Relationship Between Agriculture and Global Population
Discussing Global Agriculture

- “First” World
  - Developed Nations
- “Second” World
  - Former Communist/Command Economies
- “Third” World
  - Less/Least Developed Countries; Developing
- Poverty vs. Prosperity
- Food Production vs. Population Growth
Early Impacts of Agriculture

- Remove unwanted plants and animals from a farm area.
  - Plants and animals evolved into a symbiotic relationship.

- Social organization.
  - Structure.
  - Affluence.

- Population growth.
  - More children means more workers and care of elderly.
World Population Increase

Population in billions

- 1804: 1 billion
- 1922: 2 billion
- 1959: 3 billion
- 1974: 4 billion
- 1987: 5 billion
- 1999: 6 billion
- 2013: 7 billion
- 2028: 8 billion

- 118 years to reach 1 billion
- 37 years to reach 2 billion
- 15 years to reach 3 billion
- 13 years to reach 4 billion
- 14 years to reach 5 billion
- 12 years to reach 6 billion
- 15 years to reach 7 billion
- 15 years to reach 8 billion

- 2028 is projected to be 20% of the 2050 level.
Thomas Robert Malthus (1766-1834)

- Studied human population growth.
- Was a major influence on others, including Darwin.
- Prophesized that population would outgrow food production.
Malthus Pessimism

Population - geometric

Food production - arithmetic
Malthus Optimism

➢ War.
   • Kills people, directly and indirectly (i.e. hunger).
   • Armies spread disease.
   • Winners can thrive and prosper.

➢ Famine.
   • Localized.
   • Farmers historically are malnourished group.

➢ Pestilence.
   • 13th Century plague killed 50% of Europeans.
   • Trade and traders (sailors) spread disease.
   • HIV.
Napoleon Bonaparte (1769 – 1821)

- Never interrupt your enemy when he is making a mistake.
- Impossible is a word found only in the dictionary of fools.
- A picture tells a thousand words.
- An army marches on its stomach.
Reduction in population increase

- Food production has become more dependable.
- Improved transportation of food.
- Raising family incomes to purchase food.
- Improved housing and public hygiene and reduced infectious diseases.
- Medical advances.
- Human Migration
Social changes in developing countries

- Secondary school enrollment increases.
- More women are using contraception.
- Greater job availability due to better economic systems and increased world trade.
- Infant mortality had declined significantly.
Increase in Food Production & Availability

- Food production has become more dependable.
- New lands under cultivation – Irrigation Systems
- Improved genetics, production practices, yields
- Improved preservation of food.
- Improved transportation of food and expanded global market trade channels for food
Top 10 Sending Countries

Net Migration

Mexico, China, Tanzania, Congo, Philippines, Pakistan, Kazakhstan, Bangladesh, India, Burma
Migration

➢ Country to Country.
  • To USA from Europe.
  • To USA from South America and Asia.
  • To Europe from North Africa and Asia.
  • From Soviet Union.

➢ Within countries.
  • Rural to Urban.
  • Religion & Politics.
Urbanization

- South Asia
- Saharan Africa
- East Asia
- Western Asia
- Latin Am.
- North Am.

Urban: 
- South Asia: 75%
- Saharan Africa: 50%
- East Asia: 75%
- Western Asia: 75%
- Latin Am.: 100%
- North Am.: 100%
Area Planted
(Million Ha)

1955 = 1161.3 Ha
2005 = 1378.5 Ha
Yield per Person
(Kg/person)

- Cereals: 1955 - 2005 +17%
- Roots: 1955 - 2005 -30%
- Pulses: 1955 - 2005 -18%
- Oil Crops: 1955 - 2005 +16%
- Vegetables: 1955 - 2005 +62%
- Fruit: 1955 - 2005 +28%
People fed by a single farmer

- 1940: 19 people
- 1950: 27 people
- 1960: 46 people
- 1970: 73 people
- 1980: 115 people
- 1990: 129 people
- Today: 144 people
Aren’t We Wonderful

- World population has risen over 80% since 1960.
- In 1961 1.5 m ha of crop land and in 1998 only 0.1 m ha more.
- Yet farmers are now feeding twice as many people.
- And! People are eating more calories than before – at least 3,000 kcal available but not accessible – maldistribution of resources.
“Food Security” (WHO)

“when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life”

- A household's physical and economic access to sufficient, safe, and nutritious food that fulfills the dietary needs and food preferences of that household for living an active and healthy life.
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<th>Country</th>
<th>Public</th>
<th>Private</th>
<th>Total</th>
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<td>Developing Countries</td>
<td>11,770</td>
<td>609</td>
<td>12,379</td>
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<td>Developed Countries</td>
<td>9,797</td>
<td>10,353</td>
<td>21,250</td>
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<tr>
<td>Total</td>
<td>21,567</td>
<td>10,962</td>
<td>32,530</td>
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## R&D Investments 1995

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<th>Private</th>
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<tr>
<td>Developing Countries</td>
<td>95</td>
<td>5</td>
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<tr>
<td>Developed Countries</td>
<td>49</td>
<td>51</td>
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<tr>
<td>Total</td>
<td>66</td>
<td>34</td>
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</table>
Proprietary Ownership

- Plant Variety Protection – PVP
- Plant Patent – PP
  - Whole plants.
  - DNA sequences.
Proprietary Claims

- Plant germplasm.
- Trait-specific genes.
  - Round-up ready.
  - *Bt* insect resistance.
  - Tolerance to: stress, disease, cold.
  - Quality traits: starch, oil, amino acids.
Proprietary Claims

- Transformation technologies.
- Promoters to control genes.
- Markers to identify the presence of a desirable trait.
- Gene silencing or regulating technologies.
- Genomics.
Top 10 Seed Companies

- DLF-Trifolium (Denmark) $352,000,000
- Sakata (Japan) $401,000,000
- Takii (Japan) $425,000,000
- Bayer Crop Sci (Germany) $430,000,000
- KWS Ag (Germany) $430,000,000
- Land O'Lakes (US) $615,000,000
- Group1 Limagrain France $756,000,000
- Syngenta (Swiss) $1,743,000,000
- Dupont (US) $2,781,000,000
- Monsanto (US) $4,476,000,000

Top 10 = 57%, Top 3 = 44%, Top 3 = 39%, Monsanto = 10% world seed
Future Public R&D Investment

- Sustained low food prices builds complacency.
- Concerns that increased food will lead to population explosion.
- Private investment in biotechnology will take care of future needs.
- Distrust in agricultural research (i.e. mad cow disease, GMO scares, etc.)
What, Where and How
Agricultural Land
(Million Ha)

- Arable: 1,398 Million Ha
- Permanent: 136 Million Ha
- Pasture: 3,442 Million Ha
Major Agricultural Crops

- Maize: 596 mMt
- Rice: 593 mMt
- Wheat: 582 mMt
- Barley: 136 mMt
- Sorghum: 60 mMt
- Millet: 27 mMt
- Soybean: 162 mMt
- Oil palm: 98 mMt
- Coconut: 40 mMt
- Canola: 40 mMt
- Dry bean: 20 mMt
- Others: 20 mMt
Roots
- Potato - 302 mMt
- Cassava - 170 mMt
- Sweet potato - 138 mMt

Vegetable
- Tomato - 100 mMt
- Cabbage - 50 mMt
- Onion - 50 mMt

Fruits
- Oranges - 66 mMt
- Apple - 60 mMt
- Grapes - 60 mMt
- Banana - 58 mMt
Crop Production
(Billion $)

- China: 20.4%
- USA: 12.4%
- India: 10.9%
- Russia: 3.0%
- Brazil: 4.0%
- France: 2.5%
- Germany: 1.5%
- Argentina: 2.0%
- Italy: 1.9%
- Indonesia: 2.5%
Cropped land: Production

(% of World Total)
Industrial Agriculture

- Relies on large heavy machinery and chemicals.
- Uses fossil fuels and converts them to food and other crops.
- Although often considered to highly sophisticated, many operations require large amounts of (low-paid) labor.
Traditional Intensive Agriculture

- Produces the highest crops yields/area.
- Uses lots of hand labor.
- Cycles soil nutrients through livestock manures and returning other organic matter to the soil.
- China has maintained good soil fertility for 1000’s of years of farming.
Shifting Cultivation Agriculture

- Farmers ‘hack’ small plots of farmland from forests.
- Continue to farm that portion of land until nutrients are depleted.
- Often utilizes inter cropping, legumes and grains.
- Land is later re-fertilized by natural process.
Nomadic Herders Agriculture

- Usually land incapable of crop production on even a low intensity.
- Farmers follow the seasons and generally leave an area before depletion of soil nutrients.
USA Agriculture
World Population in mid-2012 was Estimated to Be:
- **7.057 Billion** (7 Billion reached!)

World Population in 2025 is Estimated to Become:
- **8.082 Billion** (< 2011’s prediction)
- *Africa* could reach **1.446 Billion**
<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China (PRC)</td>
<td>1,350 Million</td>
</tr>
<tr>
<td>2</td>
<td>India</td>
<td>1,260 Million</td>
</tr>
<tr>
<td>3</td>
<td>USA</td>
<td>314 Million</td>
</tr>
<tr>
<td>4</td>
<td>Indonesia</td>
<td>241 Million</td>
</tr>
<tr>
<td>5</td>
<td>Brazil</td>
<td>194 Million</td>
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World Population Top Ten
(2012 Data, Population Reference Bureau)

6. Pakistan 180 Million
7. Nigeria 170 Million
8. Bangladesh 153 Million
9. Russia 143 Million
10. Japan 128 Million