Modelling Post-Harvest Facility Location Problem Using Remote Sensing Data

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INTRODUCTION

• Broccoli is a major specialty crop with well known nutritional value
• Farm gate vale in the U.S. in 2014 was $896 million (USDA, 2014)
• Consumed nationwide, but production is concentrated mainly on California
• Interests and efforts in expanding the current Eastern Broccoli Industry

RESEARCH QUESTION

As broccoli supply in the east coast increases, what is the optimal supply chain structure?

➢ What is the optimal location (and capacity) of broccoli cooling facilities?

➢ Which cooling technology should be used at each location?

➢ Given supply and demand locations, what is the optimal flow of broccoli that minimize supply chain costs?

OBJECTIVE

Develop a mathematical programming model to design the optimal broccoli post-harvest cooling network using publicly available remote sensing data

DATA

Satellite Cropland Data Layer
(Source: USDA NASS CropScape)

GIS tools to extract:
• Location/Coordinates
• Acreage

Technology
Capacity
(boxes/day)
Fixed Cost
Variable Cost
(boxes)
Ice-Slurry
6000
$113,000
$1.52
Hydro-Cooling: 1 Pallet
288
$116,000
$0.40
Hydro-Cooling: 6 Pallet
1728
$260,000
$0.11

OBJECTIVE

The objective is

Minimize $\theta = \text{Transportation cost (from farm to cooling facilities + from cooling facilities to the demand location)} + \text{Cooling cost (variable cooling cost + fixed cost)}$

subject to:

1. $\sum_j x_{ij} \leq 1$, for all $j$

2. $\sum_j a_{m,j} = 1$, for all $m$

3. Each farm ships broccoli to at most one cooling location;

4. $a_{m,j} \leq D_{m,j} \times V_{G}$; for all $m, j$

5. Broccoli has to be sent to cooling facilities located within certain distance range

6. $\sum_{j} a_{m,j} \times x_{j} \times x_{i} \leq \sum_{j} y_{j} \times x_{i} = 1$ for all $m$

MODEL

CONCLUSION

• Ice-Slurry cooling technology is favored under most scenarios

• The mix of Ice-Slurry and Hydro-Cooling (1 pallet) technology is preferred as the unit variable cooling cost of Ice-Slurry technology increases

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