ISSN 2321 3361 © 2020 IJESC

Research Article Volume 10 Issue No.7

# A Comparative Assessment on Production Cost and Output Yield of Organic and Bt Cotton Farmers

Srushtideep Angidi[1], Ajay Bogati[2]
Banaras Hindu University, Uttar Pradesh, India[1]
Lovely Professional University, Punjab, India[2]

**Abstract:**
The recent years has seen a serious concern over the problem of environmental degradation and an urgent need for its sustainability has been raised. To achieve a friendly and green environment, research discloses that organic farming can partly offer a solution. The organic farming has its own benefits and hardship son farmer's life. This paper therefore attempts to assess the expenditure and margin incurred between organic cotton farmer and Bt cotton farmer. The study reveals that organic farmer produced equivalent net income in some cases, even higher income compared to Bt farmers with much healthier biodiversity.

**Keywords:** Organic cotton, Bt cotton, Input cost and Economic output.

## I. INTRODUCTION:

Current market trends reveal that organically produced products are becoming widely accepted throughout the world. As people around the globe are becoming aware of introduction of a reckless chemical based agricultural policy in the recent decades and their adverse impact on the health and environment. Due to which they tend to approach towards organic farming for healthier biodiversity. This increases the demand of organic crop not only food and horticultural crops but also various other cash crop and plantation crops. Of all other cash crops, Cotton plays a dominant role in India's economy. Cotton and its value-added products are major export earners for India's national income. The Indian cotton industry provides employment to more than 15 million people, contributing 20% to the Gross National Product and 30% to the total agricultural exports. (Subbiah and Jeyakumar, 2009).
Cotton is the only genetically engineered crop grown widely in India, after being introduced during the last decade. Genetically engineered cotton is also grown widely in China, South Africa and the US. These genetically engineered cotton varieties are known as 'Bt cotton'. Bt cotton plants contain a gene from the soil bacterium Bacillus thuringiensis, which produces a toxin designed to kill a group of insect pests, mostly larvae of moths, which are generally called 'bollworm' (Tirado,Reyes. 2010). The introduction of Bt cotton in 2002 pushed India to the rank of second-largest global producer of cotton. Now in India almost 90% of the cotton cultivation area is under Bt Cotton. The data, for the year 2010-11, shows that out of total area of 111.42 lakh hectares under cotton cultivation, 98.54 lakh hectares are under Bt Cotton. Since most of the Bt cotton hybrids produce only the medium and long staple lint, increase in area under Bt cotton has led to decline in output of premium quality cotton. i.e. extra-long staple cotton which fetches good price in the market. The only safe conclusion from the studies carried out so far on Bt cotton in India (and elsewhere) is that the performance and impact of Bt technology are very variable and depend critically upon a wide range of social, institutional, economic and agronomic factors (Glover, 2009, Gruère et al., 2008, Raney, 2006, Smalexet al., 2006). Research results about the impacts of Bt cotton coming from econometric field based studies in India draw a very polarised picture so far: one set of studies claims to demonstrate its complete economical and technical success and another set highlights the failures and farmers' hardships that have accompanied its introduction. This has seriously distorted public debate and impeded the development of sound, evidence-based policy" (Glover, 2009).

## II. METHODOLOGY:

### Data source
The study is absolutely based on primary data source, related on various aspects of organic farming is collected from farmers who were practicing the organic and Bt cotton farming. Those details are used to calculate input and output cost of production. The detailed information on quantities and cost of different inputs used in production and labour used was collected for this study.. For this study the survey was conducted on farmers in the Jangaon district from Telangana. The Jangaon district was purposively selected due to the fact in the district efforts are being made by the CSA-Hyderabad to help the farmers in adopting organic farming. The non-adaptor of organic cotton farming where found to be Bt-farmers. We compared the returns and input cost of Bt cotton farmer and non Bt organic cotton farmers.

### Sampling:
To make sure that all parameters for the survey was invariable, apart genetically engineered seeds of Bt and the chemicals used by conventional farmer all other agronomic practices were kept as identical as possible between organic farmer and Bt farmers.The problem with data collected from farmer is that isn't always analogous its rather contracting and depends from farmer to farmer on their experience and the knowledge they have acquired over years of farming.So we tried to calculate an net average that would cost a single farmer for one crop season based on the data collected from the survey. In the survey, we collected data from total 12 farmer. Out of the 12 farmer,7 farmers were organic cotton growers while the remaining 5 farmers were Bt cotton growers. All Bt cotton farmers we encountered engage in chemically intensive agriculture, with high use of pesticide and chemical fertilisers while 5 out of 7 organic farmer were certified producer and rest 2 farmer were in transition period.

Our sample size is small but by ensuring detailed data collection from the small group of farmers with very specific analysis criteria to present the data that would reflect actual status of cotton farmers of the districts.

**Data Analysis:**
The data was collected face to face with standardized validated questionnaire. The survey was carried out such that the data collected would present the information on the expenditure incurred by farmer on each operation along with detailed input quantity and cost of each particular input involved in the operation. As the expenditure cost of each farmer is contrasting from other due to various socio-economic and environment factors it is difficult to calculate exact amount of money or expenditure that would require for a single farmer to grow an acre of cotton crop in one crop season. After analysis the data thoroughly of each individual farmer, we concluded and calculated the average amount of money that was required by a single farmer to grow an acre of cotton crop. In addition to farmers' interviews, we also collected information about the knowledge, attitude and practices regarding pesticide usage by farmers and its toxic effects on their life and environment.

## III. RESULTS & DISCUSSION:

### 1. Cost of cultivation:
The cost of cultivation of the Bt cotton farmers is 21% more compared to organic cotton farmer from table 1. This reflects major differences in cost of seeds, pesticides, fertiliser, which are all much higher for Bt cotton farmers than organic farmers.

### 1.1. Labour and machinery cost:
The amount of money that farmers spent on labour and machinery was slightly higher for organic than for Bt cotton farmers, although the difference was not statistically significant. The higher cost of labour on organic farms might relate to the higher labour involved in non-chemical fertilisation and pest protection. Organic farmers engage in a wide diversity of practices for ecological fertilisation of their soils. Similarly, for ecological pest protection, organic farmers apply a diversity of practices that involve more labour but greatly benefit the natural pest protection of their farm. All these practices involve more labour and thus also have the positive effect of more employment of local farm labour.

### 1.2. Seeds costs:
The seed cost (table 1) reflects the amount of money paid per bag of seed of 450g and also the quantity of seeds that each farmer bought per acre with the cost of labour required for sowing the seeds. On an average a cotton farmer bought 2 bags of seeds for sowing. In some cases, the farmer had to buy extra seed bag for occasions when seed germination fails or seeds are washed away by rain. The price of non-Bt cotton variety generally varies from Rs. 630 to Rs.730 depending on the variety while the price of Bt-cotton varies from Rs730to Rs 980 depending on BT hybrid I or BT hybrid II. Generally, farmer grow more than one variety in single crop season. This allows him to asses between the varieties on basis which the farmer would plan for next crop season and also it would reduce risk on crop loss due to a particular variety. Bt cotton farmers buy their seeds at the local seed and agrochemical shop. Generally, an organic farmer would have to buy his seed from various KVK or NGOs such as Ekalvaya foundation but in order to encourage more organic grower CSA is trying their best to provide most of input directly to farmer in their transition period and certified organic farmers The most common variety grown by the organic farmer were Malika, Suraj and Partech while bunny variety were grown by both farmers, organic and Bt cotton.Rasi, Partech DCH-32, Doctor Belt were commonly grown by Bt farmers.

### 1.3. Nutrient management:
Organic farming uses carbon present in the soil as organic matter. The organic materials most commonly used to improve soil conditions and fertility include farm yard manure (FYM), animal wastes, crop residues, green manures, bio-gas spent slurry, microbial preparations and vermin compost. The Organic farmer used input such as panchakavyam, jeevam irtham, neem cake, vermi-wash and cow dung as source of manure for the crop. This improves the soil biodiversity for better fixation of required plant nutrient by the micro-organism. The farmer self-produce these input themselves rather buying them from market. When used effectively, all these can provide enough nutrients for a healthy fertile soil at a fraction of the cost of chemical fertilisers. Few farmer practices intercropping the cotton with other legume crop which facilitate the process in the soil leading to better exploitation of soil resources. While Bt farmer to meet their plant need they add on an average about 4 ± 0.5 bags of DAP (each bag weighs about 40kilos), 2 Bags of urea (each bag weighs about 45kilos) and 1bag of potash (each bag weighs about 0kilos). The dosage of application depends and may change based upon the crop stand and soil fertility. Each bag of DAP is priced from Rs.1100 to Rs.1300 while urea cost from Rs.260 to Rs.300 per a bag of 45kilosand Rs.960 to Rs.1280 for a bag of potash. There is an increasing concern that continuous use of chemical fertilizers on soil depletes the soil of essential nutrients. As a result, the food produced in these soils have less vitamin and mineral content. According to data produced by the U.S. Department of Agriculture Nutrient Data Laboratory, foods grown in soils that were chemically fertilized were found to have less magnesium, potassium and calcium content. (Hunt, Harmful Effects of Chemical Fertilizers).

### 1.4 Plant protection cost:
Bt cotton farmers continued to use a large amount and variety of chemical pesticides, especially insecticides. We encount ered various chemical which were by the Bt-cotton farmer in controlling the pest population. The common chemical that Bt farmer used were Monocrotophos, Confidor (Bayer – imidacloprid), Coragen and Chlorpyrifos. Monocro tophos is an organophosphorus insecticide classified as Highly Hazardous by the World Health Organisation (WHO class Ib). Bt cotton farmers stated that they spray chemical pesticides as prevention, even at times when they did not really have pest attacks in their crops. Apart from use of insecticides and pesticides few farmers used weedicides to control the growth of weed which in turn would reduce their cost on labour for weeding. Not surprisingly, the money spent by Bt cotton farmers on pesticides was considerably more than the money spent by organic farmers on biopesticides. Dr. Kranthi, Director of the Central Institute of Cotton Research (CICR) in Nagpur, reported that Bt cotton had increased the use of some dangerous pesticides (Mudur, 2010). This seems to be due to the emergence of new devastating pests, like mealybug, never before seen by Indian farmers. For years, many experts have been warning that sucking pests are becoming a more serious problem on Bt cotton because of a decline in the bollworm population and changes in crop ecology (Wang et al., 2008,

Wu et al., 2002, Lu et al., 2010). Even after chemical application and use of Bt hybrid seeds most of the farmer had reported that they have bollworm infestations and damage in their cotton crop. This may be due to adaptation of pest to tolerate the toxin and chemical. Due to which in a course of time the pest will be able to withstand against these toxins and there would be a need for development of different practices method to control the emerging unaffected insect and pest species. On other hand, Organic farming exclusively depends upon protecting the crop with the use of natural enemy of the pest and use of bio-pesticides. General biopesticides used by organic farmer were neem oil, Chilli and ginger extract, vitex leaf extract, Aloe and vitex extract. Biopesticides generally affect only the target pest and closely related organisms, in contrast to broad spectrum, conventional pesticides that may affect organisms. By avoiding the use of broad-spectrum synthetic pesticides, which severely disrupt natural control and promote the occurrence of secondary pest. In order check the growth of pest population the farmer reported that they used certain trap such as pheromone traps, sticky traps and light traps that coincides with pest population. When compared to costly chemicals each trap cost from Rs.15 to Rs.45 depending upon the trap they used.

**1.5 Cotton Yield**

Cotton yields were highly variable within each type of farm and even within each type of cotton hybrid planted. There is no relationship between higher yield and specific hybrids, the yield depends on various extrinsic factors such as changes in current year's rainfall, soil fertility and timely management through proper monitoring of field. The change of yields was not significantly different between Bt and organic cotton, although Bt cotton yields were higher than organic cotton yields (Table 1). On an average a Bt farmer produces about 7 to 9 quintals per acres this yield may vary from crop season to season. While organic farmers produce about 5 to 7 quintals per acre. Organic farmer also stated if all the other factors such as rain and climate are favourable with proper monitoring and timely management there would be satisfactory increase in the yieldof cotton. It is important to remember that any yield advantage of Bt cotton should not be expected as a reduction in crop losses due to pests (less pest damage), since the Bt trait is not a technology that enhances productivity as such (Tirado, Reyes. 2010). As per farmers this year yield for both Organic and Bt farmer were less due to unanticipated rainfall during at undesirable stages of the crop stages. In spite of higher yield of Bt farmer than organic farmer due to increase demand of organic products in the market the organic cotton yields about Rs.1000 to 1500 more than that of Bt farmers. It is remarkable, however, the difference in the quality of organic cotton ended up earning 18.45% more than which Bt farmer would earn for his yield The table shows the average money that a Jangaon farmer spent on their crop in a single crop season. Our data reflects more than simply the price tag of the input.

**Table.1. Input cost and output yield between Organic and Bt farmer**

| **Particulars** | **Organic cotton** | | | **Bt.Cotton** | | |
|---|---|---|---|---|---|---|
| **Input** | **Qty.** | **Per unit cost** | **cost** | **Qty.2** | **Per unit cost3** | **cost4** |
| Human labour | 32 | 250 | 8000 | 28 | 250 | 7000 |
| Bullock labour (in hrs) | 2 | 800 | 1600 | 2 | 800 | 1600 |
| Machine hour | 4 | 980 | 3920 | 3.5 | 980 | 2940 |
| Seeds | 2 | 680 | 1360 | 2.4 | 930 | 2352 |
| FYM (tonnes) | 3.4 | 1200 | 4080 | 4 | 1200 | 3600 |
| Organic manure | | | 2165 | | | |
| Fertilisers | | | | 2 | 276 | 552 |
| Urea | - | - | - | 4 | 1250 | 5000 |
| DAP | - | - | - | 1 | 980 | 980 |
| Potash | - | - | - | | | |
| Pest and Disease Management | | | | | | |
| Biopesticides and traps | | | 1380 | | | - |
| Chemical Management | | | - | | | 3275 |
| *Total cost* | | | **22505** | | | **27299** |
| **Output** | | | | | | |
| Total Yield (in quintal's) | 5.4 | 5690 | **30726** | 8 | 4120 | **32960** |

**Change In gross margin between Organic farmers and Bt farmers:**

The table shows the cost based on the operation and agronomical practices that are required for growing one acre of cotton. Its shows the change in gross margin between the organic and Bt farmers. The marginal change in the cost of input is because most of organic farmer do not buy most of organic input from the market they rather self-produce their own inputs such as manures like panchakavyam, jeevamirtham, leaves extract, ginger garlic chillies extract, green manure, vermi-compost, farm compost, natural plant protectors etc but there are farmer who have recently adapted to organic farming who buy their input from the market. The cost of the organic inputs is comparatively lesser than that of the intensive chemical used by the Bt farmer only problem with organic input are that they are need in the higher proportion. There is no additional cost on irrigation for either farmer because they complete depend upon the rainfall for irrigation. According to observation, this year the yield was comparatively less for both organic and cotton farmer due to change in rainfall and seasonal pattern which escalate the problem of pest and disease incidence on the crop. The excessive rains during October's makes it hardto harvest the cotton bolls due to which the labour required for harvest increase causing an upsurge in the cost of harvesting. The rains at crop maturity not only increase the chance of disease or pest attack but also decreases the quality of the cotton leading to poor market value. However, when you compare the data in the change in cost of input the Bt cotton farmer needed to spend more than that of organic farmer as shown in the table this difference between organic & Bt- cotton farming is that Bt farming relies on use of different chemical to control and fight pest, diseases and weeds and provide necessary plant nutrition. The organic farming relies on basic natural principles like composting, biodiversity instead to produce healthy, abundant food The main conclusion is that there is small difference in the capital required for various operation to grow crop by either farmer other than additional cost that is debited on the Bt farmer due to use of these extensive chemicals. These chemical not only add up on their cost of cultivation but also has several ill effects on the biodiversity. On an average the Bt farmer have to spend around Rs.4000 to Rs.5000 more than organic farmers.

**Table 2. Cost Comparison for Organic and Bt Farmers (Rs/acre)**

| Operations | Organic Cotton | Bt cotton | Change in gross margin |
|---|---|---|---|
| Land Preparation | 4225 | 3532 | 693 |
| Seeds and Sowing | 1760 | 2415 | -655 |
| Manure | 5910 | 3675 | 2235 |
| Chemical Fertilizer | 0 | 5932 | -5932 |
| Weeding and intercultural operations | 3675 | 4145 | -470 |
| Plant Protection | 2235 | 3275 | -1040 |
| Harvesting | 4700 | 4325 | 375 |
| **Total Cost** | **22505** | **27299** | **-4794** |

**Perception of farmers regarding chemicals use:**

During the survey we tried to evaluate the knowledge, attitude and practices regarding pesticide usage by farmers and its toxic effects on their life and environment. It was observed that most of farmer learnt about the chemical by communicating with retailers while few knew about it by interacting with co-farmers. There are chemical consultancies and company who are trying to make themselves aware by public advertising and farmer meetings in the village. During application of any chemical pesticides protective measures such as use of face mask, gloves and shoes are considered for effective means of reducing the risks of farmer's health but it was observed that no chemical using farmer used these protective measures. Most of the farmer were aware of the ill effects of these chemical on their health and they had adequate knowledge of these protective measure but this doesn't reflect in their practices.Unsafe disposal of both unwanted chemical and empty chemical containers could put the general population at higher risk. During the study majority of the respondents reported that containers used were thrown into open fields. This unsafe practice will have an impact on the soil and environment which may pose risk on non-targeted organism

## IV. CONCLUSION:

It is clear from our data, by engaging in economic and ecological farming and by diversifying their cropping system and relying more their community, non-Bt farmer can achieve a better, more secure economic livelihood than Bt farmers. Higher profitability is the important feature for any farmer the net average income earned by organic farmer was about Rs. 2560 and with about R. 4794 less on their cost of cultivation making total profit of about Rs.7354 over Bt cotton farmers. Bt cotton farmers are under high vulnerability and risk because of high cost of cultivation, high-chemical application, low-diversity farming, and high debt. If Bt farmers continue to use large amount of chemicals in order to control the pest and manage crop health it would impose a serious threat not only to the soil and water quality but actual quality of cotton produced. Use of Bt cotton goes hand in hand with use of intensive hazardous chemicals. As a consequence of private company and consultancies to promote hybrid seeds and the aggressive marketing techniques of the seed companies, advising farmers on how to maximise yields. This clearly promotes higher use of chemical fertilisers and pesticides by Bt cotton farmers. Government and NGOs should present the facts and reality of the use of the chemical fertilisers and pesticide by planned extension teaching and trainings. Whereas our agricultural development has focused on increased productivity rather than on a holistic natural resource management. So, there is proper need of extension education service in order to aware farmers.

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