CASE STUDY: HYBRID MAIZE PRODUCTION AND CLIMATE CHANGE IN ZAMBIA

“Maize and traditional agricultural systems in Africa”

Kurt Waldman
Crops are amorphous
Ecology of maize

Maize takes various forms: sweet, pop, dent, flint, flour

What are the main uses in the US?
# Uses of corn in the US

<table>
<thead>
<tr>
<th>Use</th>
<th>Amount</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>million bushels</td>
</tr>
<tr>
<td>Livestock feed</td>
<td>5,250</td>
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<tr>
<td>Ethanol production</td>
<td>3,650</td>
</tr>
<tr>
<td>Exports</td>
<td>1,850</td>
</tr>
<tr>
<td>Production of starch, corn syrup, sweeteners</td>
<td>943</td>
</tr>
<tr>
<td>Human consumption—grits, corn flour, corn meal, beverage alcohol</td>
<td>327</td>
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Maize growing areas in the US
Nature of maize: Open-pollinator

- Stamen and ovaries separated by a meter or more
- Massive amount of pollen
- Exchanges genetic material promiscuously
- And can self-fertilize

Hard to control maize!
What is a hybrid?

- Self-fertilization: dubious traits
- Cross-pollination: new generation has desirable traits
- Breeders allow 2 lines to self-pollinate, then cross in the next generation to create a hybrid.
Hybridization process
Heterosis

- **Hybrid vigor:** combining favorable genetic material
- All the features we breed for can exist in single landrace
- **Hybrids:** crossing 2 or more inbred genetic lines to produce heterosis
Open pollinated variety (OPV)

- Less high tech improved maize composites
- Selection of combination of desired traits from self pollinated plants
- Aim to produce uniform crop
- Rarely as productive as hybrids but can be replanted by farmers
Discussion question

- What do you think of hybrid crops? Why?
Vegetable or grain?

- Depending on its function and how it is grown
- In a nutritional and physiological sense
- High in carbs, low in protein
Advantages of maize

- Yields more food per unit of land and labor
- Every part of the plant can be used
- Variety can be tailored to the usage
- Fits into the growing season in many parts of Africa
Disadvantages

- Vulnerable to environmental shocks
  - water, sunlight, and N
- Crop storage is difficult in the tropics
- Not completely nutritious
  - deficient vitamin and protein
“Maize is life”

- Maize spread rapidly in last 500 years
- Supplanted traditional grains (which were well adapted)
- Now makes up 50% of calories and 90% of cultivated land
Average maize yield

African Green Revolution?

1960-90: 1% growth
1991-1997: 3% growth
Barriers to maize production in Africa

- 40% of Africa’s land is sloping and eroding
- Acidic soil, low in nutrients and liable to lose nutrients
- But main limitations presented by rainfall and moisture

Red porous laterite soils
Average annual rainfall in Africa
Changing patterns of climate

- Bi-modal pattern of seasons (wet/dry)
- ITCZ: Inter tropical convergence zone
- Seasonality produces wide variation from year to year

“shifting rain of beaming turbulence”
Drought in Africa

- Drought is historically common in Africa
- Cumulative effect of short or delayed rains
- Quick maturity of some cultivars allows them to escape drought
Maize growth stages and water use

A few days of drought during tasseling can impact yield
Protensia’s dilemma

• What are all the possible options for Protensia?

• What would you do if you were in his position?
“Hegemonic Leviathan”

- Maize fits into the growing season and is easily manipulated through genetic recombination
- Maize went from a vegetable crop to the dominant staple across the region in a matter of centuries
- Agencies from government to NGO to research all promoting maize via breeding programs