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**Economics Of  
Bt cotton vis-à-vis Traditional Cotton  
Varieties**

(Study in Andhra Pradesh)

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**Executive Summary**

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## Executive Summary

### Introduction:

India occupies pre-eminent position with regard to area under cotton crop. It is next only to US and China in terms of production. However cotton economy in India is beset with a plethora of problems. Although, cotton consumption in the country is rising quite rapidly, the domestic production is fluctuating from year to year. The yield per hectare is one of the lowest in the world due to short supply of quality seeds and vulnerability of crop to pests and diseases. Also, farmers in traditional cotton growing areas switch over from cotton to other competing crops. The production of cotton in the decade of eighties registered an annual growth of 4.1 per cent. During 1991-92 to 2002-03, this momentum was lost and production growth rate decelerated to 1.4 per cent per annum. The tenth plan target of cotton production is set at 216 lakhs bales by 2006-07. Keeping in view the recent trend of production growth and the problems associated in cotton economy this target appears to be non attainable.\*

Andhra Pradesh had cultivated cotton in 8.03 lakh hectares and produced 10.86 lakh tons of lint (170 kg bales) in 2002-03. That amounts to 10.47 and 12.46 per cent of all India figures respectively. AP ranks third after Maharashtra (28.00 ha) and Gujarat (16.30 ha) in area and production. Maharashtra's share is 29.75 per cent in production whereas Gujarat has 19.22 per cent. Yield wise Andhra Pradesh surpasses other two states with 230 kgs per hectare. Punjab, Haryana and Tamilnadu have greater yields (410, 340 and 305). But in those states area of cotton under irrigation is also high. Andhra Pradesh has just 18.8 per cent of area under irrigation where as Punjab, Haryana and Tamilnadu have 99.6, 99.7, and 38.3 respectively.

The cotton crop is highly susceptible to insect pests. About 166 different species of insect pests are reported to attack cotton at various stages of its growth. Among these, the Cotton bollworm, Whitefly, Jassids, Pink bollworm and Spotted boll worms cause heavy damage. In India 50 percent crop damage can be attributed to pests and diseases where as it is only 24.5 percent in the world. Of the 96000 metric tons of

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\* CACP, 2004-05



technical grade pesticides that are manufactured in India 54 percent is used on cotton. In the long run it will have a great impact on the environment and hence, the need to develop alternative systems like bio pesticides, harnessing genetic engineering, comes to the fore. Integrated pest management (IPM) that focuses on prevention of pests and their damage through an integrated approach of multiple pest suppression techniques needs to be vigorously promoted.

Bt. cotton holds a promise to the cotton farmer in the form of lower pesticide costs. It was the first among the genetically modified crops that were to be introduced to India. The acronym Bt. stands for 'Bacillus Thuringensis'. Some environmentalist groups have expressed the fear that the foreign gene may spread in to the ecosystem and make the insect pests develop resistance to Bt. They aver that longer cultivation of these crops may finally lead to the disappearance of native varieties. A few economists and agricultural scientists working with NGOs claim that the technology would lead to the monopoly of certain multinational companies. They also conclude that the returns on Bt. cotton are not good enough when compared to the high cost of the licensed seed.

Setting aside the apprehensions of some environmentalists and NGO groups, some Indian scientists have endorsed the superiority of Bt cotton in pest resistance. Kranti et al., (2005) have written that despite some shortcomings Bt cotton is still the most potent and best available option for bollworm management in India. They also add "even the best of the currently available pesticides do not kill more than 78-80 per cent boll worm larvae under field conditions, which Bt cotton does. Hence, the Bt technology is considered to be more effective than the best currently recommended pesticides against *H. armigera*". They have concluded from their three-year scientific field trial evaluation data that there are consistent yield and ecological benefits from Bt cotton despite minor inadequacies in toxin expression.

Bt cotton has been endorsed by thousands of farmers ever since its introduction in 2002, as can be seen from its immense popularity and enormous technology adoption rate. There is widespread feeling among agricultural scientists that the NGO's reaction must be more tempered and must be based on in depth study. Some scientists conclude, 'since Bt transgenic technology has thus far proven itself to be one of the most environment friendly method of boll worm management, it is in the interest of the technology itself that researchers, technology providers and administrators ensure that it

must be provided to the farmers in a form which gives the best possible returns for their investment.'

### **Scope of the study:**

Though the focus of the present study is mainly on economics of Bt. cotton, an attempt is also made to look into the controversial new technology of genetically modified crops. The need, the promise, the performance, the effect on the environment and its future is analyzed with the help of existing literature and with primary data collected from two major cotton producing districts in the state where the Bt. seed companies also concentrate their operations. Guntur district has fertile soils and grows cotton mostly in un-irrigated conditions. The other district, Warangal is relatively a new entrant to cotton cultivation and raises the crop with well irrigation. Unfortunately, both districts top in the incidence of farmers' suicides in their respective zones, i.e. Coastal Andhra and Telangana.

The nature and severity of pest attack and number of sprayings of different varieties of pesticides are also enumerated in both Bt. and non- Bt. cotton. To assess the advantages or disadvantages of Bt. cotton vis-à-vis traditional varieties farmers' opinions are sought on aspects like the availability, cost and quality of seed, need for pesticides, labour, fertilizers, machines, irrigation, the quality of cotton, market prices, yields etc. An effort is also made to gauge the impact of Bt. cotton technology on the economic development of the village as a whole and across socio-economic groups, farmers of different land size groups and landless as well. But the limitation here is that the farmers' experience is too short (two years) to give much credence to their opinions. The study also tries to seek answers from the farmers about their introduction to Bt. technology and experience with it's cultivation from seed to the harvest. Their response regarding the impact of Bt. cultivation on the environment, i.e., on other plants, insects, animals and humans is also elicited.



## **Objectives:**

The study is embarked on with the following objectives.

1. To examine the advantages and disadvantages of Bt. cotton as a pest resistant variety in rained as well as irrigated conditions.
2. To assess the cost of cultivation of Bt. cotton as compared to other cotton varieties grown by farmers.
3. To assess the net returns to Bt. cotton as compared to other cotton varieties.
4. To identify the reasons behind the differences in the cost of cultivation and the net returns.
5. To examine the cost and returns differences across the different areas in the state.
6. To examine the other factors behind the differential performance such as the germplasm, quality of seed, other inputs, farmer behaviour and other support systems.
7. To find out about any other impact perceived by the farmers such as on the pest population/ incidence, other crops, or the environment.
8. To comment on the usefulness of the technology and ways, if any, to improve the performance.

## **Methodology:**

In this study a four-stage sample design has been used. The first stage sampling units are the districts, the second stage sampling units are the mandals with in the selected districts and the third stage sampling units are the villages with in the selected mandals and the fourth stage sampling units are the cotton cultivators with in the selected villages. For selecting the sample farmer households, cotton cultivators in each village are classified into two groups viz., Bt. Cotton cultivators and non-Bt. Cotton cultivators. Again farmers in each group are classified in to three-landholding groups viz., below 5 acres, 5-10 acres and above 10 acres. Farmers in each landholding group are further classified into two categories viz., farmers cultivating cotton on irrigated land and farmers cultivating cotton on un-irrigated land. From each category representing a particular irrigation status, land holding group and type of cotton cultivation (Bt. or Non.Bt.) farmer households are selected at random. The total sample size chosen is 180. The reference year chosen for the study is 2004-05.



## **An overview:**

In Guntur district majority of the farmers, about 70 per cent are dependent on canal whereas the others are relying on tanks. In Warangal, 74 to 89 per cent of the farmers are depending on open wells as main source of irrigation. It appears that source of irrigation and size of landholding has very little impact on the choice of the seed, i.e. Bt or non-Bt. In Guntur, in addition to Bt and Non-Bt cotton, Paddy, Maize and Chillies are grown. The other crops like Turmeric, Groundnut, Green gram, Black gram, Red gram, Tomato, Jute etc., are grown by few farmers in a very limited extent. In Warangal, farmers are buying only from licensed Bt seed dealers. So, there is no cultivation of unlicensed seed. Among the non-Bt Bunny and Super Bunny are popular. Paddy and Maize are the main food crops that are raised. Commercial crops include Chillies and Turmeric.

Though Bt cotton cultivation was started in the state in a limited way in 2001-02, it picked up only in 2004-05. A number of brands of Bt-G, Hybrid, and non-Hybrid seeds are available in the state and they are being used by the farmers. Genuine Bt cotton varieties are being grown since two years. They are Rasi and Monsanto-Mahyco seeds. In the first year of the crop they were favoured by equal number of farmers. But by second year, i.e., the reference year, Rasi seeds are grown by 81 per cent of the farmers where as Mahyco could not increase its popularity and remained at 19 per cent.

In Warangal district 69 per cent of the farmers have used Rasi seeds and 31 per cent farmers have raised the Mahyco variety in Bt category. The other hybrids that are very popular are Bunny, Super Bunny and Brahma. The farmers felt that Rasi variety is more suitable for their region where un-irrigated conditions prevail most of the time.

It is observed that about half of the Bt farmers did not report any damage due to bollworms. Even for the rest of Bt farmers the attack was only light or moderate. The results are definitely encouraging when compared to non-Bt farmers. In Warangal district, severity of Bollworm attack is more among the non-Bt farmers when compared to Bt farmers indicating some advantage of Bt variety.

The cotton farmers of Guntur districts habitually use higher quantities of pesticides on their crop. The awareness of the farmers regarding the effectiveness of Bt cotton resulted in perceptible reduction in pesticide use. Bt cotton-G farmers are applying 55 per cent less quantity of pesticides and incurring 55 per cent less costs



when compared to non-Bt farmers. Bt-NC farmers have also reduced the usage by 46 per cent.

### **Economics of Bt cultivation:**

A variety of commercial crops are grown in Guntur district and it is known for its high use of chemical pesticides. Similar observation is also seen with the sample farmers. Cost of pesticides takes the single largest share with 24 per cent in Bt category and 36 per cent in non-Bt category. Harvesting of cotton occupies the next place with 23, 23 and 17 per cent in Bt-G, Bt-NC and non-Bt groups respectively. A good harvest means a higher cost for the farmer, which he may not grudge. Cost of human labour involving other operations comes next with 14 per cent in both Bt and Non-Bt. Bt farmers feel the pinch on account of high seed cost amounting to 9 per cent while it is only 4 per cent for non-Bt farmers. Costs on irrigation are insignificant as the crop's demand is low and the water supply is also very inconsistent and uncertain.

The terrain and soils in the study area do not show much variation. Significant differences are also not seen either in input use or in cost of cultivation between irrigated and un- irrigated fields. Despite popular use of tractors bullock labour is also used for inter-culture operations and transport from fields to homes. Use of organic manures is also widely observed. There is large employment of human labour in cotton harvesting that spreads over few months. A variety of commercial crops are grown in the district and it is known for its high use of chemical pesticides. Similar observation is also seen with the sample farmers.

In Warangal, cost of pesticides occupy the major place with 25 percent followed by fertilizers (21), seed (12), cotton picking (11) percent in Bt category. In non-Bt category as expected, costs of pesticides are quite high with 34 percent followed by cost of fertilizers, 18 percent. Ten percent of the costs are going to human labour. Cost of seeds is only 4 percent. All the farmers in the sample are using licensed Bt seed. Hence the cost of the seed is high and occupies 12 per cent in the total costs. This is three times higher than the non-Bt seed. The costs on bullock labour and the charges on the tractor are nearly the same. Organic manure is also widely being used. The costs on chemical fertilizers are next only to costs on pesticides. Pesticides form the highest

proportion of costs with 34 percent in non- Bt and 25 percent in Bt. On the whole costs on Bt are 14 percent higher than those of non-Bt.

	<b>Guntur</b>		<b>Warangal</b>	
	<b>Bt</b>	<b>Non-Bt</b>	<b>Bt</b>	<b>Non-Bt</b>
Yield/ha kgs	3341	2290	2380	1623
Gross income	57307	40348	41817	27969
Total cost	30901	31289	34232	28952
Net income	26406	9059	7585	- 983

The small farmers in Bt category have reported higher yield than the overall average. This may be due to intensive cultivation practices followed by them. Even non-confirmed Bt category farmers have reaped higher yield of 46 percent when compared to non-Bt farmers both in Guntur and Warangal.

**Guntur:**

It is observed that cotton raised in irrigated fields is yielding two quintals more than the un- irrigated. In non-Bt varieties the difference is very large. The net income derived by Bt farmers is Rs. 26406 while it is Rs. 9059 for the non-Bt farmers. When compared with non-Bt farmers Bt-G farmers have gained three times more. Similarly Bt-NC farmers have gained two and half times more. Income differences among irrigated and un- irrigated category of farmers is also more marked in Bt-G group.

**Warangal**

Yields in Warangal district are quite low when compared with those of Guntur. The soils in the sample area of the district are not well suited to cotton cultivation. The average yields of Bt cotton of Warangal are comparable with those of Non-Bt cotton of Guntur. Further, low rainfall in the reference year has contributed to lower yield. The net income of the Bt farmer is Rs. 7585. Non-Bt farmers have actually suffered negative incomes on an average of Rs. (-) 983.



## **Bt cotton: Farmers' perspective**

About 93 per cent of farmers in Guntur felt a disadvantage with availability of licensed seed. Though 74 per cent felt an advantage with the quality of the Bt seed, 41 per cent felt the cost of the licensed seed is priced high. Lesser pest incidence is reported by 89 percent and an equal number of farmers expressed advantage with expenditure on pesticides. Advantage over fertilizer use and lower labour need is reported by 44 and 39 percent respectively. The quality of cotton seems to be surely an advantage with 94 percent farmers and market preference for Bt cotton is reported by 50 percent. It has good staple length and everyone has agreed that the colour of the fibre is superior. When it comes to price and marketing aspects majority felt not much difference. Thirty three percent had better yields where as 28 percent had better profit

In Warangal, eighty seven percent have felt slightly disadvantage with availability of genuine Bt seed as not every dealer sells those seeds. The cost of Bt. Seed is nearly four times higher. Fifty eight percent farmers have expressed faith in its pest resistance capability and fifty three percent felt the advantage in the cost on pesticides. The quality of cotton was appreciated by 87 percent of the farmers and roughly an equal number said the colour was also good. Ninety three percent felt advantage with the yield and eighty nine percent said they could have got better profits if not for the bad rainfall.

Cultivation of Bt cotton itself is a nascent technology that the cultivators have experienced for the last two years. Here, an attempt is made to gauge their opinions about the impact the technology has made across the cross sections of castes, size groups of farmers, economic class and on the village itself. In Guntur, a vast majority, 93 percent feel that higher income families have benefited by Bt and 7 percent feel that Bt has positive impact on the poor as well. While everyone has accepted that Bt has positive impact on large and medium farmers, 13 percent said landless are also helped by way of better employment as a result of better harvest. Same analogy as given in income levels has emerged on the caste front as 60 percent expressed that upper castes have had a positive impact, only 20 percent felt that scheduled castes were also the beneficiaries.



Bt farmers in Warangal district have reported that the advantage with Bt cultivation accrued more to upper caste, upper income and large farmers and it has tapered down along the caste and income groups

Cultivators are encouraged to raise Bt cotton by licensed seed companies through their agents who distribute pamphlets and display posters well before the season begins. They also garner the support of village elders in their propaganda. Thirty one percent of Bt farmers reported that they introduced to Bt cultivation by seed company agents. Another 24 percent said they acted on the advice of fellow farmers.

A number of advantages were put forward by seed suppliers in support of Bt cultivation. Among these the three main reasons were lesser need for pesticides, higher yield and better quality cotton. The other reasons are higher marketability and better price. Forty four percent in Bt farmers have reported lesser use of pesticide as the reason given by the suppliers. Similarly 47 percent in Bt quoted increase in yield as advantage.

Main benefit of the Bt cotton as conveyed by the seed suppliers in Warangal district to a large number of farmers (67 percent) is the lesser use of pesticide. Other benefits that are projected to farmers are good quality cotton (56 percent), higher marketability (56 percent), better price (51 percent) and increased yield (49 percent).

Licensed seed companies spend substantial amounts for marketing. Their field agents visit all the villages well before the season and contact village elders and farmers who can in turn influence others. Fifty percent of the sample said they were approached by agents of the seed companies and by farmers on their behalf to promote the seed.

Seed companies are vigorously promoting sales in Warangal district also. The field team came across many billboards in the villages. Mahyco was active in the first year. But, the farmers were disappointed with the outturn of their variety. They found that Rasi was performing better in the region. So, the next year Rasi stepped up their campaign to woo many more farmers

All the farmers in Guntur have agreed that the plants are flowering 1 to 10 days early. This they attribute to the pest resistance of the plants in the early phase of growth. Similarly, farmers in Warangal district have also reported early flowering of Bt cotton. Fifty nine percent said that plant flowered early by 10 days and another 41 have reported early flowering by nearly 15 to 20 days.



None of the Bt farmers have reported any inspection of their crop by agriculture department or other government personnel.

Marketing of Bt cotton was no problem to the cultivators. On the other hand they have said that Bt cotton looks better as the bolls are less damaged. Usually they mix the Bt cotton with other non-Bt cotton while selling. The traders also do not make any distinction between these two varieties in fixing the price.

Agricultural scientists advise raising a non-Bt variety as refugia. Accordingly seed dealers are providing non-Bt seed also with every pack of seed. But only 41 percent of Bt growers in Guntur are complying with this direction. The rest are not bothered to demarcate some land for this purpose. They complain that the land would be wasted, as this variety will not yield anything.

Farmers in Warangal district seem to have greater compliance with the advice of planting refugee crop as 96 percent of them said that they have planted it. Only 4 percent have said that it would not give any yield and it was a wasteful exercise

There seems to be no dispute over the efficacy of genuine Bt seed as every farmer has agreed that it is more resistant to bollworm attack than non Bt varieties. But this view is shared by only 89 percent of non-confirmed Bt cultivators. Seventy four percent of Bt-G and sixty three percent of Bt-NC farmers have said that the resistance to boll worm is as high as 25 to 50 percent when compared to non Bt

Even in Warangal district, farmers have good faith in Genuine Bt seed. Ninety eight percent have said that the variety is superior in resisting the bollworm. Among those, eight percent felt that the superiority is as high as 50 to 75 percent. The others felt that it is below 25 percent. For other pests it has no superiority, they added

An overall favourable perception is noticed among the sample farmers of Guntur towards Bt as 90 percent expressed willingness to raise the crop again. Though twenty percent of Bt farmers have incurred losses they attribute that to non-performance of particular varieties of hybrids. Even larger percentage of farmers in Warangal are willing to continue, (96%), with Bt cultivation citing its superior pest resistance. The others complained about high cost of seed and wrong selection of hybrid for Bt by the seed companies as the reasons for discontinuation.

An overwhelming majority of Bt farmers expressed that the government must consider supplying genuine Bt seed at reasonable cost and paying good price for Bt



cotton in the market. A quarter of the farmers have also indicated that the extension agencies must step up their role in giving timely advice in crop practices as the technology itself is new to the farmer. Eighty four percent of farmers in Warangal district demanded that the government should pay higher price for Bt cotton.

Though the farmers are apprehensive about the ill effects of Bt cotton on environment they could not pin point any for the present. They themselves agree that their experience is too little in coming to any conclusion.

### **Conclusion:**

1. It is no secret that Bt cotton was cultivated in India well before the government gave its permission for its official entry. Area under Bt cotton continues to grow rapidly with or without licensed seed.
2. At present Bt cotton is cultivated extensively in countries like China and United States of America.
3. The government's responsibility must not cease with according permission for the release of Bt varieties but also should continue in monitoring environmental changes that may occur subsequently.
4. Few farmers have reported skin irritation when Bt cotton is stored in the houses. This can be probed further by appropriate authority.
5. There were reports of failure of the crop in Warangal district. After wide discussions with farmers and agricultural officials, it appears that the failure was mainly due to poor yield potential of the soils, prolonged dry conditions, selection of wrong Bt hybrids by the seed companies.
6. There was no attempt by the agricultural department in disseminating the knowledge about Bt technology or how it works. Whatever knowledge the farmers gathered about Bt cotton was from seed dealers. As a result there were high expectations about its yield boosting properties despite poor soils.
7. Indian scientists have also endorsed the efficiency of the Bt technology. Kranti, a senior scientist at Central Institute of Cotton Research writes "I earnestly hope that the meaningless hullabaloo raised over Bt cotton by the NGOs comes to an end soon and that a brilliant technology such as Bt cotton, which is state-of-the-art in eco-friendly cotton pest management will be improved further and



stabilized in good varieties and hybrids so as to ensure a pesticide-free profitable and sustainable cotton pest management in India,”

8. Spurious seed is flooding the market even in ordinary varieties. It is easily imagined how Bt seed can be adulterated keeping in view the high demand and high cost.
9. There should be a genuine attempt in reining the seed companies in fixing the seed price. Reducing the seed cost of licensed seed will ensure the new technology available to small and marginal farmers who otherwise would turn to grey market resulting in crop losses.
10. If we set-aside for the moment the merits and demerits of cultivation of a commercial crop like cotton by marginal and small farmers, the need of the hour, as indicated by farmers themselves, is availability of the new technology i.e., the Bt seeds at an affordable price. For them the issue of long time effects on environment will take a backseat. Any technology that would give them a higher return, however small, would be fine for them. Now the onus lies on the government and Indian agricultural scientists to meet their expectations.

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