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Economic Analysis of Bt Cotton Production in the Western Undulating Zone of Odisha, India

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A B S T R A C T

The present study was undertaken in the Kalahandi district of Odisha, where Bt cotton is a prominent commercial crop. The objective was to analyse the cost and return structure of Bt cotton cultivation. Primary data were collected from 90 farmers across two blocks—Bhawanipatna and Kesinga—during the 2018–19 cropping season. Farmers were selected from six villages representing different farm sizes, with 45 farmers surveyed per block. A structured schedule was used to conduct farmer interviews and identify production-related problems through the survey method. The study revealed that, on average, resource use per hectare included 144.10 man-days of human labour, 7.91 pair-days of bullock labour, 22.24 quintals of manure, Rs. 867.22 on irrigation, and Rs. 6,689.87 on plant protection. The overall Cost C per hectare was Rs. 1,00,606.76, while Cost A and Cost B were Rs. 80,746.48 and Rs. 83,270.76, respectively. The benefit-cost ratio stood at 1.36, indicating higher profitability compared to other crops cultivated in the region. Bt cotton technology has positively influenced the socio-economic conditions of farmers by enhancing crop yields and lowering input costs. This has led to higher farm incomes, ultimately contributing to an improved standard of living for the cultivators.

Introduction

Cotton is one of India's key commercial crops, contributing over 30% of the nation's foreign exchange earnings (Qaim, *et al*., 2006). Although India covers about 21% of the global cotton cultivation area, its productivity remains low—around 293 kg lint/ha compared to the global average of 600 kg/ha (Sen, 2003; Channakeshava and Patil, 2006). To address agrarian and ecological challenges, India introduced genetically modified Bt (*Bacillus thuringiensis*) cotton in 2002. This variety resists the American bollworm (*Helicoverpa armigera*), a major pest, with the aim of reducing pesticide use, minimizing yield losses, and improving farm income and health (Gaddi, *et al*., 2002). Despite debates over its benefits and drawbacks, Bt cotton hybrids were first adopted in 2002 by 54,000 farmers covering about 50,000 hectares. By 2003, the area doubled to 100,000 hectares

(Narayanamoorthy and Kalamkar, 2006; Chandrasekhara Rao and Mahendra Dev, 2009). Adoption accelerated in the following years. In 2004, the area quadrupled to 0.5 million hectares, and in 2005 it rose to 1.3 million hectares—a 160% increase over 2004. The growth trend continued in 2006, with the area tripling to 3.8 million hectares, surpassing China's Bt cotton coverage of 3.5 million hectares for the first time. In 2007, India saw a record 63% increase, expanding to 6.2 million hectares, the largest Bt cotton area globally. The upward trajectory persisted in 2008 (7.6 million hectares) and 2009 (8.4 million hectares) (Dodamani, *et al.,* 2010).

Between 2005 and 2009, India recorded the highest annual growth rates among biotech cotton-producing nations—160% in 2005, 192% in 2006, 63% in 2007, 23% in 2008, and 11% in 2009. Within eight years, Bt hybrids covered nearly 87% of India's cotton area. The availability of more hybrids and reductions in seed costs from 2006 further encouraged expansion. Among states, Maharashtra leads with 3.4 million hectares under Bt cotton, followed by Gujarat (1.68 m ha) and Andhra Pradesh (1.05 m ha). Bt cotton is now grown across all three cotton-producing zones in India (Verma , 20002; Ramasundaram, *et al.,* 2005). The surge in Bt cotton cultivation was driven largely by severe pest pressures in recent years, which had increased production costs, reduced yields, and caused significant economic hardship. Biotechnology offered a solution by introducing pest resistance directly into the crop. Seen as a "ray of hope," Bt cotton was commercially released in 2002 to combat these issues (Kunnal, *et al.,* 2004). Nevertheless, concerns were raised by farmers' groups, environmentalists, NGOs, and other stakeholders regarding potential ecological and socio-economic risks (Abdul Qayuum & Kiran Sakkhari, 2003). Studies have shown mixed outcomes, leading to confusion over the true impact of Bt technology (Khadi, 2006; Hugar, *et al.,* 2009). The present study aims to assess Bt cotton's effect on output across farms of different sizes, providing a clearer picture of its role in enhancing productivity and addressing the long-standing challenges in India's cotton sector.

Materials and Methods

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 2018- 19 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.

The study uses a multistage sampling design to select districts, blocks, villages, and bt cotton growers in Kalahandi district of Odisha. The first stage involves purposively selecting Kalahandi district, randomising two blocks, and obtaining a complete list of villages, and ninety farmers were selected also randomly from six villages, 15 each. Production costs and returns are estimated using the CACP standard cost concept.

Cost concept

The cost concepts generally used in farm management studies viz. cost A_1, cost A_2, cost B_1, cost B_2, cost C were considered in the present study.

Cost A_1 = Cost of hired human labour and attached labour

+ Cost of hired and owned bullock labour
+ Cost of hired and owned machine charges
+ Cost of pesticides, seeds, manures & fertilizers
+ Depreciation, repair and maintenance of

implements and farm building
+ Irrigation charges
+ Land revenue, cesses and other taxes
+ Interest on working capital
+ Transportation charges

Cost A_2 = Cost A_1 + rent paid for leased in land

Cost B_1 = Cost A_1 + interest on value of owned capital assets excluding land

Cost B_2 = Cost B_1 + rental value of owned land and rent paid for leased Land

Cost C_1 = Cost B_1 + imputed value of family labour

Cost C_2 = Cost B_2 + imputed value of family labour

Cost C_3= Cost C_2 + value of management input at 10 Percent of Total cost (C_2)

Farm business measures

- ✓ Net income (NI) = Gross Income – Cost C_2
- ✓ Family labour income (FLI) = Gross Income – Cost B_2
- ✓ Farm Business Income (FBI) = Gross Income – Cost A_1
- ✓ Owned Farm Business Income = Gross Income – Cost A_2
- ✓ Farm Investment Income (FII) = Net income + Imputed value of owned land+ interest on value of owned capital assets excluding land

or

Farm Business Income – Imputed value of family labour

Results and Discussion

Size of holding

The details about average operational size of the land holdings and area under Bt-cotton are presented in Table 1.

The overall operational sizes of holding under Bt-cotton of small, medium and large farmers are found to be 0.66, 1.61, and 2.68 respectively in study area.

Resource use level of Bt cotton

The information on per hectare utilization of different inputs for Klahanie district of India state of Odisha is presented in Table 2

Human labour

In Bhawanipatna block, total human labour use was 145.36 man-days per hectare, with 64.57 male and 80.79 female labour days. Similarly, Bt-cotton in Kesinga block used 142.83 man-days per hectare, comprising 60.82 male and 82.01 female labour days. Overall, Kalahandi district recorded 144.10 man-days per hectare with 62.70 male and 81.40 female labour days.

Thus, female labour use exceeded male labour in both regions, and labour efficiency was observed to be higher in Kesinga block of Kalahandi district.

Bullock power

Overall, bullock power use was 7.91 pair days per hectare, with 8.05 pair days each in Bhawanipatna and Kesinga blocks. Utilization was higher in large holdings (11.30 pair days) than medium (6.77) and small (5.65) holdings.

Machine power

At the overall level, the per hectare use of machine power was 3.74 hrs comprising 3.78 hrs in Bhawanipatna block 3.70 hrs inkesinga block. The per hectare bullock power utilization was observed more in case of large size group of holding (4.27 hrs) than medium

(3.56 hrs) and small (3.41 hrs) size group of holdings in study are.

Seeds

At the overall level, 1.81 kg seeds were used. Seeds were used more in large size group (1.98 kg) followed by medium size group (1.84 kg) and small size group (1.60kg). The per hectare use of seeds was observed more in case of large size group of holding (1.98 kg) than medium (1.84 kg) and small (1.60 kg) size group of holdings in study are.

Manures and fertilizers

At the overall level, manure use was 22.24 q/ha, higher in large holdings than small and medium ones. Per hectare use of nitrogenous, phosphorus, and potash fertilizers was 82.49, 40.82, and 41.77 kg, slightly exceeding recommended doses, especially in large holdings.

Irrigation and plant protection charges

Per hectare irrigation charges were higher in large holdings (Rs 896.29) than medium (Rs 865.56) and small (Rs 839.83) groups. Overall plant protection charges were Rs 2307.23, showing increased use with larger holdings, indicating economies of scale.

Cost of cultivation of Bt cotton

The per hectare cost of cultivating Bt cotton was calculated using standard cost concepts. Tables 3, 4, and 5 present detailed information on cost components across various holding sizes in Kalahandi district, Odisha. The overall cost of cultivation per hectare (Cost 'C') was Rs 64,385.15.

Family labour constituted the largest share at Rs 16,726 (25.99%), followed by rental value of land at Rs 14,643.96 (22.74%), and hired human labour (male and female) at Rs 11,867.37 (18.44%). Other costs included bullock labour Rs 4,384.98 (6.81%), manures Rs 3,386.53 (5.26%), seeds Rs 3,310.76 (5.14%), plant protection Rs 2,434.63 (3.78%), interest on fixed capital Rs 1,464.40 (2.27%), nitrogenous fertilizers Rs 1,013.65 (1.57%), irrigation charges Rs 581.63 (0.90%), phosphorus Rs 422.79 (0.66%), potash Rs 367.49 (0.57%), and working capital interest Rs 28,939.67 (44.94%). Of the total cost, Cost 'A' was Rs 31,550.80 (49.00%) and Cost 'B' was Rs 47,659.15 (74.01%).

Across different holding sizes, per hectare Cost 'C' was Rs 53,395.19 for small, Rs 62,124.42 for medium, and Rs 67,727.17 for large holdings. There was considerable variation in input use across farm sizes, leading to differences in overall cultivation cost. Larger farms showed higher costs due to better access to capital and institutional credit, resulting in greater resource use and higher yields compared to small and medium farmers.

Table.1 Distribution of holding in different size groups of sample farms of blocks (Area in Hectares)

Sl. No.	Size of land holding	Small	Medium	Large	Pooled
1	Average of total land holding	0.69	2.05	7.04	3.26
2	Area under Bt-cotton crop	0.66	1.61	3.14	1.80
3	96.58	96.58	78.81	44.57	55.40

Note: Figures in the parentheses indicate the percentage to average of total land holding

Table.2 Resource use level of Bt cotton growers (Per ha)

Sl. No.	Particulars	Size of groups											
		Bhawanipatna				Kesinga				Overall			
		Small	Medium	Large	Pooled	Small	Medium	Large	Pooled	Small	Medium	Large	Pooled
1	Human labour (Days)	139.52	144.45	152.1	145.36	136.2	142.62	149.68	142.83	137.86	143.54	150.89	144.10
	a. Male	60.62	69.11	63.98	64.57	56.02	66.06	60.39	60.82	58.32	67.59	62.19	62.70
	b. Female	78.9	75.34	88.12	80.79	80.18	76.56	89.29	82.01	79.54	75.95	88.71	81.40
2	Bullock labour (pair days)	5.12	6.69	12.34	8.05	6.18	6.84	10.26	7.76	5.65	6.77	11.30	7.91
3	Machine power (hrs.)	3.45	3.58	4.32	3.78	3.36	3.54	4.21	3.70	3.41	3.56	4.27	3.74
4	Seeds (Kg)	1.62	1.92	2.01	1.85	1.58	1.76	1.94	1.76	1.60	1.84	1.98	1.81
5	Manure (q)	20.42	18.06	26.2	21.56	25.12	21.52	22.1	22.91	22.77	19.79	24.15	22.24
6	Fertilizers (Kg)				0.00				0.00	0.00	0.00	0.00	0.00
	i) Nitrogen	80.23	85.6	84.56	83.46	81.41	80.68	82.46	81.52	80.82	83.14	83.51	82.49
	ii) Phosphorus	38.95	40.62	41.9	40.49	39.95	40.62	42.9	41.16	39.45	40.62	42.40	40.82
	iii)Potassium	39.1	41.5	43.92	41.51	40.1	41.6	44.42	42.04	39.60	41.55	44.17	41.77
8	Irrigation Charges (in Rs)	875.15	888.51	912.1	891.92	804.5	842.6	880.48	842.53	839.83	865.56	896.29	867.22
9	Plant protection charges (in Rs)	2257.15	2462.84	2614.34	2444.78	2014.6	2215.63	2278.8	2169.68	2135.88	2339.24	2446.57	2307.23

Table.3 Item wise cost of cultivation of Bt-cotton of Bhawanipatna block

Sr No	Cost items	Small	Medium	Large	Pooled
		Value	Value	Value	Value
1	Hired Human labour				
	a) Male	19121.62	21415.58	19169.2	19902.13
	b) Female	24886.71	23349.42	26406.64	24880.92
2	Bullock labour	4074.17	4927.5	6055.83	5019.17
3	Machine power (hrs.)	2732.07	3550	4191.67	3491.24
4	Manure (q)	2293.03	2545	2633.33	2490.45
5	Seeds (Kg)	2392.47	5044	9464	5633.49
6	Fertilizers (Kg)	0	0	0	0
	i. Nitrogen	1836.6	1906.67	1944	1895.76
	ii. Phosphorus	3830.67	3965	4135	3976.89
	iii. Potassium	1434.07	1645.83	1812.5	1630.8
7	Irrigation Charges (in Rs)	875.15	888.51	912.1	891.92
8	Plant protection (in Rs)	6547.53	6703.33	6813.67	6688.18
9	**Working capital (in Rs)**	**70024.09**	**75940.84**	**83537.94**	**76500.95**
10	Int.on working Capital	1400.48	1518.82	1579.24	1499.513333
12	Depre.on farm impliments	2100.72	2278.23	2369.86	2249.603333
13	Land revenue and	115	115	115	115
	Cost 'A'	**73640.29**	**79852.89**	**87602.04**	**80365.06667**
14	Rental value of land	1400.1	1510.5	700.6	1203.733333
15	Int. on fixed capital @ 10%	1156.2	1645.3	1656.4	1485.966667
	Cost 'B'	**76196.59**	**83008.69**	**89959.04**	**83054.77333**
16	Family labour	0	0	0	0
	a.Male	8960	6400	5760	7040
	b. Female	16640	10560	3200	10133.33333
	Cost 'C'	**101796.59**	**99968.69**	**98919.04**	**100228.1067**
II	**Output (q)**	19.11	17.71	17.32	18.05
	a.Main produce	119139.02	109515.7143	108855	112503.244
	b.Bye-produce	1025.6	1150.8	1250.35	1142.25
	Gross income	**120164.62**	**110666.5143**	**110105.35**	**113645.494**
III	Cost of 'C' net of bye produce	100770.99	98817.89	97668.69	99085.85667
IV	Per quintal cost	5326.88	5644.76	5711.26	5553.83

Table.4 Item wise cost of cultivation of Bt-cotton of Kesinga block

Sr No	Cost items	Small	Medium	Large	Pooled
		Value	Value	Value	Value
1	Hired Human labour				
	a) Male	18752.85	21569.16	19454.88	19925.63
	b) Female	26840.48	24997.50	28765.12	26867.70
2	Bullock labour	5380.00	6338.33	7873.33	6530.55
3	Machine power (hrs.)	2575.83	3186.67	3956.67	3239.72
4	Manure (q)	2285.00	2544.20	2635.00	2488.07
5	Seeds (Kg)	3808.71	3197.78	3088.49	3364.99
6	Fertilizers (Kg)	0.00	0.00	0.00	0.00
	i. Nitrogen	1692.00	1850.67	1930.67	1824.45
	ii. Phosphorus	3240.00	3335.00	3565.00	3380.00
	iii. Potassium	1736.67	1985.00	2130.00	1950.56
7	Irrigation Charges (in Rs)	875.15	888.51	912.10	891.92
8	Plant protection (in Rs)	6556.00	6700.67	6818.00	6691.56
9	**Working capital (in Rs)**	**73742.69**	**76593.49**	**81129.26**	**77155.15**
10	Int.on working Capital	1474.85	1531.87	1622.59	1543.10
12	Depre.on farm impliments	2212.28	2297.80	2433.88	2314.65
13	Land revenue and	115.00	115.00	115.00	115.00
	Cost 'A'	**77544.82**	**80538.16**	**85300.72**	**81127.90**
14	Rental value of land	1200.30	1301.80	801.84	1101.31
15	Int. on fixed capital @ 10%	1052.30	1254.60	1465.70	1257.53
	Cost 'B'	**79797.42**	**83094.56**	**87568.26**	**83486.75**
16	Family labour	0.00	0.00	0.00	0.00
	a.Male	9010.20	6540.20	5834.50	7128.30
	b. Female	16752.50	11008.60	3350.00	10370.37
	Cost 'C'	**105560.12**	**100643.36**	**96752.76**	**100985.42**
II	**Output (q)**	19.64	18.97	18.16	
	a.Main produce	129661.92	126711.42	114684.33	123685.89
	b.Bye-produce	1050.20	1080.40	1020.60	1050.40
	Gross income	**130712.12**	**127791.82**	**115704.93**	**124736.29**
III	Cost 'C' net of bye produces	104509.92	99562.96	95732.16	99935.02
IV	Per quintal cost	5374.75	5305.40	5327.80	5335.98

Table.5 Item wise Overall (Pooled) cost of cultivation of Bt-cotton in Study Area

Sr No		Small	Medium	Large	Pooled
	Cost items	**Value**	**Value**	**Value**	**Value**
1	Hired Human labour				
	a) Male	18937.235	21492.37	19312.04	19913.88
	b) Female	25863.595	24173.46	27585.88	25874.31
2	Bullock labour	4727.085	5632.915	6964.58	5774.86
3	Machine power (hrs.)	2653.95	3368.335	4074.17	3365.48
4	Manure (q)	2289.015	2544.6	2634.165	2489.26
5	Seeds (Kg)	3100.59	4120.89	6276.245	4499.24
6	Fertilizers (Kg)				
	i. Nitrogen	1764.3	1878.67	1937.335	1860.105
	ii. Phosphorus	3535.335	3650	3850	3678.445
	iii. Potassium	1585.37	1815.415	1971.25	1790.68
7	Irrigation Charges (in Rs)	875.15	888.51	912.1	891.92
8	Plant protection (in Rs)	6551.765	6702	6815.835	6689.87
9	**Working capital (in Rs)**	**71883.39**	**76267.165**	**82333.6**	**76828.05**
10	Int.on working Capital	1437.665	1525.345	1600.915	1521.3067
12	Depre.on farm impliments	2156.5	2288.015	2401.87	2282.1267
13	Land revenue and	115	115	115	115
	Cost 'A'	**75592.555**	**80195.525**	**86451.38**	**80746.483**
14	Rental value of land	1300.2	1406.15	751.22	1152.5217
15	Int. on fixed capital @ 10%	1104.25	1449.95	1561.05	1371.7483
	Cost 'B'	**77997.005**	**83051.625**	**88763.65**	**83270.762**
16	Family labour	0	0	0	0
	a.Male	8985.1	6470.1	5797.25	7084.15
	b. Female	16696.25	10784.3	3275	10251.852
	Cost 'C'	**103678.355**	**100306.025**	**97835.9**	**100606.76**
II	**Output (q)**	**19.375**	**18.34**	**17.74**	
	a.Main produce	124400.47	118113.567	111769.665	118094.57
	b.Bye-produce	1037.9	1115.6	1135.475	1096.325
	Gross income	**125438.37**	**119229.167**	**112905.14**	**119190.89**
III	Cost of 'C' net of bye produce	102640.455	99190.425	96700.425	99510.438
IV	Per quintal cost	5350.815	5475.08	5519.53	5444.905

Table.6 Cost, returns, gross income and B: C ratio of Bt cotton

		Size of Group											
Sl. No	**Particulars**	**Bhawanipatna**				**Kesinga**				**Overall**			
		Small	**Medium**	**Large**	**Pooled**	**Small**	**Medium**	**Large**	**Pooled**	**Small**	**Medium**	**Large**	**Pooled**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**8**	**10**	**11**	**12**	**13**	**14**
1	**Total cost (Rs)**												
	Cost 'A'	73640.29	79852.89	87602.04	80365.07	77544.82	80538.16	85300.72	81127.90	75592.56	80195.53	86451.38	80746.48
	Cost 'B'	76196.59	83008.69	89959.04	83054.77	79797.42	83094.56	87568.26	83486.75	77997.01	83051.63	88763.65	83270.76
	Cost 'C'	101796.59	99968.69	98919.04	100228.11	105560.12	100643.36	96752.76	100985.42	103678.36	100306.03	97835.90	100606.76
2	**Profit (Rs)**												
	Cost 'A'	46524.33	30813.62	22503.31	33280.42	53167.30	47253.66	30404.21	43608.39	49845.82	39033.64	26453.76	38444.41
	Cost 'B'	43968.03	27657.82	20146.31	30590.72	50914.70	44697.26	28136.67	41249.54	47441.36	36177.54	24141.49	35920.13
	Cost 'C'	18368.03	10697.82	11186.31	13417.38	25152.00	27148.46	18952.17	23750.87	21760.02	18923.14	15069.24	18584.13
3	**Production (q)**	19.11	17.71	17.32	18.05	19.64	18.97	18.16	18.92	19.38	18.34	17.74	18.49
4	**Gross income (Rs)**	120164.62	110666.51	110105.35	113645.49	130712.12	127791.82	115704.93	124736.29	125438.37	119229.17	112905.14	119190.89
5	B:C ratio												
	i) Cost 'A'	1.63	1.39	1.26	1.41	1.69	1.59	1.36	1.54	1.66	1.49	1.31	1.48
	ii) Cost 'B'	1.58	1.33	1.22	1.37	1.64	1.54	1.32	1.49	1.61	1.44	1.27	1.43
	iii) Cost 'C'	1.18	1.11	1.11	1.13	1.24	1.27	1.20	1.24	1.21	1.19	1.15	1.18

Cost, returns, gross income and B:C ratio of Bt cotton

Table.5 presents per hectare cost, returns, gross income, and B:C ratio. Gross income per hectare was Rs 66,535.75 for small, Rs 90,276.33 for medium, and Rs 91,740.09 for large holdings. The average yield was 20.52 quintals per hectare, generating Rs 88,144.91.

Yields by group were 15.90 quintals (small), 20.27 quintals (medium), and 21.60 quintals (large), indicating increased Bt cotton output with larger holdings. Medium farms had the highest profit at Cost 'C' (Rs 28,151.91), followed by large (Rs 24,012.92) and small (Rs 13,140.56) farms. The benefit-cost ratio at Cost 'C' was highest for medium farms (1.45), followed by large (1.35) and small (1.25) farms.

The overall benefit-cost ratio was 1.37. Since the benefit-cost ratio exceeded unity across all cost and holding groups, Bt cotton cultivation is considered an economically viable option in the study area.

The present study study estimates the cost and return analysis of Bt cotton in Odisha's Kalahandi district. Findings reveal that per hectare resource use included 144.10 man-days of human labour, 7.91 pair days of bullock labour, 22.24 quintals of manure, Rs. 867.22 for irrigation, and Rs. 6,689.87 for plant protection. The average Cost C per hectare was Rs. 1,00,606.76, with Cost A and Cost B recorded at Rs. 80,746.48 and Rs. 83,270.76, respectively. The overall benefit-cost ratio stood at 1.36, making Bt cotton more profitable than other local crops. However, farmers still struggle with challenges like poor seed quality, pest problems, and limited knowledge of modern practices. The study highlights the importance of strengthening agricultural extension services to overcome these issues and improve the outcomes of Bt cotton cultivation in the region.

References

Chandrasekhara Rao, N. and Mahendra Dev., S. (2009). Socioeconomic Impact of Transgenic Cotton. Agric. Econ. Res. Rev., 22 : 461-470.

Channakeshava, R. and Patil, B.V. (2006). Performance and economics of Bt cotton hybrid compared to conventional cotton hybrid against major insect pests under irrigated ecosystem. Karnataka J. Agric. Sci.,19(4): 949-951.

Dodamani, M.T., Kerutagi, M.G. and Jayashree, H. (2010). Financial viability of cotton growers in northern Karnataka. Karnataka J. Agric. Sci., 23 (2): 262-264.

Gaddi, G.M., Mundinamani, S.M. and Patil, S.A. (2002). Yield gaps, constraints and potential in cotton production in north Karnataka - An econometric analysis. Indian J. Agril. Econ., 57 (4): 722-734.

Hugar, L.B., Amruta, C.P. and Patil, B.V. (2009). Productivity difference between Bt and non Bt cotton farms in Karnataka state, India – Econometric evidence. Karnataka J. Agric. Sci., 22(2): 349-352.

Khadi, B. M. (2006). Impact of Bt cotton on agriculture in India. In: National training programme on use of biotechnology in agriculture and awareness campaign in Bt cotton, central institute of cotton research, Nagpur (M.S.) India, pp.1-5.

Kunnal, L.B., Gaddi, M., Olekar, J.N. and Dabali, S.D. (2004). New cotton production technology in Karnataka- An econometric analysis. Paper presented in the symposium strategies for sustainable cotton production- A Global Vision; University of Agricultural Sciences, Dharwad (Karnataka) India.

Narayanamoorthy, A. and Kalamkar, S.S. (2006). Is Bt cotton cultivation

economically viable for Indian farmers? An empirical analysis. Economic and Political Weekly. June 30, pp. 2716-2724.

Qaim, M., Subramanian, A., Gopal Naik, G. and Zilberman, D. (2006). Adoption of Bt cotton and impact variability: Insights from India. Review of Agricultural Economics, 28: 59-71.

Ramasundaram, P., Ingle, R., Dhote, S. and Singh, P. (2005). Cost of cultivation of cotton. Financing Agric., 37 (2):22-25.

Verma, A.R. (2002). Economics of production, resource use efficiency and constraints: A case study of onion in Shajapur district of Madhya Pradesh. Bihar J. Agric. Mktg., 10(4): 429-439.

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