Factors Affecting Adoption of Bt Cotton: A Case Study

Vijay Laxmi Pandey, and Ajit Dash

**Abstract**—Adoption of Bt cotton can help in achieving higher yields and also tackling the environmental problems by reducing pesticide use in cotton growing. A household survey was carried out to understand the impact of Bt cotton cultivation on cotton productivity and pesticide use in Ralegaon block in Yavatmal district of Maharashtra State. Primary data were collected from 100 farmers in two selected villages. The Tobit model was used for analyzing the factors affecting the adoption of Bt cotton. The Benefit Cost analysis show that it is economical to grow cotton both Bt and non-Bt, but B/C ratio of Bt cotton was higher than the non-Bt cotton. Analysis of data shows that adoption of Bt cotton is significantly affected by farmers' perception of environmental effect, education, household size, and age of head of the household.

**Keywords**—BT Cotton, Tobit Model, Maharashtra.

I. INTRODUCTION

New and efficient technology, such as genetically modified organisms, can play a very vital role in boosting agricultural growth. Access to quality seed is the critical input for improving agricultural productivity in the situation of scarce and fixed land and water resources. It has been estimated that the direct contribution of quality seeds in total production is about 15-20 percent depending upon the crop. This can be further raised up to 45 percent with efficient management of other inputs [2].

In India, about 70 percent seeds are farm saved and public and private sector supply only 30 percent of the required seeds [2,3]. Varietal breakthrough and its dissemination by public agencies are not keeping pace with the country’s varied requirements. The seed replacement rate in respect to various crops is also very low and there is a need to raise it to fill the existing gaps in the actual and potential yield. The NSSO data show that around 30 percent farmers were replacing seed every year and 32 percent replaced the seed every alternate year. Moreover, 17 percent farmers reported that they replace seed after four or more years [4]. It is being stated that certified seeds are available in surplus quantity since year 2004-05 (Table I).

On the other hand remarkable growth in cotton crop in India is an example to pursue. Since year 2002, it has been observed that there is significant increase in area and production of cotton. The growth rate in area and production was 4.59 percent and 9.86 percent respectively during this period. The cotton yield improved from 202 kg/ha in 1988-89 to 491 kg/ha in 2011-12 (Figure 1).

**TABLE I**

<table>
<thead>
<tr>
<th>Year</th>
<th>Requirement</th>
<th>Availability</th>
<th>Surplus(+) Deficit(-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-2005</td>
<td>110.83</td>
<td>132.27</td>
<td>+21.44</td>
</tr>
<tr>
<td>2005-2006</td>
<td>107.08</td>
<td>140.51</td>
<td>+33.43</td>
</tr>
<tr>
<td>2006-2007</td>
<td>128.76</td>
<td>148.18</td>
<td>+19.42</td>
</tr>
<tr>
<td>2007-2008</td>
<td>180.74</td>
<td>194.31</td>
<td>+13.57</td>
</tr>
<tr>
<td>2008-2009</td>
<td>207.28</td>
<td>250.35</td>
<td>+43.07</td>
</tr>
<tr>
<td>2009-2010</td>
<td>249.12</td>
<td>279.72</td>
<td>+30.6</td>
</tr>
<tr>
<td>2010-2011</td>
<td>290.76</td>
<td>321.36</td>
<td>+30.6</td>
</tr>
<tr>
<td>2011-2012</td>
<td>330.41</td>
<td>353.62</td>
<td>+23.21</td>
</tr>
</tbody>
</table>

Source: [2]

This amazing performance of cotton can be attributed mainly to adoption of Bt cotton and active participation of private companies’ in development and dissemination for adoption of technology in the farmer’s field. Adoption of Bt cotton is associated with tackling the environmental problems by reducing pesticide use in cotton growing and also achieving higher yields. This performance was complemented by the government policy support and good export market for the cotton.

However, there are many reports of failure of Bt cotton in India due to reasons like, spurious seeds, emergence of secondary pests as well as new pests and diseases, etc.
Concerns are raised that adequate public research, development, extension and regulatory environment for legitimizing the technology adoption are not in place. Other concern is the high price of seeds to a level that it may not be accessible by the small and marginal farmers. Further, issue of bio-safety is also linked to GM crop especially for Bt cotton. To address these issues a case study was undertaken in 100 households of the Ralegaon block in Yavatmal district of Maharashtra. This paper discusses finding of this study and suggestions to make use of technology for revitalizing and sustaining the agriculture.

II. DATA AND METHODOLOGY

A household survey was carried out to understand the impact of Bt cotton cultivation on cotton productivity and pesticide use in Ralegaon block in Yavatmal district of Maharashtra State. Primary data were collected from total 100 farmers in two selected villages. The non-Bt cotton growers were selected purposively. The information collected pertains to socio-economic and demographic profile of the household, input used and output from cotton cultivation and people’s perception on impact of Bt cotton cultivation.

Benefit cost analysis was carried out for both Bt and non-Bt cotton crop. The Tobit model was used to study various factors influencing adoption of Bt cotton. The functional form of Tobit model is as follows

\[ Y_i = X_i \beta \quad \text{if } i^* = X_i \beta + u_i > T \]

or

\[ Y_i = 0 \quad \text{if } i^* = X_i \beta + u_i < T \]

Where \( Y_i \) is the probability of adoption; \( i^* \) is non-observable latent variable; \( \beta \) is \( k \times 1 \) vector of parameters to be estimated; \( u_i \) is an independently normally distributed error term with zero mean and constant variance \( \sigma^2 \) and \( T \) is a non-observable threshold level. The above equation is a simultaneous and stochastic decision model. If non-observed latent variable \( i^* \) is greater than \( T \), the observed qualitative variable \( Y_i \) that indexes the adoption becomes a continuous function of explanatory variables and zero otherwise (i.e. non-adoption of Bt cotton). The maximum likelihood approach is used to estimate the coefficients in the equation. \( T \) value for adoption of Bt cotton was decided on the basis of the proportion of area under cotton cultivation. If proportion of Bt cotton area was less than 70 per cent then that farmer was taken as non-adopter.

III. RESULTS AND DISCUSSION

Bt cotton was introduced with the intention of reducing pesticides use. Reduction in pesticide use after adoption of Bt cotton was reported by the 47 per cent farmers. However, for 10 per cent of the farmers this reduction was only in first 2-3 years. Pest resistance to earlier pesticides was reported by the 35 per cent of the farmers. It has been observed from the farmers’ response that use of some new pesticides after adoption of BT cotton has arisen which fall in the category of extremely hazardous and highly hazardous pesticides. Nevertheless, the way farmers perceive impact of Bt cotton on environment also has impact on adoption or dis-adoption of Bt cotton. The farmers’ perception on environmental impact given in Table II, shows that bulk of the farmers were not sure of its impact. Only 16 per cent of the farmers were of the view that it has a beneficial impact on environment. However, 19 per cent were of the view that it has a bad impact. The idea of having allergy to cattle due to feeding of Bt cotton seeds was dismissed by most of the farmers (75 per cent).

On the yield front, 90 per cent of the farmers were of the view that yield of Bt cotton is higher than the non-Bt cotton. More than 10 per cent of gain was reported by bulk of the farmers (72%). Farmers’ revealed that with the use of Bt seeds their cost of cultivation has gone down and there is increase in the productivity of the cotton. Most of the farmers seem to be happy with the adoption of Bt cotton. The results of benefit cost analysis show that it is significantly higher for the Bt cotton crop (1.89) as compared to the non-Bt cotton (1.13). Therefore, it is much more beneficial to grow Bt cotton crop (Table III).

Further it was observed that the desi (Local) varieties of the seeds are not available any more even if farmers want to sow it. These desi varieties were more drought resistant. Even availability of non-Bt hybrid seed is not there in the area. Therefore, farmers are forced to only grow Bt cotton. It was observed that every year new varieties are introduced in the market and farmers find themselves confused to select a seed type. The study reveals that public extension services are almost non-existent to give advice on selection of seeds and use of pesticides. Farmers have to rely on the extension...
services provided by the input dealers and private seed company employees. In the study area it was observed that seed dealers and pesticides dealers are the same and they try to sell seeds and the insecticides which are new in the market. It was further observed that there new pest infestation i.e. mealy bug was observed by some of the farmers in the field. But there was no extension officer available to advise them on control of this pest.

Thus the concerns that were raised on the adequate public extension services and regulatory environment for legitimizing the technology adoption are correct and need to be fixed. There is need to make farmers more aware build their capacity to reap the benefits of this technology.

**IV. CONCLUSION**

New and efficient technology, such as genetically modified crops, can play very important role in boosting agricultural growth. Access to quality seed is the critical input for improving agricultural productivity in the situation of scarce land and water resources. The remarkable performance of cotton in India can be attributed, mainly to adoption of Bt cotton and active participation of private companies. It is being envisaged that adoption of Bt cotton can help in achieving higher yields and tackling the environmental problems by reducing pesticide use in cotton growing.

A survey of 100 households in Ralegaon block in Yavatmal district of Maharashtra state for understanding the impact of Bt cotton cultivation revealed following results. The survey reports reduction in pesticide use by the 47 per cent farmers. However, it was indicated that use of some new pesticides after adoption of BT cotton has arisen which comes in the category of extremely hazardous and highly hazardous pesticides. Bulk of the farmers was not sure of environmental impact of Bt cotton. Farmers’ revealed that with the use of Bt cotton seeds their cost of cultivation has gone down and there is increase in the productivity of the cotton. Most of the farmers seem to be happy with the adoption of Bt cotton. The Benefit Cost analysis show that it is economical to grow cotton both Bt and non-Bt, but B/C ratio of Bt cotton was higher than the non-Bt cotton. Analysis of data shows that adoption of Bt cotton is significantly affected by farmers' perception of environmental effect, education, household size, and age of head of the household. However, the adequate public extension services and regulatory environment for legitimizing the technology adoption need to be fixed. There is need to make farmers more aware and build their capacity to reap the benefits of this technology.

**REFERENCES**