Adoption of Unapproved Varieties of Bt Cotton in Pakistan: Impact on Production and Trade

By
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Plan of Presentation

• Background

• Why unapproved Bt cotton in Pakistan

• Bt cotton survey 2009

• Conclusions and direction for future research
Importance of Cotton for Pakistan

- 4th largest producer

- 3rd largest consumer

- Cotton and textiles contribute
  - 10% to GDP
  - 21% to employment
  - 60% to export earnings (yarn and finished textile products)

- Cotton farmers’ problem
  - high fluctuations in yield (pest infestation)
  - high cost of production (38% on plant protection)
Yield per hectare in Selected Countries
GM cotton is considered a solution to farmer’s problem

- GM cotton is obtained by inserting the gene of soil born bacterium *Bacillus thuringiensis* (Bt) into cotton seed. This gene produces Cry protein that is harmful to the larvae of moths and butterflies, beetles, and flies.

- **Cost advantages**
  - Reduces the number of sprays => Reduces pesticide expenditure
  - Labor saving

- **Yield advantages**

- **Higher profitability than conventional varieties**
  - Despite higher price of seed

- **Health and environmental advantages**
  - Lower exposure to hazardous pesticides
## Comparison of cost and yield between Bt and non-Bt varieties in China and India

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Bt Cotton in Pakistan

• Cotton is grown in two provinces: Punjab (80%), Sindh (20%)

• Private breeders developed Bt type varieties by using Monsanto’s transforming event MON531 (Bollgard)

• PARC conducted a detailed scientific survey in 2008

  – 50% of the cotton growing area in Punjab and 80% in Sindh was under these unapproved Bt type varieties
  – 39 unapproved varieties of Bt cotton were under cultivation.
  – 10% of the sample in Punjab and 19% in Sindh were not positive for the Cry protein
  – Variation in intensity of protein expression from high concentration to low
  – Non-uniform plant population

• ⇒ variable and unknown quality of seed – seed mixing – spurious seed
Why Unapproved Bt Cotton?

• Slow progress in agricultural biotech research (initiated in 1981)
  – Mainly 2 public institutions and many private breeders are involved
  – Weak research infrastructure
  – Weak institutional support
  – Lack of coordination

• Lack of political will to adopt biotechnology (slow progress in the legislation process)
  – Convention on Biodiversity (CBD) was signed in 1992
  – Cartagena Protocol on Biosafety was signed in 2001 but not ratified until 2009
  – Biosafety guidelines and the rules approved in April 2005
  – An independent body, the Intellectual Property Organization - Pakistan (IPOP) has been formed in 2005
  – Amendments in the Plant Breeders’ Right Act and Seed Act are still awaiting approval from the parliament
Current Situation

• For the approval of a GM variety, a three tier system is introduced
  – Institutional biosafety committee (IBC), Technical advisory committee (TAC), National biosafety committee (NBC)
  – Variety → IBC → TAC → NBC → IPOP → NBC → field trials

• No variety was submitted to NBC for approval until 2008
  – Fear of infringement of Monsanto’s patent rights
  – Fear of law suit and trade sanctions if infringement is found

• The GoP recently approved the field trials for six Bt cotton varieties and allowed the import of hybrid seed from India and China for field trials

• The commercial Bt seed is expected to be available for the 2010-11 planting season
Issues Raised in Public Debate

- **IPR**
- **Technical issues**
  - Bt varieties are ineffective for sucking pests (CLCV)
  - Lack of awareness about the use of biotechnology

- **Market issues**
  - Uncertain seed quality
  - Inefficient seed pricing
  - Confidence of farmers on approved varieties
  - Impact on textile sector (quality of fiber)

- **Social issues**
  - Uneven distribution of benefits (raised by NGOs)
  - Issue of food security (long duration)
Bt Cotton Survey 2009

- PARC (2008) survey examined the presence/absence of Cry protein in the existing Bt varieties

- PARC survey did not collect information on the economic performance of these varieties in Pakistan

- Bt Cotton Survey 2009 aims to examine the economic impact of the unapproved Bt varieties on cost of production, yield and gross margin in Pakistan
Agro-climatic Zones of Pakistan
Sample Selection Methodology

• The selected sample is drawn from the existing sampling frame of the Pakistan Rural Household Survey (PRHS) (2 rounds)
  – 4 cotton growing districts in 2 provinces

• One district selected from each province based on the share of cotton production in the province (Bahawalpur in Punjab and Mirpur Khas in Sindh)
  – 16 villages, 208 cotton farmers

• Survey conducted during February-March 2009 (difficult security situation)

• How representative are these districts of cotton growing areas
Selected Sample – Bt Cotton Survey 2009
## Basic Facts – Selected Sample

<table>
<thead>
<tr>
<th></th>
<th>CW-Punjab</th>
<th>CW-Sindh</th>
<th>Bahawalpur</th>
<th>Mirpur Khas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence of poverty (%)</td>
<td>55.51</td>
<td>56.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of rural population</td>
<td>17.47</td>
<td>11.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of rural poor</td>
<td>20.13</td>
<td>13.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development Rank</td>
<td>64/100</td>
<td>65/100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weather</td>
<td>Hot and dry</td>
<td>Hot and humid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil quality</td>
<td>Sandy</td>
<td>Clay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average distance (in km) between selected villages and major facilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance to seed/fertilizer/pesticide shop</td>
<td>15</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance to ZTBL</td>
<td>18</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance to nearest clinic/dispensary</td>
<td>3</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance to secondary girls school</td>
<td>13</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance to secondary boys school</td>
<td>11</td>
<td>9</td>
<td></td>
<td></td>
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Percentage Distribution of Farmers by Operated Land

- Less than 5 acres: Bhawalpur 14.4%, Mirpur Khas 24.0%
- 5 to under 12.5 acres: Bhawalpur 52.9%, Mirpur Khas 55.8%
- 12.5 to under 25 acres: Bhawalpur 19.2%, Mirpur Khas 11.5%
- 25 to under 50 acres: Bhawalpur 9.6%, Mirpur Khas 6.7%
- 50 acres and above: Bhawalpur 3.8%, Mirpur Khas 1.9%
Type of Tenure

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<th>Type of Tenure</th>
<th>Bahawalpur</th>
<th>Mirpur Khas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner operator</td>
<td>77.9</td>
<td>73.1</td>
</tr>
<tr>
<td>Sharecropper and tenant</td>
<td>23.1</td>
<td>9.6</td>
</tr>
<tr>
<td>Owner cum sharecropper</td>
<td>2.0</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.8</td>
</tr>
</tbody>
</table>
Adoption of Bt Cotton

% farmers

2006 2007 2008

Bahawalpur
Mirpur Khas

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Type of Cotton Grown

- Bt only: Bhawalpur 58.7%, Mirpur Khas 86.5%
- Non-Bt only: Bhawalpur 27.9%, Mirpur Khas 9.6%
- Both Bt and non-Bt: Bhawalpur 13.5%, Mirpur Khas 3.8%
Sources of Bt Cotton Seed

- Seed dealer: 86.8%
  - Bhawalpur: 34.7%
  - Mirpur Khas: 52.1%
- Fellow farmer: 5.3%
  - Bhawalpur: 7.1%
  - Mirpur Khas: 8.2%
- Landlord: 6.6%
  - Bhawalpur: 0%
  - Mirpur Khas: 6.6%
Awareness about Bt Technology among Farmers

Do you know that poor quality of Bt seed may not be effective to control pests?

- Bahawalpur: 18.4%
- Mirpur Khas: 13.26%

Do you know about the refuge area?

- Bahawalpur: 3.94%
- Mirpur Khas: 2.04%
Seed Expenditure (Rs/acre)
Total Pesticide Expenditure (Rs/acre)

Bahawalpur
- Bt: 2,555
- Non-Bt: 3,238

Mirpur Khas
- Bt: 1,929
- Non-Bt: 2,636

Significantly different
Number of pesticide Sprays

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<tr>
<th></th>
<th>Bt</th>
<th>Non-Bt</th>
</tr>
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<tr>
<td>Bollworm spray</td>
<td>1.54</td>
<td>4.04</td>
</tr>
<tr>
<td>Non Bollworm</td>
<td>2.60</td>
<td>3.88</td>
</tr>
<tr>
<td>Bollworm spray</td>
<td>1.18</td>
<td>2.67</td>
</tr>
<tr>
<td>Non Bollworm</td>
<td>3.12</td>
<td>3.50</td>
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Significantly different

Bahawalpur

Mirpur Khas
Pesticide Expenditure (Rs/acre)

![Graph showing pesticide expenditure for Bollworm spray and Non Bollworm spray in Bahawalpur and Mirpur Khas.]

- Bt and Non-Bt significantly different.
Total expenditure (Rs/acre)
Yield (Kg/acre)

Significantly different
Revenue (Rs/acre)

- Bahawalpur
  - Bt
  - Non-Bt

- Mirpur Khas
  - Significantly different

Revenue comparison between Bahawalpur and Mirpur Khas, showing significantly different results.
Gross Margin (Rs/acre)

Bt

Non-Bt

Significantly different
## Characteristics of Adopters and Non-adopters

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<th>Household Characteristics</th>
<th>Farm characteristics</th>
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<tr>
<td>Age (years)</td>
<td>Household size</td>
<td>Operated land (acres)</td>
</tr>
<tr>
<td>Experience in cotton farming (years) (+)</td>
<td>Number of dependents</td>
<td>Owned land (acres)</td>
</tr>
<tr>
<td>Education (years)</td>
<td>Own motorcycle (yes=1)</td>
<td>Cotton area as % of Kharif area</td>
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<td>Degree of risk aversion (-)</td>
<td>Own TV (yes=1)</td>
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<td>Value of livestock (Rs/animal) (+)</td>
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<td></td>
<td>Have telephone (yes=1)</td>
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<td>Agricultural credit (yes=1)</td>
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<td>Crop income (Rs/year)</td>
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<td>Livestock income (Rs/year)</td>
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<td>Other income (Rs/year) (-)</td>
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<td>Share of food expenditure (-)</td>
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<td>Share of education expenditure (+)</td>
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Summary of Findings

• Technical issues
  – Low levels of awareness among farmers about Bt technology
  – The impact of Bt varieties differs across two districts

• Market issues
  – Adoption rate is high among both owners and sharecroppers
  – Pesticide expenditure is lower and seed expenditure is higher on Bt varieties
  – Higher revenue
  – Profitable for farmers

• Social issues
  – Both owners and sharecroppers get the benefit
Comparison of Pakistan’s Unapproved Bt Varieties with China and India’s Approved Bt Varieties

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<td>Pakistan (2009)</td>
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<tr>
<td>Bahawalpur</td>
<td>-0.90</td>
<td>-21.07</td>
<td>64.9</td>
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<td>-1.86</td>
<td>-26.81</td>
<td>76.3</td>
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Future Directions for Research

• Need for a national survey
  – Due to the high diversity of cotton growing areas, more location-specific information and larger sample size is required

• Need for further analysis
  – Can Pakistan come out of unregulated market after the commercialization of Bt cotton?
Thank You