An economic analysis of *Bt* cotton production in Hisar and Sirsa districts of Haryana

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ABSTRACT : The present study was conducted to study the economics of *Bt* cotton production in Hisar and Sirsa districts of Haryana. A random sample of 120 *Bt* cotton growers from 8 randomly selected villages was taken. In Hisar district the average gross income/ac on medium farms were Rs. 36799.40 as compared to large farms (Rs. 36263.00) and small farms (Rs. 34380.57)/q cost of production in Sirsa found to be highest on small farms (Rs. 3139.75) followed by medium (Rs. 3100.77) and large farms (Rs. 2977.09)/ac net returns on total cost and return over variable cost were higher in Sirsa Rs. 10740.74 and Rs. 25962.62 as compared to Hisar Rs. 6712.89 and Rs. 18703.85, respectively.

The sufficient irrigation facilities reduced/ac cost of production incurred on irrigation to almost half in Sirsa district (4.32 %) as compared to Hisar (10.96%). The yield gap was observed in both districts due to inadequate crop stand, burning due to high temperature at emergence, sucking pests and wilting at maturity. The major constraints felt by farmers in Hisar district were inadequate irrigation facilities (94.44 %), non-availability of good quality insecticides (77.77 %), non availability of labour (72.22%), unfavourable climate condition (61.11 %) and non availability of timely fertilizers (55.56 %). There was a serious problem of non availability of labours in Sirsa district which was felt by 75.00 per cent farmers.

Key words : *Bt* cotton, constraints, cost of production, gross returns, net returns, labour, production, returns over variable cost

Cotton is the most important commercial crop of India often referred as the "White Gold" consumes about 54 per cent of the total insecticides used in our country. With the commercialization of agriculture the importance of cash crops like cotton has increased. Nevertheless farmers continue to use insecticides repeatedly as they have no option except to 'spray' or 'pray'. This had frustrated the farmers, scientists and policy makers alike. Bt cotton came at a time when they were desperately looking for an alternative and dependable control measure. India has the largest area under cotton cultivation with relatively low productivity primarily due to the large area under rainfed cultivation with inadequate supply of inputs. Area wise, India ranks first in world, whereas it ranks second in production with 27 million bales next to china with 33 million bales. Even though great strides have been made in cotton production in India but still there is a need to improve the yield levels further in order to meet the demand for cotton in the 21st century. In Haryana, cotton is mainly grown in Sirsa, Hisar, Fatehabad and Bhiwani districts. Wide fluctuations have been observed in both in area and production of cotton crop in the state. It is observed that with favorable weather conditions crop production increased into the double average production.

Bt cotton has increased yield by upto 50 per cent, reduced insecticide sprays by half, with environmental and health implications and increased income by upto US \$250 or more/ha which has contributed to social benefits and alleviation of their poverty(Monga,2008). Bt cotton is playing immense role in enhancing the economy of the farmers in Haryana. Since the Bt cotton is grown in Haryana there is substantial increase in production of cotton. As a consequence of the above comparative advantages of Bt over non Bt, there has been gradual and consistent replacement of non Bt cotton with Bt cotton. The present study was, therefore undertaken to study the economics of Bt cotton cultivation and to work out the index of yield gaps and economic losses in Hisar and Sirsa district of Haryana.

The Sirsa and Hisar districts with highest production of cotton in the state were selected for this study. These two selected districts accounted for about 64 per cent of total area and contributed about 65 per cent of total production of cotton in Harvana during the year 2010-2011. From these selected districts, two blocks from each district i.e. Barwala and Hisar II block from Hisar district and Sirsa and Ellenabad block from Sirsa district were selected randomly. A sample of two villages was selected randomly from each block. Thus, Panihari and Nezia Khera from Sirsa block and Talwara Khurd and Khari Sureran from Ellenabad block and Baddonpatti and Behbalpur from Barwala block and Kirtan and Dhobi from Hisar II block were selected, respectively.

Both primary as well as secondary data were collected for this study. A sample of 15 respondents including small, medium and large farmers from each selected village making a sample of 120 farmers was taken (Table 1). The survey method consisting of personal interview of selected respondents through specifically designed and pre tested schedule was followed for collecting the required primary data. The cost and returns from production of *Bt* cotton and yielding were computed by using simple tabular analysis, averages and percentages. The yield gap was also computed by using simple tabular analysis. The data relate to *kharif* 2012-2013 were collected from the selected respondents. Simple budgeting technique was used as analytical tool to analyze the data.

Cost and returns of Bt cotton production on small, medium and large farms : The cost and returns of Bt cotton production in Hisar district has been shown in Table 2. The cost/ac was divided into three categories viz., operational cost, material cost and fixed cost. The cost of production on small farms was Rs. 27126.92/ac (Table 2). The rental value of land, irrigation, picking, plant protection and fertilizer use were the major items of total cost constituting 28.20, 11.63, 9.69, 7.95 and 7.79 per cent, respectively followed by management charges (5.85 %), risk factor (5.85 %), seed cost (4.76 %), hoeing/ weeding (4.10%) and preparatory tillage (3.23%). In case of medium farms, the cost of production/ ac was worked out as Rs. 29366.27/ac . The rental value of land, picking, irrigation, fertilizer use and plant protection were the major items of total cost contributing 39.03, 12.56, 11.04, 7.46 and 7.28 per cent, respectively followed by management expenses (6.01 %), risk factor (6.01 %), seed cost (5.66 %), hoeing/weeding (4.43 %) and preparatory tillage (3.39 %). The cost of production on large farms was found Rs. 30811.20/ac, which was highest as compared to the cost of production on medium farms (Rs. 29366.27/ac) and small farms (Rs. 27126.92/ac).

Table 1. Category wise number of farmers selected from both the districts

District	Small (Upto 5 ac)	Medium (6-10 ac)	Large (above 10 ac)	Total
Hisar	23	17	20	60
Sirsa	8	24	28	60
Total	31 (25.83)	41 (34.17)	48 (40.00)	120

Note: Figures in parenthesis indicate percentage to total

The rental value of land, picking, irrigation, fertilizer use and plant protection were again the major items of total cost accounted for 42.15, 13.85, 10.27, 8.05 and 6.01 per cent, respectively followed by management expenses (5.78 %), risk factor (5.78 %), seed cost (4.34 %), hoeing/ weeding (3.86 %) and preparatory tillage (3.33 %). The comparative analysis of expenditure incurred on different item on small, medium and large farms shows that/ac expenditure incurred on picking, fertilizer use and rental value was highest on large farms as compared to that of medium farms followed by small farms. But in case of management expenses, risk factor, preparatory tillage, hoeing/weeding and interest, the/ac expenditure incurred on these items was highest in medium farms followed by small farms and large farms. Among all 3 categories farms/ ac expenditure incurred on seed cost and irrigation was found highest on small farms followed by medium and large farms. The average gross income/ac on medium farms was Rs. 36799.40 as compared to large farms (Rs. 36263) and small farms (Rs. 34380.57). This may be attributed to highest production (8.16q) on larger farms followed by medium farms (7.90g) and small farms (7.57q). Consequently/ac net returns over total cost was highest on medium farms (Rs. 7433.13) followed by small farms (7253.65) and large farms (Rs. 5451.80). Similarly, the return over variable cost was highest on medium farms (Rs. 19134.17) followed by small farms (Rs. 18536.69) and large farms (Rs. 18440.58). The costs of production /q on large, medium and small farms were Rs. 3775.88, Rs. 3717.24 and Rs. 3583.47, respectively (Dass et al., 2014).

In Sirsa, district the cost and returns of *Bt* cotton production/ac on small, medium and large farms were Rs. 32088.26, Rs. 31472.87 and Rs. 29264.84, respectively (Table 3). On small farms, the rental value of land, picking, fertilizer, plant protection, seed, irrigation, risk factor and management charges were major items which accounted for 37.71, 11.98, 7.99, 7.21, 5.86, 5.13

and 5.13 per cent of the total cost, respectively. In case of the medium farms rental value of land, picking, plant protection, fertilizer, seed, risk factor, management charges, hoeing/ weeding and irrigation were again the major items of total cost constituting 39.72, 12.76, 7.21, 6.68, 6.09, 4.94, 4.94, 4.34 and 4.30 per cent, respectively. The same tempo was observed on large farms which accounted for 36.90, 13.56, 7.58, 7.23, 6.92, 5.18 and 5.18 per cent of the total cost in the items rental value of land, picking, fertilizers, plant protection, seed, risk factor and management charges, respectively. The expenditure incurred on different item on small, medium and large farm shows that/ac expenditure incurred on picking, plant protection and seed was highest on large farms as compared to that of medium farms. It was found that most of the large and medium farmers have their own tube wells, tractors and other operational equipments due to which/ac expenditure incurred on preparatory tillage, sowing and irrigation was less on medium and large farms as compared to that of small farms. The/ac net return on small, medium and large farms were Rs. 10211.74, Rs. 12857.13, and Rs. 9423.37 after deducting the total cost of Rs. 32088.26, Rs. 31472.87 and Rs. 29264.84 from the gross returns Rs. 42300 Rs., 44060 and Rs. 38688.21/ac, respectively. The cost of production/q was found to be highest on small farms (Rs. 3139.75) followed by medium (Rs. 3100.77) and large farms (Rs. 2977.09). Resultantly, /ac production on small farms was highest (10.22q) as compared to medium farms (10.15q) and large farmers (9.83q).

The costs and returns on overall farms in Hisar and Sirsa district have been compared in Table 4/ac cost of production found to be less in Hisar district (Rs. 29101.43) as compared to that of Sirsa (Rs. 30941.99). In Hisar /ac cost of production incurred on major items rental value of land, picking, irrigation, fertilizer, plant production, risk factor, management charges, seed and hoeing/weeding were 27.68, 12.12,

No. Quantity Value Per centage Quantity Value Qu	Sr.	Particulars		Small			Medium			Large		
I. Operational cost 1. Operational cost 3.39 3.16 Preparational expenses 1.30 875.00 3.23 3.36 0.115 1.117 Sowing Trigational operational expenses 1.30 1.42 497.00 1.83 1.20 335.00 1.155 1.00 Sowing 3.42 1.142.00 0.53 0.60 1032.00 0.35 3.66 Sowing 3.42 1114.28 4.10 0.53 2.60 1157 1.10 Sowing 3.42 1114.28 4.10 0.33 3.66 0.75.00 3.35 0.10 1.66.0 0.35 3.66 0.75.00 Sob Total 2.42 2.688.57 9.69 0.865.00 11.6 0.00 0.155 2.16 0.75.00 0.75 0.66 0.75.00 0.75 0.66 0.75.00 0.75 0.66 0.75.00 0.75 0.66 0.75.00 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75<	No.		Quantity	Value	Per centage of total cost	Quantity	Value	Per centage of total cost	Quantity	Value Per centage of total cost	Per centage of total cost	
Preprint on thilds 250 875.00 3.23 2.80 9.66.78 3.39 3.16 Preprint of trighting 1.42 477.00 1.83 1.40 462.00 1.57 1.17 Swith matching 0.711 $1.42.00$ 0.52 0.60 1.200 0.355 0.85 Swith matching 2.42 11.47 4.70 0.71 14.200 0.355 0.865 0.155 0.66 Picting 2.42 11.74 5.66 675.00 12.56 675.00 Swith reacting $2.74.35$ $21.174.25$ 4.76 870.00 169.06 116.00 Swith reacting $2.74.35$ 4.76 870.00 169.06 116.00 116.00 Swith reacting $2.74.35$ 4.72 33.60 32.50 116.00 116.00 116.00 Swith reacting $2.74.35$ $2.34.5$ $2.34.5$ $2.34.5$ $2.36.0$ Swith reacord $3.72.1174.2.5$		I. Operational cost										
	1.	Preparatory tillage	2.50	875.00	3.23	2.80	996.78	3.39	3.16	1027.00	3.33	
	2.	Irrigational operational expenses	1.30	487.50	1.80	1.40	462.00	1.57	1.17	389.96	1.27	
Ridging 0.71 142.00 0.52 0.60 102.00 0.35 0.85 Hering / weaking 2.42 $114.2.0$ 0.52 0.60 102.00 0.35 0.85 Sub Total \mathbf{x}	ю.	Sowing	1.42	497.00	1.83	1.20	336.00	1.15	1.00	341.67	1.11	
Horing 3.42 1114.28 4.10 4.20 1302.00 4.43 3.66 Sub Total Sub Total Status 2.42 1114.28 4.10 4.20 1302.00 4.43 3.66 Sub Total Material cost 7.39.28 1290.78 4.76 870.00 1662.67 5.66 675.00 Fertilizer (gg) Nirrogen 92.85 488.11 1.81 115.00 611.80 2.03 3.50 (i) Phosphates 53.57 1739.28 1290.78 4.76 870.00 6.75.00 6.75.00 (i) Phosphates 53.57 1774.20 871.00 100.00 0.00<	4.	Ridging	0.71	142.00	0.52	0.60	102.00	0.35	0.85	212.50	0.69	
Picking 2.42 $2.628.57$ 9.69 2.60 3685.00 12.56 21.1 I. Material cost T. Material cost 774.35 21.17 6883.78 23.45 21.60 3683.78 23.45 21.60 368.75 21.60 3683.78 23.45 51.60 52.60 52.60 52.60 52.60 52.60 52.60 52.60 52.60 52.60 52.60 52.60 52.60 52.60 52.00 52	വ വ	~	3.42	1114.28	4.10	4.20	1302.00	4.43	3.66	1189.50	3.86	
Sub Total 574.35 21.17 683.77 23.45 I. Material cost T. Material cost 7.39.28 1290.78 4.76 870.00 162.67 5.66 675.00 Sertilizer (kg) (a) Nitrogen 92.85 $4.81.11$ 1.81 115.00 115.00 1162.67 5.66 675.00 Fertilizer (kg) 53.57 1174.25 4.32 53.57 1174.26 2.08 116.00 0.54 5.20 (a) Nitrogen 53.57 1174.26 7.79 $0.82.50$ 0.19 0.00 0.54 5.20 (a) Others (Zinc, Boron, NPK etc.) 4.85 211.42 0.82 0.81 1.000 0.54 5.20 Part protection 4.25 217.14 7.95 3.35 1.72 3.35 Plant protection 4.25 2157.14 7.95 3.35 7.46 5.20 Plant protection 4.55 2137.50 7.46 5.20 1.00	6.		2.42	2628.57	9.69	2.60	3685.00	12.56	2.16	4267.00	13.85	
II. Material cost T. Material cost 5:66 675:00 Retial (g) 739:28 1290.78 4.76 870.00 1662.67 5:66 675:00 Retial (g) (a) Nitrogen 92.85 488.11 1.81 115.00 611.80 2.08 116.00 (a) Nitrogen 92.85 488.11 1.81 115.00 611.80 2.08 116.00 (a) Nitrogen 53.57 1174.25 4.32 55.00 127.60 4.35 55.00 (a) Others (Zinc, Boron, NPK etc.) 4.85 221.42 0.82 4.4 144.00 0.49 5.20 Total 21.30 496.99 1.83 2.85 3.56.20 7.46 3.50 Path 21.31.26 7.79 3.85 3157.14 1.163 4.75 3.27.50 7.28 3.83 Path Drotection 3.85 3157.14 1.163 7.46 7.46 7.46 Sub total 3.85 3157.14 7.95 4.75 2137.50 </td <td></td> <td>Sub Total</td> <td></td> <td>5744.35</td> <td>21.17</td> <td></td> <td>6883.78</td> <td>23.45</td> <td></td> <td>7427.63</td> <td>24.11</td>		Sub Total		5744.35	21.17		6883.78	23.45		7427.63	24.11	
Seed (g) 739.28 1290.78 4.76 870.00 1662.67 5.66 675.00 (a) Nitrogen (b) Phosphates 53.57 1174.25 4.32 55.00 115.00 611.80 2.08 116.00 (a) Nitrogen (b) Phosphates 53.57 1174.25 4.32 55.00 1276.00 4.35 50.00 (c) Potash (c) Potash 14.28 228.48 0.84 10.00 0.54 25.00 (d) Others (Zinc, Boron, NPK etc) 4.85 221.42 0.82 1.14.00 0.199 5.20 Plant protection 4.25 2157.14 7.95 4.76 3.83 3.83 3.85 3.85 3.85 3.85 3.85 3.85 3.85 3.85 3.86 3.36 3.		II. Material cost										
Fertilizer (kg) (a) Nitrogen (b) Nitrogen (c) Nitrogen <th col<="" td=""><td>1.</td><td>Seed (g)</td><td>739.28</td><td>1290.78</td><td>4.76</td><td>870.00</td><td>1662.67</td><td>5.66</td><td>675.00</td><td>1337.39</td><td>4.34</td></th>	<td>1.</td> <td>Seed (g)</td> <td>739.28</td> <td>1290.78</td> <td>4.76</td> <td>870.00</td> <td>1662.67</td> <td>5.66</td> <td>675.00</td> <td>1337.39</td> <td>4.34</td>	1.	Seed (g)	739.28	1290.78	4.76	870.00	1662.67	5.66	675.00	1337.39	4.34
(a) Nitrogen92.85488.111.81115.00611.802.08116.00(b) Phosphates53.571174.254.3255.00167.004.3550.00(c) Ottash53.571174.254.3255.00167.000.495.20Total7.0110.00160.000.495.201174.251174.251174.252137.5011923.35Ty7.0121.30496.991.8328.8562.501.923.353.35Plant protection2.132.137.463.353.157.1411.634.63.353.353.35Insecticide2.120.824.163.363.353.157.1411.634.63.363.35Insecticide2.123.853.157.1411.634.63240.0011.044.3Insecticide9.85.223.263.269.86.983.367.463.55Insecticide9.85.223.263.267.283.351176.526.01Insecticide9.86.983.361.0099.533.72110781.453.6729.96Sub total10099.533.72110781.453.6729.01193Nangement charges1584.385.851766.526.01193Risk factor11584.385.851766.526.01193Risk factor11383.041.723363.242100.00193Risk factor7.481.72 <td>ъ.</td> <td>Fertilizer (kg)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	ъ.	Fertilizer (kg)										
		(a) Nitrogen	92.85	488.11	1.81	115.00	611.80	2.08	116.00	599.32	1.95	
(c) Potash 14.28 228.48 0.84 10.00 160.00 0.54 25.00 $Total$ $Total$ 14.25 221.42 0.82 4.4 144.00 0.49 5.20 $Total$ $Total$ 211.30 211.30 211.30 2191.80 7.46 5.20 $Total$ $Total$ 21.30 2157.14 7.95 3.75 2191.80 7.46 5.20 Plant protection 4.25 2157.14 7.95 4.75 2137.50 7.28 3.83 Plant protection 3.85 3157.14 11.63 4.6 3240.00 11.04 4.3 Intrigation 3.85 3157.14 11.63 4.6 3240.00 11.04 4.3 Intrest @ 12 per cent for half 3.85 3157.14 11.63 4.6 3.36 3.36 Sub total $11.765.22$ 3.26 3.721 1766.52 6.01 9.36 Sub total 10099.53 37.21 1766.52 6.01 9.36 Total working cost (I+II) $1.884.38$ 5.85 1766.52 6.01 9.36 Risk factor 10099.53 37.21 10781.45 36.72 3.672 Transportation charges 1584.38 5.85 1766.52 6.01 9.36 Transportation charges 1584.38 5.85 17766.52 6.01 Risk factor 1284.38 5.85 17766.52 6.01 Risk factor 11.72 5.85 1766.52 6.01		(b) Phosphates	53.57	1174.25	4.32	55.00	1276.00	4.35	50.00	1062.50	3.45	
		(c) Potash	14.28	228.48	0.84	10.00	160.00	0.54	25.00	350.00	1.14	
Total Total <th< td=""><td></td><td>(d) Others (Zinc, Boron, NPK etc.)</td><td></td><td>221.42</td><td>0.82</td><td>4.4</td><td>144.00</td><td>0.49</td><td>5.20</td><td>466.67</td><td>1.51</td></th<>		(d) Others (Zinc, Boron, NPK etc.)		221.42	0.82	4.4	144.00	0.49	5.20	466.67	1.51	
FYM $21:30$ 496.99 1.83 28.8 562.50 1.92 32.50 Plant protection 4.25 2157.14 7.95 4.75 2137.50 7.28 3.83 Insecticide/ Pesticide) 3.85 3157.14 11.63 4.6 3240.00 11.04 4.3 Interest (0) 3.85 3157.14 11.63 4.6 3240.00 11.04 4.3 Interest (0) 3.85 3157.14 11.63 4.6 3240.00 11.04 4.3 Interest (0) 3.85 3.25 3.25 3.36 3.36 3.36 Sub total 10099.53 37.21 10781.45 36.72 4.6 In Fixed cost 10099.53 37.21 10781.45 36.72 In Fixed cost 10099.53 37.21 10781.45 36.72 In Fixed cost 1766.52 6.01 1766.52 6.01 In Fixed cost 1722 5.85 1766.52 6.01 Risk factor 11.72 5.85 1776.52 6.01 In Fixed cost 11.72 $5.86.00$ 1.93 Management charges 7650.00 28.20 7600.00 25.88 Rental value of land 11283.04 41.62 17701.04 39.03 Oth coduction (g) (g) 743.17 7.90 36031.90 Rental value of land 7550 700.00 28.206 19.3 Sub total (g) (g) (g) (g) (g) Sub total<		Total		2112.26	7.79		2191.80	7.46		2478.49	8.05	
Plant protection 4.25 2157.14 7.95 4.75 2137.50 7.28 3.83 Insecticide/ Pesticide) 3.85 3157.14 11.63 4.6 3240.00 11.04 4.3 Interest @ 12 per cent for half 3.85 3157.14 11.63 4.6 3240.00 11.04 4.3 Interest @ 12 per cent for half 3.85 3157.14 11.63 4.6 3240.00 11.04 4.3 Sub total 885.22 3.26 3.26 986.98 3.36 7.28 3.36 Sub total 1009953 37.21 10781.45 36.72 Total working cost (I+II) 1584.38 5.85 1766.52 6.01 III. Fixed cost 1584.38 5.85 1766.52 6.01 Management charges 1584.38 5.85 17766.52 6.01 Management charges 1584.38 5.85 17766.52 6.01 Management charges 1584.38 5.85 17766.52 6.01 Management charges 11723 7660.00 29.36 1993 Rental value of land 7650.00 28.20 7600.00 29366.27 100.00 Poduction (q) 7.57 33632.42 7.90 36031.90 8.16 Otal cost (Rs) 117701.04 39.03 767.50 767.50 Rental value of land $7.3380.57$ 7.90 36031.90 8.16 Production (q) 7.57 33632.42 7.93 767.50 Ost of producti	ю.	FYM	21.30	496.99	1.83	28.8	562.50	1.92	32.50	567.00	1.84	
	4.	Plant protection	4.25	2157.14	7.95	4.75	2137.50	7.28	3.83	1851.15	6.01	
Irrigation 3.85 3157.14 11.63 4.6 3240.00 11.04 4.3 Interest @ 12 per cent for half 885.22 3.26 986.98 3.36 4.3 of the growth period 10099.53 37.21 10781.45 35.72 Sub total 10099.53 37.21 10781.45 35.72 Sub total 10099.53 37.21 10781.45 35.72 Total working cost ($1+11$) 1584.38 5.85 1766.52 6.01 Tisk factor 1584.38 5.85 1766.52 6.01 Risk factor 1584.38 5.85 1766.52 6.01 Nanagement charges 1584.38 5.85 1766.52 6.01 Risk factor 1584.38 5.85 1766.52 6.01 Transportation charges 1584.38 5.85 1766.52 6.01 Rental value of land 11283.04 41.62 760.00 25.88 Sub total 11283.04 41.62 760.00 25.88 Production (g) 757 33632.42 7.90 36031.90 Production (g) 7.57 33632.42 7.90 36031.90 Nain 7.57 33632.42 7.90 36031.90 Sub total 78.66 743.15 767.50 Production (g) 733.136 743.13 Sub total 7433.13 717.24 Sub total 8.767 7433.13 Sub total 8.767 $773.17.24$ Sub total 8.767 74		(Insecticide/ Pesticide)										
Interest @ 12 per cent for half 85.22 3.26 986.98 3.36 of the growth period 10099.53 37.21 10781.45 $3.6.72$ Sub total 10099.53 37.21 10781.45 $3.6.72$ Sub total 10099.53 37.21 10781.45 36.72 Total working cost (1+11) 1584.38 5.85 1766.52 6.01 III. Fixed cost 1584.38 5.85 1766.52 6.01 Risk factor 1584.38 5.85 1766.52 6.01 Management charges 1584.38 5.85 1766.52 6.01 Management charges 1584.38 5.85 1766.52 6.01 Risk factor 1584.38 5.85 1776.52 6.01 Management charges $1.228.00$ 2.820 7660.00 25.88 Rental value of land 11283.04 41.62 11701.04 39.03 Sental value of land 7.57 33632.42 7.90 36031.90 8.16 Main 7.57 33632.42 7.90 36031.90 8.16 Production (q) 7.87 33632.42 $7.67.50$ 767.50 Beturn over variable cost (Rs.) 1283.05 769.40 8.16 Net returns (Rs.) 3583.47 3583.47 7433.13 So to f production (Rs./q) 3583.47 3577.24	വ. വ	Irrigation	3.85	3157.14	11.63	4.6	3240.00	11.04	4.3	3165.00	10.27	
of the growth period Sub total10099.5337.2110781.45 36.72 Sub totalTotal working cost (1+11) 1584.38 37.21 10781.45 36.72 Total working cost (1+11) 1584.38 5.85 1766.52 6.01 III. Fixed cost 1584.38 5.85 1766.52 6.01 Risk factor 1584.38 5.85 1766.52 6.01 Management charges 1584.38 5.85 1766.52 6.01 Transportation charges 764.28 1.72 568.00 1.93 Transportation charges 7660.00 28.20 7600.00 25.88 Rental value of land 11283.04 41.62 11770.04 39.03 Sub total 11283.04 41.62 11770.04 39.03 Coll (q) 7.57 33632.42 760.00 29366.27 100.00 Production (q) 7.57 33632.42 760.00 767.50 (b) By product 748.15 748.15 767.50 767.50 Gross returns (Rs.) 18536.69 7633.190 8.16 Net returns (Rs.) 3533.47 3533.47 7433.13 Scat of production (Rs./q) 3533.47 3717.24	.9	Interest @ 12 per cent for half		885.22	3.26		986.98	3.36		995.76	3.23	
Sub total10099.5337.2110781.4536.72Total working cost (I+II)1584.3.881766.5.231766.5.23III. Fixed cost1584.3.885.851766.526.01Risk factor1584.385.851766.526.01Risk factor1584.385.851766.526.01Management charges 464.28 1.72 568.00 1.93 Transportation charges 7650.00 28.20 7600.00 25.88 Rental value of land11283.04 41.62 11701.04 39.03 Sub total11283.04 41.62 11701.04 39.03 Production (q) 7.57 33632.42 760.00 25.88 Return over variable cost (Rs.) 748.15 767.50 767.50 Return over variable cost (Rs.) 18536.69 767.50 767.50 Net returns (Rs.) 7253.65 7433.13 3717.24 So of production (Rs./q) 3583.47 3717.24		of the growth period										
Total working cost (I+II)I5843.88I7665.23III. Fixed costIII. Fixed cost 17665.23 17665.22 6.01 III. Fixed cost 1584.38 5.85 1766.52 6.01 Risk factorIndamagement charges 464.28 1.72 568.00 1.93 Transportation charges 464.28 1.72 568.00 1.93 Transportation charges 7650.00 28.20 7600.00 25.88 Rental value of land 11283.04 41.62 11701.04 39.03 Sub total 11283.04 41.62 117701.04 39.03 Total cost (Rs) (I+II+III) 27126.92 100.00 25366.27 100.00 Production (q) 7.57 33632.42 7.90 36031.90 8.16 Return over variable cost (Rs.) 748.15 748.15 36799.40 767.50 Net returns (Rs.) 18536.69 7433.13 3717.24 Net returns (Rs.) 3583.47 3583.47 3717.24		Sub total		10099.53	37.21		10781.45	36.72		10394.79	33.74	
III. Fixed costIII. Fixed cost 1584.38 5.85 1766.52 6.01 Risk factor 1584.38 5.85 1766.52 6.01 Management charges 1584.38 5.85 1766.52 6.01 Management charges 464.28 1.72 568.00 1.93 Transportation charges 464.28 1.72 568.00 1.93 Rental value of land 7650.00 28.20 7600.00 25.88 Sub total 11283.04 41.62 29366.27 100.00 Sub total 757 33632.42 7600.00 25.88 Total cost (Rs) (1+11-11) 27126.92 100.00 25.88 Production (q) 7.57 33632.42 7600.00 25.88 Return (q) 7.57 33632.42 7600.00 26031.90 Return over variable cost (Rs.) 748.15 767.50 767.50 Return over variable cost (Rs.) 18536.69 767.50 36799.40 Net returns (Rs.) 7253.65 733.13 7433.13 Cost of production (Rs./q) 3583.47 3717.24				15843.88			17665.23			17822.42		
Risk factor 1584.38 5.85 1766.52 6.01 Management charges 1584.38 5.85 1766.52 6.01 Transportation charges 464.28 1.72 568.00 1.93 Transportation charges 7650.00 28.20 7600.00 25.88 Sub total 7650.00 28.20 7600.00 25.88 Total cost (Rs) (1+11+11) 27126.92 100.00 25.88 Total cost (Rs) (1+11+11) 277126.92 100.00 25.88 Total cost (Rs) (1+11+11) 277126.92 100.00 25.88 Induction (q) 7.57 3632.42 7.90 36031.90 Return (q) 7.57 33632.42 7.90 36031.90 8.16 (b) By product 748.15 7.90 36031.90 767.50 (c) By product 8.16 767.50 767.50 767.50 (b) By product $7.53.65$ 7.90 36031.90 8.16 (b) By product $7.53.65$ 7.90 3631.90 767.50 Return over variable cost (Rs.) 18536.69 767.50 767.50 Net returns (Rs.) 7253.65 $7.3383.47$ 733.13 Cost of production (Rs./q) 3583.47 3717.24		III. Fixed cost										
Management charges 1584.38 5.85 1766.52 6.01 Transportation charges 464.28 1.72 568.00 1.93 Rental value of land 7650.00 28.20 7600.00 25.88 Sub total 7650.00 28.20 7600.00 25.88 Total cost (Rs) (1+11+11) 27126.92 100.00 25.88 Production (q) 7.57 33632.42 7700 7600.00 Production (q) 7.57 33632.42 7.90 36031.90 (b) By product 748.15 748.15 767.50 Gross returns (Rs.) 34380.57 7.90 36031.90 767.50 Return over variable cost (Rs.) 18536.69 767.50 36799.40 Net returns (Rs.) 7253.65 7433.13 7433.13 Cost of production (Rs./q) 3583.47 3583.47 3717.24	1.	Risk factor		1584.38	5.85		1766.52	6.01		1782.24	5.78	
Transportation charges 464.28 1.72 568.00 1.93 Rental value of land 7650.00 28.20 7600.00 25.88 Sub total 11283.04 41.62 11701.04 39.03 Total cost (Rs) (1+11+11) 27126.92 100.00 25.88 Production (q) 7.57 33632.42 700.00 29366.27 100.00 Rental cost (Rs.) 7.57 33632.42 7.90 36031.90 8.16 Production (q) 7.57 33632.42 7.90 36031.90 8.16 Return over variable cost (Rs.) 748.15 767.50 767.50 767.50 Return over variable cost (Rs.) 18536.69 19134.17 7433.13 7433.13 Cost of production (Rs./q) 3583.47 3583.47 3717.24	2.	Management charges		1584.38	5.85		1766.52	6.01		1782.24	5.78	
Rental value of land 7650.00 28.20 7600.00 25.88 Sub total 11283.04 41.62 11701.04 39.03 Production (q) 7.57 33632.42 100.00 29366.27 100.00 Rentum out 7.57 33632.42 7.90 36031.90 8.16 Rentum over variable cost (Rs.) $7.8.15$ 34380.57 7.90 36031.90 8.16 Return over variable cost (Rs.) 748.15 723.65 77.90 36031.90 8.16 Net returns (Rs.) 7253.65 7383.17 767.50 767.50 Cost of production (Rs./q) 3583.47 3583.47 3717.24	з.	Transportation charges		464.28	1.72		568.00	1.93		508.30	1.65	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	4.	Rental value of land		7650.00	28.20		7600.00	25.88		8916.00	28.94	
(I+II+III) 27126.92 100.00 29366.27 100.00 7.57 33632.42 7.90 36031.90 8.16 7.57 33632.42 7.90 36031.90 8.16 7.57 33632.42 7.90 36031.90 8.16 7.51 748.15 748.15 767.50 8.16 Rs.) 34380.57 3430.57 36799.40 8.16 iable cost (Rs.) 18536.69 19134.17 19134.17 i.) 7253.65 3 583.47 3717.24 i.on (Rs./q) 3583.47 3717.24		Sub total		11283.04	41.62		11701.04	39.03		12988.78	42.15	
7.57 33632.42 7.90 36031.90 8.16 356 78.15 748.15 767.50 8.16 362 78.1 748.15 767.50 36799.40 8.16 8.16 36799.40 19134.17 184 9.1 18536.69 19134.17 184 9.1 7253.65 7433.13 54 9.1 3583.47 3717.24 37		Total cost (Rs) (I+II+III)		27126.92	100.00		29366.27	100.00		30811.20	100.00	
7.57 3632.42 7.90 36031.90 8.16 356 748.15 748.15 767.50 8.16 362 (Rs.) 34380.57 36799.40 36190.40 362 ariable cost (Rs.) 18536.69 19134.17 184 (s.) 7253.65 7433.13 54 ction (Rs./q) 3583.47 3717.24 37		Production (q)										
(Rs.) 748.15 767.50 (Rs.) 34380.57 36799.40 362 ariable cost (Rs.) 18536.69 19134.17 184 (s.) 7253.65 7433.13 54 ction (Rs./q) 3583.47 3717.24 37		(a) Main	7.57	33632.42		7.90	36031.90		8.16	35631.00		
e cost (Rs.) 34380.57 36799.40 e cost (Rs.) 18536.69 19134.17 7253.65 7433.13 (Rs./q) 3583.47 3717.24		(b) By product		748.15			767.50			632.00		
(Rs.) 18536.69 19134.17 7253.65 7433.13 3583.47 3717.24		Gross returns (Rs.)		34380.57			36799.40			36263.00		
7253.65 3583.47 3717.24		Return over variable cost (Rs.)		18536.69			19134.17			18440.58		
3583.47 3717.24		Net returns (Rs.)		7253.65			7433.13			5451.80		
		Cost of production (Rs./q)		3583.47			3717.24			3775.88		

Economic analysis of production

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No.			Small			Medium			Large	
		Quantity	Value	Per centage of total cost	Quantity	Value	Per centage of total cost	Quantity	Value Pei of	Value Per centage of total cost
I. Operational cost	cost									
1. Preparatory tillage	lage	2.60	834.35	2.60	2.00	668.67	2.13	2.30	725.00	2.47
	Irrigational operational expenses	1.00	417.80	1.30	1.00	308.33	0.98	1.00	325.00	1.11
3. Sowing		1.00	328.00	1.02	1.00	291.76	0.93	1.00	287.50	0.98
4. Ridging		1.00	97.00	0.30	1.00	126.00	0.40	1.00	173.33	0.59
5. Hoeing / weeding	ling	3.87	1382.70	4.31	2.83	1366.67	4.34	3.16	1250.00	4.27
Picking	1	2.92	3845.34	11.98	2.50	4016.60	12.76	2.8	3966.67	13.56
Sub Total			6905.19	21.51		6778.03	21.54		6727.50	22.98
II. Material cost	st									
1. Seed (g)		927.00	1878.60	5.86	975.00	1916.60	6.09	1041.66	2025.45	6.92
(a) Nitrogen		119.00	642.60	2.00	116.00	614.00	1.95	100.00	495.66	1.69
(b) Phosphates		41.50	1030.33	3.21	43.30	1015.00	3.23	46.66	1080.83	3.69
(c) Potash		32.00	487.50	1.52	16.00	240.00	0.76	25.00	350.00	1.20
(d) Others (Zin	(d) Others (Zinc, Boron, NPK etc.)	13.30	405.00	1.26	10.00	233.34	0.74	5.33	291.66	1.00
Total			2565.43	7.99		2102.34	6.68		2218.15	7.58
3. FYM		10.15	198.00	0.62	15.00	264.00	0.84	13.33	242.00	0.83
4. Plant protection	n	4.08	2312.25	7.21	3.67	2267.00	7.21	3.83	2116.65	7.23
(Insecticide/ Pesticide)	'esticide)									
5. Irrigation		4.47	1676.37	5.22	4.16	1356.87	4.30	5.16	975.00	3.34
	Interest $@$ 12 per cent for half		919.38	2.87		869.02	2.76		846.52	2.89
of the growth period	period									
Sub total			9550.03	29.77		8775.83	27.88		8423.77	28.79
Total working cost (I+II)	cost (I+II)		16455.22	51.28		15553.86	49.42		15151.27	51.77
III. Fixed cost										
1. Risk factor			1645.52	5.13		1555.38	4.94		1515.12	5.18
2. Management charges	harges		1645.52	5.13		1555.38	4.94		1515.12	5.18
3. Transportation charges	charges		242.00	0.75		308.25	0.98		283.33	0.97
4. Rental value of land	land		12100.00	37.71		12500.00	39.72		10800.00	36.90
Sub total			15633.04	48.72		15919.01	50.58		14113.57	48.23
Total cost (Rs.) (I+II+III)	(III+II+I) (·		32088.26	100.00		31472.87	100.00		29264.84	100.00
Production (q)										
(a) Main		10.22	42025.00		10.15	43645.00		9.83	38256.21	
(b) By product			275.00			415.00			432.00	
Gross returns (Rs.)	(Rs.)		42300.00			44060.00			38688.21	
Return over vai	Return over variable cost (Rs.)		25844.78			28506.14			23536.94	
Net returns (Rs.)	s.)		10211.74			12587.13			9423.37	
Cost of Production (Rs./q)	tion (Rs./q)		3139.75			3100.77			2977.09	

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Tat	2		on on Uver	Production on Over all farms in Hisar and Sirsa district of Haryana (2012-2013)	isar and si	sa district o	ot Haryana (20	12-2013)	(Ks/ac)	
Sr.	Particulars		Small			Medium			Large	
No.		Quantity	Value	Per centage of total cost	Quantity	Value	Per centage of total cost	Quantity	Value Per centage of total cost	Per centage of total cost
,	I. Operational cost	0		0						
-	Preparatory tillage	2.82	966.26	3.32	2.30	742.67	2.40	2.50	854.47	C.85
0.	Irrigational operational expenses	1.29	446.48	1.53	1.00	350.38	1.13	1.15	398.43	1.33
З.	Sowing	1.20	391.55	1.35	1.00	302.42	0.98	1.10	346.98	1.16
4.	Ridging	0.72	152.16	0.52	1.00	132.11	0.43	0.86	142.14	0.47
ы. С	Hoeing / weeding	3.76	1201.92	4.13	3.28	1333.12	4.31	3.52	1267.52	4.22
6.	Picking	2.39	3526.85	12.12	2.74	3942.87	12.74	2.56	3734.86	12.44
	Sub Total		6685.22	22.97		6803.57	21.99		6744.40	22.47
	II. Material cost									
1. 1	Seed (g)	761.42	1430.28	4.91	981.22	1940.22	6.27	871.32	1685.25	5.61
2.	Fertilizer (kg)									
	(a) Nitrogen	107.95	566.41	1.95	111.67	584.09	1.88	109.81	575.25	1.92
	(b) Phosphates	52.85	1170.92	4.02	43.82	1042.05	3.37	48.34	1106.49	3.68
	(c) Potash	16.42	246.16	0.85	24.33	359.17	1.16	20.37	302.66	1.01
	(d) Others (Zinc, Boron, NPK etc.)	4.82	277.36	0.95	9.54	310.00	1.00	7.18	293.68	0.98
	Total	182.04	2260.85	7.77	189.36	2295.31	7.42	185.70	2278.08	7.59
з.	FYM	27.53	542.16	1.86	12.83	234.67	0.76	20.18	388.41	1.29
4.	Plant protection	4.27	2048.59	7.04	3.86	2231.96	7.21	4.07	2140.28	7.13
	(Insecticide/ Pesticide)									
ы. С	Irrigation	4.25	3187.38	10.96	4.59	1336.08	4.32	4.42	2261.73	7.54
6.	Interest $@$ 12 per cent for half		955.99	3.29		878.30	2.84		917.15	3.05
	of the growth period									
	Sub total		10425.25	35.83		8916.54	28.81		9670.90	32.21
	Total working cost (I+II)		17110.47	58.80		15720.11	50.80		16415.30	54.68
	III. Fixed cost									
1.	Risk factor		1711.05	5.88		1572.01	5.08		1641.53	5.46
5.	Management charges		1711.05	5.88		1572.01	5.08		1641.53	5.46
ю.	Transportation charges		513.53	1.76		277.86	0.90		395.69	1.32
4.	Rental value of land		8055.33	27.68		11800.00	38.14		9927.67	33.08
	Sub total		11990.96	41.20		15221.88	49.20		13606.42	45.32
	Total cost (Rs.) (I+II+III)		29101.43	100.00		30941.99	100.00		30021.71	100.00
	Production (q)									
	(a) Main	7.87	35098.44		10.07	41308.73		8.97	38203.59	
	(b) By product		715.88			374.00			544.94	
	Gross returns (Rs.)		35814.32			41682.73			38748.53	
	Return over variable cost (Rs.)		18703.85			25962.62			22333.23	
	Net returns (Rs.)		6712.89			10740.74			8726.82	
	Cost of production (Rs./q)		3697.76			3072.69			3346.90	

Economic analysis of production

10.96, 7.77, 7.04, 5.88, 5.88, 4.91 and 4.13 per cent, respectively. But in Sirsa the rental value of land, picking, fertilizer, plant protection, seed, risk factor and management charges were major items which accounted for 38.14, 12.74, 7.42, 7.21, 6.27, 5.08 and 5.08 per cent of total cost, respectively followed by irrigation (4.32%), hoeing/weeding (4.31%) interest (2.84%) and preparatory tillage (2.10%). It may attributed to higher/ac production (10.07 q) in Sirsa as compared to that of Hisar (7.87 q), due to which, the/ac cost of production on picking was higher in Sirsa district (Rs. 3942.87) than Hisar (Rs. 3526.85).

There was sufficient irrigation facility in Sirsa district which reduced/ac cost of production incurred on irrigation to half (4.32%) as compared to Hisar (10.96 %). The good source of irrigation in Sirsa district leaded to enhance the rental value of land which accounted for 38.14 per cent of the total cost as compared to that of Hisar (27.68%). The average gross income/ac in Sirsa were Rs. 41682.73 as compared to Hisar (Rs. 35814.32). /q of Bt cotton realized by the farmers in Hisar and Sirsa was reported as Rs. 3697.76 and Rs. 3072.69, respectively. The/ac net returns over total cost was higher in Sirsa (Rs. 10740.74) as compared to Hisar (Rs. 6712.89). Similarly, the net returns over variable cost were higher in Sirsa (Rs. 25962.62) as compared to Rs. 18703.85 in Hisar.

Yield gaps analysis and economic losses in cotton production : There have been always yield gaps on the farmer's field. There exist some factors responsible for low yields compared to potential yield and the highest yield attained *on par*ticular farms. The yield gap I is denoted by gap between potential yield and average actual yield and yield gap II is denoted by gap between highest yield and average actual yield on the farms. A wide gap existed in the cotton productivity in both the districts (*i.e.* Hisar and Sirsa) are given in Table 5. The/ac magnitude

of yield gap I was found 5.13 q in Hisar district where as it was 3.93 q/ac in Sirsa district. Similarly yield gap II for Bt cotton in Hisar and Sirsa district was noticed as 4.13 and 2.93 g/ac. The index of yield gap I and II for Bt cotton were found 0.39 and 0.34 and 0.28 and 0.22 in Hisar and Sirsa district (Ashok et al., 2012). The economic losses were found very high as presented earlier through yield gaps 4.53 q/ac overall in case of *Bt* cotton in both the districts. The yield gap was observed due to inadequate crop stand, seedling burning due to high temperature at emergence, late rainfall coinciding with flowering and fruit setting, sucking pests especially the whitefly, mealy bug, cotton leaf curl virus (CLCuV) disease and wilting at maturing.

Table 5. Attainable yield gap in Bt cotton productionin Hisar and Sirsa district of Haryana

			(q/ac)
Particulars	HISAR	SIRSA	OVERALL
Potential yield	13.00	14.00	13.50
Actual average yield	7.87	10.07	8.97
Highest yield	12.00	13.00	12.50
Yield gap I	5.13	3.93	4.53
Yield gap II	4.13	2.93	3.53
Index of yield gap I	0.39	0.28	0.34
Index of yield gap II	0.34	0.22	0.28

Constraints in *Bt* **cotton production :** Gradually farming has become more and more commercialized with passage of time. Now, it aims at increasing/unit productivity of land, labour and other scarce farm resources. An attempt was made to analyze the constraints responsible for lower yields in the farmers' field. In Hisar district 94.44 per cent of farmers felt the problem of inadequate irrigation facilities followed by non availability of good quality insecticides (77.77 %), non availability of labour (72.22 %), unfavourable climate condition (61.11 %) and non availability of good quality seed (55.56 %) as shown in Table 6 (Radha and Chowdry 2005). Similarly in Sirsa district there

Sr.	Constraints	HIS	SAR	SIF	RSA
No.		Number of	Respondent's	Number	Respondent's
		farmers	response (%)	of farmers	response (%)
		(N = 60)		(N = 60)	
1	Non availability of adequate good quality seed	33	55.56	15	25.00
2	Non availability of labour	43	72.22	45	75.00
3	Lack of technical knowledge	30	50.00	40	66.67
4	Unfavourable climatic condition	37	61.11	12	20.00
5	Non availability of good quality insecticides/ pesticides	47	77.77	30	50.00
6	Non availability of good quality weedicide	17	27.78	15	25.00
7	Non availability of timely fertilizers	33	55.56	28	46.67
8	Inadequate irrigation facilities.	57	94.44	10	16.67

Table 6. Constraints faced by farmers in production of Bt cotton in Hisar and Sirsa district in Haryana

was a serious problem of non availability of labour which was felt by 75 per cent farmers. It was observed mainly after commencement of Mahatma Gandhi National Rural Employment Guarantee Assurance Scheme

(MGNREGA). Most of the labours were diverted towards MGNREGA scheme covering various kind of work. In Sirsa district technical knowledge with respect to varieties, time of sowing, dose and type of pesticides and chemical, fertilizer and various cultural operations were found inadequate among 66.67 per cent of the farmers followed by non availability of good quality insecticides (50%). Non availability of timely fertilizers was felt among 46.67 per cent farmers in Sirsa district. The other constraints were non availability of adequate good quality seed (25%), non availability of good quality weedecide (25%) and inadequate irrigation facilities (16.67%).

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