Direct Marketing VegShed of New Mexico: Exploring a geospatial methodology to optimize the distribution of locally-produced food.

Overview: Consumer demand for locally-produced food has increased sharply in recent years (1). Consumers are looking for food that is fresh, high in nutritional content, grown locally or regionally on family-scaled farms (2). Furthermore, locally-produced food can help to reduce food insecurity, support farmers and rural economies, encourage more healthful eating habits, and reconnect consumers with farmers (3).

Being consumer demand is coupled with continuous growth in local food markets, such as direct marketing using farmers markets and community-supported agricultural (CSA) enterprises. For these reasons, local and regional food system assessments are becoming a popular tool for examining and planning more sustainable food production, distribution and consumption. A successful analysis can be one tool to assessing production and consumption. Analogous to the physical concept of a watershed, a foodshed is a bounded area of land that provides some portion of the food needs to a green population center (4).

This study aims to establish a vegetable foodshed for New Mexico by first determining the service areas for fresh unprocessed vegetables, and second to optimize the food's allocation to meet consumer dietary need and minimizing the distance traveled.

Farmland Representation: Although the USDA National Agricultural Statistics Service (NASS) collects farm-level data, production information at this scale is not made available to the public to protect the privacy of farmers. Therefore, this project established a methodology (refer to Figure 1) for using NASS CropScape with a pixel size of 0.22 acres as a proxy for farm-level data. Raster data from 2010 through 2012 were reclassified to extract areas with annual vegetable and melon production. This land base was converted to raster format and aggregated to polygons. Points with acreage attribute data were spatially joined to the closest polygon. Finally, the polygons were converted to points that represent the centroid location of vegetable production (refer to Map A).

Maximum Capacitated Coverage: Using an Excel sub-model, productivity (yield) was calculated for each of the farm points and nutritional demand was estimated for all population within U.S. Census Block Groups (4). ArcGIS Network Analyst was employed to allocate vegetables across New Mexico. Maximum Capacitated Coverage optimized the food distribution by minimizing impedance (distance from farm to population), while meeting the nutritional demand. Please refer to Map B and C. This geospatial analysis led to 99.2% of the state's vegetable demand being met at a total distance of 18,335 food miles.

Service Areas: Using the same input of available supply (land productivity as yield) and demand (population nutrition needs of vegetables), Network Analyst was utilized to identify two service areas: 25-mile network, shown in green in Map D, and 100-mile network, shown in purple. The smaller service area represents the maximum distance consumers would travel to the farm for purchasing food (5); while the larger area represents the local VegShed for direct marketing via farmers' markets, CSA distribution, or retail outlets. The 25-mile area services 73.6% of New Mexico's population while 85.3% of residents are within the 100 mile network.

Limitations: This analysis is constrained by the input parameters, such as road network accuracy or validity of yield assumptions. Further, this optimization does not apportion demand across >1 facility. Results would be refined if partial demand could be met by >1 facility.

Abbreviated Citations:
(4) Powers J. (2002). Closing the Distance Gap through Community Supported Agriculture.

Image Sources:
(2) Santa Fe Express. https://www.santafeexpress.com/ (6) Economic
twicklung stadt 09-07-2005-540000)

Figure 1: Farmland Representation

Map A: Farmland and Population

Map B: Maximum Capacitated Coverage

Map C: Maximum Capacitated Coverage for Metro-Albuquerque, New Mexico

Map D: Direct Marketing Service Areas