The Effects of Climate Change on The Maple Sugaring Economy

Keith Riley
Overview

- Background
- Technologies
  - Past and Present
- Current Economy
  - Market Type
- Threats of Climate Change
- Effects of Climate Change
Background

- New England and New York combined produce 75% of the United States maple syrup
- Vermont produces 44% of US maple syrup
- Talk of climate change is worrying some maple producers
- Many producers say they are tapping their trees earlier every year
Background

- Maple Syrup has been made for centuries starting with Native Americans
- At one time maple sugar was the only sweetener available in the US
- There are many other products besides maple syrup: Maple Sugar, Maple Candies, Maple Cream
- Takes roughly 40 gallons of sap to produce 1 gallon of syrup
- Season lasts 4-6 weeks from late February to April
Maple Sugaring Technology

- Maple Sugaring in the past
  - Vary labor intensive
  - Buckets
  - Collection containers
  - Lots of manpower
  - Vehicles or animals
Maple Sugaring Technology

- Maple sugaring in the present
  - Plastic tubing
  - Vacuum lines
  - Less manpower
  - Less Vehicles
Current Maple Sugaring Economy

- 4,000+ seasonal jobs in VT
- $15 million dollars in direct sales to the economy
- Many family owned business
- Indirect economic impact to VT’s economy $211 million (tourism, retail shops)
- Both Oligopoly and Pure Competition
Market Type

- Oligopoly as a region
  - Canada VS. US
  - Large scale producers by state
- Pure Competition within each state
  - 2000 individual producers
  - Relatively low barriers of entry less than $100,000
New England and New York Market Share

Value of Maple Syrup Production in New England & New York

- Vermont: 44% ($11,353k)
- New York: 23% ($5,903k)
- Connecticut: 2% ($399k)
- Maine: 15% ($3,925k)
- Massachusetts: 6% ($1,651k)
- New Hampshire: 10% ($2,672k)
Climate Change

- Maple syrup production is entirely dependant on the weather. Any change, no matter how slight, can throw off production numbers and cause the industry to decline.
Temperature

Current Temperatures

Projected Temperature in 75 Years
Maple Tree Population

Current Maple Tree Population

Projected Population in 75 years
Threats of Climate Change

- Change in freeze/thaw cycles
- Insect infestation
- Air Pollution
- Extreme weather events
- Canadian Production
Freeze/Thaw Cycles

- Night time temperature below 25°Celsius and day time temperatures above 40°Celsius
- Once a string of days occurs without a drop below freezing, sap stops flowing
- Small window of opportunity
- Tap to early, trees may “dry out” tap to late, and miss the best sap flows
Insect infestations

- Two insects of concern: Forest Tent Caterpillar, and The Pear Thrip
- Can effect the rate of photosynthesis resulting in less sugar stored
- More days above freezing increases the chance of insects surviving longer
Air pollution

- Acid rain can damage stems and roots
- Increased air pollution can add to the greenhouse effect
- Air pollution may also act as a fertilizer in some cases
Extreme Weather Events

- **Drought**
  - Causes decrease in stored root starches which results in decrease in sugar content

- **Tropical Systems**
  - Could cause major wind damage

- **Ice Storm the of 1998**
  - Categorized as 200-500 year event
  - Affected four states and Quebec
  - $15 million dollar loss to entire industry
  - Some counties in New York had 100% production loss
  - Total impact of storm is still unknown
Canadian Production

- In the 1950’s the US produced 80% of the world’s maple syrup and Canada produced 20% since then the numbers have flipped.
- Many producers are able to access areas that in the past were inaccessible because of snow cover.
- This drives the wholesale price down for the whole industry.
Economics of Climate Change

- Externalities
- Fixed and Variable costs
- Market type Shift
- Substitutes
- Supply and Demand
- Conservation
Externalities

- **Short-run Positive**
  - Tourism (hotels, restaurants)
  - Retail shops that sell syrup
  - Maple festivals

- **Negative**
  - Firms that use sugaring for supplemental income (dairy farms, and other agricultural businesses)

- **Long-run Negatives**
  - Tourism (hotels, restaurants)
  - Retail shops that sell syrup
  - Maple festivals
Fixed and Variable Costs
Fixed Costs

- Fixed Costs
  - Maple Trees: determined by land value, age of trees and taxes
  - Processing facility Sugar House
  - Evaporator
  - Other accessories: reverse osmosis, per-heaters
  - Sap collection Equipment: taps and tubing system, vacuum pumps
Variable Costs

- Labor: management, sap collection, sugarhouse operation, maintenance
- Fuel: wood, gas, oil
- Electricity
- Marketing: advertising campaigns
- Sales costs and container costs
# Fixed and Variable Costs

## Fixed Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Yearly cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugarbush (20 acres@$1000 per acre)</td>
<td>400.00</td>
</tr>
<tr>
<td>Sugarhouse and related Items</td>
<td>732.50</td>
</tr>
<tr>
<td>Sap Collection equipment</td>
<td>546.00</td>
</tr>
<tr>
<td>Other fixed cost</td>
<td>1009.00</td>
</tr>
<tr>
<td><strong>Total Yearly Fixed Cost</strong></td>
<td><strong>2687.50</strong></td>
</tr>
</tbody>
</table>

## Variable costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Yearly cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor: Management,</td>
<td>2182.50</td>
</tr>
<tr>
<td>Labor: Management,other operational costs</td>
<td></td>
</tr>
<tr>
<td>Fuel, Utilities, Sap collection</td>
<td>145.00</td>
</tr>
<tr>
<td>Marketing and Bottling</td>
<td>1050.00</td>
</tr>
<tr>
<td><strong>Total yearly Variable costs</strong></td>
<td><strong>3377.50</strong></td>
</tr>
</tbody>
</table>

**Total Fixed cost + Total Variable Cost**                   **6065.00**
# Production and profit

<table>
<thead>
<tr>
<th>Normal Production and Price</th>
<th>Rise in price same production</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expected Revenues</strong></td>
<td><strong>Expected Revenues</strong></td>
</tr>
<tr>
<td>300 gallons</td>
<td>300 gallons</td>
</tr>
<tr>
<td><strong>Anticipated sales</strong></td>
<td><strong>Anticipated sales</strong></td>
</tr>
<tr>
<td>275 gallons</td>
<td>275 gallons</td>
</tr>
<tr>
<td><strong>Other product</strong></td>
<td><strong>Other product</strong></td>
</tr>
<tr>
<td>25 gallons</td>
<td>25 gallons</td>
</tr>
<tr>
<td>275 gallon X $30 per gallon</td>
<td>275 gallon X $35 per gallon</td>
</tr>
<tr>
<td>= $8,250.00</td>
<td>= $9,625.00</td>
</tr>
<tr>
<td>25 gallon X $50 per gallon</td>
<td>25 gallon X $55 per gallon</td>
</tr>
<tr>
<td>= $1,250.00</td>
<td>= $1,375.00</td>
</tr>
<tr>
<td><strong>Total Revenues</strong></td>
<td><strong>Total Revenues</strong></td>
</tr>
<tr>
<td>$9,500.00</td>
<td>$11,000.00</td>
</tr>
<tr>
<td><strong>Total Fixed cost + Total Variable Cost</strong></td>
<td><strong>Total Fixed cost + Total Variable Cost</strong></td>
</tr>
<tr>
<td>$6,065.00</td>
<td>$6,065.00</td>
</tr>
<tr>
<td><strong>Total Annual Profit</strong></td>
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</tr>
<tr>
<td>$3,435.00</td>
<td>$4,935.00</td>
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## Production and Profit

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<th>Production drops and price rises</th>
<th>Production Loss</th>
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</thead>
<tbody>
<tr>
<td><strong>Expected Revenues</strong></td>
<td>220 gallons</td>
</tr>
<tr>
<td><strong>Anticipated sales</strong></td>
<td>200 gallons</td>
</tr>
<tr>
<td><strong>Other product</strong></td>
<td>20 gallons</td>
</tr>
<tr>
<td>200 gallons X $35 per gallon =</td>
<td>$7,000.00</td>
</tr>
<tr>
<td>20 gallons X $55 per gallon =</td>
<td>$1,100.00</td>
</tr>
<tr>
<td><strong>Total Revenues</strong></td>
<td>$8,100.00</td>
</tr>
<tr>
<td><strong>Total Fixed cost + Total Variable Cost</strong></td>
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<tr>
<td><strong>Total Annual Profit</strong></td>
<td>$2,035.00</td>
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<td><strong>Total Annual Profit</strong></td>
<td>$935.00</td>
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Market Shift

- Climate change could cause a shift within each state from a Pure Completion Market to an Oligopoly market.
- Change in weather could reduce overall production which may cause some smaller firms to combine into larger firms creating an Oligopoly.
Substitutes

- Substitutes for Syrup
  - Not many substitutes based on peoples tastes and preferences
  - Maple flavored syrups Aunt Jamiami but contain little if any pure maple syrup
- Substitutes for trees
  - Syrup can be made from other trees like Red and Silver Maple, also Box Elder and White Birch
  - These trees also depend on freeze/thaw cycles, and have much lower sugar content in sap
Supply and Demand

- Maple Syrup is relatively price-inelastic demand mainly due to lack of substitutes.
- S represents current market supply and S1 represents supply after effects of global warming.
Conservation

- There is not much interest in conservation
- Takes 40-75 years for a Maple tree to mature
- Not many people are planting trees
- Seeds only disperse around 200ft from the parent tree
Conclusions

- In the future there may be some non-market measures to help producers (government subsidies)
- Not enough information for definite conclusions that climate change is having an effect
- Climate change could end the US maple sugar industry
- Vermont’s Maple Sugaring may be affected the most
- New technologies may help to reduce the effects in the future