Operational Process of Waste Vegetable Oil (WVO) Business

- A Pilot Study of the Boston Metro Area -

PROJECT DESCRIPTION

Using the Boston Metro area, I conduct a pilot study on a virtual business idea that sells Waste Vegetable Oil (WVO) as a source of renewable energy and demonstrate the following three steps of the business operational process: **(1) the WVO-collection trucks visit fast food restaurants and collect WVO; (2) the collected WVO is delivered to refineries to be processed; and finally, (3) the processed WVO is sent to the customers to power special generators on-site.**

Since the major costs of my business idea occur in the processes of oil collections and deliveries, the main goal of the project is on designing effective and efficient collection-delivery routes (i.e. minimum total travel distance) between fast food restaurants-refineries and refineries-potential customers. By finding out these driving routes, I will be able to minimize the total operating cost and also reduce carbon footprint of my WVO business.

METHODOLOGY

The methodology used in this project is logically designed so that I am able to target any areas in the future for WVO business opportunities. Here, Massachusetts is randomly chosen as my initial area of interest and shopping centers are selected as my potential customers.

1. Identify and gather the appropriate background geospatial data layers from MassGIS, which include CENSUS2000 TIGER road lines, hydrology, open spaces, and land use.
2. Download locational information of fast food restaurants (NAICS code: 722211) and shopping centers (SIC code: 651201) with over $1 million sales volume in Massachusetts using Reference USA.
3. Geocode locations of fast food restaurants and shopping centers in Massachusetts. In this case, both resulted in 90% and 8% of matched and unmatched addresses, respectively.
4. Create a density surface map of 1,250 fast food restaurants in Massachusetts. My final area of interest is determined to be the Boston Metro area, as it is the most dense field as shown in Figure 1.
5. Select by location and sort out 214 fast food restaurants and 46 shopping centers that are only within the Boston Metro area as shown in Figure 2. Geocoding results within the area reveals 0% of unmatched addresses.
6. Theoretically designate 4-6 potential refinery sites that are in the industrial land use area (Land Use code: 16), far from the residential area (Land Use code: 12), and close to the densely located fast food restaurants as shown in Figure 3.
7. Create a network dataset from TIGER road lines and calculate the WVO collection-delivery routes using Network Analysis.

FIGURES

Figure 1. Density Surface of 1,250 Fast Food Restaurants in MA (Left)

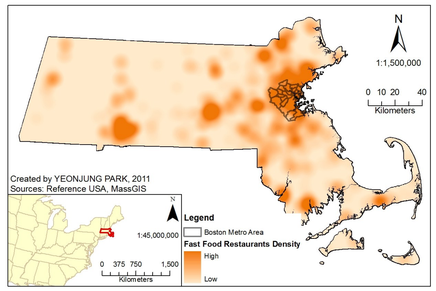
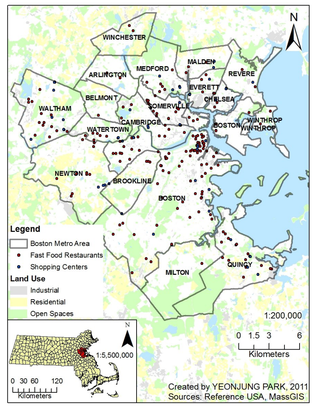


Figure 2. Final Area of Interest: The Boston Metro Area (Right)



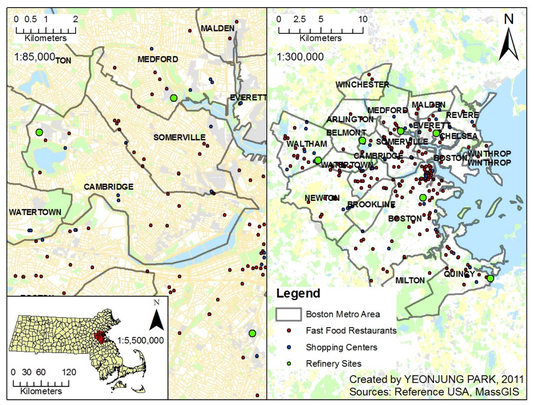


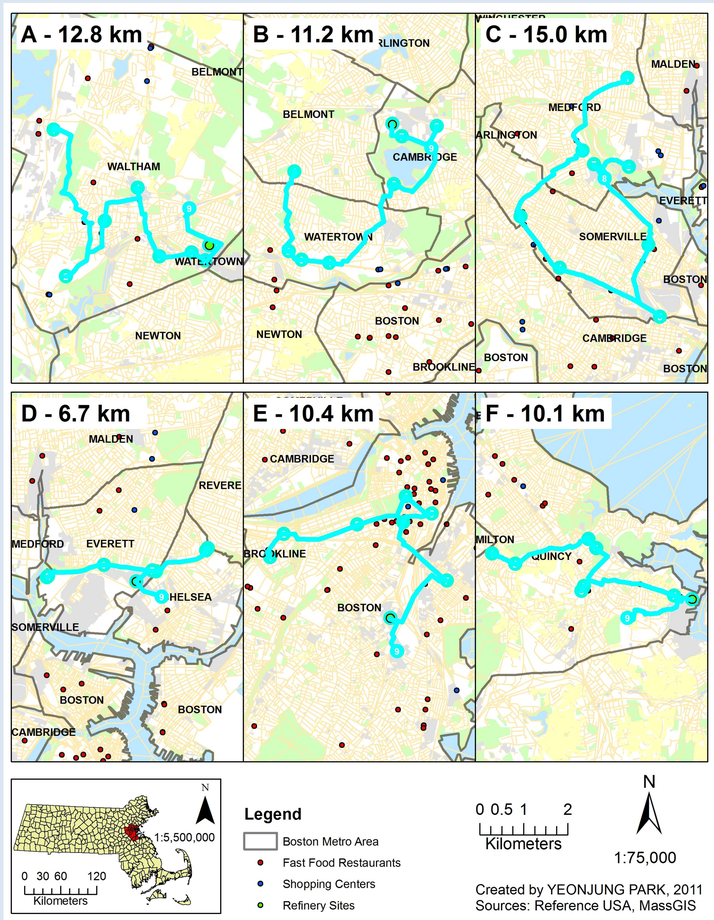
Figure 3. 6 Potential Refinery Sites (Right) & Closed-up View of 3 Refinery Sites in Cambridge, Medford, and Boston (Left)

ANALYSIS & RESULTS

Roughly estimating that one fast food restaurant generates an average of 350 gallons of WVO per month, a WVO-collection truck with a capacity of 2,500 gallons is capable of making 7 stops during its collection routes. Assuming that I own 2 WVO-collection trucks due to a tight start-up budget, I would be needing at least 2 refinery sites within the area of interest amongst 6 potential refinery sites located in Waltham, Cambridge, Medford, Everett, Boston, and Quincy.

Given the assumptions above, I analyze the WVO collection-delivery routes of each case by selecting top 7 fast food restaurants and 1 shopping center surrounding the refinery sites. As for the fast food restaurants, priority selection is given to a restaurant that has more chains within the Boston Metro area. Several best scenarios with minimum total travel distance are presented in Figure 4.

Figure 4. WVO Collection-Delivery Routes in the Boston Metro Area



GIS Network Analysis results indicate that the two shortest WVO Collection-Delivery routes exist when refinery sites are placed in Everett and **Quincy**. However, instead of Everett, I would consider placing one of the two refineries in **Cambridge** so that the refinery site is able to serve the entire upper Boston Metro area (with the shortest independent route among the choices A, B, and C).

Finally, it is important to note that there can always be some potential variability on the results of this pilot study due to the following underlying assumptions: (1) it is possible to theoretically choose the preferred locations of the WVO refinery without any political or economic conditions being taken into account; and (2) both the fast food restaurants and shopping centers individually agree to sign the contract to take part in my business idea (as found in some real cases).

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