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Economic Assessment of Adoption of Production Technology of Cotton in Western Maharashtra Region of Maharashtra

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ABSTRACT: *The study has assessed the economic analysis and impact assessment of production technology of cotton cultivation in Western Maharashtra region of Maharashtra for the year 2013-14, based on the data of costs and returns of crop. 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 70471.44 and BCR has 1.06, whereas the per quintal cost of production was ₹4329.32 at the overall level for improved cotton cultivation methods. Further, there was a 19.34 per cent yield gap between actual yield and demonstration plot yield, in which cultural practices (8.20 per cent) have shown a stronger effect than input use (11.14 per cent). The composite index of technology adoption was 54.32 per cent which indicated that the sample farmers adopted less than 45 per cent recommended cotton production technology and obtained 16.13 qtls/ha yield. The contribution of different components on impact of cotton production technology in Western maharashtra region, net returns was maximum (55.52 per cent). The most important constraint in improved method of cotton cultivation has been identified as 'high cost of seed, fertilizers and labour charges, lack of knowledge about fertilizers application, seed treatment and low price for produce. The improved cotton production technology method being more skill oriented, the study has observed that yields can be increased on adoption and the constraints are addressed on war-footing basis.*

Keywords: *Production function, Technological gap and resource use gap, Yield gap.*

INTRODUCTION

Cotton (Gossipium SPP) 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 and below), medium staple (20.5 mm to 27.00 mm), long staple (27.50 mm to 32.00 mm) and Extra long stable (32.5 mm to above). Cotton is used to make a number of textile products. The first Chiese paper was made of cotton fiber. The cotton seed which remains after the cotton is ginned is used to produce cotton seed oil. Cotton seed hulls can be added to dairy cattle rations for roughage.

WORLD AND INDIA

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

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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).

India's export of cotton was insignificant up to 2004-2005 and increased only during 2005-2006 and 2006-2007. India exports cotton 5000 (1000 480 Ib. Bales) in 2010 and 7500 (1000 480 Ib. bales) in 2013.India exports cotton to Asian countries *viz.* Indonasia (50,534 Tons), Thailand (44,478 Tons), Viatnam (35,670 Tons) and negligible quantities to Philipines and Malaysia. India exports to these are approximately 12 per cent of their requirement. Main competition for India for export of cotton is from Australia and USA. India needs to strive for higher productivity and lower cost of production on one hand and improve quality on the other for enhancing export to these countries.

In the present study an attempt has been made to analyze the impact of improved technologies on cotton production in different regions of Maharashtra. The studies undertaken so far had mostly focused on the favorable effects of technological change. The reasons for the rate of adoption lagging behind expectation have been virtually unexamined. Therefore, a study which focuses 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 of Western Maharashtra region in Maharashtra" 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

(i) To study the resource use efficiency and cost and returns of cotton in Western Maharashtra region.

(ii) To study technology adoption and its impact on production of cotton in Western Maharashtra region and

(ii) To examine the constraints in adoption of cotton production technologies in Western Maharashtra region.

MATERIALS AND METHODS

The study was conducted in the Western Maharashtra region of Maharashtra. Two districts from the region viz; Jalgaon and Dhule and from each district two tahsils were selected on the basis of maximum area under cotton cultivation . Two village from each tahsil were selected. Among each village, 12 samples were selected thus sample from each size group i.e. 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 of cultivation. Thus, the total size of sample size comprise of 96 farms. The farmers were interviewed by 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. Five inputs were considered as important factors contributing to the production. The equation fitted was used in following form.

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

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 pair in 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,

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

Where,

b_i = Elasticity of production of i^{th} input
Y = Geometric mean of output
X_i = 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).

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

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.

$$\log (Y_2/Y_1) = [\log (b_0/a_0)] + [(b_1 - a_1) \log H_1 + (b_2 - a_2) \log B_1 + (b_3 - a_3) \log M_1 + (b_4 - a_4) \log N_1 + (b_5 - a_5) \log P_1] + [b_1 \log (H_2/H_1) + b_2 \log (B_2/B_1) + b_3 \log (M_2/M_1) + b_4 \log (N_2/N_1) + b_5 \log (P_2/P_1)] + [U_2 - U_1]$$

Technological Adoption Pattern on Sample Farm

In order to measure the technology adoption index 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.

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

Where,

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

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

RESULTS AND DISCUSSION

Per Hectare Cost of Cultivation

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 1.

It can be seen from the Table 1 that at the overall level, per hectare cost of cultivation of cotton i.e. Cost '*C*' was ₹ 70471.44. Amongst the different items of cost, hired human labour charges was the major item of cost which accounted ₹ 14459.59 (20.52 per cent) followed by rental value of land to ₹ 12354.81 (17.53 per cent) and family human labour ₹ 11643.01 (16.52 per cent). Of the total cost of cultivation of cotton, the Cost '*A*' was ₹ 43829.23 (62.19 per cent) and cost *B* was ₹ 58828.44 (83.48 per cent). Among the size group of holdings, the per hectare yield was 15.90 quintals, 16.80 quintals, and 15.80 quintals in small, medium and large size groups, respectively. It indicated that the per hectare yield of cotton has increased with an increase in the size of holdings. The gross income received from cotton was ₹ 72811.20, ₹ 77100.00 and ₹ 73531.20 in small, medium and large size groups, respectively, While at overall level, it was ₹ 74547.30.The per hectare net profit has increased with the increasing size of group.

At the overall level *B* : *C* ratio was 1.41. From the above discussion it is indicated that the per unit cost of cultivation was declining as size group increased.

Per Hectare Resource use Levels of Cotton in Western Maharashtra region

The quantities of various inputs used directly affected the cost of cultivation and therefore, utilization of inputs such as human labour, bullock labour, seeds, manures, fertilizer etc., have been studied in per hectare physical and monetary terms. The per hectare utilization of physical quantities of different inputs are presented in Table 2.

It was accompanied by lower cost of cultivation in improved method of cotton owing to the higher requirement of inputs. 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, fertilizers etc.

Table 1

per hectare cost of cultivation of cotton in Western Maharashtra region(Value Rs.)

Sr.no	*Cost items*	*Small*		*Medium*		*Large*		*Overall*					
I. 1	*Hired Human labour (Mandays)*	*Qty*	*Value*	*Per cent*	*Qty*	*Value*	*Per cent*	*Qty*	*Value*	*Per cent*	*Qty*	*Value*	*Per cent*
	(a) Male	15.12	3024.00	4.41	10.16	2032.00	2.82	30.45	6090.00	8.70	21.65	4330.89	6.15
	(b) Female	98.12	14718.00	21.48	68.14	10221.00	14.16	58.16	8724.00	12.46	67.52	10128.70	14.37
2	Bullock power (Pair days)	8.20	4920.00	7.18	12.40	7440.00	10.31	8.15	4890.00	6.98	9.50	5700.65	8.09
3	Machine power	11.12	333.60	0.49	16.13	483.90	0.67	13.56	406.80	0.00	13.99	419.79	0.60
4	Seed (Kgs)	1.80	3708.00	5.41	1.85	3811.00	5.28	1.87	3852.20	5.50	1.85	3816.77	5.42
5	Manures (qtls.)	20.32	4064.00	5.93	25.16	5032.00	6.97	30.18	6036.00	8.62	27.06	5412.19	7.68
6	Fertilizers (Kgs)												
	N	90.80	1470.05	2.15	110.20	1784.14	2.47	105.16	1702.54	2.43	104.52	1692.20	2.40
	P	48.16	1069.15	1.56	50.12	1112.66	1.54	52.60	1167.72	1.67	51.13	1135.00	1.61
	K	49.14	628.99	0.92	36.13	462.46	0.64	40.13	513.66	0.73	40.27	515.40	0.73
9	Plant protection charges (Rs.)		2615.30	3.82		2012.18	2.79		2818.16	4.02	2531.89	3.59	
10	Incidental charges (Rs.)		815.19	1.19		680.20	0.94		915.60	1.31	825.59	1.17	
11	Reapirs (Rs.)		617.20	0.90		715.19	0.99		715.80	1.02		700.28	0.99
	Working capital (Rs.)		*40000.67*	*58.39*		*38004.90*	*52.67*		*40948.08*	*58.46*		*39870.58*	*56.58*
12	Int.on Working Capital		2400.04	3.50		2280.29	3.16		2456.89	3.51		2392.24	3.39
13	Depre.on farm impliments		1415.16	2.07		1816.19	2.52		1329.56	1.90		1496.67	2.12
14	Land revenue and taxes		70.26	0.10		82.19	0.11		62.14	0.09		69.74	0.10
	Cost 'A'		43886.13	64.06		42183.57	58.46		44796.67	63.96		43829.23	62.19
15	Rental value of land		12064.94	17.61		12767.81	17.69		12193.06	17.41		12354.81	17.53
16	Int .on fixed capital		3215.14	4.69		2918.60	4.04		2312.58	3.30		2644.39	3.75
	Cost 'B'		*59166.21*	*86.37*		*57869.98*	*80.20*		*59302.31*	*84.67*		*58828.44*	*83.48*
17	Family labour												
	(a) Male	31.56	6312.00	9.21	48.80	9760.00	13.53	30.85	6170.00	8.81	36.63	7326.77	10.40
	(b) Female	20.18	3027.00	4.42	30.20	4530.00	6.28	30.45	4567.50	6.52	28.77	4316.24	6.12
	Cost 'C'		68505.21	100		72159.98	100		70039.81	100		70471.44	100
II	*Output (qtls.)*												
	(a) Main produce	15.90	72504.00		16.80	76608.00		15.80	72680.00		16.13	73894.18	
	(b) Bye-produce	5.12	307.20		8.20	492.00		12.16	851.20		9.81	653.12	
III	Cost 'C' net of bye produce		68198.01			71667.98			69188.61			69818.32	
IV	Per quintal cost		4289.18			4265.95			4379.03			4329.32	

(Figures in parentheses indicate percentage to the Cost 'C')

Table 2
Per hectare resource use levels of cotton in Western maharashtra region

Sr. No.	*Particulars*	*Size group*			
		Small	*Medium*	*Large*	*Overall*
1.	Total Human labour (days)	164.98	157.30	149.91	154.59
	(a) Male	46.68	58.96	61.30	58.29
	(b) Female	118.30	98.34	88.61	96.30
2.	Bullock power (pair days)	8.20	12.40	8.15	9.50
3.	Machine power in hrs.	11.12	16.13	13.56	13.99
4.	Seed (Kgs)	1.80	1.85	1.87	1.85
5.	Manures (qt.)	20.32	25.16	30.18	27.06
6.	Fertilizers (Kg.)				
	N	90.80	110.20	105.16	104.52
	P	48.16	50.12	52.60	51.13
	K	49.14	36.13	40.13	40.27
7.	Irrigation Charges (Rs.)	2017.18	2218.16	3115.60	2661.24
8.	Plant protection charges (Rs.)	2615.30	2012.18	2818.16	2531.89

Per hectare resource use gap of cotton in Western Maharashtra region.

Table 3 presents the per hectare resource use gaps of cotton cultivation in recommended and actual use levels of inputs and output as per the adoption level. 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 Western Maharashtra region, the inputs *viz;* human labour, manures, phosphorus and potash were utilized less than the recommended. At the overall level, the per hectare excess use of bullock power was more than recommendation in Western maharashtra region (3.52 per cent) .

The gap between actual and recommended yield was 19.34 per cent. It was maximum in manures (63.92 per cent) and it was followed by potash (38.05 per cent), seed (25.89 per cent), phosphorus (21.34 per cent), human labour (18.69 per cent) and nitrogen (16.38 per cent).

Cobb-Douglas production function estimate for demonstration plot and sample cultivators farm in western maharashtra. To know the contribution of major inputs in the production of cotton on the farmers plot and demonstration plot. The functional analysis was carried out. The results of the same are depicted in Table 4.

The results of the table indicated that the 72 per cent variation in the productivity of cotton on

Table 3
Per hectare resource use gap of cotton in Western Maharashtra region (Perha.)

Sr. No.	*Particulars*	*Sample cultivators*	*Recommended*	*Gap*	*% Gap*
1.	Total Human labour (days)	154.59	190.12	35.53	18.69
2.	Bullock power (pair days)	9.50	9.16	–0.34	–3.72
3.	Seed (Kg.)	1.85	2.50	0.65	25.89
4.	Manures (qtls.)	27.06	75	47.94	63.92
5.	Fertilizers (Kg.)				
	N	104.52	125	20.28	16.38
	P	51.13	65	13.87	21.34
	K	40.27	65	24.73	38.05
6.	Yield (qtl)	16.13	20	3.87	19.34

farmer's plots had been explained by selected variables. The magnitude of the same was to the tune of 73 per cent for demonstration plot. The coefficient for human labour and manures were found to be positively significant.

To know whether the above two production functions *viz;* on farmer's plots and on demonstration plots, were differ from each other, the Chow's '*F*' test was carried out.

Table 4
Cobb-Douglas of production function estimate for demonstration plot and Sample farms in Western Maharashtra region

Sr. No.	*Particulars*		*Method of cultivation*	
			Sample cultivator farms	*Demonstration plot (Recommended)*
1	Intercept		0.8808	1.6989
2	Human labour (days)	X_1	0.6417*** (0.1890)	0.6287** (0.2465)
3	Bullock labour (days)	X_2	0.8112** (0.3823)	0.8015** (0.2909)
4	Seed (Kgs.)	X_3	0.1225* (0.0640)	0.1204* (0.0625)
5	Manures (Kgs.)	X_4	0.0199** (0.0093)	0.0181*** (0.7283)
6	Nitrogen (Kgs.)	X_5	0.0013 (0.1678)	0.0013** (0.0605)
7	Phosphorous (Kgs.)	X_6	0.0018 (0.2174)	0.6014 (0.1985)
8	Potash (Kgs.)	X_7	0.0018 (0.0224)	0.0012 (0.1698)
9	Coefficient of Multiple Determination	R^2	0.72	0.73
10	Number of observation	N	72	30
11	D.F.		64	22
12	F-value		17.06***	13.40***

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

*, ** and *** indicates significance level at 10, 5 and 1 per cent level

The value of Chow's '*F*' test had turned out to be 17.06 with 1 per cent level of significance, implying therby the estimated production functions on farmers plot and demonstration plot were different. An attempt was made to examine on which fronts two production functions differ from each other. The difference between the coefficient of corresponding parameters between two functions were tested by '*t*' test. These differences were due to change in slope as well as intercept parameter. The magnitude of intercept term was 0.73 for demonstration production functions, while it was 0.72 for farmers plot production function and the difference between two was significant, indicating therby effect of pre-sowing technology as well timely cultural practice operations. In other words, effect of use of technology was clearly seen on the demonstration plots.

As regards the magnitudes of other coefficients *viz*; seed, manures, nitrogen, phosphorus and potash were comparatively higher for the production function of the demonstration plot. It indicated that they have contributed in production of cotton on demonstration plot. The parameters obtained were useful for decomposing yield into its constituent sources.

Results of decomposition analysis of cotton in Western Maharashtra region.

In the present study, the yield gap between actual farms and demonstration methods was to the tune of 19.34 per cent (Table 5).

Among other sources of yield gap, cultural practices (8.20%) 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 11.14 per cent in cotton.

Technology adoption index on sample farm in Western Maharashtra 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 (91.67 per cent) to be on sample farms followed by date of sowing (87.15 per cent), variety (69.44 per cent), seed rate (65.63 per cent), nitrogen (42.01 per cent) and phosphorus (37.85 per cent). The lowest technology was noticed in case of manures component (30.90 per cent) of technology.

The composite index of technology adoption was 54.32 per cent which indicated that the sample farmers adopted less than 45 per cent recommended cotton production technology obtaining 16.13 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 the increase in the yield. It was also noticed that the magnitude of composite index increases as size of holding increased. The same trend was observed in adoption of seed rate, application of nitrogen and potash component of technology. The increasing trend was observed in adoption of use of fertilizer and plant protection component of technology with size of farms.

Table 5
Results of decomposition analysis in Western Maharashtra region

Source of productivity difference	*Percentage contribution*
A. Total difference observed in output	19.34
B. Source of contribution	
1. Difference in cultural practices	8.20
2. Due to difference in input use level	
(a) Human labour	1.15
(b) Bullock labour	–4.15
(c) Seed	1.10
(d) Manure	3.50
(e) Nitrogen	3.04
(f) Phosphorous	2.14
(g) Potash	4.36
C. Due to all inputs	11.14
D. Total estimated gap from all sources	19.34

Table 6
Technology adoption index on sample farm in Western Maharashtra region

Component		*Size group*			*Overall*
Sr. No.		*Small*	*Medium*	*Large*	
1.	Date of sowing	85.42	87.50	88.54	87.15
2.	Seed rate	62.50	65.63	68.72	65.63
3.	Variety	66.67	68.75	72.92	69.44
4.	Method of sowing	88.54	91.67	94.79	91.67
5.	Manures	27.08	32.29	33.33	30.90
6.	Nitrogen	40.69	41.67	43.75	42.01
7.	Phosphorous	36.46	37.50	39.58	37.85
8.	Potash	31.25	34.38	36.46	34.03
9.	Plant protection	25.00	31.25	34.38	30.21
10.	Composite Index	51.50	54.51	56.94	54.32
11.	Yield (qtls.)	15.90	16.80	15.80	16.13

Table 7
Impact of improved cotton production technology in Western Maharashtra region

Particulars	*Low adopters*	*Medium adopters*	*Low to Medium % impact*	*High adopters*	*Medium to High % imapct*
Adoption %	*42.92% (Below 50)*	*57.92% (50-70)*		*72.93% (Above 70)*	
Yield (Q/ha)					
1. Main produce	12.19	13.78	11.54	14.89	18.13
2. By-produce	7.12	8.20	13.17	9.19	22.52
Economics (Rs/ha)					
1. Gross returns	56074.00	63388.00	11.54	70531.00	20.50
2. Cost of cultivation	52981.00	58707.00	9.75	63578.00	16.67
3. Net returns	3093.00	4681.00	33.92	6953	55.52
B : C ratio	*1.06*	*1.08*		*1.11*	
Cost effectiveness of improved cotton production technology					
Added returns		7314.00		14457.00	
Added cost		5726.00		10597.00	
ICBR ratio		*1.28*		*1.36*	
Cost (Rs./Q)	4346.26	4260.30		4269.84	
Unit cost reduction (Rs./Q)		85.96		76.42	
% reduction		1.98		1.76	
Added yield (Q)		1.59		2.70	
% increase in Yield		*13.04*		*22.15*	

Impact of improved cotton production technology in Western Maharashtra region.

The result of impact of improved cotton production technology in Western maharashtra region is presented in Table 7.

Impact on yield of main produce and by-produce in the high adopters was found to be 18.13 per cent and 22.52 per cent, respectively and in case of medium adopters ,the economic impact of cotton production technology on gross returns, cost of cultivation and net returns was 11.54, 9.75 and 33.92 per cent, respectively over the low adopters. The maximum impact of cotton production technology in Western Maharashtra region was on net returns was (55.52 per cent) amongst the components considered. Percentage increased in yield 22.15 and 13.04 percentage in high and low adopters, respectively.

Identification of major constraints in adoption of improved production technology of cotton in Western Maharashtra region.

The farmers were asked to offer opinions as per priority-wise major constraints they were facing in adoption of improved production technology of cotton cultivation in Western maharashtra region. All these were sorted and screened and finally major constraints were identified and are presented in Table 8.

It is revealed that, at the overall level, the major constraint opined were high cost of seed, untimely supply of fertilizers, expensive and more labour require wage rates, high cost of plant protection measures, high wage rates, unawareness, low price to produce more labour requirement and high cost of fertilizers were reported by farmers, respectively.

CONCLUSIONS

With the forgoing discussion, the following conclusions can be drawn

(i) The cost '*c*' and net by produce was highest in medium size group than the small and large size groups. The per hectare resource use gap of cotton in Western Maharashtra region, human labour, manures and potash were having low use as compared with the recommended resource use level. Other factors such as bullock power showed excess use as compared with the recommendation of Agricultural Universities. The maximum resource gap was observed in seed and phosphorus application, whereas per hectare yield gap of cotton in Western Mahrashtra region was to be found 19.34 per cent.

(ii) The result of Cobb-Douglas production function in the Western Maharashtra region, revealed that the coefficients of multiple determination for demonstration plots for human labour, manures,

Table 8
Constraints in adoption improved production technology of cotton in Western Maharashtra region (%)

Sr. No.	*Particulars*	*Group*			
		Small (N = 32)	*Medium (N = 32)*	*Large (N = 32)*	*Overall (N = 96)*
A.	Rainfall				
	1. Abnormal distribution of rainfall	46.88	40.63	34.38	40.63
	2. Inadequate	50.00	37.50	40.63	42.71
B.	Seed rate				
	3. High cost	65.63	53.13	56. 25	58.33
	4. Lack of awareness	43.75	37.50	40.63	40.63
C.	Time of sowing and variety				
	5. Lack of awareness	46.88	37.50	34.38	39.58
	6. Non-availability of proper variety seed	62.50	56.25	53.13	57.29
D.	Method of Sowing				
	7. Recommendation not known	50.00	40.63	40.63	43.75
	8. Expensive and more labour required	65.63	59.38	56.28	60.42
	9. Seed treatment				
	10. Unawareness	50.00	65.63	62.50	59.38
E.	High cost	62.50	46.88	43.75	51.04
F.	Fertilizer application				
	11. High cost of fertilizer	84.38	75.00	75.00	78.13
	12. Inadequate supply	53.13	40.63	37.50	43.75
	13. Lack of knowledge about fertilizers	50.00	46.88	50.00	48.96
G.	Irrigation				
	14. unavaibility of irrigation sources	71.88	53.13	50.00	58.33
	15. lack of irrigation technology	78.13	59.38	56.25	64.58
H.	Labour				
	16. Inadequate	46.88	34.38	31.25	37.50
	17. High wage rates	87.50	75.00	71.88	78.13
	18. Non-availability at peak period	65.63	65.63	65.63	65.63
I.	Plant protection				
	19. Inadequate supply	37.50	34.38	31.25	34.38
	20. Higher cost	68.75	62.50	59.38	63.54
J.	Improved implements				
	21. High cost	40.63	40.63	40.63	40.63
	22. Poor economic condition	65.63	43.75	40.63	50.00
	23. Small and fragmented land holding	56.25	53.13	50.00	53.13
K.	Lack of technical know-	53.13	50.00	46.88	50.00
L.	Low price to produce	81.25	71.88	68.75	73.96

nitrogen and potash were found positive and significant. These positive and significant coefficients indicated that, one unit increase in the use of human labour, manures and nitrogen will minimise the gap.

(iii) The decomposition function analysis, revealed that 19.34 per cent yield increase was due to adoption of new technologies in cotton, in which, cultural practices (8.20 per cent) had higher role than the input use levels (11.14 per cent).At the overall level, the technology adoption index (TAI) was found high for method of sowing fallowed by date of sowing, variety, use of seed rate and phosphorous. At the overall level, technology composite index was 54.32 per cent, the contribution of component on impact of cotton production technology in Western Maharashtra region, net returns were maximum (55.52 per cent). High level adoption impact of paddy production technologies helped to increase the annual income and employment of the sample farm families.

(iv) The major constraint were reported in cotton production technology viz.'high cost of inputs, unawareness, low price to produce, lack technical knowledge, high wage rates, more labour requirement, time consuming methods and non availability of seed, fertilizers and labour were the major constraints in adoption of improved cotton production technologies.

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