"Will there be enough? Food Demand and Agricultural Capacity"

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This is not a new question!

Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio. A slight acquaintance with numbers will show the immensity of the first power in comparison with the second.

## World Population Growth

<table>
<thead>
<tr>
<th>Year</th>
<th>Population, (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1800</td>
<td>978</td>
</tr>
<tr>
<td>1900</td>
<td>1,650</td>
</tr>
<tr>
<td>1999</td>
<td>5,978</td>
</tr>
</tbody>
</table>

[www.statistics.gov.uk](http://www.statistics.gov.uk)
Food Production has increased at an incredible rate

- Expansion of cultivated and grazed lands
- Application of science to the discovery of new technologies
- Translation of knowledge to practice through education
- Establishment of market incentives and supporting infrastructure
Have there been negative consequences?

Sure – and they continue to be recognized and addressed

1. Soil Loss
2. Long-residual pesticides
3. Depletion of geological water
4. Deforestation
1930’s Wind Erosion
1930’s Water Erosion

2008 Grass Waterways
Minimum Tillage Agriculture
Dean Robert Easter
Circa 1965

“Will I eat tomorrow?”
The Green Revolution

“The SCIENCE-based transformation of agriculture that began in 1945 and continued through the 1970’s with an enormous impact on the availability of food to the people of the world.”
U.S. Land-Grant Universities were Primary Contributors to Success.

- Research and graduate education in the U.S.
- Development of agricultural universities in India, Brazil, Africa etc.
Morrill Act of 1862 granted public lands to states which could be sold to finance establishment of public universities.
What Happened

- An extended period of agricultural surplus
- Lead to reduced investments globally in agricultural research, teaching and extension.
- People retired and were not replaced
- Agricultural surpluses declined
The “Food” Crisis of 2008

- No question – it was real.
- Many factors contributed:
  - Drought
  - Population increase
  - Economic growth and dietary change
  - Lack of investment in science and development
  - Government export policies
  - Biofuel usage
923 million people in the world go hungry every day. 907 million of these live in developing countries (FAO).
Global Hunger Index

- Portion of undernourished as a percent of the population.
- The prevalence of underweight children under the age of five.
- The mortality rate of children under five.
Drivers of Food Demand

- Population
- Per capita income growth

World Population Growth, Actual and Projected, 1950-2050

Effects of Income Growth

- Very low income people spend the first increments in purchasing power on food staples.

- As incomes rise further comes addition of fruits, vegetables, dairy products, animal protein, and edible oils.
And Income Growth is very often associated with urbanization.

As people move to cities there is a shift of food budgets from grains and staple to vegetables, fruits, meat, dairy and fish.
### Percentage Change in Food Consumption 1990 to 2005

<table>
<thead>
<tr>
<th>Type</th>
<th>India (FAO, 2007)</th>
<th>China</th>
<th>Brazil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>0</td>
<td>-20</td>
<td>120</td>
</tr>
<tr>
<td>Oil crops</td>
<td>70</td>
<td>140</td>
<td>10</td>
</tr>
<tr>
<td>Meat</td>
<td>20</td>
<td>140</td>
<td>70</td>
</tr>
<tr>
<td>Milk</td>
<td>20</td>
<td>200</td>
<td>20</td>
</tr>
<tr>
<td>Fish</td>
<td>20</td>
<td>130</td>
<td>-10</td>
</tr>
<tr>
<td>Fruits</td>
<td>30</td>
<td>250</td>
<td>-20</td>
</tr>
<tr>
<td>Vegetables</td>
<td>30</td>
<td>190</td>
<td>30</td>
</tr>
</tbody>
</table>
Projected World Population in Urban Centers,
(Millions)

World Bank Development Indicators, 2000
LOTUS SUPERCENTER
I believe urbanization is a primary factor driving structural change in the agriculture.
Does all production have to be done on Mega-farms?
There is an expectation that agriculture will:

- Meet the growing global demand for food,
- Contribute significant renewable energy resources to the planet and,
- Do these things with minimal impact on the environment and society.
Food production – where and who?

High-production agriculture requires good soils, favorable climate, finance, markets, access to technology, entrepreneurs and stable government.
To what extent will “new” lands be brought into production by new entrants in agriculture?
South Korea has just struck a 99 year deal with Madagascar to lease an area half the size of Belgium to grow palm oil and no less than half of South Korea’s corn demands [...] Carl Atkins, of consultants Bidwells Agribusiness, said Daewoo Logistics' investment in Madagascar was the largest it had seen. “The project does not surprise me, as countries are looking to improve food security but its size it does surprise me.”
MOSCOW — Wearing flowing red robes and pitching his own trademark desert tent, Libyan leader Moammar Gadhafi paid a visit to Ukraine last month in search of a remarkable deal to help feed his oil-rich but soil-poor people.

Under a proposed agreement with Kiev, Libya would lease 247,000 acres of Ukraine's rich black land to grow wheat. The harvest would then be shipped back to Libya, giving the desert nation a more secure supply of food in the face of predictions about higher food prices and potential shortages in decades to come. Ukraine, in turn, would get access to Libyan oil fields, helping free it from dependence on Russia for its energy needs.
Two Issues

- There are significant regions of the world where yield per acre is very modest compared to areas where agricultural knowledge is fully applied.
  - A technology transfer and adoption challenge.

- Technology that pushes yields beyond current upper bounds.
  - A challenge to discovery science.
Board on International Food and Agricultural Development
Conference of Deans Report - 2008

- Capacity Building – human capital and infrastructure
- Value-chain development – strategic crops, post-harvest protection
- Economic and community development – youth education, leadership, retention of wealth in local communities
Renewing American Leadership in the Fight Against Global Hunger and Poverty: The Chicago Initiative On Global Agricultural Development

- Increased agricultural education and extension at all levels,
- Greater funding for agricultural research,
- More emphasis on expanding rural and agricultural infrastructure,
- Reform of U.S. institutions that deliver agricultural development assistance, and their interactions with international institutions focused on agricultural development assistance, and
- Reform of U.S. policies that discourage agricultural development abroad.

Chicago Council on Global Affairs, 2009
“The future of agriculture in the U.S. and internationally will be determined by the availability of a competent, innovative workforce – vocational and professional”

Present indicators are not good
“Since the early 1900s increasing labor efficiency in production agriculture meant that young people could leave the farm, obtain a solid education at an affordable public university and then find careers in agriculture”
“American agriculture, and by extension global agriculture, was built by the minds and the brawn of four generations of rural youth who passed through high school, community college and university programs in agriculture”

“It was an experience without parallel in history – and – it is over.”
Will you be a part of the solution to increased food production --- or will you sit on the sideline and debate what should be done?