GM Crops: Institutional and policy choices for developing countries

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Figure 11.1 Commercial production of GM crops 1996-2005

Million Hectares

Year

USA
Argentina (soy, maize)
Brazil (soy)
China (cotton)
India (cotton)
South Africa (maize, ...
I. New science but also a new institutional arrangement:
   • shift from public to the private corporate sector
   • US model and alternatives

II. Developing country agendas:
   • Global integration: global markets, global technology
   • National development: economic growth, food security, farm incomes, reduce chemical use, poverty reduction

III. Pro-poor agenda: Path not yet taken
New science and new institutional requirements

What are the institutional and policies options that shape the use of this technology?

1. R & D – From public (universities, research institutions, NARS) to private (national company, global corporations and subsidiaries)
2. IPRs and Financing model – From intellectual property based private incentives to public subsidy
3. Biosafety regulation – From precautionary to permissive
4. Seed market structure – From vertically integrated large global corporation to local units
I New science and new institutional requirements

*From R & D to farmer*

1. Biotech research (lab and field testing)
2. Biosafety approval
3. IP approval
4. Plant breeding research – adapted product
5. Seed multiplication and sales to farmer
Figure 2.2. The two step scientific process for producing GMOs

1. **Step 1: Biotechnology Research**
   - Transformation event
   - Regulatory/Biosafety Approval
   - IP negotiation

2. **Step 2: Plant breeding Research**
   - Genetic Resources
   - Plant Breeding
   - Adapted Transgenic Variety
   - Seed Industry (Royalty collection)

3. Farmers

**Notes:**
- $$$$ indicates financial transactions or costs associated with each step.
US model: corporate investment facilitated by policy environment

- **R & D** - shifts in public sector funding to public sector financing of upstream research, incentives to stronger links between public sector financed university research and private sector investments (Bayh Dole Act 1980)
- **IPRs** - shifts in legislation created incentives to stimulate private investments: gradual tightening of IP rules – patents on genes and GM varieties
- **Biosafety** - shifts in food and safety regulation supportive, evolving approach (‘science based’ or ‘permissive’)
- **Seed marketing** - creation of vertically integrated industry spanning biotechnology research, plant breeding, seed marketing
US model: political economy process

• Drivers: industry and farmers – large domestic seed markets and export potential.

• Opposition groups – environmentalists, organic farming movement.

• Supportive policy environment
EU model: shift 1996-9

• R & D – government funding: initial priority and support discontinued
• Intellectual property – tighter IPs but TRIPS exception
• Biosafety – 1997 Amsterdam treaty on precautionary principle; 1997 directive labelling; 1999 moratorium
• Seed marketing – EU based corporations did not flourish or relocated activities to US serving global markets

Continued back and forth and gridlock over decisions
EU model: political economy process

- Drivers: conflicting interests of biotech industry groups, some farmers, vs. environmentalists and anti-globalization (anti-corporate) movements, Green parties, consumer attitudes, organic and other farmer groups.
- Outcome: Precautionary biosafety rules used to restrain development, production, imports. Continues to be political battleground.
Developing countries – different models, different results

- China: major institutional shifts, building domestic capacity ($200 R & D budget, $900 in PPP), capacity and products competing with multinationals.
- Argentina and S. Africa: supportive govt policies but creating limited domestic capacity.
- India and Brazil: inconsistent policies and gridlocked process, no one happy. Contrast with EU – commercial production spreading.
Developing countries: process

• Ministries of ag, economy – all five countries are major producers and exporters of soy or cotton
• Ministries of environment – Biodiversity a critical policy issue in Brazil and India
• S & T establishments – strongest in China, Brazil and India, weak in Argentina
• Cotton, soy and maize producers and seed companies – voting with their commercial investments
• Civil society – strong environmental, social justice and anti-globalization (anti-corporate) movements in India, Brazil
• Govt policy – liberalization of economy in Brazil, agriculture in S. Africa
Govt positions and policy environment

- US – govt policy pro-GM; favourable policy and policy environment
- EU – govt policy shift 1996-99 & policy gridlock
- Argentina, China, S. Africa – govt policy pro-GM;
- Brazil, India – govt policy and environment ambiguous
Results: goals

- **Dynamic supply of seeds**: US, China
- **Biosafety management**: US, S Africa, China? Quality products: US, South Africa
- **Competitive prices**: ? China more than elsewhere?
- **Choice of varieties**: US, China
- **Slow down or ban GM crops**: EU
White bags
Institutional options

- Strong patents – stimulates R & D? higher seed prices? Monopoly supplier? Difficult to enforce. Competitive market?
- Role of public sector in R & D – Upstream biotech? Develop commercial products that are of no interest to private sector? Locally adapted products? P-P Partnership?
- Biosafety – precautionary legislation to arrest spread: perverse effects.
II Developing country agendas: what motivates countries?

**Growth and globalisation**
- Access global markets for economic growth
- Access global technology

**Human development and poverty reduction**
- Increase farm incomes of poor households
- Reduce chemical applications
- Improve food security
<table>
<thead>
<tr>
<th>#</th>
<th>Country</th>
<th>Soy</th>
<th>Maize</th>
<th>Cotton*</th>
<th>Canola</th>
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<tbody>
<tr>
<td>1</td>
<td>U.S. (82.8)</td>
<td>692</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Brazil (50.2)</td>
<td></td>
<td></td>
<td>China (50.9)</td>
<td>China (11.3)</td>
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<tr>
<td>3</td>
<td>Argentina (38.3)</td>
<td></td>
<td>Brazil (34.9)</td>
<td>India (26.4)</td>
<td>India (6.2)</td>
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<tr>
<td>4</td>
<td>China (16.9)</td>
<td>Mexico (20.5)</td>
<td>Pakistan (18.9)</td>
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<tr>
<td>5</td>
<td>India (6)</td>
<td>Argentina (19.5)</td>
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<tr>
<td>6</td>
<td>India(14.5)</td>
<td>Turkey (9.5)</td>
<td>U.K. (1.9)</td>
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<tr>
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<td>Brazil (8.0)</td>
<td>Poland (1.4)</td>
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<tr>
<td>8</td>
<td>Indonesia (12.0)</td>
<td>Australia (5.9)</td>
<td>Australia (1.1)</td>
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<tr>
<td>9</td>
<td>South Africa (12)</td>
<td>Greece (3.4)</td>
<td>Austria (0.9)</td>
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<td></td>
</tr>
<tr>
<td>10</td>
<td>Italy (10.6)</td>
<td>Egypt (2.8)</td>
<td>Czech Republic (0.8)</td>
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</table>
Table 12.1 Importance of global maize, cotton and soy markets for Argentina, Brazil, China and India (exports of crop as % of agricultural exports and total exports, average 2002-2004)

<table>
<thead>
<tr>
<th></th>
<th>Maize</th>
<th>Cotton</th>
<th>Soy</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>% ag exports</td>
<td>% total exports</td>
<td>% ag exports</td>
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<tr>
<td>Argentina</td>
<td>8.5</td>
<td>3.8</td>
<td>0.2</td>
</tr>
<tr>
<td>Brazil</td>
<td>2.0</td>
<td>0.6</td>
<td>1.8</td>
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<tr>
<td>China</td>
<td>7.1</td>
<td>0.3</td>
<td>40.0</td>
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<tr>
<td>India</td>
<td>1.8</td>
<td>0.2</td>
<td>22.6</td>
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<tr>
<td>South Africa*</td>
<td>5.7</td>
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</tr>
<tr>
<td>U.S.A.</td>
<td>9.8</td>
<td>0.8</td>
<td>3.5</td>
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</table>

*South Africa average 2003-2004
Table 12.2. Comparing crop yields, 2004 (Tons per ha)

<table>
<thead>
<tr>
<th>Country</th>
<th>Maize yield</th>
<th>Soy yield</th>
<th>Canola yield</th>
<th>Cotton yield</th>
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</thead>
<tbody>
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<td>1.3</td>
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</tr>
<tr>
<td>Benin</td>
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<tr>
<td>Brazil</td>
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<td>1.7</td>
<td>1.0</td>
</tr>
<tr>
<td>China</td>
<td>5.1</td>
<td>1.8</td>
<td>1.8</td>
<td>1.0</td>
</tr>
<tr>
<td>France</td>
<td>9.0</td>
<td>2.5</td>
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<td>Germany</td>
<td>9.1</td>
<td>1.0</td>
<td>4.1</td>
<td>NA</td>
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<tr>
<td>Greece</td>
<td>10.1</td>
<td>2.1</td>
<td>NA</td>
<td>1.0</td>
</tr>
<tr>
<td>India</td>
<td>2.0</td>
<td>1.1</td>
<td>1.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Mali</td>
<td>1.1</td>
<td>NA</td>
<td>NA</td>
<td>0.4</td>
</tr>
<tr>
<td>South Africa</td>
<td>3.1</td>
<td>1.6</td>
<td>NA</td>
<td>0.4</td>
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<tr>
<td>U.S.A.</td>
<td>10.1</td>
<td>2.8</td>
<td>1.8</td>
<td>0.7</td>
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Source: FAOSTAT (http://faostat.fao.org) and Bulletin of the International Cotton Advisory Committee
Table 11.2 – Performance advantage of Bt cotton over conventional varieties (%)

<table>
<thead>
<tr>
<th></th>
<th>Argentina</th>
<th>China</th>
<th>India</th>
<th>Mexico</th>
<th>South Africa</th>
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<tbody>
<tr>
<td>Yield</td>
<td>33</td>
<td>19</td>
<td>34</td>
<td>11</td>
<td>65</td>
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<tr>
<td>Revenue</td>
<td>34</td>
<td>23</td>
<td>33</td>
<td>9</td>
<td>65</td>
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<tr>
<td>Pesticide costs</td>
<td>-47</td>
<td>-67</td>
<td>-41</td>
<td>-77</td>
<td>-58</td>
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<tr>
<td>Seed costs</td>
<td>530</td>
<td>95</td>
<td>17</td>
<td>165</td>
<td>89</td>
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<tr>
<td>Profit</td>
<td>31</td>
<td>340</td>
<td>69</td>
<td>12</td>
<td>299</td>
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</table>

Argentina soy production

Figure 6.1: Economic liberalisation and agricultural expansion in the 1990s: grains and soy production
Argentina soy exports

Figure 12.1 Soy exports 1985-2004
III Pro-poor agenda
The Path Not Yet Taken
Pro-poor R & D agenda

• Investing in priority crops (rice, wheat, maize, cassava, plantains, sorghum, legumes)
• Investing in priority traits (increase yield, reduce variability – drought tolerance, disease resistance)
• Dynamic supply of locally adapted varieties at competitive prices for farmers
Institutions for pro-poor agenda

- Better understanding of patent regimes, seed sector, biosafety systems, research arrangements most appropriate to developing country conditions to deliver a choice of quality seeds to farmers at competitive prices.
- Upstream research by global public finance and institutions?
- Private-public partnerships?
- Political alliance for pro-poor agenda including social activists, philanthropy, industry social programmes, donors with national govts in sci, ag, envt and econ.
Current investment patterns

- Monsanto: $588million (US total 400 scientists)
- CAAS: $200million (PPP $900; 150 labs, 3200 professionals)
- EMBRAPA: $30million
- CGIAR: $25million

(shows orders of magnitude, using approximate numbers which are not strictly comparable)
Conclusions

• Unless the public sector engages in agricultural biotechnology for a pro-poor agenda, the path of technology development will be led by the global corporate sector following global profit motives.

• Unless national governments in developing countries create an institutional environment that can effectively give incentives for a supply of quality seeds, the seed market will be dominated by global corporations following global profit motives.