Bt Cotton seed production: Inter-company economic analysis in Karnataka

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ABSTRACT

The present study was an attempt to estimate the profitability of Bt cotton seed production by farmers of Karnataka under contract farming. The total cost of Bt cotton seed production varied from one company contract farmers to other. The per acre total cost of seed production was higher (₹ 96829) in case of contract farmers with JK Seeds Company followed by Monsanto seeds company farmers (₹ 95797). The net returns received from Bt cotton seed production were higher in case of Monsanto seeds company contract farmers (₹ 46387/acre) followed by Kaveri Seeds company (₹ 33076/acre). While returns to per rupee of investment was highest (1.48) in the case of Monsanto Seed Company followed by JK Seeds Company (1.36). The Garret ranking test indicated that major constraint in seed production was non-availability of trained labour with a mean score of 72.24 followed by high wage rate (67.76). As contractual problems were concerned, poor technical assistance was the major constraint with a mean score of 69.44 closely followed by low contract price (67.34).

Keywords: *Bt* cotton, seed production, cost and returns, garrett ranking technique, seed company, contract

The Monsanto Company developed *Bt* cotton (*Bacillus thuringiensis*) and it is now one of the most widely grown transgenic crops. There have been major advances in biotechnology in the recent years, and this has made it possible to directly identify genes, isolate them, know their functions and transfer them from one organism to another. These developments have spanned the entire biological sciences and now many applications have emerged, including emergence of transgenic crops, aimed at increasing agricultural productivity, improving resistance to diseases and pests, and improving the quality of the output. Since the introduction of transgenic crops in 1996, there has been

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a substantial increase in their area. The main transgenic crops include cotton, soybean, maize and canola. Cotton (*Gossypium sps*) the "white gold" and "king of fibers", is cultivated in tropical and subtropical regions of more than seventy countries across the world and enjoys a predominant position amongst all cash crops in India. India is the second largest cotton producer and consumer. The Monsanto seeds company has admitted that the pink bollworm is resistant to first generation transgenic *Bt* cotton that expresses the single *Bt* gene (Cry1Ac). (Chowdhary *et al*.).

Cotton is the major commercial crop amongst all cash crops in India and provides livelihood to more than 60 million people in its cultivation, processing and textile industry. India embarked upon commercial deployment of genetically modified crops in form of *Bt* (*Bacillus thuringenesis*) cotton in 2002 to address the various pests causing significant yield losses and reduced pesticide consumption and also increase productivity, 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. Indiscriminate use of pesticides has adversely affected pest control and profit to the farmers. Under these circumstances, Bt. Cotton has emerged as an attractive option for the cotton growing farmers (Singh and Kaushik, 2007).

Cultivation of hybrid *Bt* cotton seeds, which began in 2002-03, has seen the average income of farmers increasing by almost 575 per cent with average net returns at ₹ 64,113.96 per hectare and per hectare value of production has gone up by 79.45 per cent across Andhra Pradesh, even as pesticide consumption has declined to 0.15 kg per hectare in post-Bt cotton period of 2002-09 from 0.42 kg per hectare in pre-*Bt* cotton period of 1996-2000. (ISAAA). The area under *Bt* cotton hybrids has gradually increased from 38,038 ha in 2002-2003 to 0.5 million ha by 2004-2005 and showed a steep increase to 1.30 million ha in 2005-2006 followed by a phenomenal enhancement to 3.721 million ha in 2006-2007 and 6.200 million ha in 2007-2008 (Khadi *et al.* 2008).

India has overtaken all the countries in 2006 and became most *Bt* cotton producing country in the world. Thus, within a span of eight years, nearly 87 per cent of the cotton area in India was covered under *Bt* hybrid umbrella. It is envisaged that with the availability of more *Bt* hybrids coupled with a 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. It is projected that the multiple gene *Bt* cotton hybrids will occupy approximately 90 per cent of total *Bt* cotton area in 2010. (Bhagirath and Kadambini 2010). Companies which sell genetically-modified cotton seeds anticipate a shortage of over 10 per cent for the 2011 *kharif* season which may result in area under cotton declining by one million hectares from the present 11 million hectare. (Chowdhary *et al.*).

Methodology

The predominant *Bt* cotton seed producing districts from North- Eastern Karnataka region has been chosen for the present study. Both secondary and primary data were used. The relevant secondary data were collected from Mahyco, Bayer, Kaveri, Seed work and JK seed companies. The primary data were collected from the sample seed growers by adopting multi-stage sampling design. 200 seed producers practicing *Bt* cotton seed production were randomly selected at the rate of 40 seed growers from each seed company spread over the chosen districts.

Analytical tools applied

The data elicited through opinion survey from farmers was analysed and presented using frequencies, percentages, tabular presentation technique and other measures of central tendency.

Table 1: Input use pattern of *Bt* cotton seed production (Per acre)

Sl. No.	Particulars	Units	Seed Work Int. Pvt. Ltd.(n=40)	Bayer (n=40)	Monsanto (n=40)	Kaveri (n=40)	JK seeds (n=40)
1	Seeds	gm.	855	820	870	840	915
2				Labour			
A	Human labour	Man days	301.91	300.96	349.98	308.58	309.16
B	Bullock labour	Pair days	0.86	1.43	1.50	1.23	0.50
C	Tractor labour	Hours	4.03	4.26	4.30	4.10	4.00
3	FYM and compost	Tonnes	2.40	2.40	2.50	2.30	2.20
4	Fertilizers						
A	Nitrogen	Kg	77.91	63.37	66.50	58.73	70.45
B	Phosphorus	Kg	68.21	60.83	65.57	58.80	67.65
C	Potassium	Kg	74.81	86.23	87.53	85.40	69.25
5	PPC	L	4.20	3.75	3.90	3.71	3.94

Table 2: Cost of cultivation of Bt cotton seed production under different companies (₹ /Acre)

Particulars	Seed Work Int. Pvt. Ltd.	Bayer seeds	Monsanto Seeds	Kaveri seeds	JK seeds
		I Material Cost			
Seeds	1933 (2.04)	1760 (1.86)	0 (0)	1866 (2.00)	1900 (1.96)
FYM & Compost	2983 (3.16)	2626 (2.70)	2533 (2.64)	2733 (2.93)	2666 (2.75)
		Chemical fertilizers			
Nitrogen	1601 (1.9)	1519 (1.50)	1408 (1.60)	1338 (1.67)	1570(1.54)
Phosphorous	2703 (3.16)	2846 (2.91)	2777 (3.05)	2612 (2.73)	2876(2.89)
Potassium	2354 (3.4)	2630 (2.60)	2540 (2.57)	2648 (2.78))	2300(2.39)
Plant Protection Chemicals	4716 (4.99)	4549 (4.82)	4604 (4.80)	5130 (5.51)	4751 (4.90)
Pollination materials	1800 (1.90)	2000 (2.11)	2000 (2.08)	2100 (2.25)	1900 (1.96)
Ginning charges	2024 (2.14)	1988 (2.10)	2354 (2.45)	1902 (2.04)	2218 (2.29)
Marketing cost	900 (0.95)	900 (0.95)	900 (0.93)	900 (0.96)	900 (0.92)
		II Labour charges			
Human labour	49383 (52.34)	47889 (50.75)	50017 (52.21)	46787 (50.31)	51213 (52.88)
Bullock labour	783 (0.83)	750 (0.79)	816 (0.85)	776 (0.83)	750 (0.77)
Machine hour	2016 (2.13)	2033 (2.15)	2166 (2.26)	2050 (2.20)	2000 (2.06)
Coordinator charges	14000 (14.84)	15500 (16.42)	16000 (16.70)	15000 (16.13)	14500 (14.97)
Processing charges	18 (0.01)	17.5 (0.01)	17.5 (0.01)	20 (0.02)	19 (0.01)
Irrigation charges	2000 (2.12)	2200 (2.33)	2500 (2.60)	2000 (2.15)	2100 (2.16)
Interest on working capital	900 (0.95)	895 (0.94)	895 (0.93)	900 (0.96)	895 (0.92)
A. Total variable cost	89238 (94.59)	89224 (94.55)	90647 (94.62)	87884 (94.52)	91679 (94.68)
Depreciation	750 (0.79)	735 (0.77)	750 (0.78)	745 (0.80)	750 (0.77)
Land revenue	50 (0.05)	50 (0.05)	50 (0.05)	50 (0.05)	50 (0.05)

Rental value of land	1900 (2.01)	1900 (2.01)	1900 (1.98)	1900 (2.04)	1900 (1.96)
Interest on fixed assets	1500 (1.59)	1550 (1.64)	1550 (1.61)	1500 (1.61)	1550 (1.60)
B. Total Fixed costs	4200 (4.40)	4235 (4.48)	4250 (4.43)	4195 (4.51)	4250 (4.38)
C. Total cost	94338 (100)	94359 (100)	95797 (100)	92979 (100)	96829 (100)

Note: Figures in the parentheses indicate percentage to the total cost

Table 3: Returns from *Bt* cotton seed production under different companies (₹/acre)

Sl. No.	Particulars	Units	Seed Work Int. Pvt. Ltd.	Bayer Seeds	Monsanto Seeds	Kaveri Seeds	JK seeds
1	Main product (lint seed)	₹	101161	107220	119733	107733	101960
2	By product (lint)	₹	17158	18013	22451	18322	18904
3	Gross returns	₹	118319	125233	142185	126055	120864
4	Net returns	₹	23981	30874	46387	33076	24034
5	Cost of production	₹/kg	358.50	351.50	295.50	336.00	349.50
6	Returns to rupee investment	₹	1.25	1.33	1.48	1.36	1.25

Table 4: Constraints faced by farmers in *Bt* cotton seed production

Sl. No.	Constraints	Garret score	Rank
I	Production constraints		
1	Non availability of trained labour	72.24	I
2	Prevalence of high wage rate	67.76	II
3	Isolation trouble	54.00	III
4	In adequacy of irrigation water	39.04	V
5	Technical difficulties on operations such as roughing and pollination	44.02	IV
6	Intermittent rains hampering cultural and picking operations	23.00	VI
II	Contractual problems		
1	Poor technical assistance	69.44	I
2	Irregular payment	57.14	III
3	Manipulation of norms by firm	23.00	VI
4	Higher rejection rate	46.00	IV
5	Low contract price	67.34	II
6	Breach of contract	37.00	V
III	Plant protection constraints		
1	High incidence of diseases	66.21	I
2	High incidence of sucking insects in Bt cotton seed production	52.79	II
3	Lack of availability of genuine plant protection chemicals	31.00	III
IV	Marketing constraints		
2	High price of parents of Bt cotton seeds	63.80	II
3	Low price of the seeds offered by the agencies	71.00	I

Garrett's ranking technique

To know the acceptance of farmers and constraints in the cultivation of *Bt* cotton Garrett's ranking technique was used. It gives the change of orders of restrictions and advantages into numerical scores. The major benefit of this method as compared to simple frequency distribution is that the constraints and advantages are arranged based on their importance from respondents. Hence, the same number of respondents on two or more constraints may have been given different rank (Kumar *et al.*).

Garrett's formula for converting ranks into per cent was given by

$$\text{Per cent position} = 100*(R_{ij}-0.5)/N_j \quad (1)$$

Where R_{ij} = rank given for i^{th} factor by j^{th} individual

N_j = number of factors ranked by j^{th} individual

The per cent position of each rank was then converted into scores referring to the table given by Garret and Woodswordh (1969). For each factors, the scores of individual respondents were added together and divided the total number of the respondents for whom scores were added. These mean scores for all the factors were arranged in descending order, ranks were given and most important factors were identified

Results and Discussion

Input use pattern in Bt cotton seed production

The extent of input use by *Bt* cotton seed producing farmers under contract with various companies are presented in Table 1. As seed production being labour intensive activity, the labour usage was higher across all business contract farmers. The human labour usage was found to be the highest on those farms, who have contracted with Monsanto seeds company (349.98 man days/acre) followed by JK seeds company (309.16 man-days/acre) and Kaveri Seeds company (308.58 man-days/acre). The per acre use of seed was found to be more (915 grams) in the case of farmers who have contracted with JK Seeds Company. Across all company contract farmers the extent of usage of Bullock labours and machine hours were marginally less. Regarding fertilizer application, the farmers contracted with Seed Work International Private Limited Company used the highest (220.93 kg/acre) quantity of fertilizer and Kaveri Seeds company contract farmers used the least (202.93 kg/acre) supply of fertilizer.

Across all business contract farmers, the use of FYM quantity was also found to be very less. Among the different business contract farmers, the farmers who have contracted with Monsanto Seeds Company used relatively more (2.50 tonnes/acre) quantity of FYM. Results also showed that there was a high amount of application of chemical fertilizers in anticipation of good yield, coupled with non-availability of FYM, farmers in the study area used less quantity of farmyard manures balanced the nutrient requirement through chemical fertilizer application.

On plant protection chemicals, most commonly used insecticides/ pesticides by the sample seed growers were monocrotophos, confider, *Bt* Biozem, fame and regenta. The average quantity of these plant protection chemicals used in the form of liquids was found to be more (4.20 litres/acre) in the case of Seed Work International Private Limited Company contract farmers compared to all company contract farmers. Results of the present study are in conformity with the study conducted by Puran Mal *et al.* (2010) indicated that the *Bt* cotton farmers used less of PPC by nearly 26 per cent when compared to non-*Bt* cotton growers.

Cost structure in Bt cotton seed production

The costs structures in *Bt* cotton seed production by farmers who have contracted with various companies are presented in Table 2. Among the variable costs, expenditure on human labour was found to be higher across all business contract farmers. The per acre cost of human labour was found to be the highest (₹ 51213) and formed 52.88 per cent of the total cost in the case of farmers who have contracted with JK Seeds Company compared to other company contract farmers namely Monsanto seeds company (₹ 50017), Seed Work International Private Limited Company (₹ 49383), Bayer seeds company (₹ 47889) and Kaveri Seeds company (₹ 46787) contract farmers, because most of the operations like hand emasculation and hand pollination,

picking, spraying and weeding are more human labour intensive services. Harrowing and inter-cultivation accounted for the usage of machine work. The *Bt* cotton seed production involves technically trained labour, whose wage rate is higher as compared to other work. Thus, the cost of this item was found to be higher. Next major items of cost across all company contract farmers were the coordinator charges followed by expenditure on plant protection chemicals.

The analysis on investment made on PPC, the farmers who have contracted with Kaveri Seeds Company (₹5130) found to be spending higher (5.51%) amount compared to other company contract growers. An expenditure made on chemical fertilizers, FYM and compost and ginning charges were the other items of expenditure. The payment on machine hour, irrigation charges and seeds cost were relatively lesser in magnitude across all company contract farmers. Among fixed price, the rental value of land [₹ 1900] accounted for the major chunk of the cost of all business contract farmers and other fixed cost items included depreciation, land revenue and interest on fixed capital. Out of total cost of cultivation, the variable cost was found to be higher [>94%] than the fixed cost across all company contract farmers.

Among the various company contract farmers, the total cost of cultivation was found to be higher in the case of farmers who have contracted with JK seeds company (₹96829) followed by the Monsanto seeds company (₹95797), Bayer seeds company (₹94359), Seed Work International Private Limited Company (₹94338) and Kaveri Seeds company (₹92979) contract farmers. This may be attributed to the fact that farmers who have contracted with JK Seeds Company used more of human labour and applied more fertilizers than their counterparts. The study conducted by Mahendra and Chandrasekhara (2007) indicated that the small farmers who have taken up *Bt* cotton seed production obtained 23 per cent lower yield compared to the large farmers with a 20 per cent lesser total cost of production and 3 per cent higher cost per quintal. The small farmers spend lower amounts on almost all items of production.

Returns Structure in Bt Cotton Seed Production

The details on returns in *Bt* cottonseed production are presented in Table 3. The results on returns from *Bt* cotton seed production indicated that seed production is highly profitable. The gross returns were found to be much higher than the cost structure. Among the various company contract farmers, the gross returns found to be higher (₹142185/acre) by farmers who have contracted with Monsanto seeds company as compared to Kaveri seeds company, Bayer seeds company, JK seeds company and Seed work International Private Limited Company contract farmers with respective figures of ₹126055/acre, ₹125233/acre, ₹120864/acre and ₹118319/acre. Net returns received by farmers were also found to be higher in the case of Monsanto seeds company contract farmers (₹ 46387/acre) followed by Kaveri Seeds company (₹33076/acre), Bayer seeds company (₹30874/acre), JK seeds company (₹24034/acre), and Seed works International Private Limited Company (₹23981/acre) contract farmers. Similarly, returns per rupee of investment were found to be more in the case of Monsanto seeds company contract farmers (1.48) followed by farmers who have contracted with the Kaveri Seeds company (1.36).

It could also be seen that across the various company contract farmers, due to less quantity of farmyard manure usage the yield obtained were less than the potential yield. Thus with increased usage of FYM, the still higher level of returns and higher returns per rupee of expenditure would be obtained.

Problems faced by the Bt cotton seed growers

The details of ranks for various constraints faced by the respondents in *Bt* cotton seed production and their mean (Garrett) scores are given in Table 4. The opinion of the seed growers on the problems in growing *Bt* cotton seed was gathered right from the procurement of inputs in seed production till the crop harvested. It was observed that on production constraints, the non-availability of trained labour with a mean score of 72.24 found to be major obstacle followed by high wage rate with a mean score of 67.76. Other rank restrictions and mean scores were isolation trouble (54.00), inadequacy of irrigation water (44.02), technical difficulties on operations such as roughing and pollination (39.04) and intermittent rains hampering cultural and picking operations (23.00), respectively,

Many seed growers had to pay advance wages to the labourers especially during critical stages of operations like crossing and picking and skilled labours are required for pollination operations. One of the important problems of the seed industry is isolation distance. Only a few seed growers faced the problem of isolation distance to overcome the seed isolation problem, producers in the area might have arrived at a decision on a co-operative basis. Chulaki (2001) found that the problems faced by grain producers in production and marketing of hybrid cotton seeds in Northern Karnataka were non-availability of skilled labour and non-availability of financial assistance. As far as contractual problems were concerned, the major constraint was poor technical assistance with a mean score of 69.44 followed by low contract price with a mean score of 67.34. Other ranked limitations and mean scores were irregular payment (57.14), manipulation of norms by firm (46.00), breach of contract (37.00) and higher rejection rate (23.00), respectively. Thus, companies have to provide proper and good technical assistance to the farmers with higher contract price would benefit the farmers.

On plant protection constraints, the major limitation was a high incidence of diseases with a mean score of 66.21 followed by high incidence of sucking pest in *Bt* Cotton (52.79) and lack of availability of genuine plant protection chemicals (31.00). In this direction, an integrated disease and pest management campaign may be conducted by the companies in collaboration with the State Agricultural Universities to control the pests and diseases effectively. As far as marketing constraints were concerned, major constraint was low price of the seeds offered by agencies with a mean score of 71.00. High prices of parents of *Bt* cotton seeds was the next most significant constraint with a mean score of 63.80. Hence, companies need to relook into price of *Bt* seeds to benefit the farmers practicing *Bt* cotton seed production. Similar problems were expressed by JK seeds, Bayer seeds, Kaveri Seeds and Monsanto seeds company contract growers. The results of the study are in line with the findings of Nagaraj *et al*. (1999).

Conclusion and Policy Implications

1. Among the various company contract farmers, the cost of cultivation was higher in the case of JK seeds company (Rs.96829 per acre) compared to other company contract growers.
2. Across all company contract farmers, the net returns from *Bt* cotton seed production were higher in case of Monsanto seeds company contract farmers (Rs.46387/acre) followed by Kaveri seeds company contract farmers (Rs.33076/acre).
3. The returns to rupee investment was found to be more in case of Monsanto seeds company contract farmers i.e. 1.48 followed by 1.36 in case of Kaveri seeds company contract farmers.
4. Majority of the *Bt* cotton seed growers expressed that non-availability of trained labour and prevalence of higher wage rate were the acute constraints in seed production.
5. Pertaining to contractual problems, poor technical assistance and low contract price were the major constraints, while with respect to plant protection constraints; high incidence of disease was a major problem.

Based on the findings of the study, the following policy implications are worth considering while framing policies.

1. *Bt* cotton seeds must be made available through institutional arrangement to farmers at reasonable price to increase the use of these seeds which leads to increase in the farm income.
2. Predetermined quality specification may be given to the farmers in the beginning of the season to minimize higher rejection rate of seeds by the firms. This would enable the farmers to produce better seeds with guidance from agricultural scientists.

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