The Paradox of Productivity: Lessons from an Indigenous Agriculture

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Agriculture in Iroquoia

- Controlled by women.
- Maize may be intercropped with bean and squash.
- Fields are probably continuously cropped: no shifting cultivation.
- Crops are planted without plows—no draft animals.
Mounds

- Control plant population and spacing
- Improve soil physical environment
- Concentrate and recycle nutrients
- Facilitate weed control
- Reduce soil erosion and compaction
Advantages of Polycultures

- By mimicking natural plant communities, they are less vulnerable to catastrophic damage from weather, insects and diseases.

- Increase agricultural productivity through more efficient use of nutrients, water and light.

- Add “free” nitrogen when they include a legume.
For Every Crop a Purpose

Corn:

- Produces large amounts of calories.
- Produces modest but significant protein: 7-10%.
- Very competitive against weeds and resistant to insects.
- Upright growth habit supports beans.
Beans

- Add critical nitrogen to cropping system.
- Produce large amounts of protein.
- Amino acids complement those in corn.
Purpose (continued)

Pumpkins

- Provide significant calories and nutritionally-valuable vitamins/minerals.
- Seeds are high in oil and protein.
- Low, aggressive growth habit suppresses weeds and captures resources not used by beans or corn.
Managing Polycultures is Surprisingly Complex

- Requires in-depth knowledge of individual crops.
- Requires understanding of dynamic interactions between crops.
- Requires ability to predict interactions over wide range of environmental conditions.
But How Productive Was It?
Iroquois Agricultural Productivity: Denonville's Campaign 1687-- Destroyed 1.4 million Bushels Corn

“After having destroyed a vast quantity of fine, large corn, beans and other vegetables of which there remained not a single field, and after having burned so large a quantity of old corn that the amount dare not be mentioned, .... The quantity of corn which we found in store in this place, and destroyed by fire is incredible. ...” (O'Callaghan 1853).
Iroquois Agricultural Productivity:

Sullivan Campaign 1779

- Beatty, August 30: “Our Brigade destroyed about 150 acres of the best corn I ever saw.”

- Burrowes, August 27: “We got this night at a large flat three miles distant from Chemung where corn grows as cannot be equaled in Jersey. … in such quantities…would be almost incredible to a civilized people.”

- Shute, August 28: “It (town of Chemung) is situate 2 miles from Seneca Lake which is thirty five miles long and in some places 10 broad & the most rich and fertile country al around it-We found 200 acres of exceedingly good corn intermixed with beans, & squashes pompions & a few potatoes.”
Iroquois Maize Yields Estimated from Field Experiments

- Experiments conducted 1993 to 1997 at two sites.

- Used maize variety and agronomic practices similar to what Iroquois would have used in 17th and 18th centuries.
Iroquois Maize Yields
Field Experiments

Bu/acre

Cayuga County  Tompkins County

1st Year
2nd Year

Cayuga County
Tompkins County
Paradox of Productivity:

Grain Yields in Europe and Iroquoia
17th and 18th Centuries

*Slipher Van Bath 1963 and Mt.Pleasant 2009
What Explains this Paradox?

1. Crops: Maize is better than wheat.
3. Plows: Haudenosaunee didn’t use them!
Plows are the Mark of Civilized Agriculture

“Through the ages the plow has been the most important agricultural tool. Indeed, without it farmers could not till the soil and prepare their fields for extensive agriculture.” R. D. Hurt, *American Farm Tools*

“Tillage is so universal and so obviously essential to successful agriculture, that we accept it without questioning its origin.”

“… yet, among modern farmers tillage is rarely practiced with sufficient frequency to produce the best results.” L.H. Bailey, *Cyclopedia of American Agriculture*
But in the Western Hemisphere, indigenous farmers, prior to colonization, didn’t use plows.
Native Agriculture in the 17th Century

1653 Adriaen Cornelissen van der Donck:

“The women do all the farming and planting. They grow no wheat, oats, barley, rye etc, and are unacquainted with plowing and spadework, and do not keep their lands tidy.”

“They know nothing of manuring, fallow seasons, and proper tillage. The labor they devote is all manual, using small adzes…”

“Nevertheless they raise so much corn and beans that we purchase these from them in fully loaded yachts and sloops.”

In pre-industrial cropping systems, plant nutrients (nitrogen) are supplied by:

- Animal manure
- Legumes (forages or green manures)
- Soil organic matter (SOM)

Native farmers in the Americas relied exclusively on SOM.

Tillage plays a key role in SOM.
Tillage and Crop Yields

- Plowing (initially) Increases Soil Fertility
  - Plowing increases oxidation of soil organic matter (SOM).
  - Oxidation of SOM releases nitrogen in form that plants can use.
  - Yields increase.
But....

- When fields are repeatedly plowed, oxidation causes decrease in SOM: less nitrogen is released every year.

- Soils that have been continuously plowed release little nitrogen. Farmers call these soils “worn out”.

- Under continuous crop production, grain yields decline.

- Plowing is the single largest cause of decreased SOM in agricultural fields.
Iroquois Agriculture Productive and Stable

- Grew maize
- Access to fertile soils
- Soils maintained their fertility because they didn’t plow.
But What Did They Really Eat?
Corn
Beans
# Nutritional Content of Corn and Beans

<table>
<thead>
<tr>
<th>Crop</th>
<th>Food</th>
<th>Water g/100g</th>
<th>Energy Kcal/kg</th>
<th>Protein g/100g</th>
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<tr>
<td>Maize</td>
<td>Sweet corn</td>
<td>76</td>
<td>86</td>
<td>3</td>
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<td></td>
<td>Corn grain</td>
<td>10</td>
<td>3650</td>
<td>9</td>
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<tr>
<td>Bean</td>
<td>Green bean</td>
<td>90</td>
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<td>2</td>
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<tr>
<td></td>
<td>Kidney bean</td>
<td>12</td>
<td>3370</td>
<td>30</td>
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</tbody>
</table>
Maize and Wheat Yields in Iroquoia and Europe 17th-18th Centuries

![Bar chart showing maize and wheat yields in Iroquoia and Europe 17th-18th centuries. The chart includes bars for low, moderate, and high yields for both crops.](image-url)
People Supported by Maize and Wheat

![Bar Chart]

- **People supported/ha**
- **Energy**
- **Protein**

**Categories:**
- Maize Low
- Maize Medium
- Maize High
- Wheat Low
- Wheat Medium
- Wheat High
Conclusions

- Three Sisters was a stable, highly productive cropping system that protected resource base.
- Intercropped maize, bean, and pumpkin were a highly productive cropping system that largely satisfied Haudenosaunee dietary needs.
- Three Sisters provided more energy and protein and supported more people than wheat-based agriculture in Europe.