AEDE/IS 539
China’s Agriculture
China’s Agriculture

- Overview of Chinese agriculture
- Technology and agriculture
- China’s “green revolution”
- Output and yields
- Future challenges
Overview of Chinese Agriculture

- From GLF into 1980s, key concern was whether China’s agriculture could feed its population.
- For past 30 years, productivity growth suggests it can, e.g., grain production has increased from 247 mmt (1978) to 470 mmt (2008).
- Diffusion of technology and application of modern inputs accelerated in 1980s/90s.
- On demand side, changes in Chinese diet placing new pressures on sector – will require further R&D and investment in agriculture.
Overview of Chinese Agriculture

China’s grain production increases, 1978-2008

Million metric tons

- Rice
- Wheat
- Corn

Source: China’s National Bureau of Statistics (NBS) data.
Overview of Chinese Agriculture

- During 1950s - expansion of irrigation and land improvement
- Mid-1960s through 1980s, steady growth in production – “green revolution” in China, based on development of higher-yielding varieties, fertilizer application, and irrigation
- Process of intensification of land use, e.g., triple cropping, and intercropping of varieties
- “Grain First” policy ignored gains from diversification – reduced output of non-grain crops, e.g., oilseeds
- Post-1979, significant growth in oilseeds and meat production
Figure 1: Per capita agricultural output

Source: Naughton (2010)
Cost minimization for output of $x$:

$A = \text{China}, B = \text{USA}$
Technology and Agriculture

“Induced-innovation” hypothesis – technical change due to cost-minimizing farmers wanting to save on use of scarce resources.

China focused on improved yields/unit of land, subject to specific constraints:

- green revolution easily adapted to water-abundant, rice-growing region, but not wheat region of North China Plain

- intensification of land use necessary through terracing and multi-cropping techniques, e.g., inter and relay-cropping
Intensification of Land-Use

Terracing - Hunan Province
Intensification of Land-Use

Intercropping of wheat and trees - Shandong Province
China’s Green Revolution

- Green revolution based on water control and delivery, manufactured fertilizers, and high-yielding seed varieties:
  - irrigated area grew during 1970s, slowed during dissolution of collectives, and grew again in 1990s
  - use of chemical fertilizers replaced organic fertilizers, especially after 1978 through imports
  - China has built world’s largest seed production and distribution system
  - developed high-yielding dwarf rice variety (1964); introduced high-yielding hybrid varieties of corn (1961), and rice (1976)
Figure 2: Fertilizer and Irrigated Area

Source: Naughton (2009)
China’s Green Revolution

- Third leg of green revolution, fertilizers, only arrived in the 1980s along with rural reforms
- Some argue China’s productivity growth has been due to application of fertilizer to improved seed varieties (Huang and Rozelle, 1996)
- Others argue it was incentive effect of rural reforms driving productivity gains (Lin, 1992)
- Likely it was interaction of both technological change and incentives (Naughton, 2007)
What About Machinery?

- Until early-1970s, human labor augmented with draft animals, e.g., oxen, mules – also provided transportation and organic fertilizer
- “Big Push” industrialization resulted in investment in agricultural machinery that was a mismatch for China’s agriculture
- Small electric pumps helped with irrigation through drilling of tube-wells
- Post-reform, farmers switched to using small tractors for tilling – 14.5 million (2004), and trucks for hauling
What About Machinery?

Chinese tractor
Figure 3: Rural Motive Power

Source: Naughton (2009)
### Output and Yields

#### Comparison of yields and inputs/hectare of cropland, 1997

<table>
<thead>
<tr>
<th></th>
<th>Unit</th>
<th>China</th>
<th>World</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production/hectare</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice/paddy</td>
<td>Tons</td>
<td>6.2</td>
<td>3.9</td>
<td>7.0</td>
</tr>
<tr>
<td>Wheat</td>
<td>Tons</td>
<td>3.7</td>
<td>2.7</td>
<td>2.8</td>
</tr>
<tr>
<td>Corn</td>
<td>Tons</td>
<td>4.6</td>
<td>4.3</td>
<td>8.6</td>
</tr>
<tr>
<td>Soybeans</td>
<td>Tons</td>
<td>1.7</td>
<td>2.2</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>Fertilizer consumption/hectare</strong></td>
<td>Kilos</td>
<td>271</td>
<td>94</td>
<td>111</td>
</tr>
<tr>
<td>Farm workers/100 hectares</td>
<td>Number</td>
<td>310</td>
<td>82</td>
<td>2</td>
</tr>
<tr>
<td>Land irrigated</td>
<td>%</td>
<td>40</td>
<td>18</td>
<td>13</td>
</tr>
<tr>
<td>Tractors/1,000 hectares</td>
<td>Number</td>
<td>6</td>
<td>18</td>
<td>27</td>
</tr>
</tbody>
</table>

Source: Gale (USDA, 2002)
Future Challenges

- Unlikely intensification can continue – nutrient run-off issues, over-exploitation of water resources
- Switch to meat consumption – requires more grain for feed and also protein – e.g., it dominates imports of soybeans
- Shift into horticultural production will require better transport and storage systems
- Biotechnology has been applied in cotton sector in China, but GM rice not yet available commercially
Future Challenges

China Soybean Supply Demand

- Production (1000MT)
- Net Imports
- Total Production
- Total Consumption

Source: USDA Foreign Agricultural Service