveness and facilitating economic growth through the establishment and maintenance of industry clusters has, in recent years, regained popularity as a topic of study in academic literature (Henry, Barkley and Zhang 1997; Barkley and Henry 1997; Gibbs and Bernat 1997; Ellison and Glaeser 1997 and 1999; Kim, Barkley, and Henry 2000; Porter 2000 and 2004; Gabe 2003) and as a practical strategy for groups concerned with economic development (NGA 2002; Smith 2003). Whether comprised of a single industry or a host of interrelated firms, clusters represent a more accurate unit of analysis for economic developers, are more specific than general categories such as manufacturing or agriculture, and better capture the specific needs (technologies, supply/demand issues, accessing skilled workers, etc.) of those involved. Consequently, groups such as the National Governor's Association have identified clusters as a prime target for strengthening state and regional economies and as a more efficient way for governments to focus their time and monetary resources (NGA 2002; Porter 2000).

While the economic benefits accrued to the larger regional economy are often cited in literature, the firm/farm level benefits that small and medium sized farms can realize by acting together likely hold the most promising opportunities for organic operations. The close proximity of firms/farms in clusters facilitates stiff competition, but also provides and encourages cooperation among firms, especially in the form of knowledge exchange and collective markets for specialized workers and intermediate inputs necessary for production (Porter 2000, Krugman 1991). This may be especially important for organic farmers who are more likely than conventional farmers to turn to their peers for technical advice and may have more difficulty locating the distributors, processors, and manufacturers necessary for these specialized agricultural operations.

A 2001 nationwide survey of 1,200 certified organic farmers by the Organic Farming Research Foundation found that 69 percent of organic vegetable producers and 50 percent of organic fruit producers sold through wholesalers (Oberholtzer, Dimitri, and Greene 2005). In a 1997 survey of 720 farmers, the Organic Farming Research Foundation found the majority indicated wanting to increase wholesale marketing and regional sales (Lohr, Gonzalez-Alvarez, and Graf 2001). Additionally, a 1998 survey of retailers, manufacturers, and distributors of organic products by the Henry A. Wallace Center for Agricultural and Environmental Policy found that these groups identified locating producers of natural foods as a major concern. Accurate growth predictions and properly focused development efforts have therefore become increasingly important for all members of the supply chain: from producers considering increasing acreage or taking the necessary risk involved in transitioning to a certified organic operation, to processors and distributors, and even restaurants or grocers looking to identify and take advantage of regional farm supply (Lohr, Gonzalez-Alvarez, and Graf 2001).

A study by Lohr, Gonzalez-Alvarez, and Graf (2001) has explored the spatial nature of the organic market and worked to identify states and regions that may hold promise for organic market penetration. Their results identified 4,868 certified organic growers in 1,208 counties, with the highest concentration of farmers per county in the western U.S. and northeastern U.S. and the greatest number of counties with organic farmers in the Midwestern U.S. Retailers and natural foods restaurants, CSAs, and farmers markets were distributed evenly across the U.S. with retailers and restaurants most likely to be located in or around urban areas. Organic supermarkets and handlers were predominantly located in the western U.S. (Lohr, Gonzalez-Alvarez, and Graf 2001).

The Lohr, Gonzalez-Alvarez, and Graf (2001) study identified Alaska, Georgia, and Virginia as containing the most “organic-ready” counties, and Alaska, California, Georgia, and Virginia as having the greatest potential for organic supermarket expansion. New Jersey, New York, and California were identified as having the most potential for expansion of organic handler operations and Georgia, Ohio, Texas, and Virginia showed opportunity for continued expansion of farmers’ markets. Nearly all states contained counties that would support the expansion of organic farms with Arkansas, Indiana, Iowa, Kansas, North Carolina, Ohio, Tennessee, Virginia, and West Virginia leading the nation. The results of the Lohr, Gonzalez-Alvarez, and Graf study indicate the need to identify, locate, and connect both producers and distribution outlets, and show that the organic market could penetrate deeper in some regions.

Other studies, while not focusing specifically on organic agriculture, have shown that agglomeration occurs within agricultural and food processing industries. Ellison and Glaeser (1997) examined levels of concentration in both North American Industry Classification System (NAICS) two digit and four digit manufacturing industries. Their results indicated high levels of concentration in the production of tobacco products (two digit level) as well as wine production, raw cane sugar production, and the production of dehydrated fruits, and vegetables for soups (four digit level).

A 1999 study by Empire State Development used location quotients (LQ) to identify regional clusters within New York's food processing industry. The study identified several regions within the state for which the food growing and processing industries represent a larger portion of the local economy than in other regions of the state or nation. They include the Finger Lakes region, with high concentrations of dairy farms (with six times greater employment than expected from national employment data), fruit and nut tree production, and potato growers. Western New York had a cluster of food products machinery companies, dairy producers, and food processors. And, Central New York had high employment in both dairy and wholesale distribution of farm and garden machinery. Recent research by Goetz, Shields, and Wang (2004) identified agriculture and food clusters throughout the Northeast (as defined by the USDA). Their study employed a wide array of cluster measurement techniques including LQ, local employment analysis, shift-share analysis, wage measures, and Local Moran's I, showing not only where industries are clustering, but the value and importance of using a wide array of measurement techniques.

Our study merges the examination of organic agriculture's spatial nature with techniques of agglomeration analysis commonly used by regional economists in order to take a unique look at where and how organic operations are distributed across the U.S. Using quantitative measures of industry concentration and spatial association commonly employed by regional scientists (Gini coefficients, location quotients, and spatial econometric statistics such as Local Moran's I), this research analyzes the spatial nature of the organic industry to determine where organic production methods are currently being employed, and identifies areas with high concentrations of organic farms, organic acreage, and organic sales. Although this research is largely exploratory in nature, it is a necessary first step in identifying areas that contain industry agglomerations/clusters, eventually leading to a better understanding of why and how the industry is spatially distributed.

Data and Analytical Tools

For this analysis data are taken from the USDA's 2002 Census of Agriculture. Although the vast majority of cluster studies use employment data to evaluate the importance of industries to regional economies, the lack of this information for the organic industry requires other data to be used. Our study uses county level establishment (farm) counts, which have been suggested by Goetz, Shield, and Wang (2004) to be a superior measurement to employment, as the number of establishments are most closely aligned with the concept of a cluster (firms/farms working and competing together). Other production indicators including organic acreage and the value of organic sales are also employed. General agriculture production indicators include total number of farms, acres of harvested cropland[1], and total value of agricultural sales.

Additional data is used to explore "vertical" industry linkages that may exist within cluster counties. Data came from the Organic Trade Association (OTA) included the locations of organic support establishments in 16 OTA-defined categories, including retail outlets, processors, handlers, etc. Data from the Rodale Institute's "New Farm" website contained a directory of universities offering degree programs in sustainable agriculture. Using the OTA's "Organic Pages Online" and New Farm's "Farming for Credit Directory" 1,305 establishments in 435 counties were identified (OTA 2004; Sayre 2005). Only those establishments located within a High/high cluster were examined, resulting in 257 counties containing 960 establishments.

Acreage and the value of sales from crop and livestock production are self reported and no attempt was made to verify reports by farmers with records of organic certifiers (NASS 2004). Additionally, acreage and sales data used in this study come from raw data sources, not from adjusted values reported in official Census releases. As a result, data contained in this paper may differ slightly from other sources and may not be entirely representative of the true state of organic agriculture. However, National Agricultural Statistics Service (NASS) data, and the Census specifically, is recognized as the leading and official source of statistical information concerning United States' agricultural production, and is widely used by public and private groups for research and analysis.

[1] "Acres of harvested cropland" includes land from which crops or hay were harvested, as well as greenhouses, Christmas trees, orchards, etc. Because the amount of organic acreage must be less than or equal to the farm's acres of harvested cropland this variable was chosen over other variables such as "total cropland," or "total acres."

In a manner similar to that employed by Goetz, Shields, and Wang (2004), we use several methods of analysis to identify concentration and clustering within organic agricultural production. The use of several measurements allows us to identify the reliability and robustness of each and to make the best use of our limited data. The goal of all of these methods is to identify areas that have a concentration of organic farms, organic acreage, and/or value of organic sales above what would be expected based on national trends.

Gini Coefficients

Gini coefficients, used to measure inequalities in society, have been employed in the analysis of a wide variety of spatially patterned situations. The locational Gini coefficient, commonly used in clustering studies, provides a measure of the distribution of an economic activity through the use of establishment data and, more traditionally, employment data. Values range between 0 and 0.5, with 0.5 representing perfect inequality (the industry is concentrated in a single region) and 0 representing perfect equality (the industry is distributed evenly across regions) (Kim, Barkley, and Henry 2000). In this study we use farm (establishment), acreage, and value of organic sales data. The formula we use for the locational Gini coefficient for industry *m* is $Gini_m = \frac{\Delta}{4u}$ where $\Delta = \frac{1}{n(n-1)} \sum_{i=1}^{n} \sum_{j=1}^{n} \left| x_i - x_j \right|$ and *i* and *j* are regions $(i \neq j)$, *u* is the mean of x_i, $x_{i(j)} = \frac{\text{County } i\text{'s } (j\text{'s}) \text{ share of organic production}}{\text{County } i\text{'s } (j\text{'s}) \text{ share of total agriculture production}}$, and *n* is the number of regions.

Limitations of the Gini coefficient include its inability to distinguish between random and non-random distribution of establishments, and its sensitivity to the number of establishments, which cannot be less than the number of regions examined (Kim, Barkley, and Henry 2000), in this case counties.

Hirschman-Herfindahl Index (*HHI*)

One of the more widely used measures of spatial concentration, the Hirschman-Herfindahl index, measures the difference between the share of organic production within a county relative to the nation, and that county's share of total agricultural production relative to the nation. The squared differences are summed for all counties yielding the final index number. Values for the index range between 0, representing even distribution, and 1 when the industry is concentrated, although any value greater than 0 indicates some measure of concentration. Like the Gini coefficient, the HHI is unable to distinguish between random and non-random distribution of establishments, and is sensitive to the number of establishments (Kim, Barkley, and Henry 2000). The Hirschman-Herfindahl index used in this study is calculated as:

$HHI_{organic} = \sum_{i=1}^{n}(s_i - x_i)^2$, where i refers to a county, n is the number of counties in the U.S., s_i is county i's share of the total number of organic farms (organic acreage or organic sales) in the U.S., and x_i is county i's share of the total number of farms (farm acreage or farm sales) in the U.S.

Location Quotients

The location quotient (LQ) provides a measure of the significance of an activity (generally employment in an industry sector) in a region relative to its significance in a larger region such as a county, state, or nation. In this case, the LQ measures significance of organic production to a county. Assuming that consumers in all locations have similar tastes and preferences for the good or service in question and that worker productivity is uniform across the nation, location quotients greater than 1 indicate that the region specializes in the analyzed activity and is an exporter of the good or service, while an LQ less than 1 indicates the local economy is an importer of the good or service; the idea is that regional demand is met by regional supply when the LQ is equal to 1 (Goetz, Shields, and Wang 2004). Although the LQ is extremely easy to calculate, is used extensively, and is an indicator of an industry's importance to a region, it is limited in its explanatory power and ability to predict future competitiveness (Goetz, Shields, and Wang 2004).

Local Moran's I

The Moran's I statistic is designed to analyze patterns occurring across space. This statistic is useful because it measures the clustering of similar high or low values, greater or smaller than what would be expected to occur by chance, for establishments across county and state borders, allowing for a broader measure than the single value-per-county measure like the LQ (Goetz, Shields, and Wang 2004). Goetz, Shields, and Wang (2004) also point out that the capacity of the statistic to identify and measure proximity makes it especially suited for spatial clustering studies.

Following the methods employed by Gibbs and Bernat (1997), the local Moran's I for county *i* is calculated as: $I_i = z_i \sum_j^n W_{ij} z_j$ where *i* and *j* are 2 counties being compared, *y* is the mean for the U.S. of the indicator being used (number of organic farms, organic acreage, or organic sales), z_i is the deviation from *y* for county *i*, z_j is the deviation from *y* for county *j*, and W_{ij} is the spatial weights matrix as explained below.

First, the spatial weights matrix is constructed by identifying contiguous counties. In this study, contiguity is defined using the "queen" criterion (that is, any counties sharing a common border are defined as being contiguous) (Anselin 2003). Second, counties are assigned a value representing the difference between that county's value for the variable in question and the national average for that variable. For example, if the national average number of organic farms per county is 3, and county *i* has 12 organic farms, it is assigned a value of 9. If county *i* has 2 organic farms, it would receive a value of -1. The local Moran's I is then calculated by multiplying a county's value by the average value of its neighboring counties as defined by the contiguity matrix.

Local Moran's I values are used to identify 1) central cluster counties: those counties with a local Moran's I score greater than could occur by chance and possessing a value for the organic production indicator (farms, acreage, sales) greater than the mean. 2) Peripheral counties: those counties contiguous to central cluster counties. 3) High/high clusters: a county with a significantly high local Moran's I value surrounded by other counties with high local Moran's I values. 4) Non-cluster counties: those containing establishments but not located within a cluster. And, 5) non-establishment counties: counties which have no organic farms, acreage or sales.

Locational Correlation

The locational correlation is simply a calculated correlation coefficient for two firms, in two separate industries, in this case the correlation between organic farms (or acreage or sales) in counties found to be in a cluster and "organic support establishments" such as retailers, distributors, manufacturers, or farm input suppliers. Correlation coefficients were generated using correlation plots in GeoDa. Although the locational correlation coefficient does not provide great detail about the relationships between the industries, it does provide a first step in identifying potential "vertical linkages" within counties, allowing the researcher to then predict inter-industry linkages likely to occur within clusters (Goetz, Shields, and Wang 2004).

Results and Discussion

Results from our study are presented in the same order as described in the methods section; moving from global indicators of spatial concentration to local indicators identifying specific counties and regions in which organic agriculture has a significant presence, economically or otherwise.

HHI and Locational Gini Coefficients

The results of the HHI and locational Gini, presented in Table 1, reveal at least some concentration within organic agricultural production. The locational Gini coefficient, which takes on a value of 0.5 in complete concentration, is the easiest coefficient to interpret revealing moderate concentration in organic farms and strong concentration in organic acreage and sales. The HHI, while less intuitive, can be seen to follow a pattern similar to the Gini coefficient, thus supporting its findings.

Location Quotient

Location quotients measuring the importance of organic agriculture relative to total agriculture and national trends were calculated for all 3,069 counties for which organic agriculture data was available. However, due to federal disclosure rules results for the LQ analysis only pertain to those counties containing 6 or more organic farms reporting for the production variable being examined. Although the traditional critical value for LQ analysis is a value of 1, this analysis follows the lead of past studies, such Goetz, Shields, and Wang (2004) and Isaksen (1996), employing more stringent values of 1.25 and 3 (i.e., there is at least one-and-a-quarter, or three times, respectively, more organic production in a county than there would be if the county had a proportional share of the nations organic production). Counties representing the top 50 LQs are presented below in Tables 2, 3, and 4.

High LQs, indicating areas in which organic production clusters may exist, are found in many regions of the U.S. LQs greater than 1.25 were observed for 522 counties when the number of organic farms was examined. For organic acres and sales, 186 and 204 counties, respectively, had an LQ greater than or equal to the critical value of 1.25. An LQ greater than 3 was measured in 162 counties when examining organic farms, 117 when examining organic acreage, and 111 when examining organic sales.

As with the HHI and locational Gini coefficients, the LQ results reveal greater dispersion in the distribution of organic farms relative to the concentration in organic acreage and sales. High LQ counties were most dispersed across regions when organic production was measured using the number of organic farms. Consistent with the findings of Lohr, Gonzalez-Alvarez, and Graf (2001) the Northeastern[2] and Western[3] SARE regions, specifically California, Vermont, Maine, New York, and Washington, most often contained counties within the top 50 LQs for all measures of organic production.

Local Moran's I

Following a method similar to that outlined by Gibbs and Bernat (1997), this study defines central counties in clusters, peripheral counties in clusters, counties within High/high clusters, non-cluster counties, and non-establishment counties. Clusters were identified using the number of organic farms and acres and the value of organic sales in a county. Additionally, a county's organic production *share*, calculated as a county's organic production indicator (organic farms, acres, or sales) divided by the appropriate larger agricultural production indicator for the county (total farms, acres of harvested cropland, or total value of agricultural sales), was used to identify clusters of counties in which organic production represented a significant percentage of total agricultural production. Summary statistics for all of the organic production indicators used are presented below in Table 5. Tables 6 and 7-9 contain the names of central and peripheral

[2] Northeast states as defined by SARE include Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and West Virginia.
[3] Western states as defined by SARE include Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

counties within each cluster using the total number of organic farms, acres, and sales for each county as the organic indicator. Central and peripheral clusters identified using counties' organic production shares are provided in Tables 10 and 11, respectively. Additionally, maps of the location of these counties are presented for all variables in Figures 1 through 6.

The results of the local Moran's I analysis using total numbers per county for the organic production indicators show organic agriculture to be largely clustered in the western U.S., especially California, Washington, Oregon, and Montana. The largest cluster of organic farms was located in California, which contained 21 central cluster counties and 29 peripheral cluster counties, followed by Oregon and Washington which each contained 6 central cluster counties. Additional High/high clusters were also present in Texas, New England, and Wisconsin, centered in Vernon County, approximately 100 miles Northwest of Madison, WI and less than 200 miles from Minneapolis/St. Paul, MN.

Clusters of organic acreage were found centered primarily in Montana, specifically Blaine, Chouteau, and Daniels Counties. Two additional central clusters were identified in Kern and Santa Barbara Counties in California. Additional High/high clusters were located in North Dakota, Minnesota/Wisconsin, and eastern Michigan.

Organic sales, like organic farms, were concentrated predominantly in California, which had 23 central cluster counties and 23 peripheral cluster counties. Additional clusters were also identified in Chelan County, WA, located halfway between Spokane and Seattle, and home to the Washington Apple Commission (Tour Chelan County 2005); Grant County, WA, the nations leader in potato production and second in apple production (ePodunk 2006); and Camas County in Idaho, located just south of the Palouse region, home to some of nation's best wheat growing soils (Skinner, Weddell, and Stannard No Date).

When local Moran's I statistics were calculated using organic production shares locations of central cluster counties shifted, moving from California and other West Coast states to New England, especially Maine, Vermont, and New Hampshire. Counties with the largest percentage of organic *farms* were centered in Maine (encompassing major cities such as Augusta and Portland), and in a cluster that spanned several states including Vermont, New Hampshire and Massachusetts all in counties less than 200 miles from major cities such as Boston, MA, Hartford, CT, Providence, RI, and Albany, NY. Other High/high clusters were found in western Texas/New Mexico/Arizona, specifically the areas between El Paso, TX and Tucson, AZ, the north central (San Francisco and Napa Valley) and south central (Salinas Valley) coastal areas of California, and the Palouse regions of western Washington and northeastern Idaho. Many of these High/high clusters were also detected using the total values of organic farms, specifically those counties in California, Washington and Idaho, and El Paso County, TX.

Counties with the highest percentage of organic *acreage* were concentrated in two states, each in opposite regions of the country, Maine and Idaho. Maine's cluster was centered in Androscoggin, Franklin, and Kennebec counties and contained an additional six peripheral counties (over half of the states 16 counties). Idaho's organic acreage cluster was centered in Blaine and Camas counties and contained an additional nine counties. High/high clusters were also present in Colorado, north of Denver in Larimer and Weld Counties, Wisconsin, and California, directly north and south of the San Francisco-Oakland-Fremont metropolitan statistical area.

As with the local Moran's I analysis for the total number organic production indicators, the clustering of counties with large shares of organic agricultural sales closely matched the locations of clusters of counties with a large percentage of organic farms. An extremely large cluster of counties was found in New England centered in New Hampshire, Vermont, and Massachusetts, spreading to include Connecticut and Rhode Island, again a short distance to several major metropolitan areas.

Urban Influence

As discussed above many of the clusters identified in this study were located within close proximity of urban centers suggesting that organic agriculture is a predominantly urban activity, or is at least associated with metropolitan areas. Close proximity to, or location in, urban areas was characteristic of many cluster counties identified in this study. Using total values of organic farms, 79% of central cluster counties, 48% of peripheral cluster counties, and 45% of high/high cluster counties were found to be located in metropolitan statistical areas[4] (MSAs). Similar values were found for cluster counties identified using total values of organic sales: 88%, 48%, and 22% of central, peripheral, and High/high cluster counties, respectively, were in MSAs. These percentages were much lower for cluster counties identified using total values of organic acreage: only 40% of central cluster counties, 39% of peripheral cluster counties, and 33% of High/high cluster counties located in MSAs. Cluster counties identified using a county's share of organic production were also less likely to be found in MSA counties. When the share of organic farms was used the number of central cluster counties in MSAs was reduced by nearly one-half to 40%. The number of peripheral cluster counties located in MSAs decreased to 39%, while the number of High/high cluster counties in metro areas increased to 48%. A similar change was seen in those counties identified using the share of organic sales, with the number of central and peripheral cluster counties located in MSAs decreasing to 40% and 47%,

[4] MSAs are defined by the U.S. Census Bureau as those areas containing at least one city with 50,000 or more inhabitants, or an urbanized area (of at least 50,000 inhabitants) and a total metropolitan population of at least 100,000 inhabitants or 75,000 in New England. For more information see: http://www.census.gov/population/www/estimates/metrodef.html

respectively, while the number of High/high clusters in MSAs increased to 41%. Cluster counties identified using a county's share of cropland in organic acreage also showed a decrease and were much lower than those identified using farm or sales data. Only 20% of central cluster and peripheral cluster counties and 38% of High/high cluster counties were located in a metropolitan area.

Locational Correlation

Locational correlation provides additional insight into the organic clusters identified using the local Moran's I analysis by identifying "support establishments" likely to co-locate with organic operations in these counties. Locational correlation coefficients for organic production indicators and support establishments were calculated using 257 cluster counties containing 960 establishments in 17 establishment categories. Although this list of establishments does not contain all organic support institutions or businesses, it does represent many important support establishments and is useful for identifying how often these enterprises are likely to be found alongside organic farms.

Locational correlation coefficients for the identified support establishments are provided in Tables 12, 13 and 14 for counties identified as central, peripheral, or High/high cluster counties using each organic production indicator. For an explanatory example, the value 0.4168 presented in Table 12 for ingredient suppliers indicates that there is a 41.68 percent correlation between organic farms and organic ingredient suppliers, or these two establishments are likely to be co-located in the same county approximately 42 percent of the time (Goetz, Shields, and Wang 2004).

In all cases presented in the tables organic support establishments were most likely to co-locate with organic farms in counties where organic production represented a large proportion of the agricultural economy (those cluster counties identified using organic production shares). Counties with a large share of organic farms relative to their total number of farms were found to have co-locating support establishments almost 46 percent of the time. These were most often manufacturers and consultants. When total values of organic farms were used the locational correlation coefficient for “All Establishments” dropped to 30 percent and the types of establishments co-locating changed to ingredient suppliers and brokers, both of which were co-located with organic farms approximately 40 percent of the time. Where organic sales measured as the share of a county’s total agricultural sales were highest, support establishments could be found approximately 42 percent of the time and were most often those providing farm supplies or those manufacturing organic products. Correlation between sales and establishments dropped dramatically between cluster counties defined by production shares and those defined by total values, although the correlation between organic sales and those establishments providing farm supplies remained strong. Interestingly, there was a negative correlation between organic acreage and all support establishments, indicating that those counties with large amounts of organic acreage or a large share of their total harvested cropland in organic production were less likely to have establishments supporting the organic industry.

Knowing that counties containing large quantities of organic acreage are predominantly rural and contain few if any organic support establishments, while those containing large values for organic farms and sales are predominantly urban and are more likely to contain these establishments suggests that the organic support sector is more urban or metropolitan oriented. Therefore, metropolitan regions, specifically those cluster counties located in California and New England (Connecticut, Massachusetts, Maine, New York, New Hampshire, Rhode Island, and Vermont) were analyzed independently to remove the influence of these rural areas on the correlation coefficients. Like the locational correlation coefficients generated for all cluster counties, those generated for California and New England (presented in Tables 15-20) exhibit similar trends of highest correlation between support establishments and organic sales and the number of organic farms, and no correlation or a negative correlation between support establishments and organic acreage. However, it is interesting how much difference exists between these two regions in terms of linkages. In all cases where positive correlation occurred, correlations were strongest 1) in California counties and 2) when production shares were used to define the cluster. The exact opposite is true for New England, which exhibited much lower correlations overall, the highest being found in clusters defined by total values of production indicators.

The correlation between organic farms and all support establishments, while higher for New England than California counties when examining cluster counties by number of farms (or acres or sales) was nearly 37 percent lower when counties were defined as clusters using production shares. Additionally, the individual locational correlation coefficients were much lower in New England counties than those in California. Not surprisingly, the highest co-location in California occurred between organic farms and what could be regarded as urban establishments: publishers, restaurants, and universities. This may indicate that California's population centers are the driving factor behind this co-location. However, this co-location may also be an indication of cluster activities supporting organic growers. Guthman (2004) discusses several events that helped ignite and continued to support California's organic movement. One event, possibly the reason for the co-location of universities and organic farms in California, was the establishment of the University of California's Sustainable Agriculture Research and Education Program (located in Yolo County, a central cluster county for both organic farms and sales) at the University of California, Davis, dedicated to developing and distributing technical knowledge on sustainable agriculture initiatives. Another possible reason for co-location between restaurants and organic producers is what Gutham (2004) describes as the "counter cuisine movement" which originated in Berkeley (located in Alameda County, a peripheral cluster county for organic sales) at Alice Waters' *Chez Panisse* restaurant, which encouraged the use of local, organic produce.

As with the results for all clusters of organic acreage, counties in both California and New England showed no, or negative correlations between organic acreage and support establishments. Exceptions in California included processors and farm supply establishments in cluster counties identified using acreage numbers and universities in those counties identified as clusters of high percentage of acreage in organic production. Support services were the only establishments identified in New England's cluster of organic acreage. More establishments were located in cluster counties identified using the share of organic acreage relative to total harvested cropland, although, with the exception of ingredient suppliers, these were all negative correlations.

Although higher than correlations in organic acreage clusters, correlation coefficients were low, negative, or no establishments were present in many New England counties identified as clusters using share of organic sales. This trend was also true for cluster counties identified using total organic sales in a county, although importers and manufacturers were found to locate in these counties approximately 58 and 57 percent of the time, respectively.

Locational correlations for California, when examining those counties with organic sales as a share of all agricultural sales, were especially high (above the specified lower bound suggested by Goetz, Shields, and Wang (2004) of 75 percent) for retail establishments, associations, and distributors. As with the correlations found for California's farms, these correlations, while not providing definitive evidence, may suggest a well established cluster with input-output relationships including input suppliers, associations working to improve the economic and regulatory climates for producers, the producers themselves, distributors circulating organic products, and retailers providing a final outlet for organic products.

If the locational correlation results point to the presence of a well defined cluster, one might be tempted to disregard the Northeast as an area of organic production cluster activity. However, the lack of measurable input-output relationships in the Northeast may simply reflect a different type of marketing strategy for different types of organic farms. Results from the local Moran's I analysis showed that for organic production indicators High/high clusters were present in the Northeast for the number of organic farms and the value of organic sales, but were not present when acreage was used as a production indicator. This would suggest that organic farms in the Northeast are small, but still able to generate relatively sizeable sales. USDA ERS research (Dimitri and Greene 2002; Greene and Kremen 2003) has shown that smaller, more diversified certified organic farms, especially those in the Northeast, are often involved in mixed vegetable, fruit, herb, and flower production and that these products are grown specifically for direct sale to local consumers via farmers' markets and roadside stands. Additionally Lohr, Gonzalez-Alvarez, and Graff (2001) identified the Northeast SARE region as containing the largest number of community supported agriculture operations. This not only provides a market for farmers in the Northeast region, but, because they are not part of the vertical linkages present in areas like California, they are able to capture a larger percentage of the consumer's food dollar allowing the farms to remain both small and viable. This is not to suggest that organic operations in

California do not target consumers directly; however, these results suggest that more of California's operations are part of an industrial organic supply chain than those in New England.

Conclusions, Implications, and Future Research

Organic agriculture has experienced rapid growth in recent years; however this growth has not been spatially uniform suggesting that some form of clustering may be occurring within the industry. This study sought to analyze the spatial nature of organic agriculture and determine if spatial concentration was occurring within this specialized sector of the agricultural economy. Where and how organic operations are distributed across the U.S. was examined, identifying areas with high concentrations of organic farms, organic acreage, and organic sales and county level clusters in organic agricultural production.

Production appears most concentrated when measured using sales of organic products and organic acreage and appears more dispersed when measured using the distribution of organic farms. Through the use of location quotients and local Moran's I we identify the specific counties and clusters of counties where organic agriculture is of greater importance to the local agricultural economy. Counties with the largest LQ for organic farms were most often located in the western U.S., especially California, Washington, and Oregon, the Great Plains states, New England, and Mid-Atlantic States. Organic production clusters as measured by the Moran's I statistic followed a similar pattern clustering primarily in the western U.S. with additional High/high clusters found in the Great Plains, upper Midwest, and areas of New England. When these values were adjusted to represent organic agriculture's percentage of a county's total agriculture, central cluster counties were most likely to be found in New England.

Organic farm and sales cluster counties identified using the local Moran's I are most often located in or adjacent to metropolitan areas; this is especially true when total values of these production indicators are analyzed rather than organic production share.

Locational correlation analyses show that co-location of organic production and organic support establishments is most likely to occur in counties with a large share of their total farm operations and agricultural sales in organic. A negative correlation is observed between these support establishments and clusters of organic acreage. Examining California and New England cluster counties separately reveals large differences in how the organic industry may be operating in these two regions.

Implications of Data Analysis

The results of this research provide further evidence for clustering activity in agricultural sectors and help to strengthen the argument that any industry/sector can benefit from cluster activity. If farm operators and supporting organizations and establishments *are* working cooperatively to improve the regulatory environment and the institutionalization of organic production, it is likely that organic production in these areas will continue to grow. Previous case studies (Hassanein and Kloppenburg 1995, Guthman 2004) suggest that the presence of organic and sustainable agriculture associations in states such as Wisconsin and California have had significant and positive impacts in institutionalizing organic and/or sustainable production practices in the regions in which they operate. These organizations, and the relationships between growers which they foster, provide the added benefit of reducing risk. This is especially important for conventional growers who are required to undergo a three year transition period before gaining organic status. During this uncertain time for farmers, when prices are still at conventional levels and costs are those of an organic operation, being able to capitalize on the experience and advice of those who have gone before is very valuable. Additionally, operating in an environment in which there are known and established markets provides transitioning growers (and local lenders) added assurance their investment is sound.

Examples of current attempts to make areas identified as organic clusters more productive and viable are also available. The most notable is bans on genetically engineered crops in several California counties, including Trinity, Mendocino, and Marin (Sideman 2006) and genetically modified organism (GMO) labeling programs and "polluter pays" legislation passed by Vermont's House and Senate (Vogel 2006). These examples not only highlight the impact clusters can have on influencing policies that benefit cluster members, but point to another benefit of recognizing and understanding the spatial patterns of organic production, that of "organic zoning". Research by Parker and Munroe (2004) examining edge effect externalities experienced by organic farms bordering conventional operations suggests that organic operations may gain economic benefits from clustering together to reduce the potential for GMO drift from non-organic neighbors. According to a Pew Foundation press release, legislators from Connecticut, Maine, Massachusetts, New York, Rhode Island, and Vermont, all states identified as containing organic cluster counties by this study, have already introduced several bills to limit the presence of GMO crops within their borders (Brooks and DiFonzo 2004). Even in West Virginia, where organic production showed no clustering and very little overall presence, the Commissioner of Agriculture, has acknowledged that organic zoning may likely become a future reality (Douglas 2006). The results of this research could potentially aid state and local governments, organic growers associations, organic certifiers, etc., especially those in these organic clusters, who wish to understand and define borders for future "organic agriculture zones."

Results of this study also lend support to the idea that organic agriculture exhibits what Guthman (2004) describes as a “bipolar” nature; that is producers in the organic sector tend to follow one of two seemingly opposing views, industrial organic production on a large, impersonal scale, or production in the spirit of the “organic movement” which is tied closely to the idea of small farms producing for a local food system. Often these two philosophies are present side by side, and Guthman (2004) describes different regions of California being more prone to adopting one rather than the other, based largely on the types of agriculture traditionally practiced in the areas, i.e., in regions of large scale industrial agriculture one will be more likely to find large scale industrial organic agriculture. When looking at the spatial distribution of organic agriculture across the U.S., it appears this bipolar nature may also be present based on location; in this case different philosophies operating on opposite coasts of the U.S. In both locations organic producers and producer organizations are working to improve the production climate, as evident from proposed anti-GMO legislation, and both groups appear to be operating in similar urban influenced environments. However, in California emphasis appears to be on using organic markets (in particular high organic price premiums) as a tool to maintain economic advantage in a region characterized by high agricultural land values and the pressure on farmers to maximize value per acre in order to remain competitive with other farmers, and to resist development pressures (Guthman 2004). Many New England farmers face similar threats of development and high land prices, however, the characteristics of these farms (numerous farms generating high sales on small acreages) combined with the lack of linkages between organic production and support establishments reinforces the theory that many organic farmers in this region are direct marketing via farmers’ markets, roadside stands, and community supported agriculture and are (at least not yet) part of the “organic industry”. This is not to suggest that a particular philosophy is/was somehow rooted in the organic growers of New England or California, or that many may not wish to practice organic agriculture differently, simply that historical traditions, availability and value of farmland, and market access have influenced the nature of organic production in these different regions. As these clusters have and continue to grow it will be interesting to see if these philosophical traditions change or become more deeply rooted within the cluster's organic producers. This perceived difference between organic operations in California and New England highlights the need for further research into the factors which drive conversion to organic production and influence the formation of clusters in organic agriculture, and reinforces the diverse nature of organic farms, producers, products, and markets.

In the future more detailed regional level input-output analysis of identified clusters should be conducted to provide greater understanding of the differences and similarities between organic production clusters. Information concerning local consumers' tastes and preferences for organic products and whether demand for these foods is based on a specific value system would also be helpful for understanding these relationships and how they might vary by location. Most importantly, additional details regarding how producers are interacting within identified clusters is necessary. Specifically, whether producers located within clusters are operating independently of one another, or "competing cooperatively" to facilitate growth, promote policies, or attract other members of the supply chain in ways that will improve the economic performance of their own farm and the larger cluster as well.

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Table 1. Hirschman-Herfindahl and Gini Coefficients for organic production indicators

	Organic Farms	Organic Acres	Organic Sales
HHI	0.00084	0.00379	0.01266
Gini	0.34094	0.43889	0.44028

Table 2. Top 50 county location quotients: organic farms

Rank	State/County	LQ	Rank	State/County	LQ
1	NV\Lyon	63.19	26	ME\Knox	7.16
2	ID\Camas**	25.33	27	NY\St. Lawrence	6.92
3	ME\Hancock	13.55	28	NY\Essex	6.83
4	ME\Waldo	12.51	29	WI\Vernon**	6.66
5	ME\Franklin**	12.43	30	VT\Addison	6.62
6	VA/Cumberland	10.71	31	VA\Floyd	6.55
7	VA\Mecklenburg	10.64	32	ID\Lemhi	6.50
8	WA\Jefferson**	10.38	33	CA\San Diego*	6.40
9	VT\Windham**	10.37	34	TX\Matagorda	6.39
10	CA\San Benito**	9.52	35	NY\Ulster	6.39
11	CT\Fairfield	9.36	36	FL\Indian River	6.34
12	ME\Lincoln**	9.20	37	ME\Piscataquis	6.23
13	CA\Marin**	9.16	38	WA\Island	6.17
14	FL\Santa Rosa	8.78	39	WA\Grays Harbor	5.97
15	WA\San Juan*	8.75	40	VT\Washington**	5.90
16	OR\Lincoln	8.14	41	WA\Skagit	5.75
17	KY\Magoffin	8.14	42	FL\Gadsden	5.74
18	ME\Kennebec**	8.10	43	CA\Lake*	5.70
19	NY\Schoharie	8.06	44	TX\Lampasas	5.68
20	VA\Wythe	7.97	45	OH\Clark	5.68
21	CA\Santa Cruz*	7.84	46	OR\Josephine**	5.66
22	NH\Cheshire*	7.76	47	MA\Barnstable	5.65
23	MA\Norfolk	7.75	48	VT\Lamoille**	5.65
24	MA\Franklin	7.33	49	ID\Blaine	5.59
25	CA\Mendocino**	7.26	50	CA\Sonoma*	5.45

*Indicates a county appearing in the Top 50 LQs for two organic indicators
**Indicates a county appearing in the Top 50 LQs for all three organic indicators

Table 3. Top 50 county location quotients: organic acres

Rank	State/County	LQ	Rank	State/County	LQ
1	ID\Camas**	139.21	26	NY\Tioga*	11.73
2	CA\Marin**	50.65	27	CA\Santa Barbara*	11.63
3	ME\Franklin**	48.16	28	CA\Placer	11.36
4	NY\Yates*	25.62	29	VT\Lamoille**	11.31
5	WA\Jefferson	25.50	30	NY\Columbia*	10.99
6	CO\Larimer*	24.09	31	CA\Nevada	10.75
7	MA\Hampshire*	23.06	32	IA\Jefferson	10.71
8	WI\Vernon**	22.23	33	VT\Caledonia	10.53
9	NY\Erie	18.22	34	PA\Juniata	10.44
10	CA\San Diego*	17.90	35	VT\Washington**	10.30
11	CA\Mendocino**	17.11	36	CO\Delta*	10.29
12	ME\Hancock	16.96	37	ME\Lincoln	10.26
13	CA\San Benito	15.70	38	OR\Coos*	10.05
14	VT\Orange*	14.93	39	MD\Kent*	9.75
15	MN\Washington	14.83	40	OR\Josephine**	9.66
16	NY\Cortland*	14.32	41	CA\Ventura*	9.37
17	MA\Middlesex	13.95	42	CA\Butte*	9.23
18	NY\Seneca	13.29	43	VT\Windham**	9.08
19	CA\Santa Cruz*	12.85	44	ND\Kidder	8.85
20	WA\Chelan*	12.61	45	WI\Monroe	8.77
21	VT\Windsor*	12.37	46	CA\Colusa	8.62
22	ME\Kennebec**	12.02	47	CA\El Dorado	8.25
23	TX\Collin	12.01	48	CA\Sutter	8.16
24	ME\Waldo	11.89	49	CA\Lake*	8.07
25	ME\Somerset	11.75	50	WI\Trempealeau	8.03

*Indicates a county appearing in the Top 50 LQs for two organic indicators
**Indicates a county appearing in the Top 50 LQs for all three organic indicators

Table 4. Top 50 county location quotients: organic sales

Rank	State/County	LQ	Rank	State/County	LQ
1	ID\Camas**	107.99	26	CA\Amador	10.24
2	OR\Josephine**	53.99	27	NM\Rio Arriba	9.87
3	MA\Hampshire*	36.25	28	TX\Robertson	9.51
4	MA\Worcester	35.75	29	ME\Kennebec**	9.07
5	VT\Orange*	31.49	30	MA\Berkshire	9.06
6	CO\Larimer*	30.77	31	OH\Athens	8.92
7	VT\Windham**	27.49	32	WA\Chelan*	8.75
8	VT\Lamoille**	26.33	33	WA\Douglas	8.73
9	ME\Franklin**	25.87	34	CO\Delta*	8.54
10	CA\Nevada	25.46	35	NY\Cortland*	8.13
11	NH\Cheshire*	25.18	36	CT\New London	7.97
12	OR\Coos*	25.05	37	CA\Santa Barbara*	7.55
13	WI\Vernon**	24.07	38	CA\Placer	7.17
14	CA\Marin**	23.64	39	CA\Yuba	7.17
15	CA\Mendocino**	19.52	40	CA\Kern	7.01
16	MD\Kent*	18.71	41	ME\Cumberland	7.00
17	WA\Klickitat	18.18	42	CA\Ventura*	6.91
18	WA\San Juan*	17.09	43	WA\Jefferson	6.83
19	VT\Windsor*	16.66	44	CO\Fremont	6.69
20	NY\Yates*	15.00	45	NY\Tioga*	6.62
21	MT\Blaine	13.75	46	CA\Butte*	6.62
22	VT\Washington**	12.19	47	IA\Winneshiek	6.59
23	MI\Ionia	11.97	48	NY\Columbia*	6.59
24	ME\Lincoln**	11.60	49	CA\Sonoma*	6.50
25	CA\San Benito	10.60	50	MD\Baltimore	6.50

*Indicates a county appearing in the Top 50 LQs for two organic indicators
**Indicates a county appearing in the Top 50 LQs for all three organic indicators

Table 5. Characteristics of organic production clusters from local Moran's I

Organic Production Indicator	No. of Counties Containing Variable	No. of Counties Above Average	No. of Counties with Sig. High-high Local Moran's I	Central Clusters	Peripheral Clusters
Organic Farms	1959	789	323	34	63
Organic Acreage	1461	544	217	5	18
Organic Sales	1959	365	78	26	41
Organic Farms/Total Farms	1959	1035	146	5	13
Organic Acres/ Harvested Cropland	1461	546	96	5	15
Organic Sales/Total Value of Ag. Products Sold	1959	495	68	5	17

Table 6. Local Moran's I central cluster counties – organic farms, acres, sales

Central Cluster Counties Organic Farms	Central Cluster Counties Organic Acres	Central Cluster Counties Organic Sales
State/County	**State/County**	**State/County**
CA/Butte	CA/Kern	CA/Butte
CA/Fresno	CA/Santa Barbara	CA/Fresno
CA/Kern	MT/Blaine	CA/Imperial
CA/Lake	MT/Chouteau	CA/Kern
CA/Los Angeles	MT/Daniels	CA/Kings
CA/Mendocino		CA/Madera
CA/Merced		CA/Marin
CA/Monterey		CA/Mendocino
CA/San Benito		CA/Merced
CA/San Diego		CA/Monterey
CA/San Joaquin		CA/Orange
CA/San Luis Obispo		CA/Riverside
CA/Santa Barbara		CA/San Benito
CA/Santa Cruz		CA/San Diego
CA/Sonoma		CA/San Luis Obispo
CA/Stanislaus		CA/Santa Barbara
CA/Sutter		CA/Santa Cruz
CA/Tehama		CA/Sonoma
CA/Tulare		CA/Stanislaus
CA/Ventura		CA/Sutter
CA/Yolo		CA/Tulare
OR/Clackamas		CA/Ventura
OR/Douglas		CA/Yolo
OR/Jackson		ID/Camas
OR/Lane		WA/Chelan
OR/Linn		WA/Grant
OR/Marion		
WA/Chelan		
WA/King		
WA/Okanogan		
WA/Skagit		
WA/Snohomish		
WA/Yakima		
WI/Vernon		

Table 7. Local Moran's I peripheral cluster counties – organic farms

State/County	State/County	State/County
CA/Amador	CA/Santa Clara	OR/Washington
CA/Calaveras	CA/Shasta	OR/Yamhill
CA/Colusa	CA/Siskiyou	WA/Benton
CA/Contra Costa	CA/Solano	WA/Douglas
CA/Glenn	CA/Trinity	WA/Ferry
CA/Humboldt	CA/Tuolumne	WA/Grant
CA/Imperial	CA/Yuba	WA/Island
CA/Inyo	IA/Allamakee	WA/Kittitas
CA/Kings	MN/Houston	WA/Klickitat
CA/Madera	OR/Benton	WA/Lewis
CA/Marin	OR/Coos	WA/Lincoln
CA/Mariposa	OR/Curry	WA/Pierce
CA/Mono	OR/Deschutes	WA/Skamania
CA/Napa	OR/Hood River	WA/Whatcom
CA/Orange	OR/Jefferson	WI/Crawford
CA/Placer	OR/Josephine	WI/Juneau
CA/Plumas	OR/Klamath	WI/La Crosse
CA/Riverside	OR/Lincoln	WI/Monroe
CA/Sacramento	OR/Multnomah	WI/Richland
CA/San Bernardino	OR/Polk	WI/Sauk
CA/San Mateo	OR/Wasco	

Table 8. Local Moran's I peripheral cluster counties – organic acres

State/County	State/County	State/County
CA/Inyo	CA /Ventura	MT /Phillips
CA/Kings	MT/Cascade	MT /Pondera
CA /Los Angeles	MT /Fergus	MT /Roosevelt
CA /San Bernardino	MT /Hill	MT /Sheridan
CA /San Luis Obispo	MT /Judith Basin	MT /Teton
CA /Tulare	MT /Liberty	MT /Valley

Table 9. Local Moran's I peripheral cluster counties – organic sales

State/County	State/County	State/County
AZ/La Paz	CA/Plumas	ID/Lincoln
AZ/Yuma	CA/Sacramento	WA/Adams
CA/Alameda	CA/San Bernardino	WA/Benton
CA/Calaveras	CA/San Joaquin	WA/Douglas
CA/Colusa	CA/San Mateo	WA/Franklin
CA/Glenn	CA/Santa Clara	WA/King
CA/Humboldt	CA/Solano	WA/Kittitas
CA/Inyo	CA/Tehama	WA/Lincoln
CA/Lake	CA/Trinity	WA/Okanogan
CA/Los Angeles	CA/Tuolumne	WA/Skagit
CA/Mariposa	CA/Yuba	WA/Snohomish
CA/Mono	ID/Blaine	WA/Whatcom
CA/Napa	ID/Elmore	WA/Yakima
CA/Placer	ID/Gooding	

Table 10. Local Moran's I central cluster counties – organic production share

Central Cluster Counties Organic Farms / Total Farms	Central Cluster Counties Organic Acres / Acres of Harvested Cropland	Central Cluster Counties Organic Sales / Value of Agricultural Products Sold
State/County	**State/County**	**County**
ME/Androscoggin	ID/Blaine	MA/Hampshire
ME/Franklin	ID/Camas	MA/Worcester
ME/Kennebec	ME/Androscoggin	NH/Cheshire
MA/Franklin	ME/Franklin	VT/Orange
VT/Windham	ME/Kennebec	VT/Windham

Table 11. Local Moran's I peripheral cluster counties – organic production share

Central Cluster Counties Organic Farms / Total Farms	Central Cluster Counties Organic Acres / Acres of Harvested Cropland	Central Cluster Counties Organic Sales / Value of Agricultural Products Sold
State/County	**State/County**	**State/County**
ME/Cumberland	ID/Bingham	CT/Tolland
ME/Lincoln	ID/Butte	CT/Windham
ME/Oxford	ID/Cassia	MA/Berkshire
ME/Sagadahoc	ID/Custer	MA/Franklin
ME/Somerset	ID/Elmore	MA/Hampden
ME/Waldo	ID/Gooding	MA/Middlesex
MA/Berkshire	ID/Lincoln	MA/Norfolk
MA/Hampshire	ID/Minidoka	NH/Grafton
MA/Worcester	ID/Power	NH/Hillsborough
NH/Cheshire	ME/Cumberland	NH/Sullivan
NH/Sullivan	ME/Lincoln	RI/Providence
VT/Bennington	ME/Oxford	VT/Addison
VT/Windsor	ME/Sagadahoc	VT/Bennington
	ME/Somerset	VT/Caledonia
	ME/Waldo	VT/Rutland
		VT/Washington
		VT/Windsor

Table 12. Locational correlation: organic farms and organic support establishments

Support Establishments	High/high Counties (organic farms)	Support Establishments	High/high Counties (organic farms as share of total farms)
Ingredient Suppliers	0.4168	Manufacturer	0.4586
Broker	0.4011	Consultant	0.3956
Farm Input Supplies	0.2636	Association	0.3856
Association	0.2614	Universities	0.3166
Manufacturer	0.2559	Ingredient Suppliers	0.3061
Consultant	0.2226	Exporter	0.2800
Retail	0.2054	Processor	0.2688
Certifier	0.2029	Farm Input Supplies	0.2036
Support Services	0.1546	Importer	0.1750
Universities	0.1542	Publishers	0.1740
Importer	0.1428	Distributor	0.1583
Exporter	0.1359	Broker	0.1305
Processor	0.1348	Retail	0.1077
Distributor	0.1316	Certifier	0.0993
Publishers	0.1123	Support Services	0.0837
Package Suppliers	0.1114	Restaurant/Chef	-0.0352
Restaurant/Chef	0.0359		
All Establishments	**0.3089**	**All Establishments**	**0.4581**

Table 13. Locational correlation: organic acreage and organic support establishments

Support Establishments	High/high Counties (organic acreage)	Support Establishments	High/high Counties (organic acres as share of harvested cropland)
Certifier	0.1868	Certifier	0.2621
Processor	0.0915	Ingredient Suppliers	0.0227
Farm Input Supplies	0.0849	Universities	0.0174
Ingredient Suppliers	0.0075	Consultant	0.0144
Association	-0.0168	Processor	-0.0196
Universities	-0.0345	Exporter	-0.0317
Package Suppliers	-0.0610	Broker	-0.0330
Retail	-0.0641	Farm Input Supplies	-0.0331
Manufacturer	-0.0687	Distributor	-0.0386
Restaurant/Chef	-0.0689	Manufacturer	-0.0423
Consultant	-0.0740	Association	-0.0441
Exporter	-0.0745	Retail	-0.0619
Broker	-0.0747	Importer	-0.0655
Importer	-0.0868	Publishers	-0.0674
Support Services	-0.1144	Support Services	-0.0845
Distributor	-0.1160		
All Establishments	**-0.0610**	**All Establishments**	**-0.0274**

Table 14. Locational correlation: organic sales and organic support establishments

Support Establishments	High/high Counties (organic sales)	Support Establishments	High/high Counties (organic sales as share of ag. products sold)
Farm Input Supplies	0.3385	Farm Input Supplies	0.5069
Certifier	0.2325	Manufacturer	0.4457
Publishers	0.1166	Association	0.4371
Association	0.0965	Retail	0.3320
Broker	0.0914	Importer	0.3204
Processor	0.0759	Consultant	0.3113
Retail	0.0707	Ingredient Suppliers	0.2991
Package Suppliers	0.0641	Exporter	0.2500
Ingredient Suppliers	0.0423	Publishers	0.2021
Manufacturer	0.0091	Distributor	0.1904
Restaurant/Chef	-0.0065	Universities	0.0465
Exporter	-0.0104	Certifier	-0.0471
Distributor	-0.0121	Support Services	-0.0618
Consultant	-0.0221	Broker	-0.0693
Support Services	-0.0441	Processor	-0.0847
Universities	-0.0632		
Importer	-0.0640		
All Establishments	**0.0267**	**All Establishments**	**0.4191**

Table 15. Locational correlation--California: organic farms and organic support establishments

Support Establishments	High/high Counties (organic farms)	Support Establishments	High/high Counties (organic farms as share of total farms)
Broker	0.5315	Publishers	0.6472
Farm Input Supplies	0.4095	Restaurant/Chef	0.5073
Ingredient Suppliers	0.3852	Universities	0.4836
Association	0.2113	Manufacturer	0.4581
Package Suppliers	0.2006	Broker	0.3548
Consultant	0.1892	Processor	0.3125
Manufacturer	0.1549	Exporter	0.2983
Retail	0.1526	Importer	0.2564
Publishers	0.1142	Package Suppliers	0.1179
Support Services	0.0916	Association	0.1179
Universities	0.0808	Certifier	0.1113
Certifier	0.0667	Farm Input Supplies	0.0705
Exporter	0.0649	Consultant	0.0472
Processor	0.0522	Support Services	-0.0458
Importer	0.0109	Ingredient Suppliers	-0.1038
Restaurant/Chef	-0.0215		
Distributor	-0.0491		
All Establishments	**0.2078**	**All Establishments**	**0.4924**

Table 16. Locational correlation--New England: organic farms and organic support establishments

Support Establishments	High/high Counties (organic farms)	Support Establishments	High/high Counties (organic farms as share of total farms)
Manufacturer	0.2634	Universities	0.2040
Association	0.2603	Association	0.1945
Universities	0.2573	Manufacturer	0.1442
Ingredient Suppliers	0.1664	Consultant	0.1372
Support Services	0.1540	Publishers	0.1312
Retail	0.1389	Support Services	0.0839
Consultant	0.1208	Processor	0.0737
Publishers	0.1135	Retail	0.0612
Processor	0.0574	Broker	0.0304
Certifier	0.0362	Ingredient Suppliers	0.0142
Broker	0.0044	Farm Input Supplies	-0.0059
Distributor	0.0023	Restaurant/Chef	-0.0223
Importer	-0.0260	Certifier	-0.0415
Exporter	-0.0393	Distributor	-0.0670
Restaurant/Chef	-0.0441	Exporter	-0.1138
Farm Input Supplies	-0.1239	Importer	-0.1321
Package Suppliers	-0.1252		
All Establishments	**0.2189**	**All Establishments**	**0.1252**

Table 17. Locational Correlation--California: organic acreage and organic support establishments

Support Establishments	High/high Counties (organic acreage)	Support Establishments	High/high Counties (organic acres as share of harvested cropland)
Processor	0.2527	Universities	0.2080
Farm Input Supplies	0.1729	Processor	-0.0411
Certifier	0.0851	Distributor	-0.0733
Association	-0.0163	Manufacturer	-0.0758
Universities	-0.0315	Consultant	-0.1039
Broker	-0.1421	Broker	-0.1152
Publishers	-0.1520	Certifier	-0.1152
Restaurant/Chef	-0.1570	Association	-0.1247
Retail	-0.1646	Retail	-0.1416
Ingredient Suppliers	-0.1726	Support Services	-0.1608
Manufacturer	-0.1832	Ingredient Suppliers	-0.1621
Importer	-0.2115	Farm Input Supplies	-0.1683
Consultant	-0.2208	Exporter	-0.1868
Distributor	-0.2381	Importer	-0.2255
Exporter	-0.2402		
Support Services	-0.2681		
All Establishments	**-0.1830**	**All Establishments**	**-0.1264**

Table 18. Locational correlation--New England: organic acreage and organic support establishments

Support Establishments	High/high Counties (organic acreage)	Support Establishments	High/high Counties (organic acres as share of harvested cropland)
Support Services	0.0578	Ingredient Suppliers	0.2704
		Universities	-0.0066
		Consultant	-0.0767
		Processor	-0.0822
		Importer	-0.0838
		Association	-0.1167
		Distributor	-0.1337
		Publishers	-0.1751
		Farm Input Supplies	-0.1775
		Support Services	-0.1810
		Manufacturer	-0.1911
		Retail	-0.1967
All Establishments	**0.0578**	**All Establishments**	**-0.2312**

Table 19. Locational correlation--California: organic sales and organic support establishments

Support Establishments	**High/high Counties (organic sales)**	**Support Establishments**	**High/high Counties (organic sales as share of ag. products sold)**
Farm Input Supplies	0.3045	**Retail**	0.8771
Certifier	0.1851	Association	0.8594
Association	0.1358	Distributor	0.7641
Publishers	0.1179	Farm Input Supplies	0.7331
Consultant	0.0771	Manufacturer	0.6261
Retail	0.0522	Ingredient Suppliers	0.4382
Broker	0.0513	Consultant	0.4381
Processor	0.0357	Exporter	0.4381
Package Suppliers	0.0355	Importer	0.4381
Ingredient Suppliers	-0.0281	Publishers	0.4381
Distributor	-0.0442	Universities	0.3095
Manufacturer	-0.0515		
Restaurant/Chef	-0.0553		
Exporter	-0.0567		
Support Services	-0.1049		
Importer	-0.1146		
Universities	-0.1489		
All Establishments	**-0.0361**	**All Establishments**	**0.6601**

Table 20. Locational correlation--New England: organic sales and organic support establishments

Support Establishments	**High/high Counties (organic sales)**	**Support Establishments**	**High/high Counties (organic sales as share of ag. products sold)**
Importer	0.5872	Ingredient Suppliers	0.1640
Manufacturer	0.5656	Manufacturer	0.1632
Association	0.2628	Importer	0.0725
Ingredient Suppliers	0.2483	Certifier	0.0503
Retail	-0.0584	Retail	-0.0255
Distributor	-0.2339	Processor	-0.0521
Exporter	-0.2339	Association	-0.1089
Support Services	-0.2628	Support Services	-0.1089
Universities	-0.3057	Consultant	-0.1220
Consultant	-0.3927	Publishers	-0.1487
Publishers	-0.3927	Exporter	-0.1660
		Universities	-0.1680
		Distributor	-0.2029
All Establishments	**0.0833**	**All Establishments**	**-0.0057**

Figure 1. Significant high/high clusters: organic farms

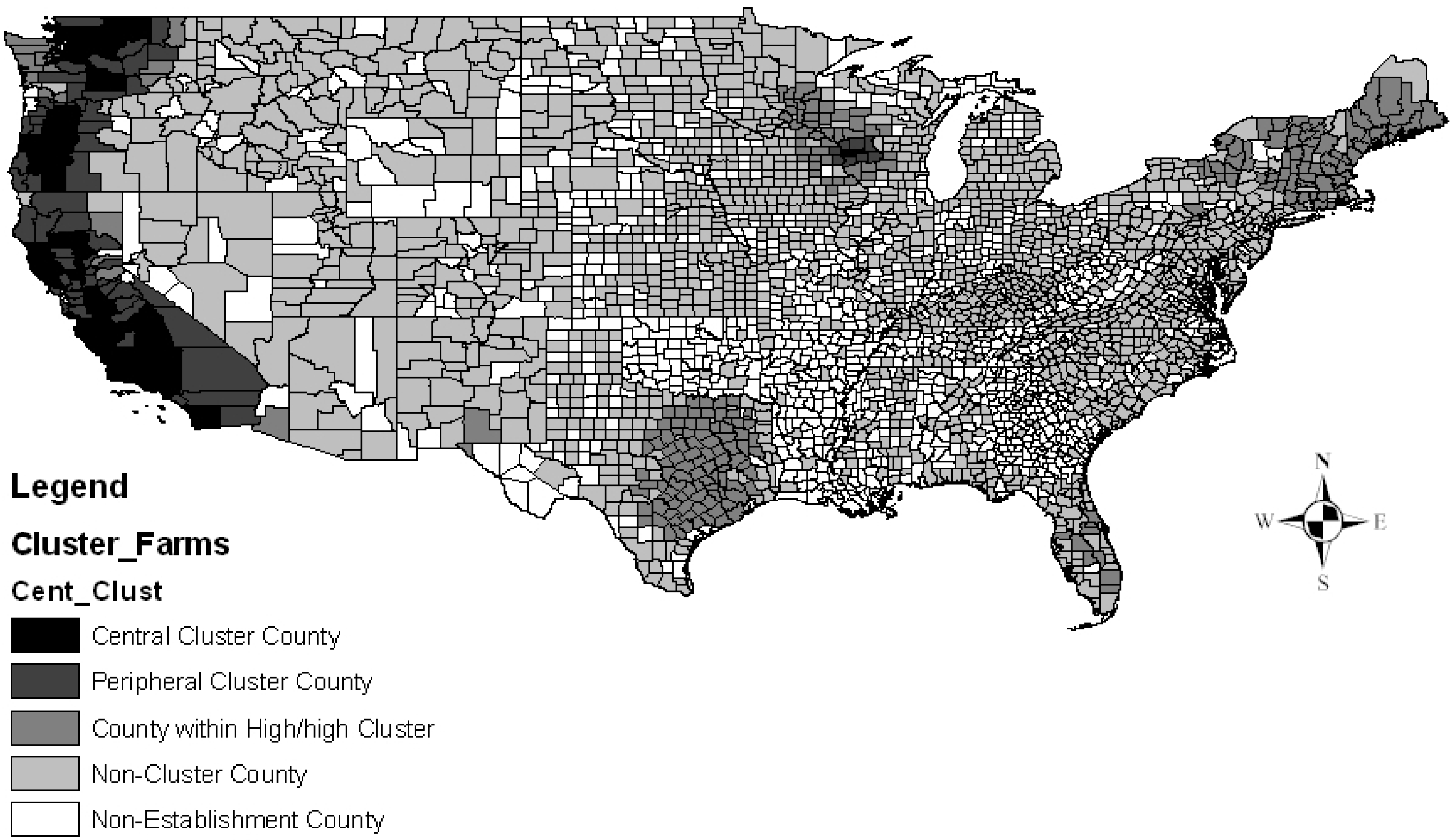

Figure 2. Significant high/high clusters: organic acres

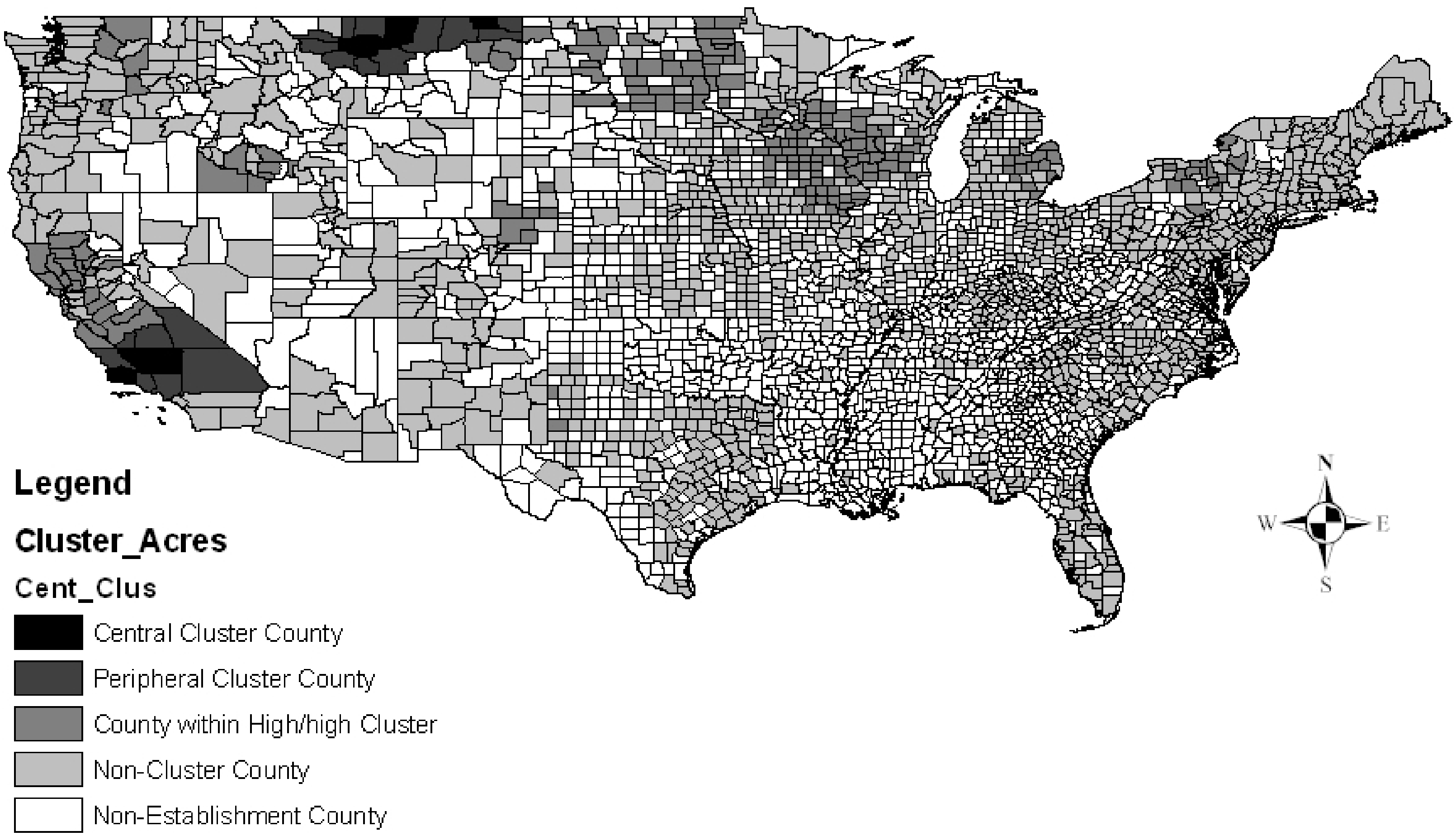

Figure 3. Significant high/high clusters: organic sales

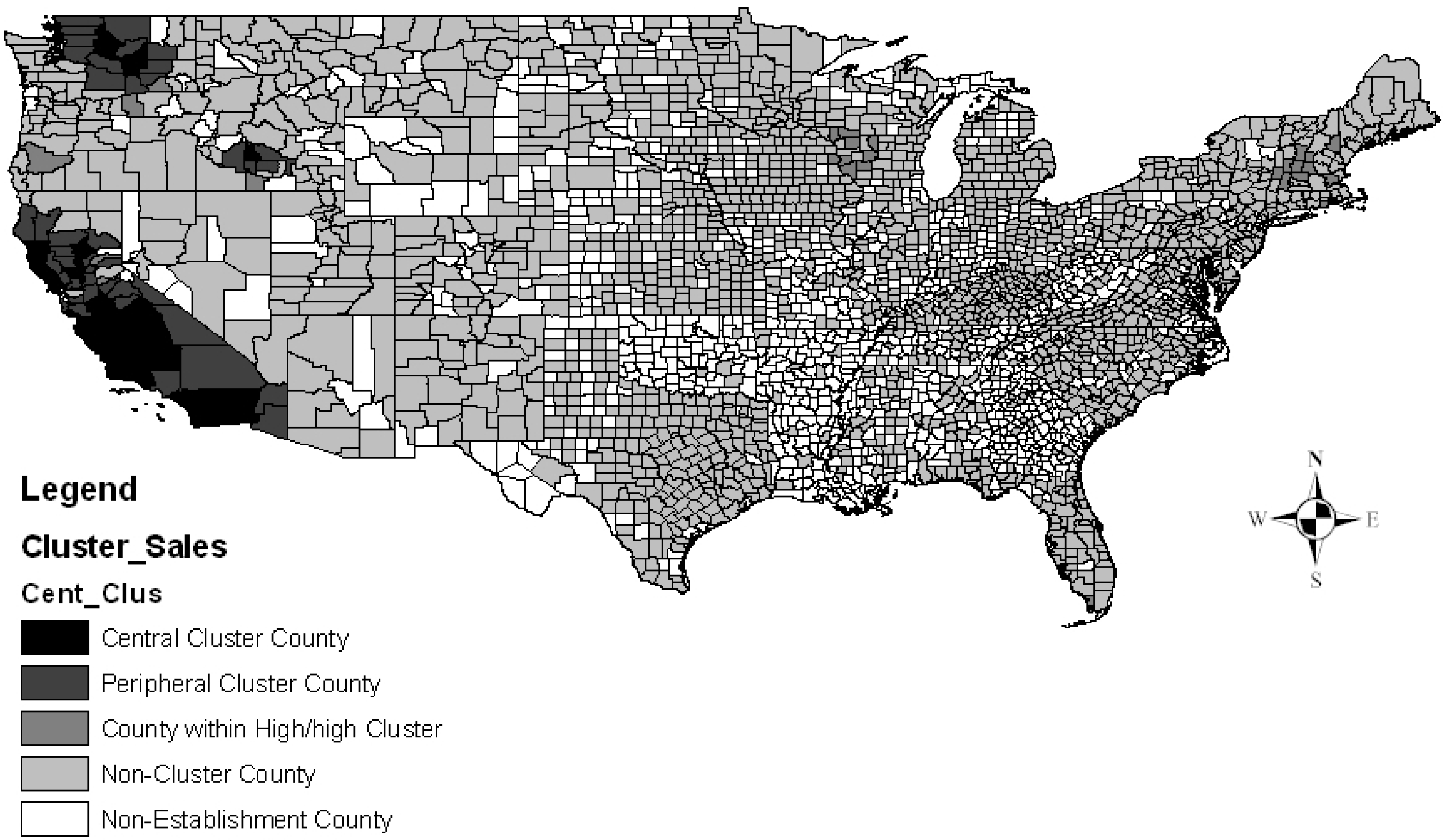

Figure 4. Significant high/high clusters: organic farms/total farms

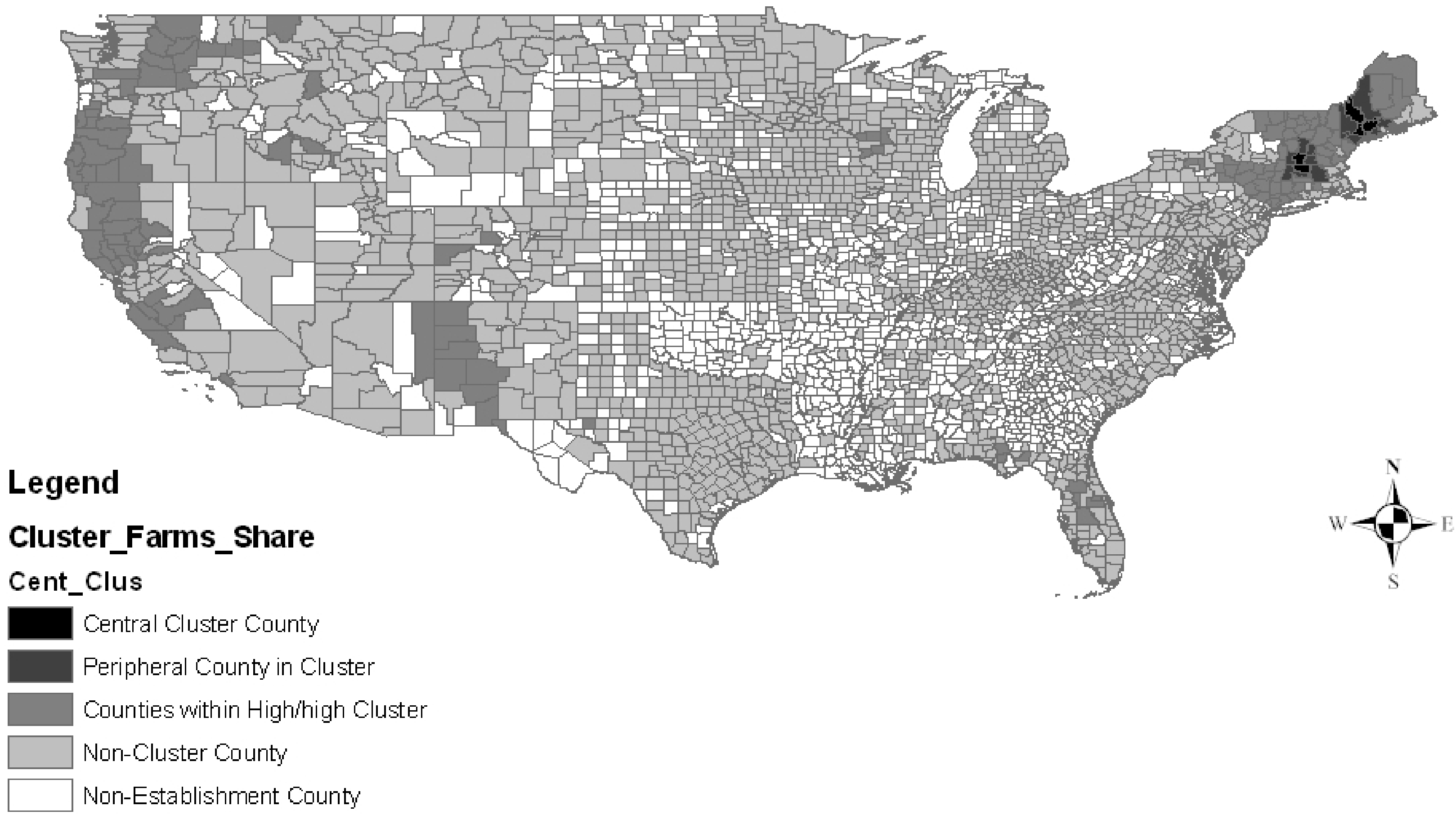

Figure 5. Significant high/high clusters: organic acres/acres of cropland harvested

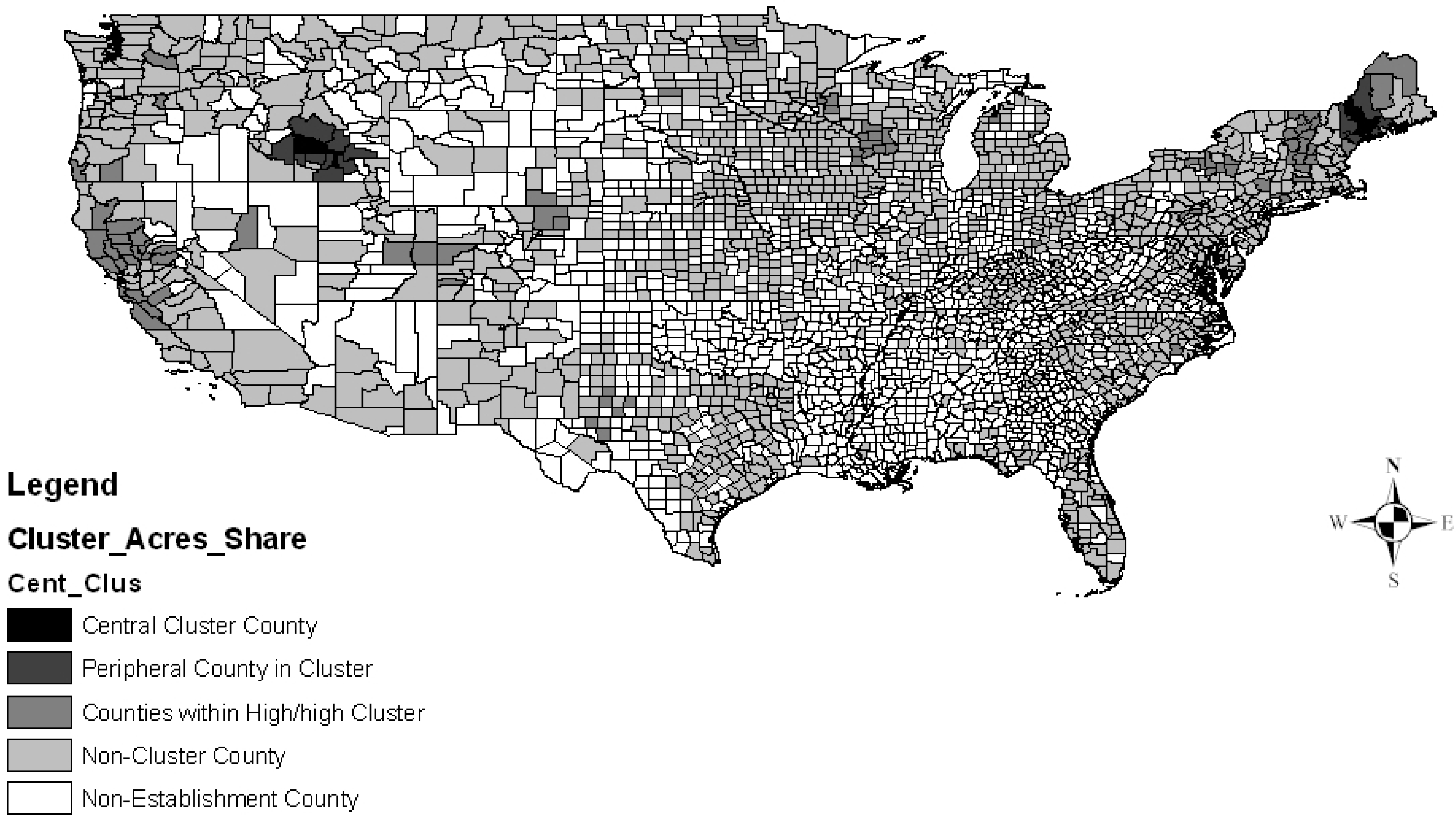

Figure 6. Significant high/high clusters: organic sales/total value of agricultural products sold