



# Cost and returns in Bt cotton cultivation across different farm sizes in northern Transitional Zone, Karnataka

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**Abstract :** Karnataka is one of the nine major Bt cotton-growing states in the country. Northern transitional zone is the major cotton growing zone of Karnataka *i.e.* 40.19 per cent of the total cotton area of Karnataka. It focused on the socio-economic characteristics of Bt cotton farmers and the efficiency of resource use in Bt cotton production under different farm sizes. Two taluks having highest cotton area were selected from the zone for study. The present study was conducted with primary data collected entirely based on a multistage sampling technique from 180 Bt Cotton growing farmers. The study pertained to the agricultural year 2010-11. The total variable cost of Bt cotton was Rs. 22192.15 where large farmers incurred high cost *i.e.* Rs. 23256.85. The total cost of Bt cotton was Rs 30920.56 and it was high in large farmers Rs. 32723.9. The net return in Bt cotton was Rs. 79456.36 and net returns were seen high in case of large farmers Rs. 84677.9. The yield per ha was 24.98 q. and medium farmers got high yields *i.e.* 25.54 q. Bt Cotton technology has positive impact on socio- economic status of farmers by increase in yield and reducing cost on inputs thereby increase in income and also standard of living

**Key Words :** Bt Cotton, Yield, Small farmer, Medium farmer, Large farmer

**View Point Article :** Gamanagatti, P.B., Dodamani, M.T., Gaddi, G.M. and Menasinahal, A.S. (2012). Cost and returns in Bt cotton cultivation across different farm sizes in northern Transitional Zone, Karnataka. *Internat. J. agric. Sci.*, 8(2): 431-435.

**Article History :** Received : 20.01.2012; Revised : 12.04.2012; Accepted : 13.05.2012

## INTRODUCTION

Concerns and controversies notwithstanding, India embarked upon commercial deployment of genetically modified crops in form of Bt (*Bacillus thuringiensis*) cotton in 2002 to address the agrarian and ecological distress with the belief that its resistance against the most devastating American bollworm (*Helicoverpa armigera*) insect pest will help in containing colossal yield loss, reducing the burgeoning consumption of expensive, toxic and environment damaging pesticides as well as assuring better yield, income and health to farm families. Though there have been mounting claims and counter claims with respect to beneficial and adverse impacts of Bt cotton,

Bt cotton, which confers resistance to important insect pests of cotton, was first adopted in India as hybrids in 2002. There were 54,000 farmers who grew approximately 50,000 hectares of officially approved Bt cotton hybrids for the first

time in 2002 which doubled to approximately 100,000 hectares in 2003. The Bt cotton area increased again four-fold in 2004 to reach half a million hectares. In 2005, the area planted to Bt cotton in India continued to climb reaching 1.3 million hectares, an increase of 160 per cent over 2004. In 2006, the adoption record increased which continued with almost a tripling of the area of Bt cotton to 3.8 million hectares. This tripling in area was the highest percentage year-on-year growth for any country planting biotech crops in the world in 2006. Notably in 2006, India's Bt cotton area (3.8 million hectares) exceeded for the first time, that of China's 3.5 million hectares. In 2007, the Indian cotton sector continued to grow with a record increase of 63 per cent in Bt cotton area from 3.8 to 6.2 million hectares, to become the largest hectare of Bt cotton in any country in the world. In 2008, the Bt cotton area increased yet again to a record 7.6 million hectares from 6.2 million hectares in 2007. Maintaining double digit growth, the Bt cotton area increased to 8.4 million hectares in 2009, over 7.6 million hectare

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in the previous year. Despite a very high level of adoption in 2008, 2009 was the fifth consecutive year for India to have the largest year-on-year percentage growth of all biotech cotton growing countries in the world; a 160 per cent increase in 2005, followed by a 192 per cent increase in 2006, a 63 per cent increase in 2007, 23 per cent increase in 2008 and a 11 per cent increase in 2009.

Thus, within a span of eight years, nearly 87 per cent of the cotton area in India came under Bt hybrid umbrella. It is envisaged that with availability of more Bt hybrids coupled with reduction in seed cost from 2006 onwards, the area under Bt cotton is likely to show a perceptible increase in future too. Among the cotton growing states Maharashtra leads the others with 3.4 m ha under Bt cotton followed by Andhra Pradesh and Gujarat with 1.05 and 1.68 m ha, respectively. Thus, it can be seen that the cultivation of Bt cotton hybrids has picked up momentum in the last four years and it is being cultivated in all the three cotton growing zones of the country.

In recent years, pest menace in cotton is severe resulting in escalation of cost of production, increase in crop losses and reduction in productivity and income to farmers. Pest problems in cotton have caused socio-economic calamity. To address these concerns biotechnology tools came handy in transferring pest resistance to cotton. Bt cotton as a ray of hope for all these maladies was released for commercial cultivation in 2002 in India. However, several apprehensions were raised against this technology by farmers' organizations, environmentalists, NGOs and other stakeholders (Abdul Qayum and Kiran Sakhari 2003). Clearly there has been a fair amount of confusion in drawing inferences on benefits and or losses from Bt cotton (Hugar and Patil, 2007). Therefore, an attempt was made in the present paper to assess the effect of Bt cotton technology on cotton output in different farm size holders. More specifically, the objectives of the study are: To study the socio-economic conditions of Bt cotton growers in the study area, to work out the cost and returns in Bt cotton cultivation across different farm size holders and to study the constraints in production of Bt cotton and to suggest appropriate remedial.

## MATERIALS AND METHODS

The multistage sampling technique was adopted for collection of primary data from sample farmers. Bt cotton is grown extensively in northern transitional zone of Karnataka *i.e.* 40.41 per cent of the total area under north Karnataka, hence, this zone was purposively selected for the study. The zone contains fourteen taluks. From the zone two taluks were selected based on the highest Bt cotton cultivation. Therefore, in the first stage these top two taluks in cotton area were selected. Based on the information provided by the office of the Assistant Director of agriculture from each taluks, five villages having highest area under cotton were selected in the second stage. Finally six small farmers, six medium farmers,

six large farmers were selected from each village randomly. Thus the total sample size of the farmers was 180.

### Nature and sources of data:

The primary data required for the study were collected through personal interview method with the help of pre-tested and well structured schedules and data pertained to the 2010-11 crop year. The secondary data on area, production, productivity of Bt and Non- Bt cotton were collected from Department of Agriculture and Directorate of Economics and Statistics (DSO) of respective districts.

### Analytical tools applied:

The tabular presentation technique was employed to calculate frequencies, percentages, and analyzing the data elicited through opinion survey.

## RESULTS AND DISCUSSION

Inputs used per hectare in Bt cotton cultivation in the study area (Table 1) revealed that the average per hectare utilization of human labour was the highest in the case of medium category farms (68.93 man days) followed by large farmers (67.74 man days) and small farmers (65.17 man days) because most of the operations such as harvesting/picking, weeding were human labour intensive. Most of the small and medium farmers used bullock labour as against use of tractor labour because use of bullock labour worked out to be cheaper than tractor labour use, but large farmers used tractor for ploughing and other operations hence the use of machine labour was more on these farms than bullock labour. This may be attributable to accomplishment of quick work and time constraint to cover larger area. Farmers in the study area used less quantity of farmyard manures, among the various category of farms quantity of farmyard manure (FYM) applied per hectare was the highest in the case of large farmers (4.42 tonnes) followed by medium category farms (4.14 tonnes) and small farms (4.12 tonnes). Results presented in the table shows that there was high amount of application of chemical fertilizers in anticipation of good yield. Pesticides and other PPC chemicals were used to minimize / control the pests. Plant protection chemicals use was high in large farms compared to small and medium farms, but it appears to be minimum cost item as the Bt cotton is pest resistant hybrid. These findings are supported by Gaddi *et al.* (2002); Khadi (2006) and Naraynamoorthy and Kalamkar (2006).

Table 2 revealed that among the three categories of farmers the total cost incurred by the large farmers was high (Rs. 32723.9/ha) as compared to small and medium farmers (Rs.29217.63/ha and Rs. 30820.15/ha). This may be attributable to the fact that large farmers used high machine labour and applied more fertilizers than their counterparts.

The cost of human labour, fertilizer, seeds and bullock labour were the items of cost with major share in the variable

**Table 1 : Input use pattern and output obtained in Bt cotton cultivation (Hectare)**

Sr. No.	Particulars	Units	Small (n=60)	Medium (n=60)	Large (n=60)	Over all (N=180)
1.	Seeds	kgs	1.19	1.16	1.23	1.19
2.	Human labour	Mandays	65.17	68.93	67.74	67.28
3.	Bullock labour	Pair days	4.45	3.65	2.96	3.69
4.	Tractor labour	Hours	0.36	1.48	2.82	1.55
5.	Farm yard manure	Tonnes	4.12	4.14	4.42	4.23
6.	Fertilizers	kg	235.86	258.71	294.50	263.02
7.	PPC	Rs.	1118.62	1065.74	1383.79	1189.38
	Main Product ( <i>Kapas</i> )	Qtls.	24.30	25.54	25.18	25.01
	By-product (stalk)	Qtls.	28.02	26.61	27.83	27.49

costs, because most of the operations like harvesting/picking, spraying and weeding are human labour intensive operations and the other operations like harrowing and inter-cultivation were bullock labour intensive. The distribution pattern of operational cost under various inputs revealed that cost of human labour was the highest in the medium case farms *i.e.* Rs.11281.47/ha, compared to large (Rs.10839.58/ha) and small farmers (Rs.10343.05/ha). Whereas average bullock labour cost was the highest in case of small farmers (Rs.2127.44/ha) followed by medium (Rs.1823.53/ha) and large farmers (Rs.1482.22/ha). The cost of seeds used was the lowest on medium farms (Rs.1941.18/ha) and the highest on large farms (Rs.2062.97/ha). Whereas expenditure on fertilizers was the highest (Rs.2965.42/ha) for large farmers as compared to medium (Rs.2579.31/ha) and small farmers (Rs.2326.34/ha). It was also noticed that the highest expenditure on pesticide

was seen on large farms (Rs.1383.79/ha) as compared to small and medium farms. The study conducted by Mahendra and Chandrasekhara (2007) indicated that the Bt cotton farmers from small farms obtained 23 per cent lower yield compared to the Bt cotton farmers from the large farms with a 20 per cent lesser total cost of production. The small farmers spent lower amounts on almost all items of production. Surprisingly, the seed cost per acre of small farmers growing Bt cotton was also lower by 27 per cent compared to the large farmers growing Bt cotton indicating that the small farmers might have gone for unofficial Bt cotton seeds. They also spent 18 per cent less on insecticides compared to large farmers growing Bt cotton.

For the overall category of respondents the per hectare cost of cultivation of Rs.30920.56 comprised of 71.77 per cent of variable cost and remaining was accounted for by the fixed

**Table 2 : Costs in production of Bt cotton (Rs. /ha)**

Sr. No.	Particulars	Small (n=60)	Per cent	Medium (n=60)	Per cent	Large (n=60)	Per cent	Over all (N=180)	Per cent
<b>Variable cost</b>									
1.	Human labour	10343.05	35.40	11281.47	36.60	10839.58	33.12	10821.37	35.00
2.	Bullock labour	2127.44	7.28	1823.53	5.92	1482.22	4.53	1811.06	5.86
3.	Tractor labour	216.00	0.74	888.00	2.88	1692.00	5.17	932.00	3.01
4.	Seeds	2020.9	6.92	1941.18	6.30	2062.97	6.30	2008.35	6.50
5.	Farm yard manure	1255.83	4.30	1240.88	4.03	1326.40	4.05	1274.37	4.12
6.	Fertilizers	2326.34	7.96	2579.31	8.37	2965.42	9.06	2623.69	8.49
7.	PPC	1118.62	3.83	1065.74	3.46	1383.79	4.23	1189.38	3.85
8.	Interest on working capital @ 8%	1631.87	5.59	1458.91	4.73	1503.07	4.59	1531.28	4.95
	Subtotal (I)	21040.05	72.01	22279.54	72.29	23256.85	71.07	22192.15	71.77
<b>Fixed cost</b>									
1.	Rental value of land	7000.00	23.96	7000.00	22.71	7000.00	21.39	7000	22.64
2.	Land revenue	50.00	0.17	50.00	0.16	50.00	0.15	50	0.16
3.	Depreciation	317.17	1.09	644.24	2.09	1480.16	4.52	813.86	2.63
4.	Interest on fixed capital @11%	810.39	2.77	846.37	2.75	938.32	2.87	865.03	2.80
	Subtotal (II)	8177.56	27.99	8540.61	27.71	9468.48	28.93	8728.88	28.23
	Total cost of cultivation (I + II)	29217.63	100.00	30820.15	100.00	32723.9	100.00	30920.56	100.00

**Table 3 : Cost and returns profile of Bt cotton production (Rs./ha)**

Sr. No.	Particulars	Small (n=60)	Medium (n=60)	Large (n=60)	Over all (N=180)
1.	Total cost of cultivation	29217.63	30820.15	32723.90	30920.56
2.	Gross returns including by-products (Rs./ha)	98429.67	115299.30	117401.80	110376.92
3.	Net return	69212.04	84479.15	84677.9	79456.36
4.	Cost of cultivation (Rs./q)	1202.372	1206.74	1303.741	1237.81
5.	Profit (Rs./q)	2848.232	3307.719	33736.22	3180.79
6.	B:C ratio	3.37	3.74	3.59	3.57
7.	Yield (q/ha)	24.30	25.54	25.10	24.98

cost items. Irrespective of items of costs, human labour and rental value of the land were the major items of costs. These observations coincide with the findings of Ramsundaram *et al.* (2005) and Kunnal *et al.* (2004).

With respect to returns analysis the gross returns obtained per hectare by large farmers were high (Rs.117401.80/ha) as compared to small and medium farmers (Rs.98429.67/ha and Rs.115299.30/ha, respectively) (Table 3). Net returns per hectare obtained were high in the case of large farmers (Rs. 84677.90/ha) as compared to small and medium farmers (Rs. 69212.04/ha and Rs.84479.15/ha, respectively). However, yield obtained by the medium farmers was the highest *i.e.* 25.54 quintals/ha as compared to small and large *i.e.* 24.30 and 25.18 quintals/ha. This might be due to better output price realized

by them than by their other counterparts.

The per quintal cost of production was Rs. 1237.81 and the per quintal profits realized were Rs. 3180.80 due to very high price received by respondents. Thus, cultivation of Bt cotton in the study area found to be very profitable as also supposed by a very high magnitude of B: C ratio of 3.57 for overall study area.

The Table 4 pertaining to problems faced by the Bt cotton growers. Most of the sample farmers opined that non-availability of labour during peak season was highly acute constraint as expressed by 73.33 per cent, 78.33 per cent and 85.00 per cent by small, medium and large farmers, respectively. The non-availability of FYM was highly acute constraint for 71.67 per cent, 50.00 per cent, and 50.00 per cent of small,

**Table 4 : Problems in the Bt cotton production under different farm size holders (n=180)**

Sr. No.	Constraints faced by farmer	Small farmers (n=60)			Medium farmers (n=60)			Large farmers (n=60)			Over all (n=180)		
		Highly acute	Acute	Not acute	Highly acute	Acute	Not acute	Highly acute	Acute	Not acute	Highly acute	Acute	Not acute
1.	Non-availability of FYM	43 (71.67)	13 (21.67)	4 (6.67)	36 (60.00)	19 (31.67)	5 (8.33)	30 (50.00)	24 (40.00)	6 (10.00)	103 (57.22)	56 (31.11)	21 (11.67)
2.	Non-availability of labour during peak season	44 (73.33)	14 (23.33)	2 (3.33)	47 (78.33)	10 (16.67)	3 (5.00)	51 (85.00)	8 (13.33)	1 (1.67)	142 (78.89)	32 (17.78)	6 (3.33)
3.	Lack of guidance from Dept. officials	40 (66.67)	20 (33.33)	0 (0.00)	34 (56.67)	25 (31.67)	1 (1.67)	34 (56.67)	24 (40.00)	2 (3.33)	104 (57.78)	73 (40.56)	3 (1.67)
4.	Low fertility status of the soil	31 (51.67)	22 (36.67)	7 (11.67)	14 (23.33)	26 (33.33)	20 (33.23)	8 (13.33)	28 (46.67)	24 (40.00)	53 (29.44)	76 (42.22)	51 (28.33)
5.	Non-availability fertilizers	36 (60.00)	17 (28.33)	7 (11.67)	29 (48.33)	27 (45.00)	4 (6.67)	26 (43.33)	29 (48.33)	5 (8.33)	90 (50.00)	74 (41.11)	16 (8.89)
6.	Price fluctuations	33 (55.00)	22 (36.67)	5 (8.33)	28 (46.67)	27 (45.00)	5 (8.33)	29 (48.33)	26 (43.33)	5 (8.33)	90 (50.00)	75 (41.67)	15 (8.33)
7.	Yield uncertainty	35 (58.33)	19 (31.67)	6 (10.00)	38 (63.33)	15 (25.00)	7 (11.67)	37 (61.67)	17 (28.23)	6 (10.00)	110 (61.11)	51 (28.33)	19 (10.56)
8.	Rain uncertainty	32 (53.33)	23 (38.33)	5 (8.33)	36 (60.00)	18 (30.00)	6 (10.00)	32 (53.33)	21 (35.00)	7 (11.67)	100 (55.56)	62 (34.44)	18 (10.00)
9.	Credit inadequacy	11 (18.33)	31 (51.67)	18 (30.00)	8 (13.33)	30 (50.00)	22 (36.67)	4 (6.67)	27 (45.00)	29 (48.33)	23 (12.78)	88 (48.89)	69 (38.33)
10.	Non-availability of cotton market nearby his place	17 (28.33)	26 (43.33)	17 (28.33)	9 (15.00)	27 (45.00)	24 (40.00)	7 (11.67)	25 (41.67)	28 (46.67)	33 (18.33)	78 (43.33)	69 (38.33)

Note: Figures in the parentheses indicate percentage to total

medium and large farmers, respectively. Because of the lesser population of livestock in the study area it has become difficult to get and non-availability of labour during peak season was reported as a highly acute constraint under all kind of farm size holders.

The low fertility status of the soil was highly acute problem for relatively more number of small farmers, where it was considered as acute problem in medium and large farmers. As expected a non availability of fertilizers was highly acute constraint for small (58.33 per cent) and medium farmers (48.33 per cent) where as it was regarded as acute problem in large farmers (48.33 per cent). Farmers have also faced problem in purchasing fertilizers due to high cost and less stock availability during peak seasons.

Because of the less economic background credit inadequacy is the acute constraint for small (51.67 per cent) and medium farmers (50.00 per cent) and not acute constraint for large farmers (48.33 per cent). The non-availability of quality pesticides was not the major constraint for all the farmers. Most of the farmer's expressed price fluctuations, yield uncertainty and rain uncertainty as highly acute problems faced by them. Most of the small and medium farmers faced the non availability of Bt cotton market at nearby place, this added to the high transportation cost incurred by these.

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