IMPACT ASSESSMENT OF ADOPTED COTTON PRODUCTION TECHNOLOGY AND CONSTRAINTS IN MARATHWADA REGION OF MAHARASHTRA STATE

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ABSTRACT

Cotton as a cash crop is grown in more than 80 countries in the world and is mainly produced in three zones of India. Maharashtra ranks 2nd in production and 2nd in productivity amongst the major cotton growing states of the country. The study has assessed the impact of production technology of cotton cultivation in Marathwada region of Maharashtra for the year 2013-14, based on the data of costs and returns. Two districts from each region viz., Jalgaon and Dhule from Western Maharashtra region, Aurangabad and Jalna from Marathwada region and Buldhana and Yevatmal from Vidarbha region were selected on the basis of maximum area under cotton. The survey method was used for the collection of primary data Apart from benefit-cost ratio (BCR), yield gap analysis, resource use efficiencies, adoption index and impact of improved cotton technology have been estimated in the study. It has shown that the per hectare cost 'C' was ₹ 45221.01 and BCR is 1.03, whereas the per quintal cost of production was ₹ 4274.65 at the overall level for improved cotton cultivation methods. Further, there was a 34.97 per cent yield gap between actual yield and yield of demonstration plot, in which cultural practices (13.33) have shown a stronger effect than input use (21.64). The composite index of technology adoption was worked out to 50.08 per cent indicated that the sample farmers adopted less than 49 per cent recommended cotton production technology and obtained 10.40 qtls/ha yield. The contribution of different components on impact of cotton production technology in Marathwada region, net returns was maximum (10.94 per cent) followed by gross returns and main produce. The constraints faced by the cotton growing cultivators were abnormal distribution of rainfall, lack of technical knowledge, high cost of seed and fertilizers, high wage rates, high labour requirement, non-availability of seed and fertilizers, low price to produce were the major constraints in adoption of cotton production technologies.

Keywords: *impact, cotton, production technology*

INTRODUCTION

Cotton (Gossipium Sp.) is considered as one of the most important cash crops which plays a vital role in the economy of the country by providing substantial employment and making significant contributions to export earnings.Cotton, the king of fibers is often quoted as 'white Gold' because its higher commercial values. Cotton is one of the principal crops of the country, it is third in total acreage planted among all crops in India behind rice and wheat.

Cotton belongs to the Malvaceae family and has important four cultivable species, viz, Gossypium arboreum, Gossypium barbadence, Gossypium hirsutum and herbaceous. Cotton has different staples according to length of fibers such as short staple (20.00 mm &b below),medium staple(20.5 mm to 27.00 mm),long staple(27.50 mm to 32.00mm) and Extra long stable(32.5mm to above).

Cotton is cultivated in more than 70 countries of the world introducing production of cotton in China (27.10 per cent), India (21.83 per cent), United States (12.67 per cent), Pakistan (8.58 per cent), Brazil (7.52 per cent), Uzbekistan (3.40 per cent) and other (18.90 per cent).China is the largest producer of cotton in the world, whereas, India is second largest followed by Uniated states, Pakistan and Brazil. The world trade figures are very different. The largest four major exporting countries are United States (10400.00), India (7500.00), Australia (4000.00) and Uzbekistan (2800.00) of 1000 480 lb. bales, where as four largest importers are china (11979.00), Bangladesh (3700.00), Turkey (3350) and Indonesia (1752.00) of 1000 480 Ib. bales in 20013. (cot. crop gov. in 2013).

The studies undertaken so far had mostly focused on both aspects of technical changes i.e. its impact on yield, returns etc. as well as the reasons for non adoption of improved technology assumes great importance. Considering the above facts the study on "Economic analysis and impact assessment of production technology of cotton in Marathwada region of Maharashtra state" was under taken.

However, in spite of many advantages, farmers have their own difficulties for not adopting improved technology at a rapid pace owing to improved methods of cotton production technology requiring management of resources skillfully which requires high precision in handling of farm resources. With this background, present study was undertaken with the objectives

OBJECTIVES

(a) To study the resource use efficiency and cost and returns of cotton in Marathwada region.

(b) To study technology adoption and its impact on production of cotton in Marathwada region

(c) To examine the constraints in adoption of cotton production technologies in Marathwada region

METHODOLOGY

The study was conducted in the Marathwada region of Maharashtra. Two districts from the region *viz.*, Aurangabad and Jalna and from each district two tahsils were selected on the basis of maximum area under study . Two village from each tahsil were selected. Among each village, 4 samples were selected as per the size group of small, medium and large. The study was based on primary data for the year 2013-14. From each district, 48 farmers were selected who were practicing improved production technology of cotton cultivation. Thus, there were a total of 96 farmers. The farmers were interviewed using specially prepared schedules. The farmers were also asked to prioritize the most important constraints they were facing in adopting improved method of cotton cultivation.

Analytical Tools

Cobb-Douglas Type of Production Function:

To identify the important factors affecting the cotton production technology for cotton cultivation, following Cobb-Douglas type of production function was employed.

$$Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}X_5^{b_5}e^u$$

$$Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}X_5^{b_5}e^u$$

Where,

Y = Output of main produce in quintals per hectare

a = Intercept

X_1 = Per hectare use of human labour in man days

X_2 = Per hectare use of Bullock in pair days

X_3 = Per hectare use of Manure in quintals

X_4= Nitrogen (kg) per hectare

X_5 = Phosphorus (kg) per hectare

e^u = error term

Estimation of marginal value product

The marginal value products (MVPs) of the individual resources were estimated and compared with the marginal cost (MC). The MVP of individual resources was estimated by using the following formula,

$$\text{Marginal value product(MVP) of } X_i = b_i \frac{\bar{Y}}{\bar{X}} P_y$$

$$\text{Marginal value product(MVP) of } X_i = b_i \frac{\bar{Y}}{\bar{X}} P_y$$

Where,

bi = Elasticity of production of i^{th} input

Y = Geometric mean of output

Xi = Geometric mean of of i^{th} input

Py = Per unit price of output

Technological gap analysis

Yield gap was worked out as the difference between demonstration plot yield and actual farmer's yield. The following Cobb-Douglas type of production function was used for this purpose. (*Guddi et al, 2002)*

$$Y = a_0 H^{a_1} B^{a_2} M^{a_3} N^{a_4} P^{a_5} e^u$$

$$Y = a_0 H^{a_1} B^{a_2} M^{a_3} N^{a_4} P^{a_5} e^u$$

Where,

Y = Output of main produce in quintals per hectare

a_0 = Intercept

H = Per hectare use of human labour in man days

B = Per hectare use of Bullock in pair days

M = Per hectare use of Manure in quintals

N = Nitrogen (kg) per hectare

P = Phosphorus (kg) per hectare

e^u = error term

a_1 to a_5 elasticities of production.

The combination of different resources to yield gap was estimated with the help of Decomposition model. The following functional form was used to work out the yield gap. *(Bisliah, 1977)* The Chow test was conducted for checking the production elasticity of the two functions.

Technological adoption pattern on sample farm

In order to measure the technology adoption, index the adoption of cotton production technology viz; date of sowing ,method of sowing, seed rate, manures, application of FYM and chemical fertilizers and plant protection measures, etc; were considered. The Technology Adoption Index (TAI) in percentage was estimated by using the following formula.

$$TAI = \frac{A_i}{M_i} \times 100 \quad TAI = \frac{A_i}{M_i} \times 100$$

Where,

Ai = Average adoption score registered by the farmer for particular component

Mi = Maximum adoption score registered by the farmer for particular component.

RESULTS AND DISCUSSION

Per hectare resource use levels of cotton in Marathwada region

The per hectare utilization of physical quantities of different inputs are presented in Table 1.

Table 1. Per hectare resource use levels of cotton for Marathwada **n=96**

Sr. No.	Particulars	Small	Medium	Large	Overall
1	Total Human labour (Days)	136.36	142.02	149.07	144.30
	a.Male	53.90	81.61	65.30	68.86
	b. Female	82.46	60.41	83.77	75.44
2	Bullock power (pair days)	05.11	06.16	012.16	08.79
3	Machine power in hrs.	03.20	03.63	06.10	04.71
4	Seed (Kgs)	01.60	01.80	01.70	01.72
5	Manures (Qtls.)	15.00	18.00	25.00	20.74
6	Fertilizers (Kgs)				
	N	72.84	85.32	70.19	75.92
	P	22.30	20.49	26.14	23.48
	K	22.77	32.61	30.89	30.00
7	Irrigation Charges (₹)	526.82	548.15	560.15	549.89
8	Plant protection charges (₹)	442.20	222.58	1025.00	640.24

It was accompanied by lower cost of cultivation in improved method of cotton owing to the higher requirement of inputs, except manure. This might be because of organic nature of the improved method of cotton cultivation. Inputs played a significant role for boosting production of cotton. The production and productivity of cotton depend on the judicious and the balanced use of inputs. The adoption level of production technologies for cotton was primarily influenced by the human labour, bullock power, seed, manures, fertilizer etc.

Per hectare resource use gap of cotton in Marathwada region

Table 2 presents the per hectare resource use gaps of cotton cultivation in recommended and actual use levels of input and output as per the adoption level.

Table 2 : Per hectare resource use gap of cotton for Marathwada region **n=96**

Sr. No.	Particulars	Actual	Demon.	Gap	% Gap
1	Total Human labour (Days)	144.30	155.40	11.10	7.14
2	Bullock power(pair days)	8.79	8.15	-0.64	-7.85
4	Seed (Kgs)	1.72	3.00	1.28	42.79
5	Manures (Qtls.)	20.74	75.00	54.26	72.34
6	Fertilizers (Kgs)				
	N	75.92	100.00	24.08	24.08
	P	23.48	50.00	26.52	53.04
	K	30.00	50.00	20.00	40.00
7	Yield (Qtl)	10.40	16.00	5.60	34.97

(-ve sign indicates excess use)

The Agricultural Universities and various research institutes recommended the input use for higher production of the crops, this differs usually from the actual use of inputs by the farmers.At the overall level in Marathwada region, the inputs viz; human labour, seed, maures andfertilizers were utilized less than the recommended. At the overall level, the per hectare excess use of bullok power was more than recommendation in Marathwada region (7.85 per cent).The gap between actual and recommended yield was 34.97 per cent. It was maximum in manures(72.34 per cent) .

Per hectare cost of cultivation cotton for Marathwada region

The per hectare cost of cultivation of cotton was worked out by using standard cost concepts. The information on various items of cost of cultivation of cotton for different size groups of holdings is presented in Table 3.

At the overall level, per hectare cost of cultivation of cotton i.e. Cost 'C' was ₹ 45221.01. Amongst the different items of cost, family human labour was the major item of cost which accounted for ₹11,985.91 (26.50 per cent) followed by rental value of land ₹ 7,708.03 (17.05 per cent), hired human labour charges ₹ 5,887.28 (13.02 per cent), bullock labour ₹ 4,012.69 (8.87 per cent), seed ₹ 3,390.97 (7.50 per cent), manures ₹ 3,111.49 (6.88 per cent), interest on fixed capital ₹ 2,856.20 (6.32 per cent), fertilizers ₹ 1,822.92 (4.03 per cent) of the total cost of cultivation of cotton the Cost 'A' was 50.13 per cent and Cost 'B' was 73.49 per cent.

Table 3 : Itemwise per hectare cost of cultivation cotton for Marathwada region (Value in ₹)

Sr. no	Cost items	Small			Medium			Large			Overall		
1	Hired Human labour (Mandays)	Qty	Value	Per cent	Qty	Value	Per cent	Qty	Value	Per cent	Qty	Value	Per cent
	(a) Male	22.71	3406.50	9.31	20.46	3069.00	7.27	25.11	3766.50	7.42	23.06	3458.89	7.65
	(b) Female	20.83	2083.00	5.69	20.25	2025.00	4.79	28.60	2860.00	5.63	24.28	2428.39	5.37
2	Bullock power (Pair days)	5.11	2299.50	6.28	6.16	2772.00	6.56	12.16	5593.60	11.02	8.79	4012.69	8.87
3	Machine power (hrs)	3.20	144.00	0.39	3.63	90.75	0.21	6.10	125.05	0.25	4.71	116.64	0.26
4	Seed (kg)	1.60	3112.00	8.50	1.80	3780.00	8.95	1.70	3213.00	6.33	1.72	3390.97	7.50
5	Manures (q)	15.00	2250.00	6.15	18.00	2700.00	6.39	25.00	3750.00	7.39	20.74	3111.49	6.88
6	Fertilizers (kg)												
	N	72.84	1033.60	2.82	85.32	1381.33	3.27	70.19	855.62	1.69	75.92	1070.37	2.37
	P	22.30	405.85	1.11	20.49	372.92	0.88	26.14	423.47	0.83	23.48	402.73	0.89
	K	22.77	245.94	0.67	32.61	384.80	0.91	30.89	364.50	0.72	30.00	349.82	0.77
7	Irrigation Charges (₹)		526.82	1.44		548.15	1.30		560.15	1.10		549.89	1.22
9	Plant protection charges (₹)		442.20	1.21		222.58	0.53		1025.00	2.02		640.24	1.42
10	Incidental charges (₹)		415.16	1.13		550.12	1.30		650.18	1.28		572.47	1.27
11	Reapirs (₹)		312.56	0.85		419.25	0.99		517.26	1.02		445.81	0.99
	Working capital (₹)		**16677.13**	**45.56**		**18315.90**	**43.36**		**23704.33**	**46.69**		20550.39	**45.44**

12	Int.on Working Capital		1000.63	2.73		1098.95	2.60		1422.26	2.80		1233.02	2.73
13	Depre.on farm impliments		738.79	2.02		915.16	2.17		812.41	1.60		834.53	1.85
14	Land revenue and taxes		**98.6**	0.27		35.16	0.08		48.25	0.10		52.93	0.12
	Cost 'A'		**18515.14**	**50.58**		**20365.17**	**48.21**		**25987.25**	**51.19**		22670.88	**50.13**
15	Rental value of land		6336.65	17.31		7419.34	17.56		8454.58	16.65		7708.03	17.05
16	Int .on fixed capital		915.18	2.50		1270.16	3.01		4780.20	9.42		2856.20	6.32
	Cost 'B'		**25766.97**	**70.38**		**29054.67**	**68.78**		**39222.03**	**77.26**		33235.11	**73.49**
17	Family labour												
	(a) Male	31.19	4679.07	12.78	61.15	9172.50	21.71	40.19	6028.50	11.87	45.81	6870.78	15.19
	(b) Female	61.63	6162.58	16.83	40.16	4016.00	9.51	55.17	5517.00	10.87	51.15	5115.13	11.31
	Cost 'C'		**36608.63**	**100**		**42243.17**	**100**		**50767.53**	**100**		45221.01	**100**
II	**Output (q)**												
	(a) Main produce	8.86	38098.00		10.14	44109.00		11.20	50400.00		10.40	45967.38	
	(b) Bye-produce	5.13	513.48		6.18	618.00		6.17	617.00		5.98	598.39	
III	Cost 'C' net of bye produce		36095.15			41625.17			50150.53			44622.62	
IV	Per quintal cost		**4073.94**			**4105.05**			**4477.73**			4274.65	

(Figures in parentheses indicate percentage to the respective cost C)

Over the size group of holding, per hectare total cost of cultivation of cotton was ₹ 36,608.63, ₹ 42,243.17 and ₹ 50767.53 for small, medium and large size group of holdings, respectively. It indicated that the per hectare yield of cotton increased with an increase in the size of holdings. The gross income received from cotton was observed to be ₹ 38611.48, ₹ 46565.77 and ₹ 51017.00 in small, medium and large size groups, respectively, While at overall level, it was ₹ 46565.77. The per hectare net profit decreased with the increasing size of group. At the overall level B: C ratio was 1.03. From the above discussion it is indicated that the per unit cost of cultivation was declining as size group increased.

Production Function Estimates of Demonstration plot and Sample cultivators

The analysis of variance in respect of the production function showed a significant variance, indicating the overall significance of the estimated production function Table 4.

Table 4 : Results of Cobb-Douglas production function for Marathwada region

Sr. No.	Particulars	Regression coefficients	
		Sample cultivators	Demo. plot
X_1	Human labour	0.0121 (0.0618)	0.3626** (0.1436)
X_2	Bullock labour	0.3429** (0.1658)	0.1415 (0.2214)
X_3	Machine labour	0.0045 (0.0366)	0.7685 (0.6819)
X_4	Seed	0.2511 (0.3131)	0.1346 (0.1578)
X_5	Manures	0.2417* (0.1130)	0.6216** (0.2486)
X_6	N	0.7016*** (0.2437)	0.2854* (0.1346)
X_7	P	0.0214 (0.0316)	0.6874** (0.3064)
X_8	K	0.5399*** (0.2190)	0.7056 (0.7316)
R^2	Coefficient of multiple determination	0.7	0.72
	Number of observation	96	30
	D.F.	87	21

(Figures in parentheses are standard errors of respective regression coefficients)

*, **, *** are significant at 10, 5, and 1 per cent level

The value for the coefficient of multiple determination (R^2) for demonstration plot was 0.72, which suggested that the six resources included in the production function had jointly explained as high as 72 per cent of total variation in the demonstration plot, whereas it was 70 per cent ($R^2 = 0.70$) for the sample farms. It showed that the variables taken into consideration were more crucial factors in demonstration plot than on the sample farm cultivators. In the demonstration plot method, human labour, manures, nitrogen and phosphorus were found positively significant. This means that usage of less than the recommended dose of these inputs would result in a increases in production.On sample farm cultivators, bullock labour , manure and potassium were positively significant. Thus, the sample cultivators farms were more labour intensive and exhaustive as it responded more to labour usage and manure application.

Results of decomposition analysis of cotton for Marathwada region

In the present study, the yield gap between actual farms and demonstration methods was to the tune of 34.97 per cent Table 5.

Table 5 : Results of decomposition analysis for Marathwada region

Sr.No.	Source of productivity difference	Percentage contribution
A	Total difference observed in output	34.97
B	Source of contribution	
	1.Difference in cultural practices	13.33
	2.Due to difference in input use level	
	a. Human labour	4.10
	b. Bullock labour	-2.18
	c. Seed	2.10
	d. Manure	6.40
	e. Nitrogen	5.02
	f. Phosphorous	4.12
	g. Potash	2.08
C	Due to all inputs	21.64
D	Total estimated gap from all sources	34.97

Among other sources of yield gap, cultural practices (13.33%) turned out to be the major contributor. Thus, without incurring extra expenditure on required inputs, only by adopting the recommended cultivation practices, the yield can be increased by 13.33 per cent in cotton. The appropriate usage of inputs can reduce the yield gap between actual farm and demonstration methods to the extent of 21.64 per cent.

Among these inputs, human labour, bullock labour and manure have proved to be more important . Patole *et al.* (2008) by using the Bislaih (1977) model of decomposition, had estimated that yield gap in chickpea in the Ahmednagar district of Maharashtra was 53 per cent, of which, input use (29%) had a higher role than cultural practices (24%).

Technology adoption index on sample farm in Marathwada region

The technology adoption of index gives the clear cut idea about the adoption of a particular technology component whereas the magnitude of composite index gives the aggregate percentage of adoption of all components of technology. The detail procedure of constructing the technology adoption index was given in methodology chapter and the information are presented in Table 6 .

The result indicated that at the overall level, the adoption of method of sowing technology component was observed maximum (86.11 per cent) to be on sample farms followed by date of sowing (77.78), variety (65.28), seed rate (61.11 per cent), nitrogen (40.97 per cent) and phosphorus (36.11 per cent) . The lowest technology was noticed in case of potash (30.21per cent) and manures (20.83 per cent) component of technology, respectively.

Table 6 : Technology adoption index on sample farm for Marathwada region

Sr. No.	Component	Size group			Overall (Percent)
		Small	Medium	Large	
1	Date of sowing	76.04	77.08	80.21	77.78
2	Seed rate	58.33	61.46	63.54	61.11
3	Variety	63.54	65.63	66.67	65.28
4	Method of sowing	84.38	86.46	87.50	86.11
5	Manures	8.33	25.00	29.17	20.83
6	Nitrogen	39.58	40.63	42.71	40.97
7	Phosphorous	34.38	36.46	37.50	36.11
8	Potash	29.17	32.29	35.42	32.29
9	Plant protection	25.00	31.25	34.38	30.21
10	Composite Index	46.52	50.69	53.01	50.08
11	Yield (qtls.)	8.86	10.14	11.20	10.40

The composit index of technology adoption was worked out to 50.08 per cent indicated that the sample farmers adopted less than 50 per cent recommended cotton production technology obtaining 10.40 qtls/ha yield. The positive relationship was observed in between composite index and yield obtained on sample farms i.e. increase in composite index resulted in increase in yield. It was also noticed that the magnitude of composite index increased as size of holding increased. The same trend was observed in adoption of all component of technology.

Impact of improved cotton production technology for Marathwada region

The impact of improved cotton production technology in Marathwada region is presented in Table 7.

The impact of technology on per hectare yield of main produce was found to be 17.11 and 6.70 per cent, respectively. In the medium adopters, the per hectare economic impact of cotton production technology on gross return, cost of cultivation and net returns was 13.67, 11.62 and 29.19 per cent, respectively over the low adopters, similarly in the high adopters, it was 4.70,3.80 and 10.94 , respectively over the medium adopters. The B:C was maximum (1.14) in high adopters followed by medium (1.13) and low adopters (1.11). The per hectare yield has increased from 8.19 to 10.59 quintal per hectare over the difference level of adoption.

Table 7 : Impact of improved cotton production technology for Marathwada region

Particulars	Low adopters	Medium adopters	Low To Medium % impact	High adopters	Medium to High % impact
Adoption %	**42.92 (Below 50)**	**57.92 (50-70)**		**72.93 (Above 70)**	
Yield (q/ha)					
1.Main produce	8.19	9.88	**17.11**	10.59	**6.70**
2.By-produce	5.13	6.18	**16.99**	6.69	**7.62**
Economics (₹/ha)					
1.Gross returns	38611.00	44724.00	**13.67**	46930.00	**4.70**
2.Cost of cultivation	34912.00	39500.00	**11.62**	41064.00	**3.80**
3.Net returns	3699.00	5224.00	**29.19**	5866.00	**10.94**
B:C ratio	**1.11**	**1.13**		**1.14**	

Cost effectiveness of improved cotton production technology					
Added returns		6113.00		2206.00	
Added cost		4588.00		1564.00	
ICBR ratio		**1.33**		**1.41**	
Cost (₹/q)	4362.75	3997.97		3877.62	
Unit cost reduction (₹/q)		264.79		120.35	
% reduction		6.21		3.01	
Added yield (q)		1.69		0.71	
% increase in Yield		**20.63**		**6.70**	

Identification of major constraints in adoption improved production technology of cotton for Marathwada

The farmers were asked to offer opinions as per priority-wise major constraints they were facing in adoption improved production technology of cotton cultivation in Marathwada region. The information regarding various constraints faced by the cultivators growing cotton for the State as a whole is presented in Table 8.

It is seen that, constraints regarding rainfall like abnormal distribution of rainfall and inadequate rainfall were reported by 50.00 and 48.96 per cent farmers, respectively at the overall level. Low price to produce, high price of fertilizer, High wage rates, lack of irrigation technology, expensive and more labour required and high cost of seed was common complaint reported by above 50.00 per cent of the farmers. In case of method of sowing , about 50-60 per cent farmers expressed difficulties to know the recommendation.

Table 8 : Constraints in adoption improved production technology of cotton for Marathwada region

Sr. No.	Particulars	Group			Overall (n=96)
		Small (n=32)	Medium (n=32)	Large (n=32)	
A.	**Rainfall**				
1	Abnormal distribution of rainfall	59.38	50.00	40.63	50.00
2	Inadequate	53.13	50.00	43.75	48.96
B.	**Seed rate**				
3	High cost	65.63	59.38	56.25	60.42
4	Lack of awareness	46.88	46.88	50.00	47.92
C.	**Time of sowing and variety**				
5	Lack of awareness	50.00	43.75	37.50	43.75
6	Non-availability of proper variety seed	68.75	59.38	59.38	62.50
D.	**Method of sowing**				
7	Recommendation not known	53.13	43.75	56.25	51.04
8	Expensive and more labour required	68.75	62.50	59.38	63.54
9	Seed treatment				
10	Unawareness	53.13	68.75	65.63	62.50
E.	High cost	65.63	50.00	56.25	57.29
F.	**Fertilizer application**				
11	High cost of fertilizer	87.50	78.13	81.25	82.29
12	Inadequate supply	56.25	46.88	46.88	50.00
13	Lack of knowledge about fertilizers	53.13	56.25	53.13	54.17
G.	Irrigation				
14	unavaibility of irrigation sources	75.00	53.13	53.13	60.42
15	lack of irrigation technology	81.25	62.50	62.50	68.75
H.	**Labour**				
16	Inadequate	50.00	34.38	53.13	45.83

17	High wage rates	87.50	75.00	81.25	81.25
18	Non-availability at peak period	68.75	68.75	71.88	69.79
I.	**Plant protection**				
19	Inadequate supply	40.63	37.50	34.38	37.50
20	Higher cost	71.88	68.75	65.63	68.75
J.	**Improved implements**				
21	High cost	43.75	46.88	59.38	50.00
22	Poor economic condition	71.88	46.88	46.88	55.21
23	Small and fragmented land holding	68.75	56.25	40.63	55.21
K.	**Lack of technical know-how**	53.13	589.38	56.25	56.25
L.	**Low price to produce**	84.38	81.25	84.38	83.33

CONCLUSION

The resource use gap was maximum in use of FYM and seed rate. The magnitudes being ranged between 43 to 73 per cent. recommendation of Agricultural Universities. Whereas per hectare resource use gap of cotton in Marathwada region the yield gap was to be found 34.37 per cent.

The major items of cost of cultivation in cotton were hired human labour charges, rental value of land, manures, bullock labour charges and family human labour. The per quintal cost of production of cotton was ₹ 4274.65 and the Benefit: cost ratio of cotton was greater than unity. Therefore, cotton is profitable enterprise, it was due to the introduction of Bt cotton cultivation.

The positive and significant coefficients indicated that, one unit increase in the use of human labour, manures, nitrogen and phosphorus will minimise the gap. The decomposition function analysis, revealed that 34.97 per cent yield increase was to adoption of new technologies in cotton. High level adoption impact of cotton production technologies helped to increase the annual income and employment of the sample farm families. The major constraint were reported in cotton production technology viz.'high cost of inputs, unawareness and low price to produce.

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