# Adoption Of Bt Cotton And Its Impact- A Case Study Of Haveri District, Karnataka

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## INTRODUCTION

Indian agriculture witnessed technological innovation in the mid sixties, which is termed as 'Green Revolution'. The discovery of High Yielding Varieties (HYV's), the package of practice for realizing their potential, the mechanization of agriculture involving the development of machinery system for irrigation, tillage, harvesting, threshing etc., are regarded as technological innovations in agriculture.

Now withstanding the above constraints, agriculture in India has undergone changes of one kind or the other, mostly in the positive direction during the past three decades. It was the Green Revolution in the seventies followed by White Revolution in the eighties. More recently, the country is witnessing the 'Blue and Yellow revolutions'.

India, on account of its geographical location, soil conditions and climate, possesses optimum conditions for the cultivation of cotton. Though cotton is grown in India from times immemorial, India's story of progress in the production of cotton, particularly since her independence, has been spectacular.

With 86 Million hectares, largest acreage in the world under cultivation of cotton, India is the largest producer of cotton in the world after China and USA. However, yield is one of the lowest in the world, less than 300 kg/ha as against world average of 608 kg /ha. Only one third of cotton area is irrigated while two-thirds is rain fed. India produces all types of cotton - short staple, medium staple, long staple and also extra staple cotton.

Cotton varieties in India are many. However, 20-25 varieties only accounted for 97 percent of the cotton produced and 80-100 varieties make up the remaining three percent. [1]

Cotton is one of the important cash crops of the country. It occupies a significant place in the agricultural and industrial (textile) economy of the country. Nearly 15 million farmers spread out in over 10 states are dependent on cotton cultivation for their livelihood. [2]

The cotton area in India shot up to 90 lakh hectares during 2006-07. Next season, it was projected at 95 lakh hectares; China had 57 lakh hectares under cotton, while US had 42 lakh hectares two years ago. As a result, India in fact tops the area under cotton cultivation for the crop year 2007[3]. No other country has improved the yield as India. Yield has gone up because of better crop management practices, reduction of pesticides and other initiatives, said Mr. Nair, Secretary General of Cotton Federation of Indian Textile Industry. [4]

## REVIEW OF LITERATURE

❁**Jikun Huang Et Al., (2002) Bt Cotton Benefits, Costs And Impacts In China:** The study conducted two follow up surveys in 2000 and 2001. The survey data on yields and econometric analyses indicate that the adoption of Bt cotton continued to increase output per hectare in 2000 and 2001 and that the yield gains extended to all provinces of the sample. More importantly, Bt cotton farmers also showed increased incomes by reducing their use of pesticides and labour inputs. Finally, survey data shows that Bt cotton continues to have positive environmental impacts by reducing pesticides use. Additionally, the study evidenced that farmers have fewer health problems because of reduced pesticides use. [12]

❁**Yousouf Ismael, Et Al., (2002) Benefits From Bt Cotton Use By Smallholder Farmers In South Africa:** The study describes the result of research conducted in the Makhathini region, Kwazulu Natal, Republic of South Africa, designed to explore the economic benefits of the adoption of Bt cotton for smallholders. Result suggests that Bt cotton had higher yields than non-Bt varieties and generated greater revenue. Seed costs for Bt cotton were double than those of non-Bt, although pesticide costs were lower. On balance, the gross margins (revenue-costs) of Bt growers were higher than those of non-Bt growers. [13]

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❁**R.M.Bennett, Et Al., (2004) Economic Impact Of Genetically Modified Cotton In India:** The study aimed at measuring the economic impact of genetically modified cotton in Maharastra State**,** India. It was the first study of its kind in India in that the data have been collected from farmers growing the crop under market conditions, rather than from trials. The research compares the performance of more than 9000 Bt and non-Bt cotton farm plots in Maharashtra over the 2000 and 2003 growing seasons. Results show that Bt cotton varieties have had a significant positive impact on average yields and on the economic performance of cotton growers.[14]

❁**Uma Kambhampati, et al., (2005) Bt Cotton Gujarat, Impact:** The study was designed to consider the impact of the adoption of Bt cotton on markets, business and institutional arrangements in India. Given that evidence to date suggests that widespread adoption of Bt cotton by farmers is likely to increase production, this study aims to assess possible implications for markets and local industries and to identify potential winners and losers. The result suggests that there are impacts on the cotton industry following from the release of Bt hybrids, and so far the impacts are noticeable.[15]

## OBJECTIVES OF THE STUDY

The aim of the study is to analyze the problems associated with production and marketing of Bt cotton and non-Bt cotton in Haveri District, Karnataka.

The present study is designed with the following objectives in mind:

**1.** To identify the major constraints in production and marketing of Bt cotton and non-Bt cotton.
**2.** To workout economic benefit of Bt cotton and non-Bt cotton.
**3.** To study the trend analysis of Bt and non Bt cotton in the study area.

## METHODOLOGY

This study is descriptive and exploratory in nature. Both primary and secondary sources of data were used in the study. The area covers seven taluks of the district viz. Haveri, Hirekerur, Ranebennur, Byadgi, Hanagal, Savanur and Shiggaon in which, Bt cotton and non-Bt cotton cultivation is carried on an extensive scale. The primary data would be collected from 200 cotton growers spread over the seven taluks, giving due weightage to the farms of different sizes and the selected farmers are duly categorized as Marginal, Small and Large farmers. Similarly, the secondary information was collected from various published and unpublished materials. The information from agricultural department, APMCs Haveri district, government reports, research workbooks and periodicals were considered as the major source of the secondary information. In addition, the information available on the website would be used for the study.

To evaluate the objectives of the study, Haveri and Ranebennur markets were selected for purposive sample. Before choosing these three markets for investigation, the various market practices followed in the marketing of Bt cotton and non-Bt cotton are considered.

## STATISTICAL TOOLS

The statistical techniques like, Mean, Standard Deviation, Coefficient of Variations, Coefficient of Correlation, are used extensively for analysis and interpretation of the data.

The extent of variability in area, production and productivity of cotton are analyzed through CV i.e. Coefficient of Variation.

$$CV = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

The cotton cultivation in Gujarat is increasing every year and it is one of the major cotton producing states of India. As per the government figures, the area under cultivation of cotton was 16.75 lakh hectares in 2002-03, which increased to 21 lakh hectares in 2006-07 .[5]

The growth of area, production and yield of cotton in Karnataka during 2004-05 to 2007-08 is analyzed in the table No.1.

**Table 1 : Growth Of Area (Ha), Production (Bales) And Yield (Kgs/Ha) Of Cotton In Karnataka -- From 2004-05 To 2008-09**

| Sl.No | Year | Area | % of Increase/Decrease over P.Y. | Production | % of Increase/Decrease Over P.Y. | Yield | % of Increase/Decrease Over P.Y. |
|---|---|---|---|---|---|---|---|
| 01 | 2004-05 | 521290 | -- | 688461 | -- | 236 | -- |
| 02 | 2005-06 | 413310 | -20.71 | 585498 | -17.59 | 253 | 6.72 |
| 03 | 2006-07 | 375960 | -9.93 | 610141 | 4.04 | 290 | 12.76 |
| 04 | 2007-08 | 403000 | 6.71 | 778000 | 21.58 | 328 | 11.59 |
| 05 | 2008-09 | 422000 | 4.50 | 912000 | 14.69 | 312 | -5.13 |
| | **Total** | **2135560** | | **3574100** | | **1419** | |
| | **Mean (X)** | **427112** | | **714820** | | **2838** | |

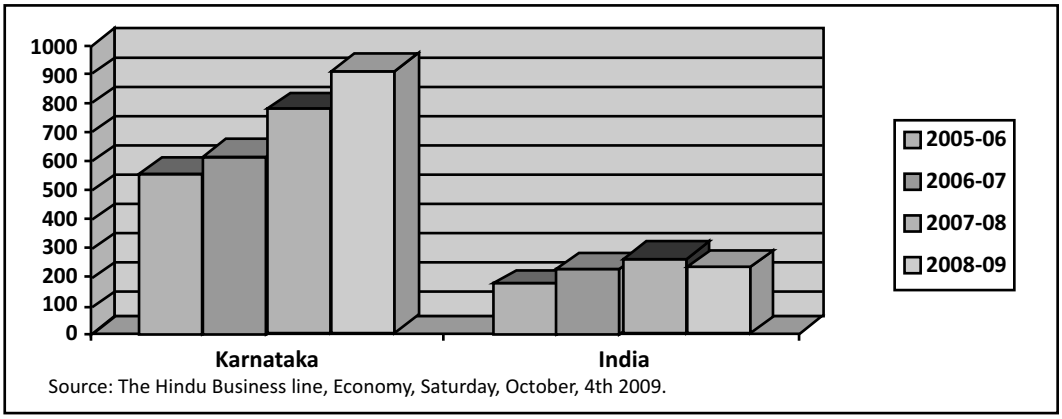
Source: Commissionerate of Agriculture office, Bangalore-2008-09.

The Table No.1 shows that the growth decreased whereas the production and yield of cotton from 2004-05 to 2008-09 showed an increasing trend, with 688461 bales to 775000 bales in production and 236 kg per hectare to 312 kg per hectare in yield. The average production of cotton from 2004-05 to 2008-09 is with mean value of 714820, whereas the yield average is with mean of 2838 for the said period.The comparative picture of cotton production of India and Karnataka during 2005-06 to 2008-09 is given in the table No.2.

**Table 2 : Comparative View Of Cotton Production Between India And Karnataka From 2005-06 To 2008-09 (Production In Lakh Bales Of 175 Kg)**

| Year | Karnataka | India | Percentage of increase in production |
|---|---|---|---|
| 2005-06 | 554 | 165 | 299.46 |
| 2006-07 | 610 | 226 | 269.91 |
| 2007-08 | 778 | 259 | 300.38 |
| 2008-09 | 910 | 232 | 392.24 |
| Mean (X) | 713 | 225.5 | |
| Coefficient of Variation | 0.499 | 0.0574 | |

**Graph 1**



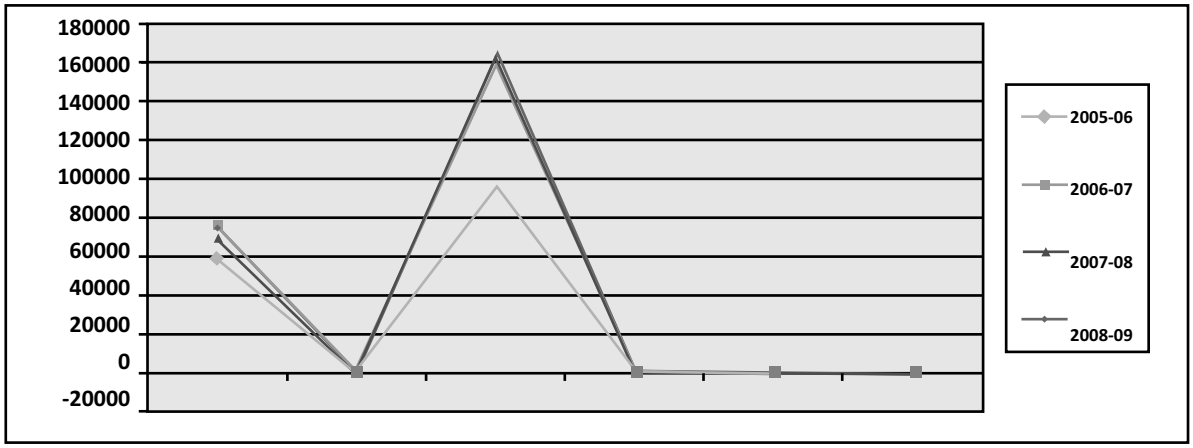

Source: The Hindu Business line, Economy, Saturday, October, 4th 2009.

The Table No.2 exhibits the increase in production of cotton in Karnataka comparatively with production in rest of India from 2005-06 to 2008-09. The increase in production was 299.46 percent during 2005-06, which increased to 392.24 percentage during 2008-09. The average production of cotton in Karnataka is more with mean value of 713 comparatively with 225.5 mean values in India. The C.V. in Karnataka is nearly perfect positive, correlation with production.The growth of area, production and yield of cotton in Haveri district from 2004-05 to 2008-09 is shown in the Table No.3.

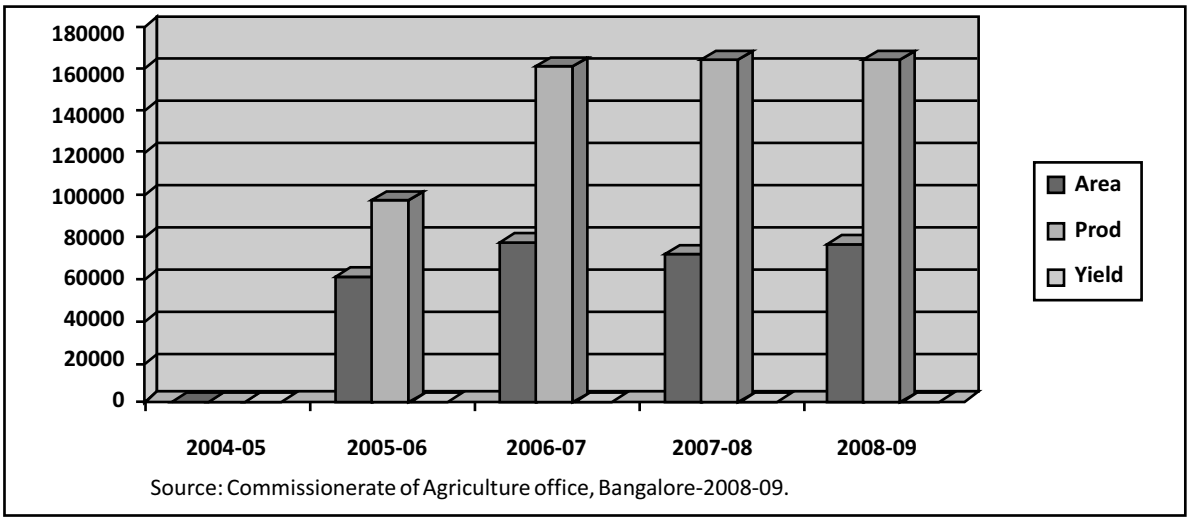
**Table 3 : Growth of Area (Ha), Production (Bales) and yield (Kgs/Ha) of Cotton in Haveri District From 2004-05 to 2008-09.**

| Sl.No | Year | Area | % of increase/Decrease over P.Y. | Production | % of increase/Decrease over P.Y. | Yield | % of increase/Decrease over P.Y. |
|---|---|---|---|---|---|---|---|
| 01 | 2004-05 | 63400 | --- | 103450 | -- | 292 | -- |
| 02 | 2005-06 | 59771 | -6.07 | 96519 | -7.18 | 289 | 1.04 |
| 03 | 2006-07 | 76459 | 21.83 | 160220 | 39.76 | 375 | 22.93 |
| 04 | 2007-08 | 69810 | -9.52 | 164259 | 2.46 | 400 | 6.25 |
| 05 | 2008-09 | 75050 | 6.98 | 165551 | 0.78 | 375 | -6.67 |
| | **Total** | **344490** | | **689999** | | **1731** | |
| **Mean (X)** | **68898** | | | **137999.8** | | **3462** | |

**Graph 2**




**Graph 3**




Source: Commissionerate of Agriculture office, Bangalore-2008-09.

The table No.5 depicts that the growth of area, production and yield of cotton in Haveri district shows an increasing trend. The area of cotton increased by 84.47 percentage from 2004-05 to 2008-09, the production ranges from 103450 lakh bales to 165551lakh bales, and it amounts to 62.48 percentages of increase in production. The yield ranges from 292 kg per hectare to 375 kg per hectare, it works out as 77.86 percentages of increase in yield. The average cotton production from 2004-05 to 2008-09 is with mean value of 137999.8, but the average yield of cotton for the said period with mean value is 3462.

## BACKGROUND OF BT COTTON IN THE WORLD

Since the introduction of transgenic crops in 1996, there has been a substantial increase in their area. The Monsanto Company developed Bt Cotton (Bacillus thuringiensis Cotton) and this is now one of the widely grown transgenic crops. It is currently grown in a large number of countries, including United States, China, India, Australia, Argentina, South Africa and Indonesia.

Bt cotton contains a foreign gene obtained from Bacillus thuringiensis, which is an aerobic bacterium characterized by its ability to produce crystalline inclusions during sporulation. This bacteria was first discovered by Japanese bacteriologists in 1901 and subsequently in 1915, a German scientist isolated the crystal toxin in Thüringen region of Germany. B thuringiensis was registered as a microbial pest control agent in 1961 under the Federal Insecticide and Rodenticide Act in the US. In India, Bt formulations have been registered under Pesticides Act 1968. With the advent of biotechnology, this bacterial gene has been introduced genetically into the cotton seeds, and it protects the plants from bollworms, a major pest of cotton. The worms feeding on the leaves of a Bt cotton plant become lethargic and sleepy and are gradually eliminated.

The adoption of the Bt cotton in major countries from 1996 is shown in the table No.4

**Table No. 4 : Adoption Of Bt Cotton In Major Growing Countries**

| Country | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|
| USA | * | * | * | * | * | * | * | * |
| Australia | * | * | * | * | * | * | * | * |
| China | | * | * | * | * | * | * | * |
| India | | | | | | | * | * |
| Indonesia | | | | | | | * | * |
| Mexico | * | * | * | * | * | * | * | * |
| Argentina | | | * | * | * | * | * | * |
| Colombia | | | | | | | * | * |
| South Africa | | * | * | * | * | * | * | * |

**Source:** James C (2003) Preview: Global Status of Commercial transgenic crops: 2003.

* Mark indicates commercial cultivation of Bt cotton has taken place.

The table No.4 shows that many countries have reported positive experiences with Bt cotton, this includes USA, China and Australia. Bt cotton has spread very rapidly in China. There is good demand for it from the farmers since it reduces the cost of pesticide applications as well as the exposure to pesticides. In China, the government has played a major role in providing GM technology to the farmers. The chronological progress of adoption of Bt cotton across countries is shown in table No.6.Commercial cultivation of Bt cotton started in US, Australia and Mexico in 1996, and in China and South Africa after a lag of one year. Countries such as India, Indonesia and Colombia have taken up its commercial cultivation much later (since 2002).

## BT COTTON IN INDIA

The Government of India allowed the production of three genetically modified Bt cotton hybrids for three years from April 2002 to March 2005. This followed the controversial unauthorized release and cultivation of Bt cotton in some areas in the previous year. The authorized cotton varieties are Bt MECH 162, Bt MECH 184, and Bt MECH 12. Officially, Bt cotton has been grown in about one hectare in Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Tamil Nadu. Unofficial use, especially in Gujarat, is said to be quite large.

MAHYCO has been developing and evaluating Bt cotton since 1996. The decision of granting approval, subject to certain conditions, for commercial cultivation of Bt cotton is based on the data generated on environment safety and large-scale field studies conducted to evaluate the agronomic potential and different location.

## BT COTTON -AGRONOMIC BENEFITS

Trials conducted in several locations in 1998/99, 1999/2000, 2000/2001/02 demonstrated the following agronomic benefits of Bt cotton:

- Good control of bollworm species in different growing areas;
- Significantly higher yield and boll retention (compared to control or non-Bt cotton);
- Reduction in expense of insecticide application;
- Additional revenue (2,500-4,000/acre) in farm income (compared to non-Bt cotton);
- No adverse effect on non target insects or adjacent non-Bt cotton crops.

The growth of area, production and yield of Bt cotton in India from 2000-01 to 2000-10 is shown in Table No 5.

**Table 5: Growth of Area, Production and yield of Bt Cotton in India from 2000-01 to 2009-10.**

| Sl.No | Year | Area (in lakh hectares | % of increase/Decrease over P.Y. | Output (in lakh bales of 170 kg) | % of increase/Decrease. over P.Y | Yield (in Kg/ hectares) | % of increase/Decrease over P.Y. |
|---|---|---|---|---|---|---|---|
| 01 | 2000-01 | 85.76 | -- | 140.00 | --- | 278 | --- |
| 02 | 2001-02 | 87.30 | 1.76 | 158.00 | -11.39 | 308 | 9.74 |
| 03 | 2002-03 | 76.67 | --0.14 | 136.00 | -16.18 | 302 | -1.98 |
| 04 | 2003-04 | 76.30 | -0.48 | 179.00 | 24.02 | 399 | 24.31 |
| 05 | 2004-05 | 87.86 | 13.16 | 243.00 | 26.33 | 470 | 15.10 |
| 06 | 2005-06 | 86.77 | -1.26 | 244.00 | 0.41 | 478 | 1.67 |
| 07 | 2006-07 | 91.44 | 5.11 | 280.00 | 14.75 | 521 | 8.25 |
| 08 | 2007-08 | 94.14 | 2.86 | 307.00 | 8.79 | 554 | 5.95 |
| 09 | 2008-09 | 94.06 | -0.09 | 290.00 | -5.86 | 524 | -5.73 |
| 10 | 2009-10 | 99.94 | 5.88 | 320.00 | 9.38 | 544 | 3.68 |
| | **Mean (X)** | **88.024** | | **229.7** | | **437.8** | |
| **Coefficient of Variation** | | **0.7454** | | **0.152** | | **0.6157** | |

Source: The Hindu, Business Line, Saturday, October 17, 2009, p.2.

The Table No.5 indicates that both area and production of Bt cotton from 2000-01 to 2003-04 was fluctuating, whereas the yield of Bt cotton from 2000-01 to 2009-10 shows an increasing trend, it amounts to 51.10 percentage of increase in yield of Bt cotton. The area and output of Bt cotton from the year 2004-05 shows the positive trend up to 2009-10. The average growth of area in Bt cotton from 2000-01 to 2009-10 with mean value is 88.024, similarly, output and yield mean value is 229.7 and 437.8 respectively. The C.V. for the said period is 0.7454, 0.152 and 0.6157 correlations with area, output and yield respectively.

Cotton yield has gone up by 65 percent since 2003. From around 302 kg a hectare during 2002-03, it is up to 518 kg this year. For the next season, according to the US department of Agriculture, it could be 539 kg a hectare. Bt cotton contribution to the total production this season and is estimated at 40 per cent and for the coming season, it is projected at 55 per cent.[6]

The cultivation of Bt cotton has increased the profitability and net income of farmers. The average net return has been ₹ 13,168 a hectare against ₹ 4,484 a hectare in non-hybrid variety crop. A recent nationwide survey of more than 3000 farmers by AC Nielsen found that for biotech cotton farmers in India, profits increased by 78 percent, on average, over farmers who planted traditional varieties. Yield increased by 29 percent on average. Pesticide use declined by 60 percent on average. The crop is harvested in 150 to 180 days, which saved 26 labour days per hectare. However, the seed cost is up by 16 percent.[7]

Cotton farmers across the country have many reasons to smile. First, they expect to reap a record crop after a majority of them opted to plant Bt cotton. Next, prices are likely to rise as prospects for exports look good with supply from the US seen lower by the mills picking up.

Despite the September 2009 rains flooding cotton fields in part of Andhra Pradesh and Karnataka, optimism prevails over the prospects of the crop. Research personnel, market analysts and seed producers are contend that the damage is not alarming. The fact that a majority of the growers have sown Bt cotton as in the last few years is another cause for optimism.

20 Bt cotton hybrids were approved for planting in 2005 compared with only four in 2004.Bt cotton among Indian

farmers proves the success of biotechnology in the field of agriculture. Karnataka's Bt cotton farmers appear on top of the world. Monsanto Company is now developing the second-generation Roundup ready flex (RRF) cotton hybrids, which is expected to increase the flexibility of application and greater weed control efficacy. [8] India is world No.2 in cotton production and world No.1 in acreage (22.8 million acres). In 2002, Bt cotton becomes the first biotech crop to be approved for commercialization in India by the Genetic Engineering Approval Committee (GEAC). In 2002**,** Bt cotton was grown in 72000 acres of land in India. In 2007, that was 14.4 million acres.[9]

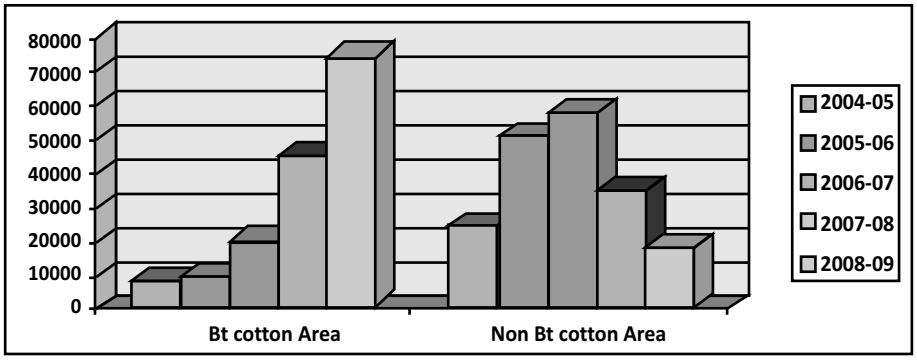
The overall production has improved in the country mainly due to switchover to Bt cotton. Moreover, the yield per hectare has gone up substantially, said Mr. Vijay Trivedi, Associate Vice-President, Commodity Research Consulting Company. The average yield rose to 511.30 Kg per hectare against 481.85 Kg per hectare last year. Area under cotton jumped to 100.96 lakh hectares from 91.98 lakh hectares. Gujarat registered the highest yield at 800 Kg per hectare, while it was 790 Kg per hectare (775.90 Kg per hectare) in Punjab. [10]An Assocham (Associated Chambers of Commerce and Industry of India) study on status of Bt cotton farmers in Andhra Pradesh reported that farmers have gained ₹ 700 crore as additional income last year. The 'socio-economic' appraisal of the villages that grew cotton threw light on the improved lot of farmers. Of the 9000 farmers the study covered, about 960 were from Andhra Pradesh, one of the biggest cotton growing states in the country. [11] The production of Bt cotton in the district started from 2004-05. The details of the area under cultivation of Bt cotton and non-Bt cotton in the Haveri district is shown in Table No.6.

**Table :6. Growth Of Bt Cotton And Non-Bt Cotton In Haveri District In 2004-05 - 2006-07**
**(Area In Hectares)**

| Year | Bt cotton Area | Non Bt cotton Area | Share of Bt cotton (In percentage) |
|---|---|---|---|
| 2004-05 | 8137 | 24413 | 33.33 |
| 2005-06 | 9159 | 50612 | 18.09 |
| 2006-07 | 19343 | 57116 | 33.86 |
| 2007-08 | 44573 | 34327 | 129.84 |
| 2008-09 | 74024 | 17910 | 413.31 |
| **Mean (X)** | **3147** | **60595** | **44.456** |
| **Coefficient of Variation** | **0.745** | **0.1525** | **0.6157** |

It is observed from the table No.6 that the area of Bt cotton during 2004-05 was 8137 hectares, which is 33.33 percent of non-Bt cotton. The area increased to 7402 hectares during 2008-09, which is 80.51 percentage of non-Bt cotton. It is important to note that the share of Bt cotton increased from 33.33 percent to 413.31 percent in Haveri district. The area of cotton in Haveri district is 74556 hectares, out of which, more than 90 percentage of area belongs to Bt cotton during 2009-10.The Bt cotton area is perfectively positive with C.V. of 0.745, but the C.V. of non Bt cotton is positive with 0.1525 in the study area. There are two major cotton markets in the Haveri district. The majority of the commission agents and wholesale dealers of cotton are concentrated in Haveri and Ranebennur. The total arrivals, turnover and average rate of Bt cotton of these two markets are shown in Table No.7.

**Graph 4**




Source:
District Agricultural Department, Haveri.

**Table 7: Trends of Bt Cotton in Haveri and Ranebennur Market-2005-06 to 2007-08**

| Bt Cotton | 2005-06 | | 2006-07 | | 2007-08 | | 2008-09 | |
|---|---|---|---|---|---|---|---|---|
| | Haveri | Ranebennur | Haveri | Ranebennur | Haveri | Ranebennur | Haveri | Ranebennur |
| Arrivals (In quintals) | 195573 | 206573 | 262412 | 293165 | 324140 | 457962 | 467280 | 495847 |
| Total Turnover (In crores) | 38.95 | 34.97 | 83.83 | 55.70 | 87.19 | 109.91 | 126.96 | 152.78 |
| Average Rate (In ₹) | 1991 | 1982 | 2550 | 2042 | 2374 | 2140 | 2654 | 2673 |

Source: Unpublished records of APMC, Haveri and Ranebennur.

Table No.7 discloses that the arrivals of Bt cotton during 2007-08 was more than double of arrivals of 2005-06 in both the markets. The average rate of Bt cotton is increasing year after year. This is because of the association of Bt cotton with more and more income as compared to non-Bt cotton. Hence, a need has been felt by the researcher to know the pros and cons of the production and marketing of Bt cotton and non-Bt cotton in Haveri district. The Coefficient of Variation of Bt turnover from 2005-06 to 2008-09 is analysed in the table No.8.

**Table 8:Coefficient Of Variation Of Bt Turnover**

| Sl.No | Bt. Cotton | Coefficient of Variation ( 2005-06 to 2008-09) | |
|---|---|---|---|
| | | Haveri Market | Ranebennur Market |
| 01 | Arrivals(in quintals) | 0.266875 | 0.624 |
| 02 | Turnover(in crores) | 0.02712 | 0.704 |
| 03 | Average Price (in rupees) | 0.00095 | 0.455 |

The Table No. 8 clearly exhibits that the Bt cotton arrival is perfectively positive in Ranebennur market with 0.624, whereas it is positive in Haveri market with 0.266875.The same position is prevailed in turnover and average price of Bt cotton at Ranebennur market comparatively Haveri market.

The economic benefit of Bt cotton in India from 2005-06 to 2009-10 is exhibited in the table No. 9.

**Table 9 : Economic Benefit of Bt cotton in India from 2005-06 to 2009-10**

**(Yield in quintals)**

| Year | Yield | | Yield increased with Bt | Sprays | | Sprays' reduction with Bt | Economic benefit per hectare |
|---|---|---|---|---|---|---|---|
| | Non Bt | Bt | | Non Bt | Bt | | |
| 2005-06 | 18.49 | 24.40 | 5.91 | 4.55 | 0.5 | 4.05 | 21780 |
| 2006-07 | 22.63 | 28.00 | 5.37 | 4.90 | 1.20 | 3.70 | 19810 |
| 2007-08 | 25.88 | 30.70 | 4.82 | 5.20 | 1.40 | 3.80 | 18260 |
| 2008-09 | 23.16 | 29.00 | 5.84 | 6.25 | 1.50 | 4.75 | 22270 |
| 2009-10 | 26.56 | 32.00 | 5.44 | 6.75 | 1.60 | 5.15 | 21470 |
| Average | 23.43 | 28.82 | 5.48 | 5.53 | 1.15 | 4.29 | 20718 |

Note:* Economic benefit per hectare is calculated on the basis of an average cotton rate of ₹ 3000/q rage cost of each bollworm complex spray of ₹ 1,000/ha

- Cotton picking still in progress in Karnataka at the date of writing.
- Economic benefit per hectare was calculated on the basis of an average cotton rate of ₹ 3000/- and an average cost of each bollworm complex spray of ₹ 1000/ha.

The table No.9 indicates that there is an average additional income of more than ₹ 20,000/ha for Bt compared to non-Bt cotton.

The survey exhibits that the recommendation of Bt cotton in the study area is shown in the Table No.10.

**Table 10 : Bt Cotton Farmers Response On Who Recommended The Growth Of Bt Cotton In Haveri District**

| | Who recommended | Percentage |
|---|---|---|
| 1. | Extension Worker | 2.47 |
| 2. | Fellow Farmer | 46.62 |
| 3. | Village Leader | 8.41 |
| 4. | Village Co-operative | 6.40 |
| 5. | Seed Company | 24.99 |
| 6. | Seed Dealer | 11.11 |
| | **Total** | **100.00** |

Source: Field survey.

The table 10 examines the question of who recommended the growing of Bt cotton to the farmers. It is based on the information available from the study area. The data indicates that in most cases, the farmers were influenced by other farmers, who recommended Bt cotton to them. The extension workers did not play much a role. In 36 percent of the cases, the farmers have indicated that the recommendation came from the seed companies or dealers.
Advantages of Bt seed as opposed to traditional cotton conveyed by Dealers/Sages Agent in Haveri district is shown in the Table No.11.

**Table 11: Opinion Of Dealers/Sales Agents Regarding Advantages Of Bt And Non-Bt Cotton**

| Sl.No. | Opinion | Percentage |
|---|---|---|
| 01 | More Profit | 73.24 |
| 02 | Less Pesticides Spraying | 66.20 |
| 03 | No Boll Shedding | 15.49 |
| 04 | Comparatively more Bolls | 59.15 |

Source: Field survey.

The Table no.11 indicates that the benefit projected by the sales agents and dealers is primarily more profit. Other benefits projected are less pesticide spraying and comparatively more bolls. Thus, the promotion done by the agents does not appear to be unreasonable.The economic characteristics of Bt cotton in the study area is shown in the table no.12.

**Table 12 : Economic Characteristics Of Bt Cotton In Haveri District**

**(In percentage)**

| Question | Yes | No | No opinion |
|---|---|---|---|
| Did any government agency approach you for inspecting the cotton variety you have sown? | 0 | 100 | 0 |
| Did any seeds' company/agency approach you for inspecting the cotton variety you have sown? | 60 | 40 | 0 |
| Do you need to buy Bt cotton seed every year? | 100 | 0 | 0 |
| Is Bt cotton seed easily available? | 97.6 | 2.4 | 0 |
| Do you face any problem in marketing of Bt cotton? | 0 | 100 | 0 |
| Will you continue with Bt cotton cultivation? | 94.1 | 2.4 | 2.4 |

Source: Field survey.

The Table no.12 indicates that in Haveri, there was no government inspection of the cotton planted in the farmer's field, but majority of the farmers were in a position to receive the inspection for cotton variety from seeds' company/agency. The farmers, as expected, need to buy cotton seeds every year, and seeds are easily available. 94 percent of the farmers

indicate that they will continue with the cultivation of Bt cotton in the following year.Physical characteristics of BT cotton in the study area is shown in the table no.13

**Table 13 : Physical Characteristics Of Bt Cotton In Haveri District**

**(In percentage)**

| Sl. No | Question | Yes | No | No Opinion/Neither |
|---|---|---|---|---|
| 01 | Is Bt cotton plant shorter? | 0 | 100 | 0 |
| 02 | Does Bt cotton have smaller bolls? | 0 | 100 | 0 |
| 03 | Does Bt cotton give lesser number of cotton pickings? | 0 | 96.5 | 3.5 |
| 04 | In your opinion, is Bt cotton is more pest resistant than non Bt? | 82.4 | 14.1 | 3.5 |
| 05 | Do you feel that the pest/ insect attack on other crop is higher or lower, when Bt cotton is cultivated? | 0 | 0 | 100 |
| 06 | Have you observed any adverse effect on the environment due to Bt cotton cultivation? | 0 | 100 | 0 |

Source: Field survey.

The Table 13 gives the responses on some other questions. The farmers indicate that the Bt cotton plants are not shorter or have smaller bolls or give lesser number of pickings. 82 percent indicate that Bt is more resistant than non-Bt. With respect to the environment, the responses indicate that Bt cotton growing is not seen to be associated with more or less pest attack on other crops, and the farmers have not seen any adverse effect of Bt cotton on the environment. The suggestion for improving the benefits of BT cotton technology in the study area is shown in the table no.14.

**Table 14: Suggestion For Improving The Benefits Of Bt Cotton Technology In Haveri District**

| Sl.No. | Suggestions | Percent |
|---|---|---|
| 01 | Reduce Seed Cost | 53.97 |
| 02 | Seed packages with less quantity seeds | 14.29 |
| 03 | Field Demonstration | 33.33 |
| 04 | Assurance of seed quality | 6.35 |
| 05 | Field visit and guidance by extension agencies | 25.6 |
| 06 | Traders should not sell spurious seeds | 36.7 |

Source: Field survey.

The table No.14 indicates that the major suggestion given by the farmers to improve benefits of Bt cotton technology is to reduce the cost of seeds. Some farmers in the study area are requesting for more extension through field visits and field demonstrations. Some farmers are concerned about spurious seeds and the need to improve the assurance of seed quality.

## CONCLUSION

The benefits of Bt cotton in India are in line with those enjoyed by farmers worldwide who have cultivated Bt cotton. The area under Bt cotton cultivation is expected to increase, it is likely that an area of 99.94 lakh hectares will be covered by 2010, leading to increased production and reduced costs in an environmentally favorable manner. This will positively affect the livelihood of millions of small farmers by improving their net incomes.

Bt cotton is undoubtedly the most studied cotton variety today. Rigorous scientific studies conducted in India and abroad demonstrate that Bt cotton and its products are safe for the environment, humans, animals and agriculture. In fact, the use of Bt cotton is a positive step towards environmental production because it makes possible the reduction of the insecticide load in the environment and reduces handling of such chemicals by farmers. This reduced use of insecticides will enhance the effectiveness of biological controls and implementation of Integrated Pest Management (IPM) programs. The higher farm income observed in the experiments has now been demonstrated by the effective and environmentally friendly plant protection tool resulting in greater cultivation of Bt cotton in the coming years. The cotton trade is looking forward to the productivity and quality benefits of Bt cotton seed. Efforts are being made to

incorporate another gene (Bollgard II) to improve efficacy and postpone possible resistance problems. As newer products are approved in the regulatory system, it is likely that farmers will have greater choice to plant hybrids according to market quality requirements.

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