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Bridging the Gap: Do Farmers' Markets Help Alleviate Impacts of Food Deserts?
Final Report

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SECTION 1

Executive Summary

Background and Methodology

Pressures of the globalized food system have left communities and individuals in precarious situations in which nutritious and accessible food is not a given; research has begun to suggest that relocalization efforts will not necessarily alleviate these trends without directed efforts to produce exchanges that enhance both food and farm security. Existing research in the area of food deserts and Community Food Security lacks significant empirical, spatially relevant support for developing a sound understanding on the variation of effectiveness of federal food assistance programs in relation to local food systems. This research begins to fill this void by first establishing the traditionally conceived food desert estimation for Washington State using grocery store location and census demographic data, followed by an expansion using farmers' markets. As food deserts are results of an interaction of concentrated poverty and low accessibility to healthful food sources, this report creates two metrics for food desert determination. For urban areas, good access is considered to be within a one kilometer walking distance. Meanwhile, the rural areas are assessed for the presence of food deserts based on a ten mile (16.1km) network distance needed to be travelled. Both the urban and rural considerations are conducted at the census tract level in which those tracts with poverty levels in excess of 20 percent and in excess of the distances identified are food deserts.

This report first establishes the presence of food deserts, then provides an assessment of the variation in redemption rates and utilization of food assistance programs (e.g., Supplemental Nutrition Assistance Program [SNAP], Women, Infants, and Children [WIC], Senior Farmers' Market Nutrition Program [Senior FMNP]). SNAP data is obtained from a reduced sample of the 20 pilot markets located in Washington, while complete WIC and Senior FMNP data have been obtained for 2009 and 2010 from all approved farmers' markets. This research seeks to achieve the following objectives:

- Quantify the utilization of food assistance programs by participants at farmers' markets.
- Quantify the variability of utilization based on market location in relation to key demographic characteristics of those eligible for federal assistance.
- Evaluate the evidence to suggest if farmers' markets site select in a similarly market-motivated fashion as other food outlets.
- Evaluate whether farm security and food security are mutually achievable goals.

This report contains descriptive summaries of 10 of the 13 urbanized areas (UA) of Washington in relation to their growing numbers of farmers' markets. The remaining three UAs had no census tracts considered food deserts. In this section visual support for any food deserts that exist in the UA is provided in addition to detail about the farmers' markets in the area and indication of the variation in WIC/Senior FMNP redemptions as well as SNAP where available. The UAs have by far the majority of farmers' markets in the state; 94 of the 169 markets. The remaining 75 markets are split between the smaller urbanized clusters (UC) of the state (37) and the remaining rural areas (38).

Findings

Findings begin to suggest substantial variation in the amount of food benefits redeemed at each market based on whether the market is in an UA, UC, or a rural location. Markets in urbanized areas took in over $655,000 dollars combined in WIC/FMNP vouchers, while UC markets took in roughly $124,000 and rural markets $9,000. These values reinforce the demographic variation in Washington and begin to highlight concerns of previous studies over the ability to achieve both farm and food security. In addition to the disparities between the rural and urban marketplaces, interesting trends appear to be emerging within urban areas. One example of this is the high rate at which urban farmers' markets are located very near larger retail grocers or groups of grocers. This is especially evident in the larger urbanized areas like Seattle in which 29 of the 57 markets are found to be within the 1km buffer of a grocer, and many others not far removed.

In addition to simply observing the presence or absence of food deserts, the final sections of this report develop spatially informed regression models. These models will better aid market managers, local

planners, and managers of food assistance programs in seeking methods of increasing the efficiency of their programs and increasing the redemption rates of vouchers, thus further alleviating food insecurity in Washington State. Results indicate a negative relationship between the population-weighted average distance individuals must travel to a market and the rate at which WIC vouchers are redeemed. These results manifest themselves in the realization that food assistance recipients who do not live close to a farmers' market site are less able to engage in the local food system despite the potential desire to do so. Additionally, as the degree of poverty of an area increases, as represented by the proportion of the population living below the poverty line, the redemption rates of WIC vouchers also increases. Similar observations exist for areas with increasing Latino populations.

To complement and provide nuance for these models, several case study communities were selected to highlight issues brought to light in the study. These rural communities, located in distinctly different regions of the state, have participated in the Washington State University Extension-based Horizons program, which targets the reduction of poverty in rural areas. These communities self-identified food security as one of several community ailments. Interviews highlight the distinctive differences rural markets face as compared to their urban counterparts: (1) they are typically much smaller and thus often must rely on volunteer time to manage and facilitate the market, (2) the ability to navigate the systems required to accept programs like SNAP are hindered by size and local knowledge of the system, (3) they must carefully balance the timing of their market to both draw in the low-income consumers as well as ensure they can attract enough vendors to keep the market sustainable. The case studies serve as examples to suggest avenues for future research and highlight the possibilities and difficulties of actions aimed to reduce food insecurity.

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INTRODUCTION

In recent years, a growing body of literature has suggested that efforts to re-localize food networks have achieved an unbalanced effect when considering who benefits (i.e., who are the major consumers) from the increased access to fresh, locally grown fruits and vegetables (e.g., Jarosz, 2008; Kremer and DeLiberty, 2011). Jarosz, for example, finds that membership and participation in Alternative Food Networks (AFNs), of which farmers' markets are a major venue, is composed largely of the metropolitan middle class, which is predominantly white and well educated. Several authors suggest price perception as the culprit behind the lack of consumption by lower-income households of fresh and local foods, while also suggesting the observations result from differences in social and cultural norms between those who do and do not consume local produce (Guthman, 2004), or simply a lack of knowledge regarding the benefits of fresh, local food and the true costs of the conventional food system (Allen et al., 2003). Each of these observations are likely contributors to the differences; however, what is often overlooked is the relationship between where local sources of produce can be obtained and where lower-income neighborhoods are found, both in urban and rural communities, and the capacity of residents in these communities to traverse this distance. In a survey of California market managers, Guthman and colleagues (2006) found that nearly 52 percent believed local demographics played an important role in the income distribution of their customers. More recently, Kremer and DeLiberty (2011) highlight the socio-spatial disparities that support Guthman's observations, in that local food movements largely target middle- and high-income populations in Philadelphia; those that were found in lower-income neighborhoods were done so by the extended effort of food justice organizations. Observations of this type urge the question of whether farmers' markets are located in much the same manner as other food outlets, and whether this perpetuates the potential for spatial mismatch with poorer communities.

Several studies from the United Kingdom, Canada, and more recently the United States have begun to uncover what has come to be coined as "food deserts" (e.g., Wrigley et al., 2002; Smoyer-Tomic

et al., 2006; Sparks et al., 2009). Several definitions of food deserts have been suggested in recent years and vary by country of consideration, as well as by whether the researchers examined rural or urban settings. For example, Morton and Blanchard (2007) considered the entirety of the continental United States and identified food deserts as counties in which all residents must drive more than 10 miles to the nearest supermarket chain or supercenter. In contrast, Larsen and Gilliland (2008) estimated the prevalence of food deserts in London, Ontario, through multiple means, including within walking distance (grocery store within 500 or 1000 meters) and public transit availability (10-minute non-transferring bus ride combined with a 500 meter walk).

Despite efforts to provide quality representations of potential food deserts in many locales, the majority of such studies fail to include accessibility to farmers' markets in these areas considered food deserts. The studies identified above generally utilize grocery store and supercenter locations as the source of fresh produce. This report expands upon these previous studies by first establishing the traditionally conceived food deserts for Washington State. We then use an extended approach that allows us to assess whether the present distribution of farmers' markets throughout the state helps to alleviate these potential inadequacies of access, or whether this distribution perpetuates the disproportionate access. Additionally, we move beyond simply identifying potential gaps and provide a means by which we can understand the impacts of distance on lower-income communities' ability and willingness to access local sources of produce at farmers' markets. To achieve this, we examine the geographic variation in redemption rates of vouchers issued under the Women, Infants, and Children (WIC) program and the Senior Farmers' Market Nutrition Program (FMNP), as well as the rate of usage of Washington's Supplemental Nutrition Assistance Program (SNAP), formerly the Food Stamp Program, based on geographic separation. Finally, we utilize case study communities who self-identified food insecurity as a community problem and who have taken various measures to mitigate the insecurity through their participation in the Extension-based Horizons program, which targets the reduction of poverty in rural areas in Washington State.

The results of this research lead to a more thorough understanding of the variation in effectiveness of food assistance programs designed to reduce food poverty by increasing access to local produce markets, and suggest efficiency improvements in the programs. Washington is the third leading producer of organic produce in the United States (USDA, 2007) with numerous well-established and emerging farmers' markets throughout the state, making it a prime location for such a study.

BACKGROUND

Rural Communities and Rural Poverty

Today, rural families are significantly more likely to experience and witness the effect of poverty and a poor economy than nonrural families (Lichter, Roscigno, & Condron, 2003; USDA-ERS, 2009). Nearly a quarter of rural children were poor in 2007, compared to 17 percent of metropolitan children (USDA-ERS). This is strongly linked to a decline in the traditional labor market that often created these communities and sustained them through much of the 20th century. Gibbs notes, "The answers lie at the center of the rural workforce quality issue. The distinctive social and economic characteristics of rural areas [are] determined largely by existing job and human capital structures" (1998, p. 62). As farming moved to an agribusiness model, small family farms became a minority in the rural landscape (Fitchen, 1981). Extractive industries such as logging and mining also slowed down as resources diminished and the public demanded more conservation and stewardship. While resource-dependent communities have long been associated with higher levels of poverty and unemployment, these changes left many rural communities even more impoverished than before (Stedman, Parkins, & Beckley, 2004).

Not all rural communities are the same and some have weathered these economic changes better than others. For example, rural communities that are less dependent on extractive industries fare better in the economic landscape. Some rural communities that have natural beauty and recreational amenities have attempted to capitalize on a growing tourist industry, although with varying degrees of success (Alliance for Excellence in Education, 2010; C. B. Flora, J. L. Flora, & Fey, 2001). As urban centers expand toward rural communities, some become "bedroom" or "commuter" communities (Salamon,

2003). Although they often lack a strong infrastructure of their own, these communities tend to have higher housing values and tax bases for schools and public works (Renkow, 2007). Another common trend in rural communities is the growing elderly or retired population, which brings with it a new set of social and health services demands (Rowles, Beaulieu, & Myers, 1996). These types of changes bring about a different labor market of service or health-oriented jobs that are dominated by women and do not generally pay the same as the male-dominated extractive industry jobs they replace.

Poverty in rural areas is also likely to be persistent and long lasting (Tickamyer & Duncan, 1990). Lichter and his colleagues (2003) argue that families in poverty in rural areas do not look the same as families in poverty in urban areas because rural families are more likely to have two parents and at least one working adult. Although there is more family and child poverty in rural communities, rural families are less likely to be dependent on cash assistance or state-based food benefits (Lichter, Roscigno, & Condron, 2003). Qualitative research suggests this is because rural adults equate dependency with lower moral standing (Sherman, 2009). This discourse, which is significantly different than the discourse found in impoverished urban areas, may play an important role in our understanding of how food insecurity is identified and addressed in rural communities. Furthermore, MacTavish and Salamon (2003) report that the day-to-day living of many rural families has been transformed by the necessity to commute to urban areas for work and goods. Rural families are experiencing a "fragmented" daily life that resembles the lives of suburban families more than the rural families that came before them. Having fewer local shopping options contributes to the fragmented and travel-burdened experiences of rural individuals and families. The two communities[1] in this project, which are discussed in later sections, were purposefully selected because they represent distinctly different rural experiences across Washington State and have had varying levels of "success" in their attempts to address food insecurity issues through the creation of a farmers' market.

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[1]The names and some characteristics of the communities have been changed to protect the confidentiality of the communities and participants.

Concentration in the Retail Food System

In 1993, the top five retail food corporations (Kroger, Albertson's, Wal-Mart, Safeway, and Ahold) accounted for roughly 20 percent of the food-at-home (FAH) retail sales in the United States. By 2000, they accounted for greater than 40 percent of sales, and concentration (CR4) in any given metropolitan area exceeded 73 percent (Hendrickson et al., 2001). Since at least the early 1990s, the traditional supermarket has seen its share of food sales slowly erode as nontraditional retailers (supercenters, dollar stores, warehouse clubs, drugstores) have increased their share of the FAH sales from 17.1 percent in 1994 to 31.6 percent in 2005 (Martinez, 2007). This heightened competition has resulted in consolidation and concentration contributing to a changing relationship within the food marketing chain.

Not only have the large supercenters increased their share of the FAH, but the food-away-from-home (FAFH) market had grown to 48.5 percent of total food expenditures by 2005. These changing conditions have necessitated the traditional grocery retailers to respond through cost-cutting measures, product and store differentiation, or both. Much of this restructuring has come in the form of focusing on the most profitable stores in the most geographically beneficial areas (Martinez, 2007). With consolidation being the primary response to these downward price pressures, one must wonder if the consumer inherently benefits. An examination of these consolidating activities suggests that even where efficiency gains were realized, cost savings were not always passed on to the consumer (Sharkey & Stiegart, 2006). The lack of savings being passed on to consumers, is in addition to the identification that from 1992 to 2002, the number of grocery stores fell from 104,105 to 95,514. Similarly, the number of companies declined from 72,274 to 67,757 (Martinez, 2007), thus providing indication of an industry whose threshold, service area/population required to profitably operate, is increasing and likely leaving reduced access to already economically challenged populations, namely rural communities. With these trends at the heart of the matter, the impetus for this research begins to arise. Previous research has

documented the restructuring effects as local grocery stores that once served small communities being replaced by larger, chain stores at further distances from these communities (Morton & Blanchard, 2007).

Food Deserts, Community Food Insecurity, and Alternative Food Networks

Food desert definitions and their empirical measures represent a parallel, but separate, line of research within the Community Food Security (CFS) literature. The integration of food deserts and CFS literature can serve to broaden the discourse and achievable outcomes of both. One can envision food deserts as a symptom of the larger CFS issue, where CFS is understood as the situation in which all households have available to them the ability to acquire nutritionally adequate, culturally acceptable, and safe food, through a sustainable food system that maximizes self-reliance and social justice (Hamm & Bellows, 2003). Though the food desert and CFS literatures have remained largely unconnected, CFS has made inroads in connecting with AFNs and other sustainable agriculture movements (Allen, 2004). Recently, studies have begun to question and explore the potential for "win-win" scenarios in producing both farm and food security (Allen, 1999; Hinrichs & Kremer, 2002; Guthman et al., 2006). Guthman and colleagues explicitly ask whether it is possible to simultaneously provide fresh, nutritious food that is affordable to low-income consumers while providing adequate returns to small-scale, sustainable farmers via farmers' markets. They find that farmers' markets do not in and of themselves create an economic win-win for producers and low-income consumers without additional directed effort. Likewise, who pays for that directed effort remains contested, at least in the minds of market managers. These authors cited above suggest that sustained and substantial funding for food support programs like FMNP may bridge the gaps between the interest expressed by participants of AFNs and CFS.

Farmers' Market Nutrition Programs (FMNP) in Washington State

Women, Infants and Children (WIC): Since 1989, the FMNP of Washington has developed a cooperative effort with the Washington State Farmers' Market Association in an effort to provide locally grown fruits and vegetables for WIC families throughout the state. In addition to improving awareness

and access to farmers' markets by high-risk families, the program also educates participants about the benefits of eating more fruits and vegetables and their relationship to preventing chronic disease. The FMNP operates yearly, June through September, and is available to all enrolled WIC clients (pregnant women, breastfeeding women, postpartum women, children from newborn to 5 years old). All participants are given packets of ten $2 checks that are redeemable at all participating farmers' markets from June through September. In 2009 the program provided local farmers with $794,938 in sales to WIC participants through redeemed vouchers.

Senior FMNP: Where WIC seeks to increase local fruit and vegetable consumption of lower-income families, so too does the Senior program for those seniors (age 60 and older) who are below 185 percent of the Federal Poverty Level. The program seeks to reduce hunger among low-income seniors by providing up to $40 dollars per season in food assistance for use at farmers' markets or for direct purchase from the farmers and delivery to those seniors who may be homebound. In 2008, over 18,000 seniors were served by the program that runs from June through October. In 2009, the program totaled $700,312 in redeemed vouchers to local farmers. In addition to aiding in relieving hunger in seniors, the program also provides them the opportunity to be actively engaged in their local communities.

Horizons Program

Another partner in the effort to increase access to healthy foods in Washington State is the Horizons program, an eight-state initiative funded by the Northwest Area Foundation, which was introduced in Washington State with three pilot communities in 2004 (WSU Extension, 2009). The primary goal of Horizons is to reduce poverty in northwest rural communities. To accomplish this, 40 rural communities with fewer than 5,000 people and more than 10 percent poverty have engaged in an 18-month guided grassroots process with trained community coaches. Coaches help identify community leaders who engage other citizens in identifying community goals and strategies for meeting them. Community members also participate in several "study circles" (these resemble focus groups) and the Leadership Plenty training designed by the *Pew Partnership for Civic Engagement*. Community leaders,

with the support of their community coach, arrange and carry out multiple meetings over the course of two months (for a total of 12 hours). During these meetings participants work together to first determine what poverty looks like in their community. As one Horizon administrator noted, the metro-centric view of what individuals and families in poverty look like is not the type of poverty experienced or witnessed in rural places. At first, many participants in the Horizons Program did not recognize the poverty or homelessness in their community because, "No one is sleeping under the overpass." However, as participants are challenged to really consider the nature of their rural poverty, the group creates an accurate portrait of the types of poverty they would like to address in their community and ways they might take action to solve those problems. For some communities, it is families living with relatives because the adults cannot find living-wage jobs. For other communities the poor in their community are elderly adults who cannot afford and/or who are unable to travel for shopping, groceries, and medical care. Several communities have opened community centers, created community-based non-profit organizations, expanded opportunities for youth, and revitalized their economy with festivals and farmers' markets. For the purpose of this research, we focus on two of the 16 communities that either formally or informally identified food insecurity as a social issue contributing to the perpetuation of poverty and suggested farmers' markets as a part of the solution. The communities are introduced in Box 1.1 (Independence Valley) and Box 1.2 (Ferris-Border Ridge). Throughout the paper, we will return to these communities as we identify examples of how their experiences exemplify the topic being considered.

Box 1.1 – Independence Valley

Independence Valley is located in Eastern Washington about an hour east of a major metropolitan area and is considered rural, remote by the U.S. Census. Previously, a river ran through this valley and was diverted as part of the New Deal work projects. The diversion created supple, sub-irrigated farmland. The Valley's subsequent numbers swelled and Independence Valley proper took hold on what was previously the river bed. Being surrounded by forested mountains, a healthy logging industry also grew during the early and mid-20th century. Independence Valley currently has a population of about 2,000 that is primarily white (93 percent) and has been experiencing decreasing enrollment in all three of the schools over the past five or 10 years. Like many other rural, remote communities, the elderly or retired population has grown, while there has been a rapid decrease in young families with children following the exit of a major local employer. In 2001 a nearby mineral refinery plant closed its doors and took 300 good-paying jobs out of the community in a matter of three months. Today, the two main employers are the hospital and the school district. The Independence Valley School District serves about 350 students and has a free and reduced lunch rate of 60 percent.

Sixty-one residents of Independence Valley participated in the community-wide study circles in 2006 and food insecurity and access to good food (especially for those living in poverty) were identified as issues the Horizons Leadership Team wanted to address. This community was very specific in their goal of having systems in place that would make it possible for the market vendors to accept WIC and SNAP coupons as well as EBT benefits at the market. Spearheaded by a local minister, the process to assemble a farmers' market moved very quickly in Independence Valley. The first market day was in June of 2007.

Box 1.2 – Ferris-Border Ridge

The area surrounding and including the very small communities of Ferris and Border Ridge in southwest Washington is home to about 2,700 people. Like Independence Valley, this area is rich in outdoor recreational activities and is located a little more than an hour away from a major urban area. They have also experienced an influx of retirees and the elderly. The Border Ridge School District reported a 42 percent free or reduced lunch rate in 2010 and about 15 percent of families had incomes below the poverty line in 2000. An important difference between Independence Valley and the Ferris-Border Ridge area, beside geographic location, is the growing Latino population in the Ferris-Border Ridge area, as it has become one of the more recent receiving communities for Mexican immigrants seeking employment in Washington State's substantial agricultural industry. Even in 2000, nearly one in six residents identified themselves as Hispanic. Today, about one-third of the children in the school district are Hispanic.

In their strategic planning phase, the Ferris-Border Ridge participants agreed that access to food choices was limited in their community, as Border Ridge has one small grocery store and other options are at least an hour away and must be accessed via a narrow toll bridge. Their primary focus related to food insecurity was to create "food sustainability" in their community. As many people in the community would like to grow their own food, creating three vibrant community gardens was one of the primary action items outlined in 2007. The goal of the community gardens was to support the local food bank (which experiences high demand) and for it to be an anchor vendor, per se, for a local farmers' market. The later creation of a farmers' market was to support the community garden and to give local low-income gardeners and farmers the opportunity to sell their produce to others in the community. The community gardens came to fruition in the spring of 2008. The farmers' market in Border Ridge began in June of 2009.

DATA AND METHODS

The following sections contain the methodological steps taken to achieve the previously outlined goals of the study. Analysis begins with a traditional food desert assessment followed by expansion into the consideration of farmers' market roles in alleviating or perpetuating those deserts. Subsequent to the identification of low-access areas, we study the accessibility through observed food assistance redemption. Intermixed within the study are collective case studies to illuminate the strengths and difficulties of establishing farmers' markets in economically challenged rural areas of Washington State.

Supermarket Accessibility

Supermarket Locations: A spatially referenced database of all supermarkets in the state of Washington was created consistent with much of the existing literature on food deserts. Similar to the

restrictions used by Sparks and colleagues (2009), these supermarkets are assumed to sell a full host of food products, though the requirement that they be a part of a large distribution system supplying multiple stores or a chain is relaxed in order to maintain those grocers that remain independent entities of significant size. We begin from the premise that those supermarkets that employ at least 50 employees will likely be able to supply the full host of products, a measure also used by other analyses including that by Blanchard and Matthews (2007). The database is populated using a dataset from ReferenceUSA. The complete dataset includes 3,812 retail food sources ranging from supermarkets down to convenience stores. From this original set, all retailers whose primary or secondary designation aligned with what could reasonably be considered a major food retailer was designated a "grocer." These designations include, but are not limited to: Grocer-Retail, Department Store (e.g. Fred Meyer); and Grocer-Wholesaler, Wholesale Club (e.g., Costco). All designations not meeting the established requirements were designated "non-grocers." In addition, those potentially meeting the correct designation, but having fewer than 10 employees, were also designated as "non-grocers." The grocer designees were further segmented by employee size with the creation of three categories: > 50 employees, > 20 employees, > 10 employees. Spot checks of the data and consultation with the data-generating firm have been conducted to verify the reliability of the data. The remainder of the report is conducted using the subset of grocers that meet the 50-employee cutoff. Discussion of the ramifications of relaxing the employee cutoff to the smaller store size levels will be addressed in the concluding remarks of the report.

Food Desert Determination: Food desert determination is generally conceived as a function of a population's ability to traverse a specified distance to a source of good food. Given the highly diverse geographic setting of Washington, one metric for this assessment does not capture a reliable measure of access limitations for all residents of the state. As such, two metrics are used; the first is based on walkable distances and used for the denser tracts, while the second uses a driving distance for the sparser tracts. To make a logical separation of which tracts to consider under which metric, the 2000 U.S. Census Tracts and the Urbanized Areas (UA) of Washington are used to designate those areas to be considered urban and thus warranting consideration via walkable distances. Section 2 of this report explores the 13

UAs of Washington, analyzing each on a case-wise basis. Those UAs that cross the state boundary (Vancouver-Portland and Lewiston-Clarkston) will be considered only in relation to the Washington components. Sparks and colleagues (2009) can be referred to for an evaluation of Portland, Oregon.

Hewko and colleagues (2002) suggest that access to amenities under the assumption that the population may likely walk, can be estimated using a Euclidean distance given the propensity of walkers to use a combination of network sidewalks and "shortcuts." A reasonable walking distance of 1 km will be used as the estimated breakpoint between high and low access. This measurement maintains general consistency with other food desert studies whose walking distance for urban areas tend to range from 0.5 km (Wrigley et al. 2003) out to a 1-mile walk (USDA-ERS, 2009b). However, the same is not true for driving trips in which the path is almost without exception linked to the road network. As such, the network will be the basis for measuring access for the remaining tracts of the state. By using travel distance over a Euclidean distance, we can more reliably estimate the time constraints that affect consumer decisions or inabilities to navigate required distances. Identification of what constitutes high versus low access has typically been done using a 10-mile (16.1km) estimate. All areas within this distance will be considered high-access areas, while those areas beyond this distance will be considered low access. Those tracts considered to be low access and that have greater than 20 percent of its population living under the poverty level, according to the 2000 Census, are deemed to be food deserts.

To develop an accurate measurement of the distance that a neighborhood or tract must travel to access a food source (supermarkets, convenience stores, and farmers' markets), the tracts are first disaggregated to their block level points and their associated population counts. By using the block level population counts rather than the geographic centroid of the tracts, a more precise measurement of the variability of the population within the tract can be accounted for. Distances, Euclidean in urban and network in rural, from these geographically accurate block points are then aggregated to the tract level to estimate the population weighted distance to the nearest retail food source. The calculation for this aggregation is as follows:

$$T_i = \frac{\sum_{k \in i} b_k (min|d_{kj}|)}{\sum_{k \in i} b_k}, \qquad \text{(Equation 1)}$$

where, T_i is the population-weighted accessibility for the tract neighborhood i, b_k is the total population of block group k, and d_{kj}, is the distance between block k and retail source j. Hewko and colleagues (2002) conclude that such a weighted distance calculation minimizes the aggregation error relative to other methods that fail to account for uneven population distribution within a tract.

Farmers' Market Accessibility

As efforts to re-localize the food system continue to flourish, a reflective eye must be focused on the distributional tendencies, both spatially and temporally, of farmers' markets. If claims of the alternative or counter ethic of local foods are to be substantiated in relation to farmers' markets, then market location and timing should be carefully considered in relation to the distributional tendencies of the current system of food retail. Thus, this section seeks to identify whether farmers' markets increase access to good food, or simply reproduce the gaps that already exist.

Farmers' Market Locations: Washington's collection of farmers' markets is increasing yearly, with the large majority being centered in the vicinity of the greater Seattle area:[2] 57 out of the total 169 markets in 2010. We have collected and maintained an accurate database of market locations and operating hours for these markets and continue to update it as new markets come on, move locations, or fail. Using this dataset of markets, the sites were geocoded in ArcGIS to the most accurate level feasible. Unlike supermarkets and other permanent sites of retail activity, a farmers' market may move from year to year. This is especially true for the lesser or non-established markets as they seek out the most suitable site to locate (Box 1.3). With such uncertainty and variability in market locations, all attempts were made

[2]The "Greater Seattle Area" refers to the area of the east side of the Puget Sound that is within the Seattle-Tacoma Urbanized Area (UA).

to geocode the sites to the most recent market location that corresponds to the location of the market during the time period for which data on food assistance redemption figures were estimated.

Box 1.3 – Finding that 'Sweet Spot'

Finding just the right location for a market is perhaps one of the most important aspects faced by new managers and supporters as they seek to get a market up and running. The local Protestant church's grassy parking lot seemed like a prime location for Independence Valley's upstart market in 2007. The area was nicely shaded, with a creek running along the back side—a great spot to hold what was hoped to become an annual kids' carved Regatta race. However, it was off the main road through town and not readily visible to passersby. John, the volunteer market president, had a better site in mind and, come the 2011 season, the idea of moving the market to the city park came to fruition. The location was seen as a great improvement over the church's parking lot. The park was right on the main street, making it highly visible to passersby as they drive through town from either direction. The same creek running past the church also ran through the park, keeping the Regatta tradition in full swing.

As great a spot as this was hoped to be, the opening day of the 2011 season was nearly lost. The wet spring had let loose the week prior and the creek spilled over its banks, flooding the park. Fortunately, the ground dried enough, though it was still rather squishy, by market day that an opening day record of 18 vendors in 19 spaces filled the northeast corner of the park. Previous years had seen an average of only 12 vendors throughout the season. The enthusiasm for the new location was evident. John is quoted in the local paper as saying, "We probably have the nicest location of any farmers' market around. I have never been to a market in a prettier spot."

Alleviate or Perpetuate Food Deserts? Using the food desert criteria described above for the conventional food retailers, we identify the areas that appear to continue to be underserved by farmers' markets. By overlaying these areas with those found in the traditional "food desert" analysis, we develop a picture of whether farmers' markets are alleviating potential food insecurities of various communities, or whether they are actually exacerbating them by adhering to similar market forces that resulted in the present supermarket distribution.

Voucher Redemption Rates and EBT Utilization

Identification of food deserts and gaps in accessibility of farmers' markets are only half of the equation. Several studies have demonstrated the remarkably low, less than 25 percent, participation rates

in farmers' markets of those receiving food stamps (e.g., Kantor, 2001). Similarly, Conrey and colleagues (2003) observed WIC FMNP redemption rates of less than 70 percent over the span of 1996 to 2001. In 2010, Washington WIC/FMNP recipients redeemed 69 percent of the distributed vouchers. Alexander (1996) suggests that the three keys to improving the success of FMNPs are education, access to markets, and market quality. To get at the heart of the food insecurity issue in this study, these observations are put into action through a test of whether increased travel time requirements actually create food deserts or whether they are simply an obstacle that communities and neighborhoods must learn to overcome, and do overcome.

To do this, data was obtained on the dollar value redeemed at each participating farmers' market in the state from both WIC and the Senior FMNP in 2009 and 2010. Further, we also establish a sense of market quality via the number of farmers' that are authorized participants at each market. Redemption rates are evaluated in relation to market location in order to examine the impacts of required travel time and accessibility. Limitations of available secondary data prevent perfect knowledge of how far each WIC voucher recipient must travel to redeem their vouchers. As such, data is available on the number of vouchers issued by each WIC clinic and the number of those vouchers redeemed. Using this available data, WIC clinic sites are used as an initial proxy for recipient location. Clinic service areas are subsequently constructed using a similar population weighted distance equation displayed in equation 1. However, in this situation we are concerned with the population weighted distance from the census block to the nearest WIC clinic. The assumption that participants will travel to the nearest clinic is a simple though often realistic assumption (Burkey, 2010). Once clinic market areas are established, regressions can be estimated to understand the influence of farmers' market accessibility, as measured by distance to the market, on clinic level redemption rates. Additional covariates accounting for clinic market area include poverty rates, access to other food retail outlets, as well as indications of racial makeup. Given that the regression is conducted on variables that span the state, concern for potential heteroskedasticity and spatial dependence is taken and tested for through their associated diagnostic tools.

Selection of Case Study Communities

Of the more than three dozen Washington communities that have participated in the Horizons program, 16 directly or indirectly identified food insecurity, availability, and/or affordability as a community problem and sought to create farmers' markets or other local food projects in response to this need. Two of these communities, located in regions of Washington that are demographically unique and rely on distinctly different industries, have been chosen for further consideration. According to the 2000 Census, the population in these communities ranges from 1,823 to 2,193, with poverty rates ranging from 17 percent to 27 percent. Each community proposed establishing a farmers' market or other community food generating source (e.g., community garden) in either 2008 or 2009. The smallest community (which also has the highest poverty rate) specifically outlined plans to become FMNP certified. This report explores these Horizons communities as "collective" case studies. Collective case studies involve using particular examples to suggest possibilities and to open future debate rather than seeking to make claims for truth (Cousin, 2005). To implement these case studies, we conducted interviews with each market manager and other prominent organizational members to begin to understand how well they feel they are achieving the food goals the community set out to achieve and how these efforts strengthen the overall community goals developed through the Horizons program. In addition, interviews were conducted of several of the key, anchor farmer vendors. Finally, to complete the case studies, each market and associated community was visited and observed by the research team to get a sense of the interactions, both monetary and social, that take place throughout the day of the market. In order for the case studies to contribute to our understanding of how the farmers' markets impact community food security, we asked questions related to, but not limited to, local producer participation, community support at all socioeconomic levels, food diversity (fruit and vegetables, dairy and eggs, meat), strategies being employed to ensure low-income and minority participation, and perceived stability of their markets. Through these discussions, we seek to identify future avenues of action to improve the vitality and

effectiveness of such grass-roots originating endeavors, with goals of both feeding these communities and supporting their farmer neighbors.

SECTION 2: WASHINGTON'S RETAIL FOOD AND DEMOGRAPHIC LANDSCAPE

The retail food landscape of Washington for the purposes of purchases for "food at home" (FAH) is readily observed to have two mostly distinct components—that of the urban food-scape and that of the rural food-scape. As such, it is not surprising that there is a high density of grocers (more than 50 employees) in the greater Seattle area, as well as other, smaller clusters in the other Urbanized Areas (UAs) of the state (Figure 1). These UAs are highlighted in Figure 2, as the lighter regions along with the locations of the farmers' markets. This figure suggests that farmers' markets form rather similar clustering in the UAs and throughout the state as do the grocers. There are markets in several rural areas, however, not served by what is being considered to be a full-service grocer.

Figure 1. Grocers with at Least 50 Employees

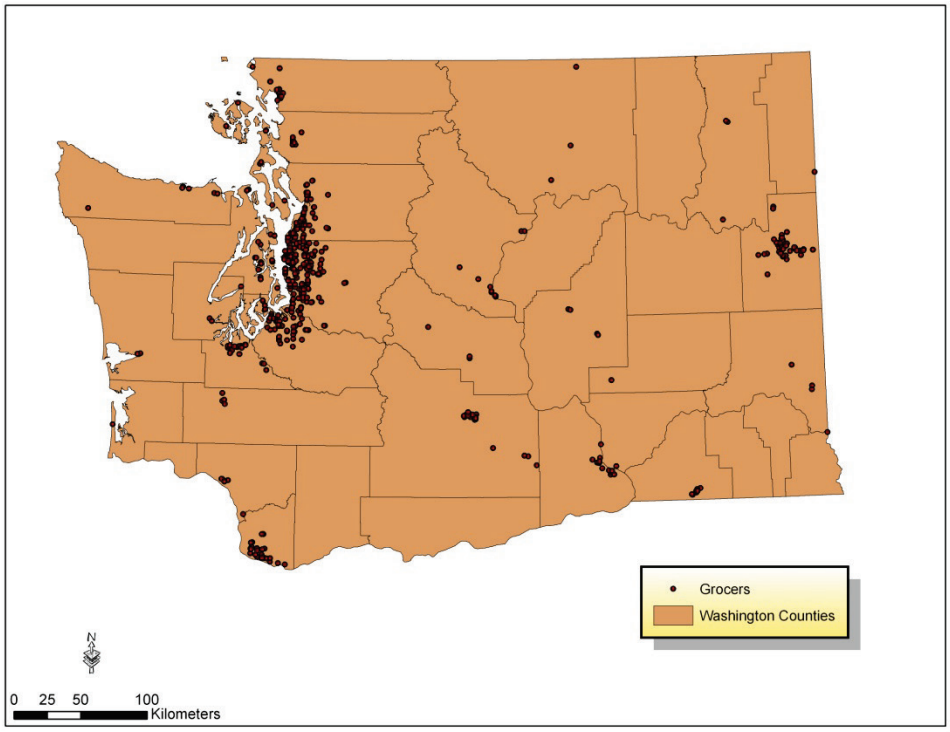
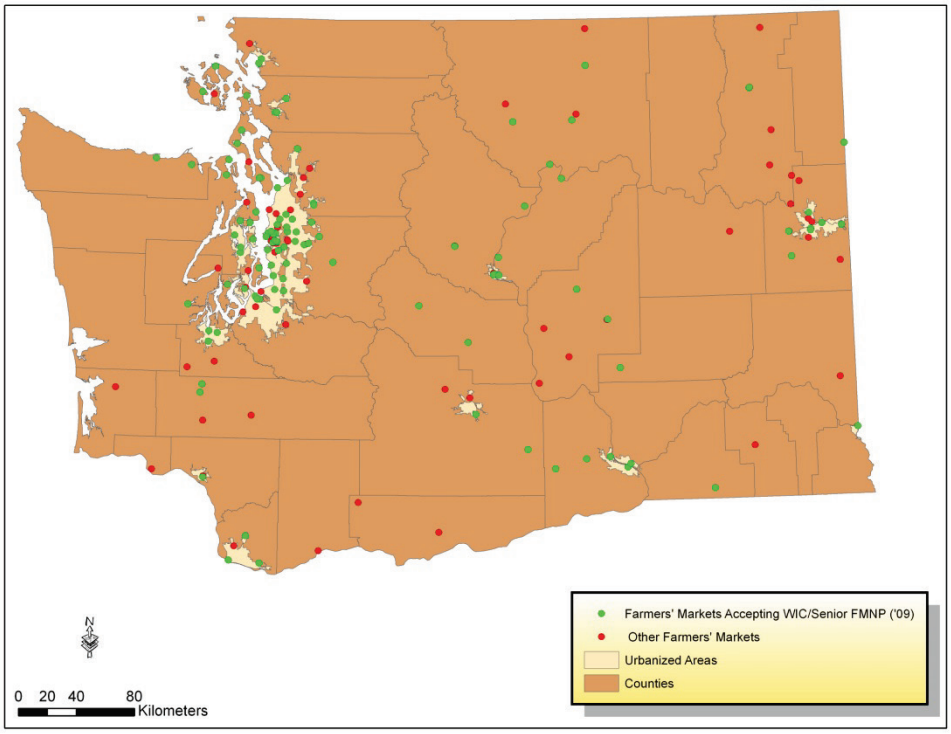


Figure 2. Farmers' Market Locations



The food desert notion is a twofold phenomenon. It is the manifestation of not only the distance needed to travel to obtain healthy and affordable food, but also the ability to traverse that distance in a reliable and consistent manner without undue hardship. Figure 3 below peels Washington to the next layer in the depiction at the tract level of poverty throughout the state. The figure suggests a spatial pattern as to where high poverty occurs, both in urban and rural contexts. Figure 3 additionally reveals the occurrences of rural food deserts. Note where these food desert tracts are located in relation to the large gaps between supermarket occurrences from Figure 1. The scatter plots in Figure 4 provide a means to test that which is casually observed in Figure 3. The Moran's I statistic is a test of the occurrence of spatial autocorrelation in a variable, where spatial autocorrelation is defined as the correlation of a variable with itself throughout space. Spatial autocorrelation of high poverty rates becomes important when considering amenity (e.g., food) access inequalities. Frame one of Figure 4 demonstrates a Moran's $I = 0.4794$ ($p < 0.001$), when considering the value of the poverty rate by tract, thus indicting a very significant degree of clustering; neighboring tracts tend to be more alike than distant tracts. Similarly, frame two displays an even higher

degree of clustering, $I = 0.5332$ ($p < 0.001$), when considering vehicle ownership rates. The owning or accessibility of a vehicle is an important determinant in traversing the necessary distance between residence and food retailer. Frame three is a bivariate depiction of a Moran's I, in which, rather than assessing a variable in relation to itself at neighboring tracts, the value of poverty is assessed in relation to neighboring vehicle access rates. This frame indicates that not only can tracts be considered to be clustered by poverty rate, and by vehicle ownership rates, but that these two variables are mutually clustered, $I = 0.3383$ ($p < 0.001$).

Figure 3. Statewide, Tract-Level Poverty Rates

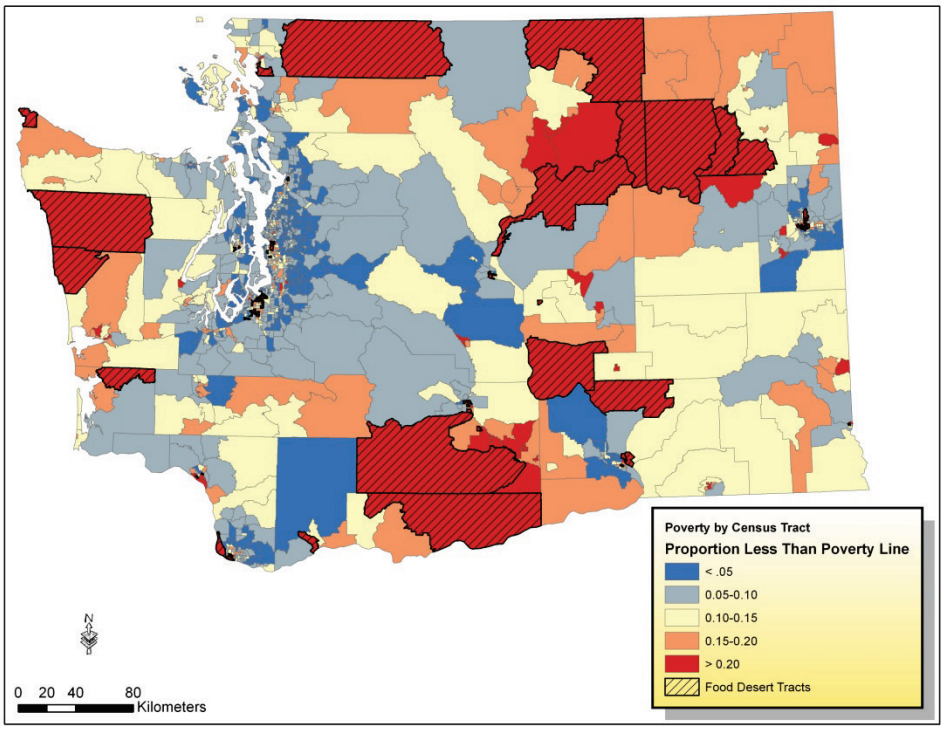
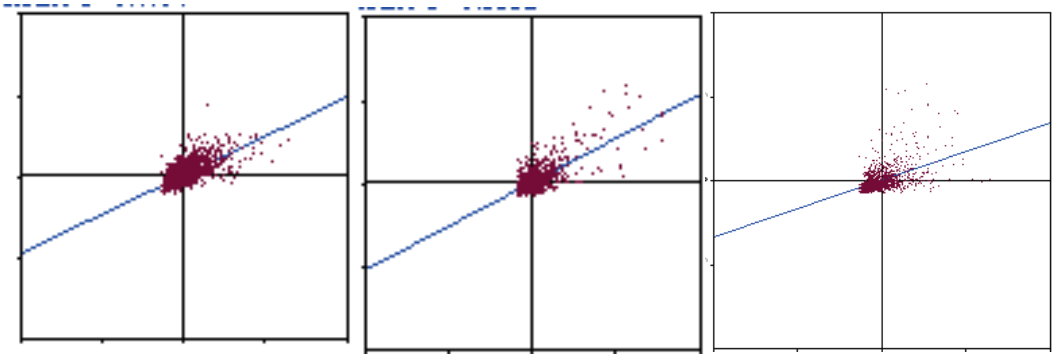


Figure 4. Moran's I Scatter Plots

(1) Proportion of the population that is less than the poverty line; (2) Proportion of the population that does not have access to a vehicle; (3) Bivariate plot of the Proportion of the population that does not have access to a vehicle compared with those that are below the poverty line.

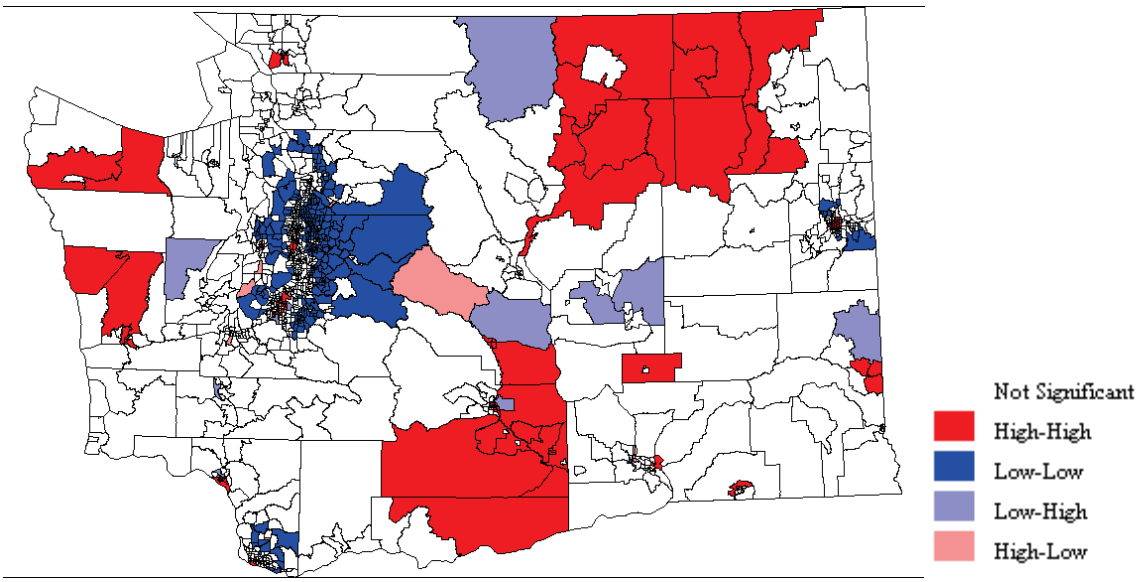
(1) (2) (3)



I = 0.4794 ($p < .001$) I = 0.5332 ($p < 0.001$) I = 0.3383 ($p < 0.001$)

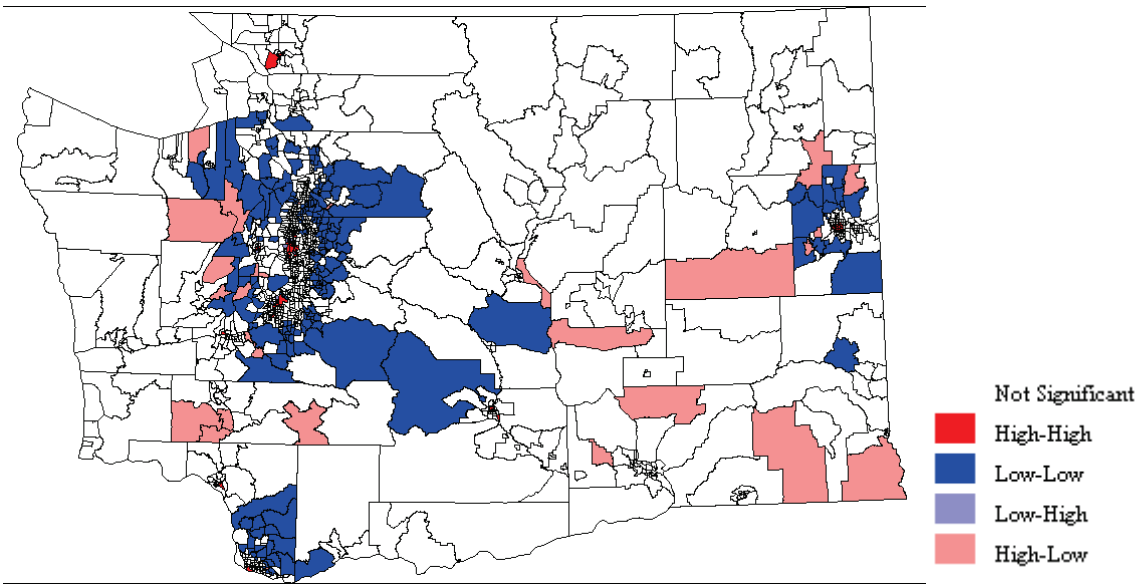
The Moran's I results above are global indicators of spatial autocorrelation, meaning considered over the entire statewide study area. Although they are very useful when considering spatial patterns as a whole, the interest of this report is the local level access-equality constraints felt by high-poverty neighborhoods. With this objective in mind, a local indicator of spatial autocorrelation (LISA) is additionally used. LISA, as opposed to Moran's I, provides indication of where significant clustering occurs and whether that clustering is high-poverty tracts clustered with other high-poverty tracts or low-poverty tracts clustered with other low-poverty tracts (Figure 5). From this LISA cluster map, observable trends in relatedness to the food desert map (Figure 3) begin to unfold. Large areas of blue (low-low) fall in many of the suburban regions of the larger UAs, while several of the urban core districts and remote rural regions appear in red (high-high). These observations of localized clustering occur at least at the $p < 0.05$ level using a first order, queens contiguity weights matrix.

Figure 5. LISA Cluster Map of the Proportion of Tract Population That Is Less Than the Poverty Level



Similar to Figure 5 above, Figure 6 below provides a multivariate LISA cluster map. Frame 3 of Figure 4 above provides evidence of a statewide spatial relatedness between poverty and vehicle access, while Figure 6 below depicts where these clusters show to be significant, at at least the $p < 0.05$ level. In Figure 6, the blue regions (low-low) indicate clustering of low poverty levels with low proportions of the population that do not own vehicles. Red clusters (high-high) suggest high poverty rates tracts whose neighbors have high rates of no vehicle ownership that depart from what would be expected under conditions of spatial randomness. Of important note here is the lack of red regions in the rural areas where it was earlier observed to have high-poverty levels. In their place, either insignificant associations occur, or alternatively, the pink (high-low) tracts indicate high poverty tracts in association with neighbors whose lack of vehicle ownership is on average low. This observation suggests that despite high poverty rates in rural tracts, access to a vehicle is not as much an inhibitor as it is in the urban settings. However, this does not imply a reliable vehicle, or the ability to drive it.

Figure 6. Multivariate LISA Cluster Map of the Proportion of the Tract Population That Is Less Than Poverty Line as Compared with the Proportion That Does Not Have a Vehicle



SECTION 3. THE URBAN FOOD DESERT

General Result Summary

Washington has 13 UAs, of which three contain no tracts that meet the food desert criteria set forth in this report either because there are no tracts with greater than 20 percent poverty (Olympia-Lacey, and Marysville) or because those high-poverty tracts that may be present do not demonstrate low-access conditions (Mount Vernon). Within these 13 UAs, 737 tracts out of the total 1,004, could be considered low-access tracts, meaning their population weighted distance to a full service grocer (> 50 employees) is more than a 1 km walk. Relaxing the 50 employee cutoff to one of 20 employees, brings 63 tracts out of the low-access designation, leaving 674 tracts remaining at a distance greater than 1 km. Meanwhile, 345 of the 737 low-access tracts, 47 percent, are at distances less than 1 km from a non-grocer. Recall that non-grocers are those establishments, such as convenience stores, that are considered not to be a full-service food retail outlet, yet have some food available. Considering now just the high-poverty tracts, 64 of the 104 are found to be low access. This observation, compounded with the previously described

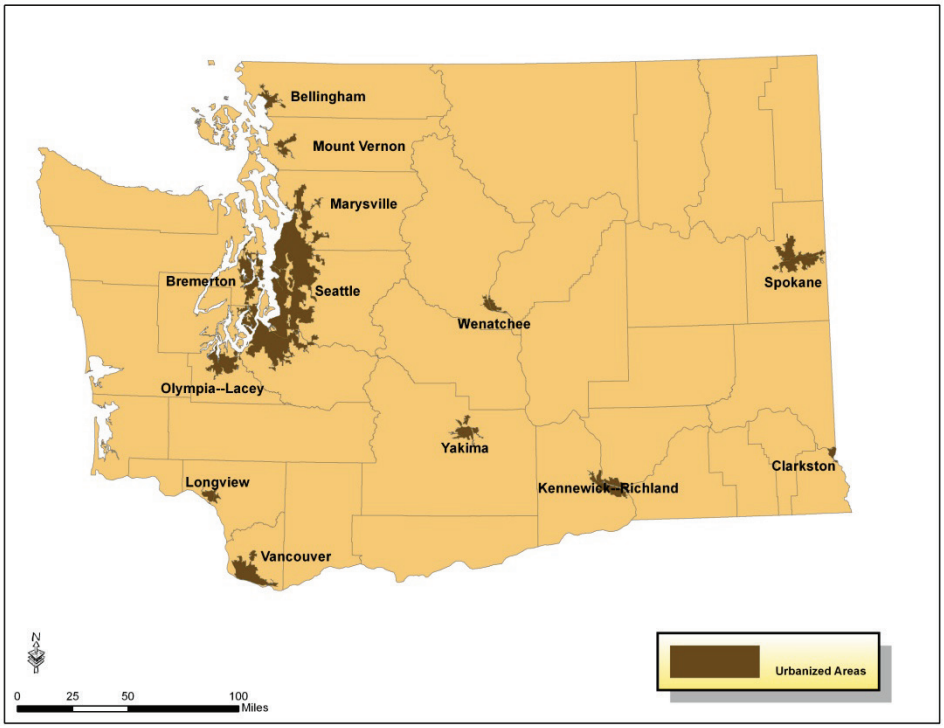
relationship between poverty and vehicle ownership in urban areas, leads us to identify these 64 tracts as the urban food deserts of Washington. A full 59 of these 64 tracts, 92 percent, are found to be at distances less than 1 km from a non-grocer.

On average, urban tracts are found to be 2.06 km from a full service grocer; 1.23 km from a non-grocer (e.g., convenience store); and 4.24 km from the nearest farmers' market. Narrowing the focus to just those tracts with a high poverty rate, we observe a reduced distance to food source for each category: 1.36 km to a grocer; 0.57 km to a non-grocer; and 2.40 km to a farmers' market. These averages may at first seem counterintuitive given our premise is centered on the lack of access for high poverty tracts; however, these results are consistent with those previously observed in the Portland area by Sparks and colleagues (2009). They suggest the distribution may be attributable to the spatial history of the region, the recent and steady population growth, and land-use planning laws that result in less-concentrated residential poverty and thus less-defined access issues. That being said, we do still observe 62 percent of the high-poverty urban tracts having food access constraints. Additionally, Sparks and colleagues point out that the food desert classification used here and in their work identifies only the access limitations of those poorer residents that live in tracts of high poverty concentration, and omits those that live in less-concentrated tracts. Subsequently, they suggest the potential for food access problems outside of food desert considerations. The urbanized areas of Washington support this concern. Using the 2000 census, we can identify nearly 3.5 million residents residing in tracts that we deemed low access, of which almost 300,000 lived below the poverty threshold. Just fewer than 70,000 of these residents live in identified high-poverty tracts. Thus, considering only high-poverty tracts omits 77 percent of the urban population living below the poverty line.

Turning now to the location of farmers' markets in relation to the observed food deserts in urban areas, we can observe that of the 64 food desert tracts, 16 are now within 1 km of a farmers' market. Of the nearly 70,000 food desert residents in the 2000 census living below the poverty line, 23 percent are now less than 1 km from a farmers' market. The 16 tracts are spread throughout the state, with eight of the ten UAs having food desert tracts possessing at least one farmers' markets within walking distance (1

km)—only Yakima and Clarkston do not. The subsections below provide more detailed explanations of the occurrence of food deserts in each urbanized area (Figure 7).

Figure 7. Urbanized Areas of Washington



Bellingham

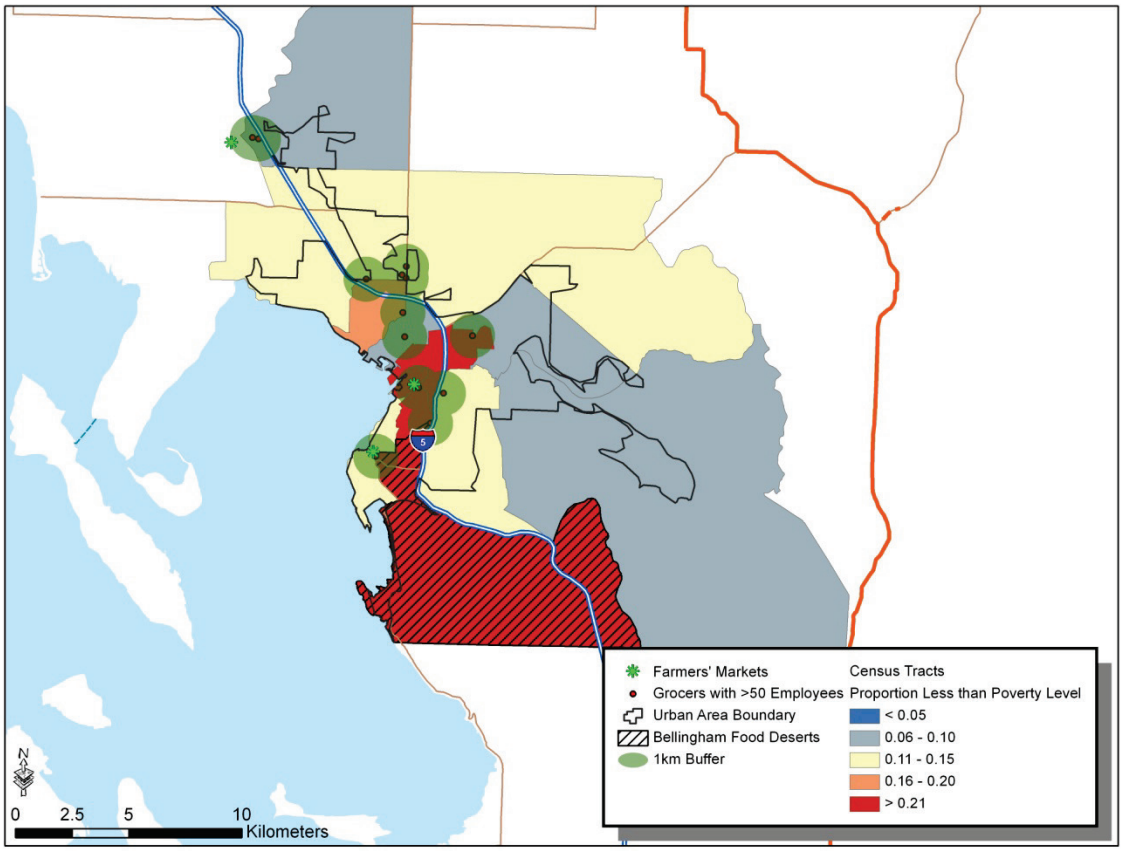
There are 14 census tracts that are contained in, or intersected by, the Bellingham Urbanized Area boundary. Five of the 14 tracts are considered high poverty, with one of them also having low access and thus fitting the designation of a food desert tract. Figure 8 below depicts the spatial arrangement of the grocers in relation to the tracts of varying poverty levels for Bellingham. From the figure, and Table 1 below, we can observe that four of the five high-poverty tracts have reasonable access to multiple grocers. Further, by observing the locational patterns of the local farmers' markets, we can see that neither market increases geographic accessibility to areas not already served by a retailer (shaded in gray). At the scale used in the displayed map, each market appears nearly on top of the grocers.

Looking more closely at the characteristics of the markets, we observe that both markets accept WIC and Senior FMNP as well as SNAP (EBT). The two markets are by the same organization with one in operation on Wednesdays and the other on Saturdays, thus distributing availability of a market out temporally. The Saturday market is considerably larger, with an average of 90 farm vendors, while the Wednesday market typically saw 12 farmers in the 2009 season. Data relating to WIC redemption is reported as a single market. Together they collected $17,240 from the Senior FMNP and $16,436 from the WIC program in 2009. In 2010, the Senior program took in $18,868 and the WIC program took in $18,654. The third market in the northwest corner of the map does not accept either WIC/Senior FMNP vouchers or SNAP benefits.

Table 1. Bellingham High-Poverty Census Tracts

High-Poverty Tracts	Proportion Less than Poverty Line	Proportion with No Vehicle	Proportion Hispanic/ Latino	Proportion Black	Distance to Grocer (km)	Distance to Farmers' Market (km)
1	52%	12%	3%	1%	0.87	1.16
2	31%	10%	4%	0%	2.59	3.00
3	28%	14%	6%	1%	0.94	1.31
4	27%	53%	5%	2%	0.65	0.49
5	24%	9%	9%	1%	0.78	2.89

Figure 8. Bellingham Retail Food Distribution



Bremerton

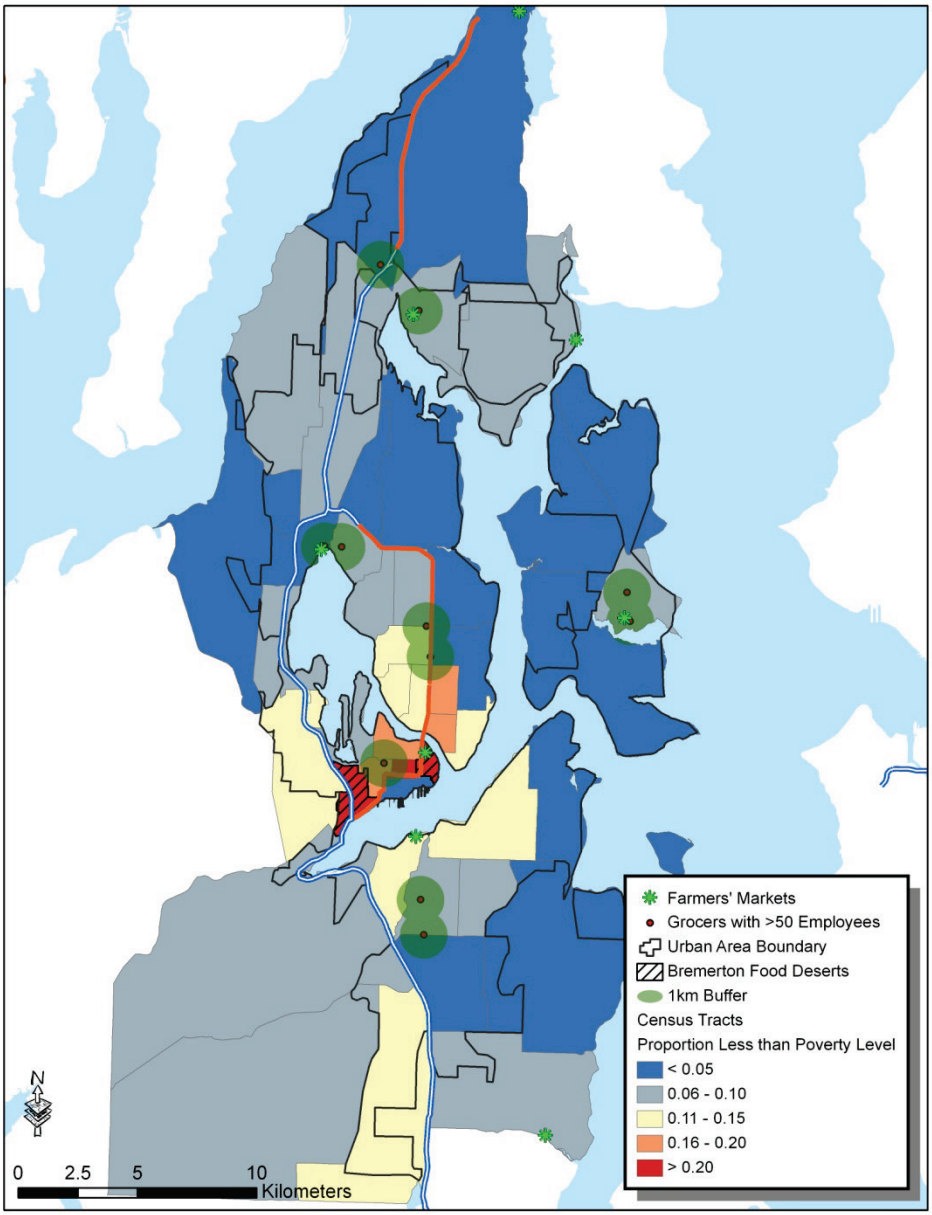
There are 45 census tracts that are contained in or intersected by the Bremerton UA, of which only three have a poverty rate greater than 20 percent. Two of the three high-poverty tracts demonstrate low access to a grocer and may be considered food deserts under our constructs. The tract identified as '1', in Table 2 below, appears to have high-access to a farmers' market, despite its low-access to a grocer. The market within this tract accepted WIC/Senior FMNP benefits in 2009 and 2010, as well as EBT in at least 2010. WIC sales contributed $3,376 and Senior FMNP contributed $2,904 in the same year, accounting for a combined nearly one-quarter of the total revenue taken in by the market's farmers. The following year, 2010, saw similar redemption values with WIC accounting for $3,600 and the Senior FMNP for $2,722. The farmers' market in Figure 9 that is not located near the high-poverty area also

accepts WIC/Senior FMNP and EBT. It has more than four times the value of farm sales (six times the average number of farmers present) as the previously discussed market, but took in nearly the same amount of WIC benefits ($3,884), though significantly more from the Senior program ($6,076) in 2009. Similar results are seen in 2010 for this market, taking in $3,266 and $5,084, respectively, for WIC and the Senior FMNP. The two farmers' markets located to the northwest of the food desert market are both larger in terms of number of vendors participating; however, they each took in roughly two-thirds of the WIC values as the market in the high-poverty area. It is also important to note from Table 2 that both of these tracts have rather high percentages of no vehicle ownership.

Table 2. Bremerton High-Poverty Census Tracts

High-Poverty Tracts	Proportion Less than Poverty Line	Proportion with No Vehicle	Proportion Hispanic/ Latino	Proportion Black	Distance to Grocer (km)	Distance to Farmers' Market (km)
1	34%	38%	9%	7%	1.81	0.54
2	31%	23%	5%	7%	2.13	3.17
3	21%	16%	6%	3%	0.9	1.21

Figure 9. Bremerton Retail Food Distribution



Clarkston

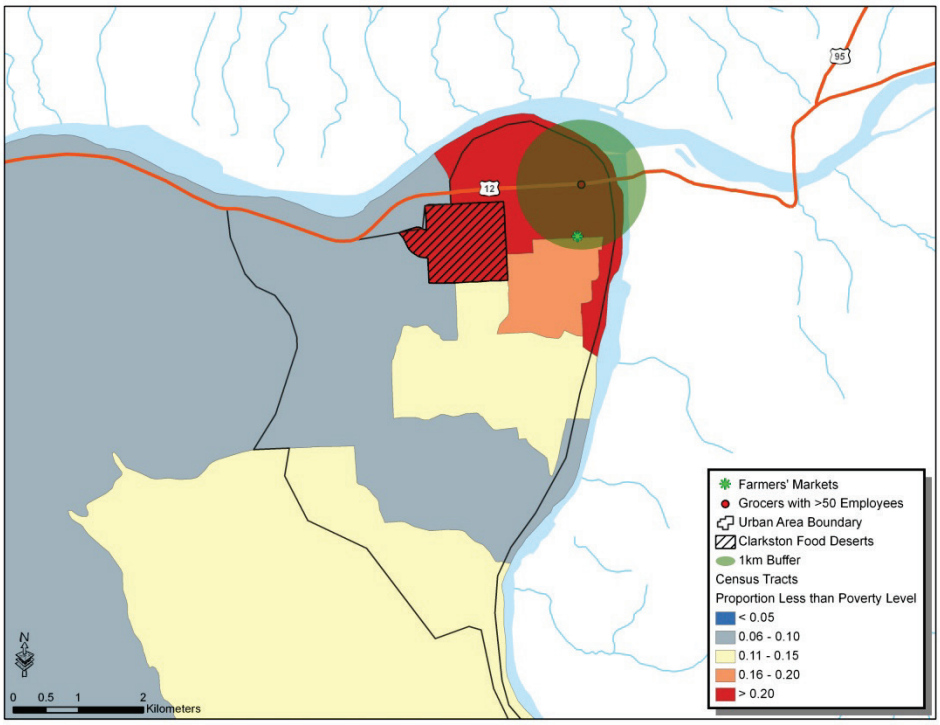
Clarkston is one of the smallest Urbanized areas included here and is generally considered an urbanized area only in conjunction with its Idaho counterpart, Lewiston. However, for our purposes, we are only considering the Washington side. There are six census tracts that are aligned with the Clarkston side of the urbanized area, and of these six, two are considered here to be high-poverty tracts. From

Figure 10, we can see that the lone area farmers' market falls within the 1 km buffer of the lone grocer, and from Table 3 we can further see that the identified food desert community remains outside of the farmers' market's 1 km distance. Fortunately, we can also observe that both the grocer and the farmers' market are in close proximity to the high poverty tracts with a substantially higher non-vehicle ownership group. This market accepted Senior/WIC/EBT in 2009 and 2010. In 2009, they took in $2,644 from WIC vouchers and $2,694 from Senior FMNP. Similar returns from 2010 with $2,016 from WIC and $2,372 from the Senior program.

Table 3. Clarkston High-Poverty Census Tracts

High-Poverty Tracts	Proportion Less than Poverty Line	Proportion with no Vehicle	Proportion Hispanic/ Latino	Proportion Black	Distance to Grocer (km)	Distance to Farmers' Market (km)
1	26%	4%	2%	0%	2.01	1.73
2	25%	13%	2%	0%	0.89	0.87

Figure 10. Clarkston Retail Food Distribution



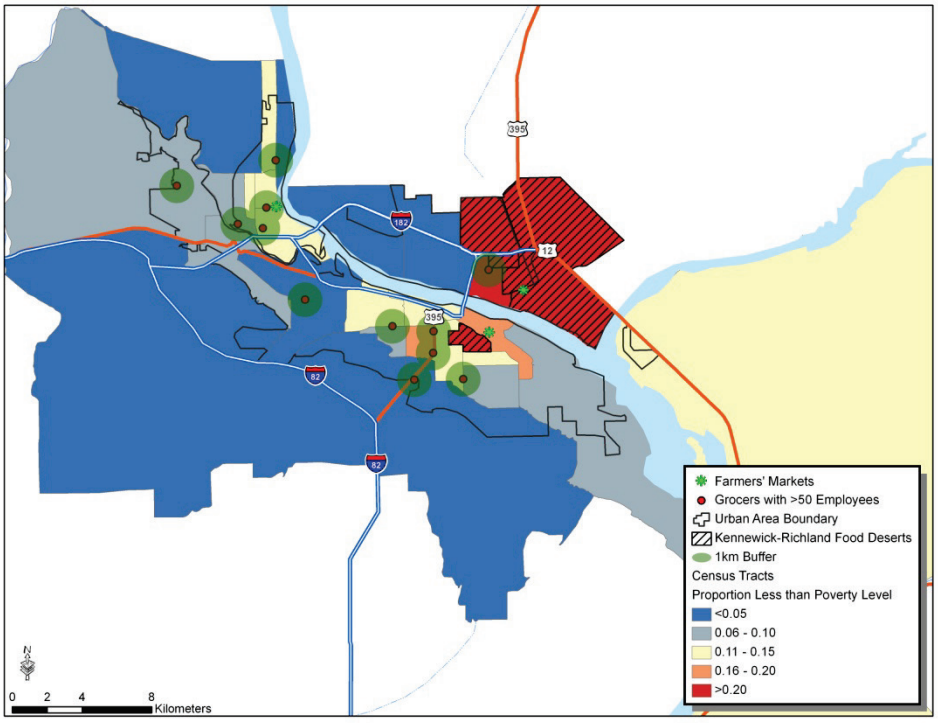
Kennewick-Richland

The Kennewick-Richland Urbanized Area contains an associated 30 census tracts, of which five have greater than 20 percent of the population below the poverty line (Figure 11). The three markets in the vicinity all accepted WIC and Senior FMNP vouchers in 2009 and 2010. The market located in the high-poverty/low-access area north of the river brought in $54,386 from WIC and $23,062 from the senior program in 2009 (the authors do not yet have data on how this compares to the total market revenue). Meanwhile, the southernmost market on the map collected $2,272 from WIC and $974 from the Senior Program. Finally, the market at the northwest corner, which is substantially larger than the southernmost market, brought in a similar amount of WIC and Senior FMNP dollars, at $3,728 and $2,528, respectively, and in 2009 accounted for roughly 3 percent of farmer sales at the market.

Table 4. Kennewick-Richland High-Poverty Census Tracts

High-Poverty Tracts	Proportion Less than Poverty Line	Proportion with No Vehicle	Proportion Hispanic/ Latino	Proportion Black	Distance to Grocer (km)	Distance to Farmers' Market (km)
1	0.37	0.2	0.72	0.01	1.67	0.92
2	0.33	0.18	0.4	0.02	1.8	1.49
3	0.31	0.13	0.61	0.03	0.91	2.26
4	0.23	0.08	0.6	0.02	1.23	2.08
5	0.23	0.09	0.79	0.05	3.46	1.64

Figure 11. Kennewick-Richland Retail Food Distribution



Longview

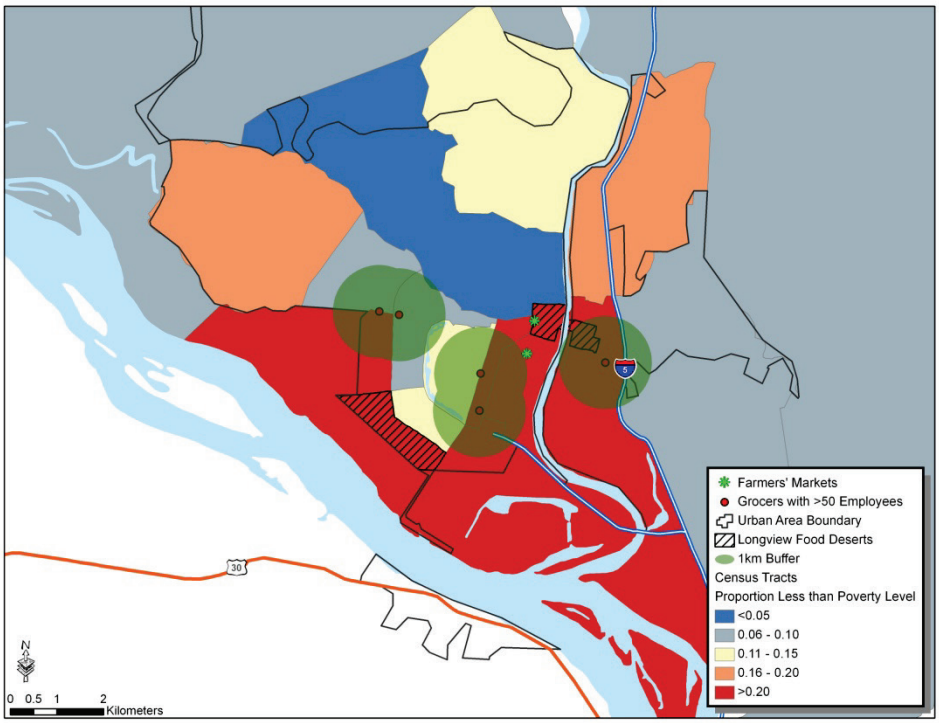
The Longview Urbanized Area, with its 18 tracts, lies along the southern border of Washington State. The city is served by five grocers of greater than 50 employees. The generation of 1 km walkable zones about each of these grocers leaves two census tracts whose poverty rate exceeds 20 percent with low access to a grocer. In Figure 12 below, two farmers' markets are observed to be located in the higher-

poverty tracts. The southernmost market is the larger of the two, operating two days a week with an average of 20 farmers at each market week, while the northern market is substantially smaller with an average of only six farmers per week, and unlike the larger market, it does not accept WIC/Senior FMNP vouchers. Neither market accepts EBT. The larger market collected $13,626 and $10,336 from WIC vouchers in 2009 and 2010, respectively, along with $9,120 and $8,730, respectively, for the same years from the Senior FMNP.

Table 5. Longview High-Poverty Census Tracts.

High-Poverty Tracts	Proportion Less than Poverty Line	Proportion with No Vehicle	Proportion Hispanic/ Latino	Proportion Black	Distance to Grocer (km)	Distance to Farmers' Market (km)
1	34%	43%	0%	2%	0.42	0.8
2	34%	17%	13%	0%	1.76	3.25
3	32%	17%	10%	1%	0.87	3.31
4	28%	20%	21%	0%	0.93	2.28
5	26%	11%	7%	0%	0.85	1.42
6	26%	26%	49%	0%	1.25	0.65
7	24%	19%	6%	2%	0.78	0.8

Figure 12. Longview Retail Food Distribution



Seattle

The Seattle Urbanized Area is by far the largest in the state and encompasses the majority of the eastern Puget Sound from roughly Everett on the north to Tacoma on the south. Associated with this UA are 609 tracts, of which 44 have poverty rates in excess of 20 percent. Of the 44 high-poverty tracts, 28 are considered to also be low-access tracts in relation to full-service grocers. The statewide clustering of high poverty noted previously is further evidenced in the Seattle UA. Here, the 28 tracts identified as food desert tracts are grouped into roughly three distinct sections of the UA, each of which also contain other nonfood desert tracts, though still high-poverty tracts.

The depiction of the Seattle UA has been broken out into three figures (13, 14, 15) to better visualize the distribution of both grocers and farmers' markets throughout the UA. From these figures, it becomes apparent that the markets may not be randomly distributed throughout the UA; there is a suggestion of a spatial pattern to their locations. To explore the existence of spatial pattern in market

location, we employ Ripley's K to test for complete spatial randomness (CSR). Figure 16 displays the UA wide distribution of markets in panel (1), while panel (2) demonstrates the degree to which clustering does occur, confirming departure from CSR. Ripley's K provides indication that clustering of farmers' markets is occurring; however, it does not aide in indicating the process behind the clustering. Several potential influencing factors are visible through inspection of Figures 13–15. Figure 14, in particular, shows strong evidence of markets being located very near retail grocery centers. Within the entire UA, 29 of the 57 markets are located within 1 km of a full-service grocer. Similar to the UAs previously discussed, the Seattle markets demonstrate interesting patterns in relation to the importance of WIC/Senior FMNP redemptions to each market.

There are too many markets to discuss independently; as such, several are highlighted here for example purposes. Mercer Island is visible in Figure 14 and possesses a very low poverty level. The island has five census tracts whose median household income ranges from $55,000 to over $127,000. The market located on the island does accept WIC/Senior FMNP vouchers and took in over $200,000 in gross farmer sales in 2009, though WIC redemption was valued at only $244 and Senior at $1,734. The next year witnessed even lower numbers for both FMNP programs. Very similar results are observed in the two markets located just to the northeast of Mercer Island, near Bellevue and Medina, which also have similar rates of poverty and income levels.

Alternatively, we can take a look in Figure 15 and observe that the market located in the largest food desert here saw gross farmer sales in 2009 in excess of $250,000 and associated combined WIC and Senior redemptions of just over $60,000, with an almost even split between the two. Just to the northwest of the market just described is another market in a tract with a significantly lower poverty rate and gross farmer sales of nearly double that of the previous, but took in less than half the value of WIC and Senior vouchers. These large differences are observable even considering that these two markets are only approximately two miles apart. Many of the food desert tracks within the Seattle UA have quite high rates of no vehicle ownership (Table 6).

Figure 13. Seattle-North Retail Food Distribution

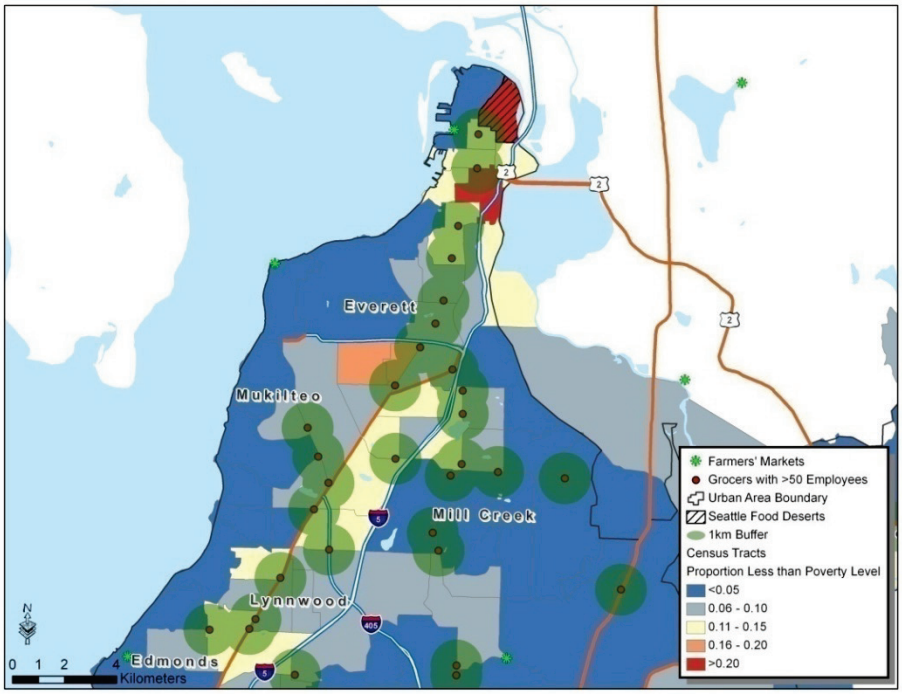


Figure 14. Seattle-Central Retail Food Distribution

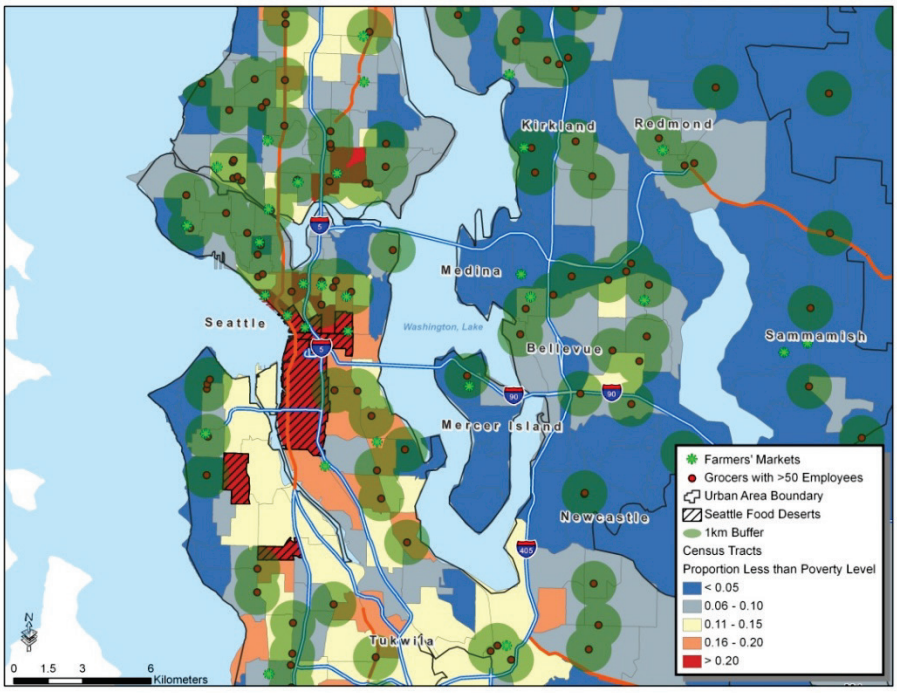


Figure 15. Seattle-South Retail Food Distribution

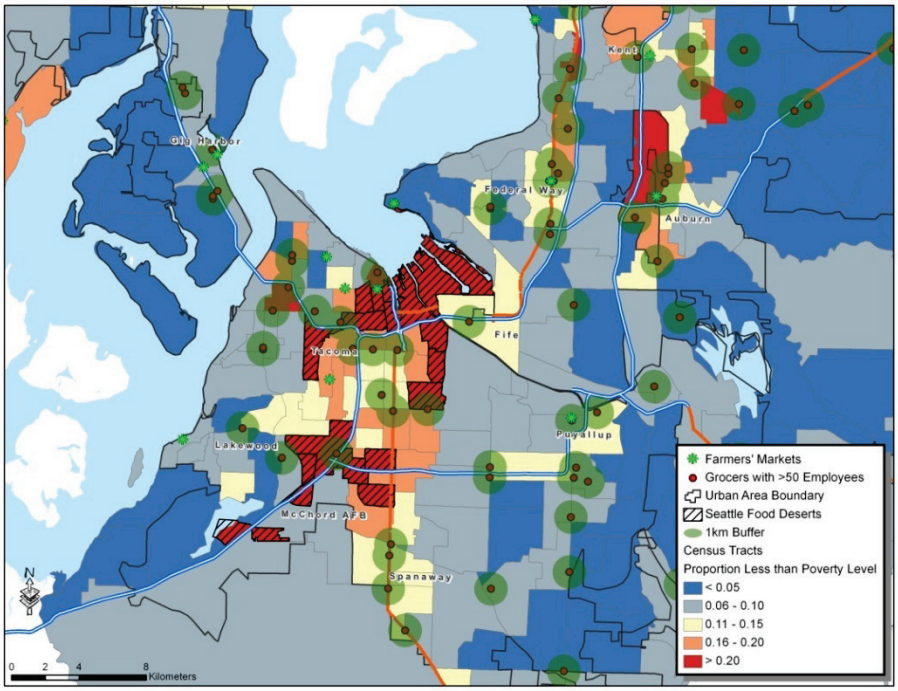
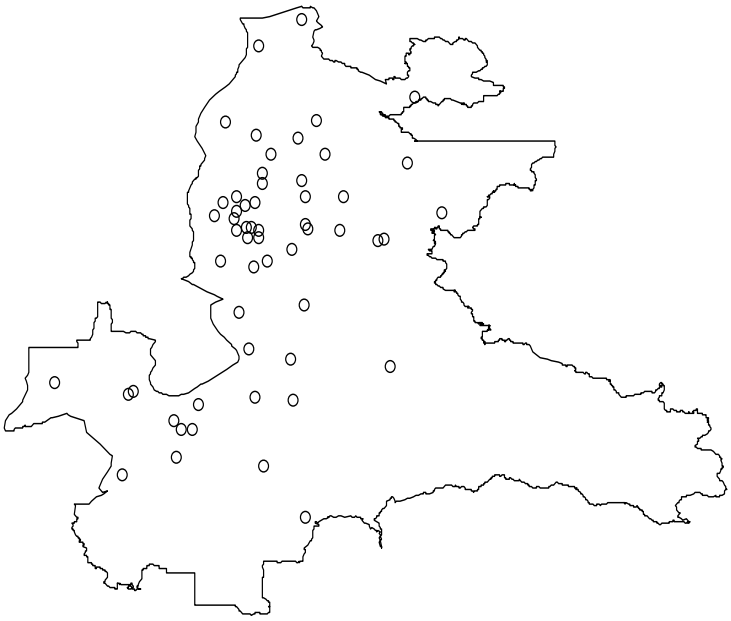


Figure 16. Seattle UA Market Distribution (1); Ripley's K (2)

(1)



(2)

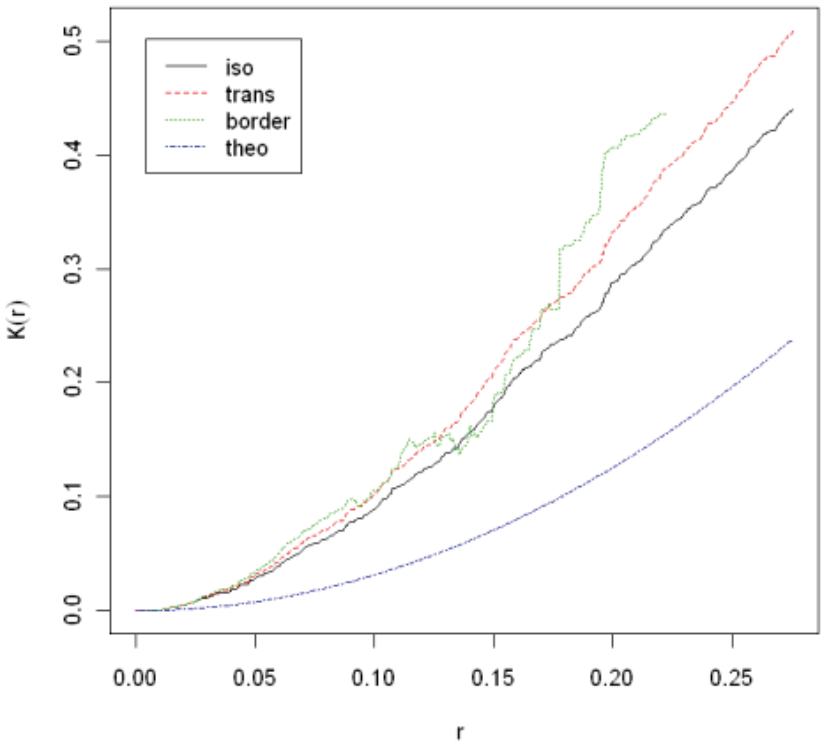


Table 6. Seattle High-Poverty Census Tracts

High-Poverty Tracts	Proportion Less than Poverty Line	Proportion with No Vehicle	Proportion Hispanic/ Latino	Proportion Black	Distance to Grocer (km)	Distance to Farmers' Market (km)
1	57%	25%	8%	10%	2.20	5.34
2	50%	73%	2%	20%	1.63	0.80
3	48%	73%	12%	10%	1.58	0.48
4	47%	64%	6%	16%	1.19	0.56
5	44%	50%	4%	2%	0.54	0.46
6	41%	44%	7%	22%	1.45	0.49
7	40%	47%	7%	19%	0.51	0.39
8	39%	29%	7%	10%	1.17	4.34
9	37%	25%	9%	2%	1.07	1.76
10	37%	18%	12%	17%	4.89	7.05
11	35%	36%	8%	12%	0.80	0.87
12	35%	56%	8%	12%	1.22	0.21
13	34%	55%	8%	29%	1.08	0.31
14	33%	25%	21%	17%	2.63	7.22
15	32%	35%	2%	17%	1.91	1.71
16	32%	33%	6%	1%	0.80	0.95
17	32%	26%	12%	21%	1.41	2.33
18	29%	25%	8%	35%	1.56	0.93
19	29%	21%	3%	2%	0.50	0.82
20	29%	18%	9%	35%	1.59	1.90
21	28%	29%	12%	35%	1.27	0.46
22	28%	18%	10%	13%	1.54	1.72
23	27%	38%	16%	30%	1.75	0.53
24	27%	19%	4%	3%	0.82	0.96
25	27%	11%	8%	22%	1.94	2.18
26	27%	47%	5%	11%	0.39	0.80
27	26%	16%	16%	20%	0.57	3.65
28	26%	15%	7%	18%	1.87	6.01
29	26%	26%	13%	14%	1.56	5.26
30	25%	9%	15%	11%	2.09	4.31
31	24%	22%	6%	11%	0.65	3.60
32	24%	2%	3%	5%	3.47	2.64
33	23%	18%	6%	5%	0.73	2.43
34	23%	55%	4%	12%	0.82	0.45
35	22%	29%	4%	6%	0.45	0.81
36	22%	6%	4%	4%	2.80	7.46
37	21%	8%	5%	9%	0.92	5.00
38	21%	22%	5%	1%	0.65	0.52
39	21%	32%	5%	3%	0.89	2.42
40	21%	38%	5%	9%	0.80	0.37
41	21%	15%	11%	16%	1.10	3.91
42	21%	5%	14%	21%	1.04	5.74
43	20%	10%	12%	28%	1.08	4.95
44	20%	5%	3%	9%	2.47	5.63

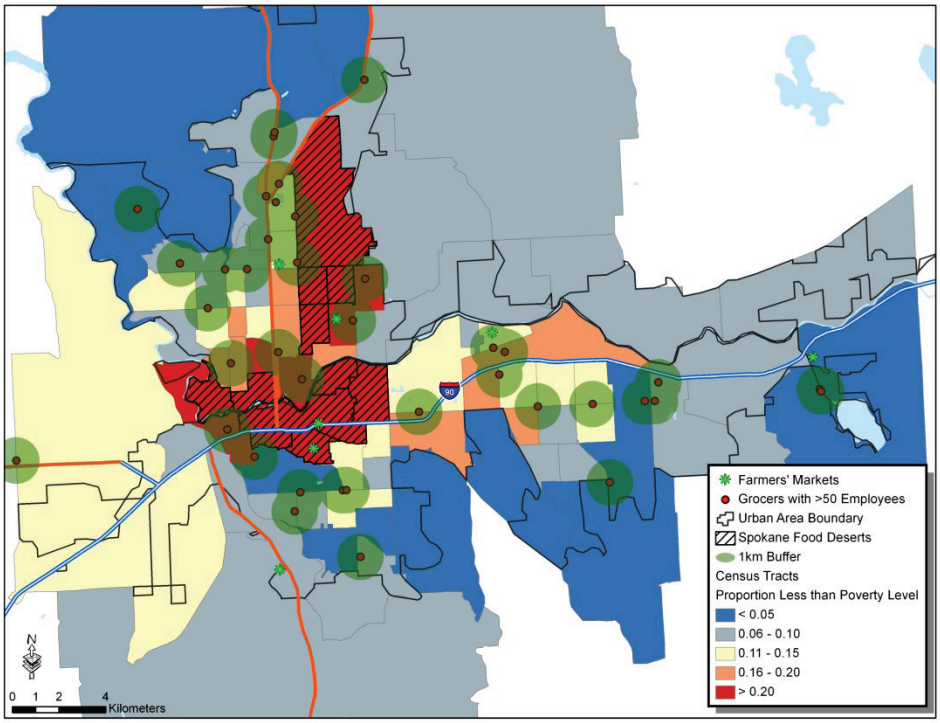
Spokane

The high-poverty tracts of the Spokane UA are highly concentrated, as evident in Figure 17. Thirteen of the 19 high-poverty tracts also meet the low-access definitions set out here and can thus be classified as food deserts. Additionally, Table 7 shows the potential correlation causing concern over the relationship between poverty and vehicle access, as five of these tracts have greater than 20 percent of their populations with no vehicle. Three farmers' markets are located within the high-poverty tracts, with two of them being in identified food deserts. These two markets have decidedly different outcomes with regard to WIC/Senior redemption. The market that appears to be on I-90 is the larger of the two and operates on Saturdays with 25 vendors reporting combined WIC and Senior sales of $63,383 in 2009 and an uncertain number of vendors collecting $46,869 in 2010. Meanwhile the other market, operating on Thursday afternoons with 10 vendors in 2009, collected only $7,446 from the two programs and $4,685 from them in 2010. This market is also a pilot market for EBT and collected $1,251 in 2009. The remaining markets in the area had results similar to the second one discussed here. The farthest east market, located in the lowest poverty level group, took in just over $6,000 in WIC/Senior FMNP, making up approximately 5 percent of the 2009 season farmer revenue. This percentage is substantially less than the 13 percent accounted for by the first Spokane market discussed.

Table 7. Spokane High-Poverty Census Tracts

High-Poverty Tracts	Proportion Less than Poverty Line	Proportion with No Vehicle	Proportion Hispanic/ Latino	Proportion Black	Distance to Grocer (km)	Distance to Farmers' Market (km)
1	47%	73%	3%	6%	1.30	2.65
2	35%	30%	4%	3%	0.75	4.41
3	34%	30%	8%	5%	1.96	0.83
4	34%	42%	6%	5%	1.37	3.37
5	33%	20%	3%	3%	0.84	0.62
6	30%	14%	4%	8%	2.49	1.18
7	30%	14%	4%	5%	1.46	1.94
8	29%	23%	5%	2%	0.61	2.16
9	28%	14%	3%	4%	0.64	3.21
10	25%	11%	0%	1%	0.92	1.89
11	25%	12%	4%	3%	1.98	0.55
12	24%	14%	2%	0%	1.15	1.49
13	24%	14%	4%	4%	0.86	3.54
14	23%	17%	3%	2%	1.44	4.72
15	23%	22%	15%	3%	2.14	2.22
16	23%	9%	4%	3%	1.56	1.10
17	22%	30%	4%	3%	1.06	1.94
18	20%	8%	2%	0%	1.04	2.19
19	20%	8%	1%	3%	1.25	1.47

Figure 17. Spokane Retail Food Distribution



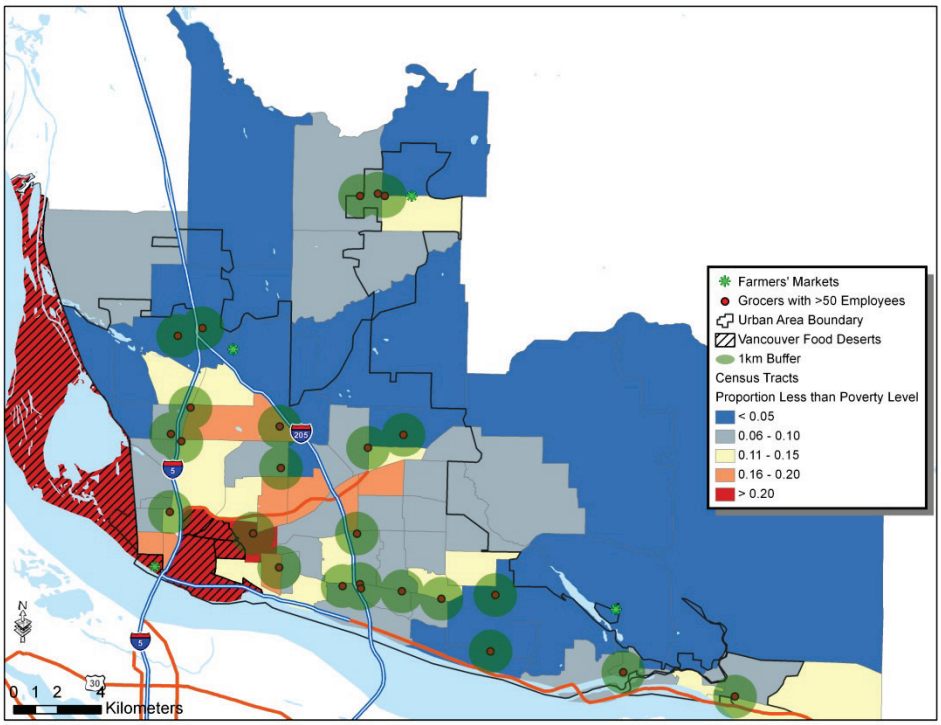
Vancouver

The Vancouver UA and its associated tracts contains seven tracts considered to be high poverty, of which six are also low access and considered to be food deserts. These seven tracts form a contiguous group in the downtown portion of the UA, and the poverty rate decreases as one moves away from this downtown area. The market located in the high poverty region operates three days a week (Fr, Sa, Su) and its 24 WIC vendors took in $55,940 in 2009, while 26 vendors reported collection of $31,306 from the Senior FMNP that year. In 2010 similar results were seen with $41,412 and $30,066, respectively, from WIC and Senior programs. Additionally, this market participated in the EBT pilot project and saw an additional $14,401. The remaining markets in the area took in considerably less, as they are smaller. For example, the market to the east and its fewer than 10 vendors took in $1,290 from WIC and the Senior FMNP in 2009 and $3,336 in 2010. This market is also an EBT pilot market and collected $602, roughly 6 percent of the value it collected from debit and credit.

Table 8. Vancouver High-Poverty Census Tracts

High-Poverty Tracts	Proportion Less than Poverty Line	Proportion with No Vehicle	Proportion Hispanic/ Latino	Proportion Black	Distance to Grocer (km)	Distance to Farmers' Market (km)
1	48%	51%	6%	2%	2.32	0.51
2	35%	8%	8%	1%	2.36	3.00
3	28%	14%	10%	5%	0.61	4.41
4	27%	23%	14%	4%	1.32	3.50
5	23%	14%	19%	3%	1.55	3.22
6	22%	12%	11%	3%	1.24	2.77
7	21%	17%	7%	3%	2.40	2.58

Figure 18. Vancouver Retail Food Distribution



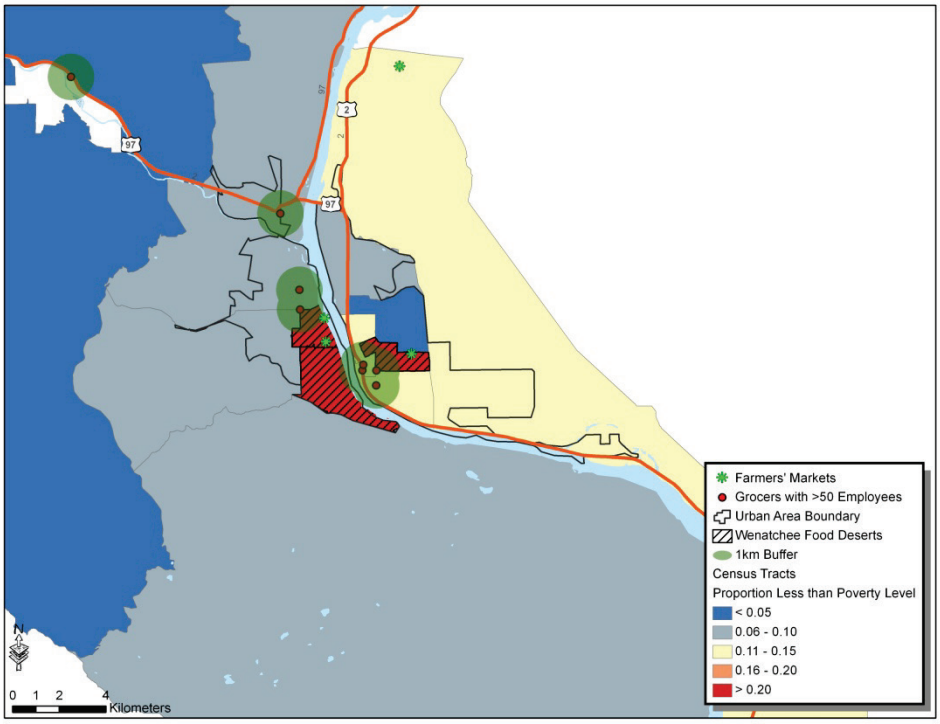
Wenatchee

Wenatchee is another of the smaller UAs of the state. It is also one with rather high Latino populations (Table 9). Tracts one and three in the table are the two highest Latino populations in the UA. The market farthest north does not take any forms of food benefits, while the two markets located on the west side of the river operate in tandem to be open four days a week with up to 28 vendors taking WIC/Senior FMNP vouchers for a total of $37,416 in 2009 and $29,914 in 2010. Alternatively, the market to the east of the river is small, taking in only $480 combined in 2009 and not reporting in 2010. The tract where this market is found is tract two (Table 9) which has the lowest percentage Latino population of the three, but also the highest diversity of access with three grocers very nearby. Note in Figure 19 that there is no close river crossing access near where these high-poverty tracts are located.

Table 9. Wenatchee High-Poverty Census Tracts

High-Poverty Tracts	Proportion Less than Poverty Line	Proportion with No Vehicle	Proportion Hispanic/ Latino	Proportion Black	Distance to Grocer (km)	Distance to Farmers' Market (km)
1	26%	17%	29%	1%	1.15	0.66
2	23%	10%	15%	0%	1.06	1.06
3	21%	12%	36%	0%	1.65	1.34

Figure 19. Wenatchee Retail Food Distribution



Yakima

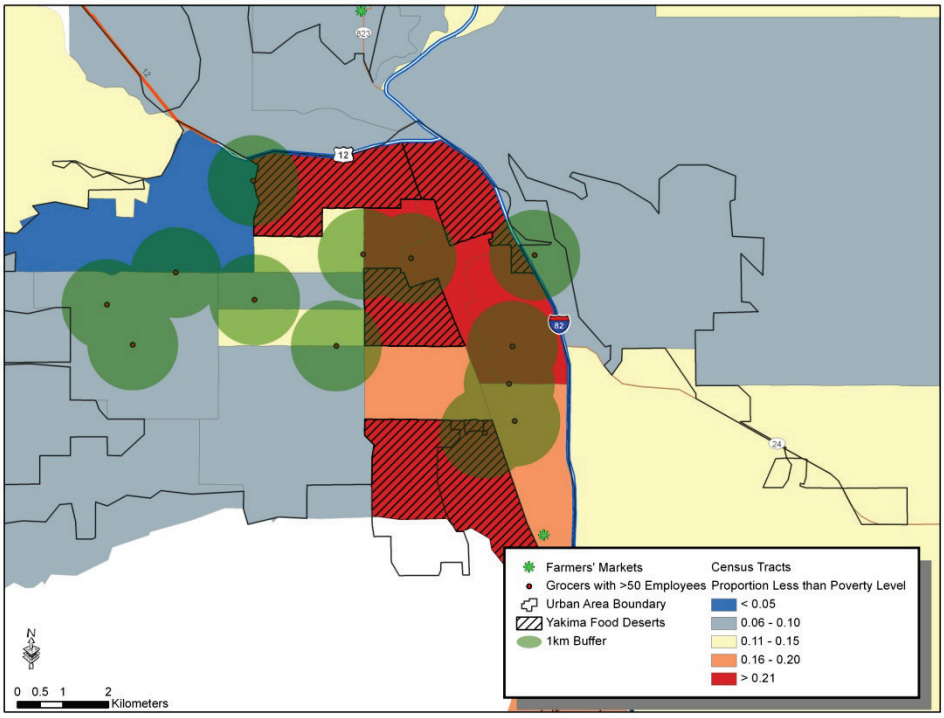
Yakima, like Wenatchee, is another UA located in the central portion of Washington, a region dominated by agricultural production. Table 10 demonstrates the very high Latino populations found in the high-poverty tracts of Yakima. In fact, using a simplistic model, the proportion of the Latino population alone explains nearly 80 percent of the variation in proportions of the population below the poverty level (R^2=0.7997). Figure 20 below does indicate that numerous grocers are found in or near the higher poverty tracts of Yakima. However, four of the seven tracts can be considered food deserts by the

present definition. Only the market found at the southern edge of Figure 20 is recorded to have taken WIC/Senior FMNP vouchers. In 2009, this market took in $60,462 from WIC and $14,792 from the Senior program, constituting nearly 35 percent of farmer revenue that season. In 2010, smaller WIC values were observed, $45,554, though larger Senior, $19,828.

Table 10. Yakima High-Poverty Census Tracts.

High-Poverty Tracts	Proportion Less than Poverty Line	Proportion with No Vehicle	Proportion Hispanic/ Latino	Proportion Black	Distance to Grocer (km)	Distance to Farmers' Market (km)
1	52%	41%	46%	1%	0.95	5.61
2	42%	17%	67%	5%	0.87	5.11
3	39%	19%	61%	2%	1.61	4.66
4	38%	17%	65%	1%	0.60	5.01
5	24%	19%	28%	2%	1.17	5.67
6	22%	8%	29%	1%	1.31	3.28
7	22%	18%	24%	1%	1.22	4.44

Figure 20. Yakima Retail Food Distribution



SECTION 4. THE RURAL FOOD DESERT

Within Washington, 82 tracts have been identified as meeting the defined requirements of a food desert, 17 of these tracts are rural. These tracts can be seen in Figure 3. Recall that as we shift our focus away from the urban setting to that of the rural one, we also shift our definition of food desert. Maintained is the requirement that the tracts are high poverty (> 20 percent), though changed is that we now use a network distance of 10 miles (16.1 km) as the condition of what constitutes low access. The tracts identified as rural food deserts have a population weighted average distance from a grocer of almost 48 km (30 miles), considerably higher than the threshold distance for the designation. Additionally, it could be argued and is a valid consideration that grocers in these areas may still provide a whole host of food options though at smaller sizes, thus they would also have fewer employees. If we drop the required employee size to 20, then that average distance drops to 28 km (17 miles) and seven of the 17 tracts would no longer come under food desert identification. Interestingly, these tracts are considerably closer

to non-grocer sources of food, 16 km on average. Additionally, as suggested previously, vehicle ownership among high-poverty rural tracts is much higher than comparably high-poverty tracts in urban settings. On average, these rural tracts have a no-vehicle ownership rate of just under 7 percent.

Access is improved to farmers' markets, over grocers, in 13 of the 17 tracts resulting in an average distance of 30.7 km (19 miles), an average that tends high due to three tracts in excess of 80 km from a market. Rural farmers' markets, those outside of a 0.5 km buffer around a UA or urban cluster (UC), constitute 38 out of the 169 statewide markets (Table 11). Of these 38 markets, 13 had WIC/Senior sales reported in 2009. Three of these 38 markets are found in identified food deserts, none of which are one of the 13 that take WIC/Senior vouchers. Six are reported to take EBT. The discrepancies between food benefit acceptance of those markets that are found in either urban areas or clusters with those found in rural areas is rather evident in Table 11 (see also Box 4.1).

Box 4.1 – "All the volunteers work their tails off."

Many small, rural, markets throughout the state rely on a corps of dedicated volunteers to make each market happen throughout the state. With small markets come small revenues, meaning not enough funds to hire a paid market manager. Independence Valley market is no exception. Since its inception in 2007, the market has become an organized nonprofit, bringing in a revenue of about $3,000 and relying on an excess of 1,300 volunteer hours, mostly by less than a half dozen individuals. Market reveune is generated through vendor sales, as they collect the greater of $5 or 5 percent each week of market operation.

With an all-volunteer effort comes growing pains of learning the ropes of managing a market. These ropes become particularily daunting when attempting to navigate the food benefits. As explained to us by Stan, the market manager* who also runs the local food bank, "there's a whole series of hoops the market has to jump through, which I don't agree with AT ALL. And there was a little class that they had for us…tellin' us, 'Well, the seniors can't buy this, but uh, WIC people can. The WIC people can't buy this, but the seniors can'." Despite these difficulties, the market has successfully began to taking the WIC and Senior FMNP vouchers in the 2010 market season. SNAP benefits is a whole different story.

The market president, John, explains the difficulties in accepting SNAP as originating first with the tax and other financial issues. With no volunteer familiar with tax laws and not enough money to pay for one, navigating the federal system is nearly prohibitive. Additionally, significant costs for each transaction are associated with operating the machines. As John considers the typical transaction of $20 at a cost of $0.35 each, he notes that "we have such a low budget…and, you know, it's all about cash flow, just because we don't have that amount of money ahead of time and we don't have a big savings account. We might be sunk before we realize we are sunk…" He continues tht they were able to secure the grant support to aquire the machinery, but have yet to be able to implement because "we didn't have…the expertise to get it off and going, so, it was a failure as a result of that."

"It's we can't can't do more than what we're already doing is really what it comes down to." John, Market President.

*The Independence Valley Market's President fills the role of what is traditionally understood as the Market Manager, while its Market Manager is responsible for the physical site organization and getting vendors squared away and sound systems set up, among other miscellaneous duties.

Markets that have yet to be analyzed in this research are those not exactly rural by definition, yet not found in association with an urbanized area. These markets are found in urban clusters: 37 markets make up this group. Twenty-five of these UC farmers' markets accepted WIC/Senior vouchers in 2009 with redemptions ranging up to $23,862 and participating vendors at each market ranging from one to 32.

Three of these UC markets are located in rural food deserts, none of which accepted food benefits in either year of the available data.

The 17 rural food desert tracts have substantial overlap with four of the five large Native American Reservations of Washington. Many other, smaller, reservations are found along coastal and inland waterways. The four reservations are those of the Makah, Quinault, Yakima, and Colville Tribes. The only large reservation not identified as a rural food desert is that of the Spokane Tribe; however, it is still a high-poverty tract. Though not defined here as a food desert since they fall one percentage point below the 20 percent poverty rate cutoff, Ferris-Border Ridge and the surrounding communities struggle with the necessity to balance transportation demands with food costs (Hackney et al., 2010). The region has several active food agencies and nonprofit groups with goals of enhancing food security for the entire five-county area that encompasses five counties in south-central Washington and north-central Oregon (Box 4.2).

Table 11. 2009 WIC/Senior FMNP Redemptions by Market Type

	UA	UC	Rural
Total Number of Markets	94	37	38
Number of Market Accepting WIC/Senior FMNP	62	25	13
Average number of Vendors accepting WIC/Senior FMNP	15	11	6
Average WIC ($) per market	$10,575.10	$4,993.04	$705.08
Average Senior ($) per market	$8,345.84	$3,419.68	$1,793.85
Total WIC	$655,656.00	$124,826.00	$9,166.00
Total Senior	$517,442.00	$85,492.00	$23,320.00

Note*:* UA=Urbanized Area; UC=Urban Cluster; Rural = remaining markets.

Box 4.2 – *A Community Food Assessment* (Hackney et al., 2010)

The Ferris-Border Ridge community is nestled within the south-central region of Washington commonly known along with its Oregon counterpart to the south as *The Columbia River Gorge*. Action teams from the area have recently conducted a five-county community food assessment. Drawing from this assessment, we learn that for residents of the Gorge area, despite its large agriculture sector, food access for many residents is difficult. The region is mostly rural with its 75,000 residents spread across 7,500 square miles, necessitating long drives to full-service grocers. We also learn from Leo, one of the Horizons volunteers and active member of several food action programs, that the area is home to "a lot of discretionary money that keeps the prices high and prices out lower-income people and they have to move further away and commute to local jobs." As lower-income residents move farther from community centers, the need for reliable and affordable transportation becomes a significant consideration in food accessibility. The community food assessment survey of area residents found that the majority of residents do shopping within their own county, but that still requires a large proportion of them to travel in excess of 26 miles. They are largely doing so to patronize larger stores with lower costs and a greater variety of food. In addition to obtaining food by traditional means at the grocery stores, many residents also relied on several secondary sources, including gardens, farmers' markets, farm stands, food pantries, senior centers, hunting, fishing, and convenience stores or gas stations. Cost and time for shopping were identified as major barriers to good food access by the assessment's respondents.

Through these assessments, the action programs were able to identify several community needs, including improving farmers' market outreach and marketing to underrepresented populations and expanding the establishment of farmers' markets that provide WIC and Senior FMNP as well as increasing familiarity with accepting EBT/SNAP programs.

SECTION 5. FOOD BENEFIT UTILIZATION

The above individual UA and rural sections paint a preliminary picture of redemption rate variability between markets. Some of the most striking differences occur even over small geographic distances, though quite large socioeconomic differences. Table 12 highlights some of these distinctions. In both years for which we have data, the markets within food deserts saw at least triple the amount of Senior/WIC vouchers redeemed (in dollars) as those markets outside of the food deserts. These distinctions are evident even while considering size of the market in terms of the number of farmer vendors present. As encouraging as these redemptions are, the unsettling notion taking shape is that of the 21 identified markets in food deserts, six of them are either rural or found in urban clusters as opposed to an urban area, and none of these six are currently set up to accept WIC/Senior vouchers or EBT. However, 10 of the 15 markets found in urban food deserts do accept the WIC and Senior Vouchers and collect them at rather impressive levels. Several of these markets would likely be negatively impacted should these forms of payment no longer be available to their lower-income consumers, a possibility that is very real for Washington consumers, farmers, and communities as the legislators continue to face budget tightening.

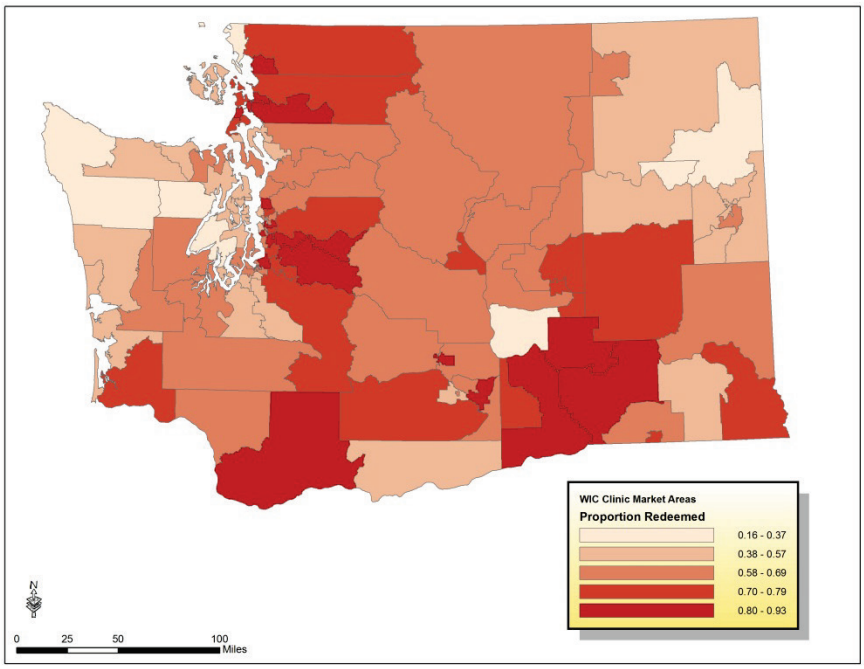
Table 12. Food Benefit Utilization Comparison between Markets inside a Food Desert to all Others

		FD Markets(n=21)		Non-FD Markets (n=149)	
		2009	2010	2009	2010
Accepted WIC/Senior FMNP		10	10	101	112
Accepted EBT			5		34
WIC/Redeemed	Average	$22,882.40	$16,103.00	$6,231.38	$5,055.89
	Max	$55,940.00	$45,374.00	$60,462.00	$45,554.00
	Min	$192.00	$304.00	$4.00	$4.00
Senior/Redeemed	Average	$17,298.80	$14,059.00	$5,036.29	$4,520.21
	Max	$33,838.00	$30,066.00	$47,082.00	$45,694.00
	Min	$288.00	$700.00	$20.00	$4.00
Average Weeks per Year			n=15*		n=129*
			22.92		22.10
Average Number of Farmers		n=6* 19.33 (R=6-70)		n=78* 21.1 (R=2-90)	

*Indicates the average was drawn from a reduced sample based on available market information.

The above discussion highlights the differences between markets in and out of food deserts (Table 12) as well as between markets located in various levels of population density (Table11). However, to get a more fluid understanding of the relationship between market and residential location, with particular focus on poverty rates, we turn now to discuss WIC voucher redemption rates at the clinic level. In 2010, the Washington Department of Health reported redemption data for health clinics throughout the state who were issued FMNP vouchers ($N = 108$), that were in turn issued to their clients. Under the conditions previously described for the creation of clinic market areas, regressions to explain redemption rates were conducted using information from the 105 clinics.[3] The resulting clinic market areas are shown in Figure 21 with their associated redemption rates.

Figure 21. WIC Clinic Market Areas and Associated Redemption Rates



[3]One of the remaining three clinics was omitted due to not being identified as the closest clinic for any population weighted census tract centroid. The other two were not able to be successfully geocoded.

A spatial pattern to the redemption rate does appear to be visually present when viewing the map. To validate the pattern, we again turn to Moran's I, which indicates significant clustering of the redemption rates at a global level ($I = 0.290$, $p < 0.001$), providing our first indication that an OLS regression may not be the best option. It is, however, a reasonable analysis to begin consideration. Table 13 displays the OLS results for this regression.

Table 13. OLS, SEM, and SLM Regressions on the Clinic Level Redemption Rate

Variable	Model	Coefficient	Std. Error	Probability
Intercept	OLS	0.751	0.0583	0
	SLM	0.556	0.085	0
	SEM	0.733	0.06	0
Quantity Distributed to Clinic	OLS	8.48E-06	3.12E-06	0.0078***
	SLM	7.47E-06	2.86E-06	0.009***
	SEM	8.46E-06	2.97E-06	0.004***
Proportion of Population Identified as Hispanic	OLS	0.389	0.142	0.0073***
	SLM	0.28	0.132	0.034**
	SEM	0.288	0.148	0.052*
Proportion of Population Living under the Poverty Line	OLS	0.621	0.34	0.071*
	SLM	0.534	0.31	0.084*
	SEM	0.623	0.325	0.055*
Proportion of Population between 100–200% of Poverty Line	OLS	-1.413	0.468	0.0033***
	SLM	-1.068	0.435	0.014**
	SEM	-1.17	0.447	0.009***
Average Distance to Grocer (>50 employees)	OLS	0.002	0.002	0.318
	SLM	0.001	0.002	0.656
	SEM	0.002	0.002	0.329
Average Distance to Grocer (>20 employees)	OLS	0.004	0.005	0.4533
	SLM	0.004	0.005	0.399
	SEM	0.008	0.005	0.095*
Average Distance to Grocer (>10 employees)	OLS	-0.004	0.008	0.668
	SLM	-0.005	0.008	0.55
	SEM	-0.013	0.008	0.111
Average Distance to Non-grocer	OLS	-0.004	0.009	0.658
	SLM	0.001	0.008	0.924
	SEM	-0.008	0.008	0.336
Average Distance to Farmers' Market	OLS	-0.003	0.002	0.093*
	SLM	-0.003	0.002	0.077*
	SEM	-0.002	0.002	0.307
Lambda	SEM	0.367	0.115	0.001***
Rho	SLM	0.254	0.089	0.004***

* p<0.1; **p<0.05; ***p<0.01.

The major variable of interest when creating the regression models was the influence of residential distance from farmers' markets and how that affects redemption rates. Our OLS regression

suggests the presence of a negative relationship, though only at the $\alpha = 0.1$ level. This negative relationship suggests, holding other factors constant, that as the average weighted distance a population must travel to get to a market increased, the rate at which WIC vouchers are redeemed at markets decreased. The proportion of the market area's population with income less than the poverty line as well as that which identifies as Latino demonstrate a significant and positive relationship with WIC/FMNP voucher redemption rates. The volume of vouchers distributed to each clinic similarly has a positive relationship. Meanwhile, the proportion of the market area that has an income between 100 and 200 percent of the poverty line shows a significant negative relationship to redemption rates. The differing signs between the proportion under the poverty line and those greater than, but less than 200 percent of it, begins to provide some interesting insight as to who the major redeemers of the vouchers might be. Distance relationships between consumers and other retail food outlets do not appear, for the most part, to be significant contributors to redemption rates.

Before considering the full implications suggested by the regression results of Table 13, we must assess the potential shortcomings of the strategy. First, the use of OLS as the Best Linear Unbiased Estimator (BLUE) requires an uncorrelated random error with a mean of zero. We first test for heteroskedasticity in the error variance and find no significant results based on the Breusch-Pagan, Koenker-Bassett, or White tests. Thus, heteroskedasticity is not considered to be of concern. However, when we turn to test for spatial dependence in the model, we do find significant results for both the Lagrange Multiplier (Lag), $p < 0.01$, and the Lagrange Multiplier (Error), $p < 0.01$, suggesting that either a Spatial Lag Model (SLM) or a Spatial Error Model (SEM) will improve performance. Though neither model produces a large change in performance, they are nonetheless an improvement and increases the confidence in the reliability of our interpretation. The SLM and SEM models improve R^2 to 0.33 and 0.34, respectively, over the 0.26 that was rendered from the aspatial OLS model. We present the results of both models in Table 13 along with the OLS results. Looking first at the spatial lag term, Rho, we observe significant and positive spatial dependence of observations on neighboring observations, thus producing the model improvement. Similarly, the SEM produces a positive and significant Lambda coefficient on

the spatially correlated error terms. Negligible performance differences exist between the two spatial models.

Interpreting the coefficients from the regression models leads us to the interesting results of the effects of poverty levels on the redemption rates. The positive coefficient on the proportion of the population with household income placing them below the poverty level suggests that as the extent of high poverty increases for a region, their propensity to redeem their WIC vouchers also increases. Alternatively, as the proportion of the population between 100 percent and 200 percent of the poverty level increases, we observe a reduction in the redemption rates. Recall that the coefficients for each variable are interpreted as changes holding all other variables constant. These countering observations suggest that those most in need of food assistance are likely those that use it at the higher rates. Further research with more specific data on this population is needed to tease out the finer details of this potential observation.

The resulting relationship in these regressions between redemption rates and the proportion of the population that identifies as Latino should come as no surprise when considering the outcomes reported in the Kennewick-Richland sections (Table 4 and Figure 11) as well as the Yakima section (Table 10 and Figure 20). Markets in these two urban areas saw two of the three highest reported values for WIC vouchers and likewise have very large Latino populations. A multi-collinearity condition number (MCN) of 20.2 suggests that potential collinearity between any of our variables, and particularly the proportion Latino and proportion in poverty, is not of significant concern (MCN of > 30 suggest multi-collinearity issues). These results suggest a potential relationship between the Latino community and the social acceptability of using food assistance (Box 5.1).

Box 5.1 – "And a challenge for me was, I didn't speak their language."

Community leaders from the Ferris-Border Ridge area set their sights on bringing food up close and personal for low-income residents, having already identified transportation concerns as one of the major hurdles for their community, due to a lack of readily available public transportation, in addition to high food prices at local food retailers. They set out to establish community gardens in an open space of a low-income housing complex, and other areas throughout the community. A great amount of volunteer effort went into obtaining materials necessary to get the project off the ground, as well as to get the site prepared through tilling and fencing and provisioning of plants, seeds, fertilizer and watering systems. Following the initial effort, all the plots were filled with initial interest. However, the following year saw very little use, and then in 2010 there was no activity at all. Debbie, one of the local volunteers laments that "we tried, and we had this garden for the last four or five years, offering land for a small price to anyone who wanted to come and grow their own vegetables on that land, and we got very few takers. And partly I think it was because they were busy working during the day and didn't have the time, or…". Finishing this thought, Leo, another volunteer continued, "when [the packing house] is working and they're packing, a lot of these people, they're working 12 hours a day, so when they come home, they don't want to play with all this food."

When asked whether many of the area's lower income residents participated in identifying strategies to address food issues, interviewees simply shook their heads and Debbie added that "as far as what direction and what choices we would make in terms of the projects…there were very few low-income people that participated at that point." At the same time, these volunteers readily recognized the growing utilization of the local food bank and the donated fresh produce supplied by local stores and the local gleaners programs. In trying to identify where the disconnect may have occurred between what appeared to be a great community effort and what turned into an untilled and unused community garden, the volunteers suggest that their failings may have been a lack of involvement in educating potential users on planting, watering, canning, and other activities involved in producing your own food.

The disconnects found in Ferris-Border Ridge efforts in contrast to the large participation at markets in areas with large Latino populations suggests careful considerations of cultural norms and active involvement of the population are must-haves to creating a successful local food environment that reaches the people for whom it is aimed.

SECTION 6. DISCUSSION AND FUTURE DIRECTIONS

The primary objective of this research was the implementation of spatially informed methodologies to aid in determining whether potential food deserts throughout Washington State, both in urban and rural settings, are systematically alleviated or exacerbated by farmers' markets. Additionally, we sought to understand how this relationship relates to the effectiveness of food assistance programs

aimed at reducing food poverty and insecurity at community levels. Results suggest distinct differences in current abilities of markets to significantly alter the healthy food landscapes of low-income areas of Washington, depending on whether the market is in a rural or urban setting. As demonstrated throughout this report, Washington is a very diverse state, and as such there is no single solution to food access issues that is likely optimal. As one of our interviewees, Leo, from Ferris-Border Ridge highlighted, "You've gotta try a hundred different things. There's no single solution. It's gonna be a hundred piece puzzle."[4] The work of Leo and the large efforts of food advocacy groups throughout his region highlight this thought. Certainly, they have learned some hard lessons about the types of programs and means of involving those they wish to help as some efforts have failed to thrive. But, they have also created numerous opportunities for struggling families to access healthy food. When the community gardens largely did not take root, the food bank moved plots of vegetables directly to the food bank such that they had produce still on the plant and ready to be picked and taken home. They have begun, as of this year, a farmers' market and participate in a travelling farmers' market throughout the region. They are trying a hundred different things.

We demonstrate here, that central to all potential solutions, is the necessary consideration of access. Access manifests itself in more than simply a distance to food source, but also in timing and ideology. Providing local food alternatives will likely lead to only marginal successes if, for whatever sociocultural reasons, it is not acceptable to the population being served. Ferris-Border Ridge observed this occurrence firsthand as their attempts at establishing community gardens in a high-poverty community that also has a high Latino population struggled despite considerable volunteer effort. Meanwhile, farmers' market participation in other communities with large Latino populations swelled.

As demonstrated in other recent studies, time and location considerations suggest that market vendors receive higher satisfaction from selling in a limited number of larger markets possessing more

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[4]Comments made by Leo, a representative of multiple food advocacy programs in the Ferris-Border Ridge community. Interviewed May 25, 2011.

amenities and varied production-based vendors (Schmit & Gomez, 2011). The rapid proliferation of markets in the greater Seattle area are further evidence of this observation. With the exception of a handful of vendors, most farmers participating in markets do so at five or fewer markets. Of the 688 farmers who accepted WIC vouchers in 2009, 659 were at five or fewer markets, and 460 attended only one. It is not surprising that rural markets are considerably smaller than their UA or even UC counterparts, with only an average of six farmers attending the rural markets and accepting WIC vouchers, while 15 farmers are on average able to do so in UA markets (Table 11). These early observations support the concerns raised by previous authors (Allen, 1999; Hinrichs & Kremer, 2006; Guthman et al., 2006) as they considered whether it is possible to simultaneously provide fresh, nutritious food that is affordable to low-income people while providing adequate returns to small-scale farmers at farmers' markets.

The rural-urban disparities begin to take further shape as we provide a deeper look into the selected case study communities. An issue that became readily apparent in Independence Valley was the necessity to schedule their market time around that of neighboring markets so they do not have to compete for vendors with the larger, more established markets to the north and south. This interrelationship forces the managers to hold it on a Friday during midday until early afternoon; a time when many must be at work. This timing has led several community members to level the charge of elitism on the part of the market managers, a charge that John, the market president, says is "pretty much a stretch," especially as they exhaust their volunteer hours to try and ensure an open market time that is long enough for all residents that are interested in the market to have time to shop. Conscious acknowledgement of the desire to play a civic role in the community is also evident with the vendors. As one such vendor put it, he prices his bags of greens right at $2 even though he could charge a little more because that is the value of the WIC vouchers; he sells a lot of greens this way. However, not every community has been as successful in trying to balance the farmer needs with those of the consumer. A second community decided not to hold a market in their community despite the outcomes of their Horizon's project due to the realization that this additional market would increase the market days

required by the farmers to be at market and away from their other required activities. The community instead chose to focus on supporting their farmers at a larger, more established market in an Urban Cluster 20 miles away. This consideration for the farmers returns again to the challenges of a "win-win."

In addition to the disparities between the rural and urban marketplaces, interesting trends appear to be emerging within urban areas. One example of this is the high rate at which urban farmers' markets are located very near larger retail grocers or groups of grocers. This is especially evident in the larger urbanized areas like Seattle in which 29 of the 57 markets are found to be within the 1 km buffer of a grocer, and many others are not far away from them. These observations, should they continue to unfold, have several potential implications. Schmit and Gomez (2011) also found that farmers' markets find positive value in locating near other retail activity, an effect of agglomeration in a sense. In this light it should be of little surprise that we see so many of these markets locating so close to established grocers.

Finally, using Bremerton as an example (Figure 9), we can see that there are two food desert tracts, but there is a grocer right in between them. The question should be asked 'Is that a bad spot for the retailer? For the consumers?' This could be asked in the sense of could this area support two grocers that could have potentially been placed in either high-poverty tract? It is very plausible that the current location is optimal for both parties independent of its technical definition as a food desert. To really get at the heart of this observation and others more research is needed on a case-by-case basis to fill in the gaps that cannot be observed from a large database of grocer locations. Each community has its nuances that need to be explored.

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