Mission 2019:
Global Food Security in the 21st century
The battle to feed all of humanity is over. In the 1970s and 1980s hundreds of millions of people will starve to death in spite of any crash programs embarked upon now. At this late date nothing can prevent a substantial increase in the world death rate, although many lives could be saved through dramatic programs to “stretch” the carrying capacity of the earth by increasing food production and providing for more equitable distribution of whatever food is available. But these programs will only provide a stay of execution unless they are accompanied by determined and successful efforts at population control. Population control is the conscious regulation of the numbers of human beings to meet the needs not just of individual families, but of society as a whole.
The “Green Revolution”

Norman Borlaug (1914-2009):
Wheat breeder and 1970 Nobel Peace Prize winner

“The Man Who Saved a Billion Lives”
Developed fast-growing, high-yield, disease-resistant, fertilizer-tolerant wheat varieties
Inspired similar efforts for rice and other grains
**Figure 3.5 Interaction of inputs in crop production: Maize yields and the use of nitrogen fertilizers in the United States.** The arrow points to the introduction of hybrid maize. By the time the planting of hybrid maize was complete (1950–1955), yields had increased significantly. The big yield increase parallels the use of nitrogen fertilizers and is caused by breeding strains that respond to nitrogen fertilizers. *Source:* Data from U.S. Department of Agriculture.
JJA Irrigation (km$^3$)

Western NA

Source: Puma & Cook, J. Geophys. Res. 2010

India

Source: Puma & Cook, J. Geophys. Res. 2010

China
The “Green Revolution”

Global wheat production increased 2x faster than population from 1975-1985

Source: FAO

Figure: Wikipedia commons
US: Increases in total production despite decline in land farmed

Production = yield x area
Yield = f(technical developments, inputs)
Table 3.4  The technological basis of modern agriculture (inputs per hectare of corn in the United States)

<table>
<thead>
<tr>
<th>Input</th>
<th>Hand Produced</th>
<th>1910</th>
<th>1980</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor (hr)</td>
<td>1,200</td>
<td>120</td>
<td>12</td>
</tr>
<tr>
<td>Machinery (kg)</td>
<td>1</td>
<td>15</td>
<td>55</td>
</tr>
<tr>
<td>Animal use (hr)</td>
<td>0</td>
<td>120</td>
<td>0</td>
</tr>
<tr>
<td>Fuel (L)</td>
<td>0</td>
<td>0</td>
<td>125</td>
</tr>
<tr>
<td>Manure (kg)</td>
<td>0</td>
<td>4,000</td>
<td>1,000</td>
</tr>
<tr>
<td>NPK fertilizer (kg)</td>
<td>0</td>
<td>0</td>
<td>316</td>
</tr>
<tr>
<td>Lime (kg)</td>
<td>0</td>
<td>10</td>
<td>426</td>
</tr>
<tr>
<td>Seeds (kg)</td>
<td>11</td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>Insecticides (kg)</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Herbicides (kg)</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Irrigation (%)</td>
<td>0</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Drying (kg)</td>
<td>0</td>
<td>0</td>
<td>3,200</td>
</tr>
<tr>
<td>Electricity ($10^3$ kcal)</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Transport (kg)</td>
<td>0</td>
<td>25</td>
<td>326</td>
</tr>
<tr>
<td>Yield (kg)</td>
<td>1,880</td>
<td>1,880</td>
<td>6,500</td>
</tr>
</tbody>
</table>

The “Green Revolution”: Key elements

- High-yield varieties (HYVs) of key crops created by traditional cross-breeding techniques
- Irrigation development
- Increased fertilizer use
- Increased pesticide use
- Substantial public investment in
  - infrastructure for irrigation and transport
  - credit for purchasing inputs
  - price guarantees.
The "Green Revolution": Key elements

Major Farming Systems
Sub-Saharan Africa
Map 1

Farming System
1. Irrigated
2. Tree crop
3. Forest based
4. Rice-tree crop
5. Highland perennial
6. Highland temperate mixed
7. Root crop
8. Cereal-root crop mixed
9. Maize mixed
10. Large commercial & smallholder
11. Agro-pastoral millet/sorghum
12. Pastoral
13. Sparse (arid)
14. Coastal artisanal fishing

Irrigated areas in rainfed farming systems
Water Bodies
Country Boundaries

FAO Disclaimer
The designations employed and the presentation of the material in the maps do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.
Mini-project 1

• Produce an oral report for the rest of the class on the Green Revolution in one of the following countries:
  • Mexico
  • Philippines
  • Malawi
  • India
  • Brazil
  • Kenya
  • United States
Mini-project 1

• Your report should answer the following questions:
  • How has agriculture in your country changed since 1950?
  • What have been the benefits of these changes?
  • What are the negative outcomes of these changes?
  • Does the history of the last 65 years provide any lessons for the future?
Mini-project 1

- Your report should be 5-6 minutes long (i.e., 5-6 content slides).
- Be prepared to present your report in class on Monday, September 21.
- Upload your report (pptx or pdf) under “Mini-project 1” in Stellar by 12 pm on Monday, Sept. 21. It should be Mac-compatible.
- Include references
Unsolicited advice

• It will be impossible to tell the whole story of 65 years of a country’s agricultural history in 6 minutes! Choose the points you think are most important for the rest of the class to understand.

• Think about the design of your slides to most effectively communicate your content.
The coming week

• Wednesday: Room ____. Librarian Chris Sherratt will give a short presentation about library resources. Rest of the class is for group work.
• Friday: Up to your group! 3-270 and E25-117 are available for your use.
• Please have your group email me and Mike Eddy a progress report or draft of your presentation by Friday afternoon at 5 pm; this progress report/draft will be shared with mentors.
• A brief journal entry will be due by Wednesday, Sept. 23.