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Economic Analysis and Impact Assessment of Paddy Production Technology in Vidarbha Region of Maharashtra

R.B. Hile[1*], A.S. Darekar[1], S.B. Datarkar[1] and B.T. Kamble[1]

Abstract: *The study has assessed the economic analysis and impact assessment of production technology of paddy cultivation in Konkan region of Maharashtra for the year 2013-14, based on the data of costs and returns. Apart from benefit-cost ratio (BCR), yield gap analysis, resource use efficiencies, technology adoption index and impact of improved paddy technology have been estimated in the study. It has shown that per hectare cost 'C' was ₹ 51,646 and BCR has 1.27, whereas, per quintal cost of production was ₹1,296 at the overall level for improved paddy cultivation methods. Further, there was a 23.83 per cent yield gap between actual yield and demonstration plot yield, in which cultural practices (12.17 per cent) have shown a greater effect than input use (11.66 per cent). The composite index of technology adoption was 54.38 per cent, which indicated that the sample farmers adopted less than 46 per cent recommended paddy production technology and obtained 36.56 q/ha yield. The contribution of different components on impact of paddy production technology in Vidarbha region of Maharashtra, net returns was maximum (63.00 per cent) followed by machine power, gross returns and main produce.*

The most important constraint in improved method of paddy cultivation has been identified as 'high cost of inputs,abnormal distribution of rainfall, adopted traditional methods, expensive and more labour required, high wage rates, lack of awareness, lack technical knowledge and low price to produce. The improved paddy 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, Yield gap, Decomposition model, Technologyadoption index and Impact of improved production technology.*

INTRODUCTION

India is one of the leading rice producing country amongst the world with cultivated area of 43.97 Mha and production of 100 Mt in 2011-12. The leading states in rice cultivation are: West Bengal, Uttar Pradesh, Orissa, Andhra Pradesh and Panjab. Maharashtra is one of the major rice growing state in India. Paddy is grown on 15.40 million hectares with an annual production of 35.00 million tonnes and productivity at 1821 kg/ha during the year 2011-12. Maharashtra ranks 12th in production and 13th in productivity among major rice growing states of the country (India Stat.Com, 2011).

In India, rice is an important ingredient of household food-basket, yet its yield level is low, stagnant and uncertain (Barah, 2009). Among the various agronomic practices judicious use of manures and fertilizers is one of the important strategies for increasing production of rice per unit area. The breeding of high yielding varieties have laid the basis for rice production in India. The improved varieties can give the anticipated yield per unit area, when grown under favorable environmental conditions without which they are not able to manifest their maximum yield potential. The high yielding varieties are highly responsive to fertilizers. In India, taking into consideration the soils having low levels of organic carbon, it is a great challenge to feed hybrid rice with balanced nutrition. Therefore, more attention needs to be given on organic sources like FYM, poultry manures and green manuring with optimum use of chemical fertilizers. More specially,

[1] Associate Professor, Ph.D. Scholar and Junior Research Assistant
[*] *E-mail : rbhile@gmail.com*

green revolution denotes the large increase in crop yields which in recent years, resulted mainly from the development and adoption of new hybrids and the improved technology associated with their culture.

In the present study an attempt has been made to analyze the impact of improved technologies on paddy 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 paddy production technology in Vidarbha regionof 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 paddy 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 paddy in Vidarbha region

(ii) To study technology adoption and its impact on production of paddy in Vidarbha region and

(ii) To examine the constraints in adoption of paddy production technologies in Vidarbha region

MATERIALS AND METHODS

The study was conducted in the Vidarbha region of Maharashtra. Two districts from the region *viz;* Bhandara and Gondiya and from each district two tahsils were selected on the basis of maximum area underpaddy cultivation. Two village from each tahsil were selected. Among each village, 9 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, 36 farmers were selected who were practicing improved production technology of paddy of cultivation. Thus, the total size of sample size comprise of 72 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 paddy cultivation.

ANALYTICAL TOOLS

A, part from budgeting techniques, following analytical tools was employed:

Cobb-Douglas type of Production Function

To identify the important factors affecting the paddy production technology for paddy 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.

$$Y = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_{67}^{b_7} e^u$$

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 = Seed (kg)

X_4 = Per hectare use of Manure in quintals

X_5 = Nitrogen (kg) per hectare

X_6 = Phosphorus (kg) per hectare

X_7 = Potash (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,

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

Where,

bi = Elasticity of production of ithinput

Y = Geometric mean of output

X_i = Geometric mean of ofithinput

P_y = 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.

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

Technological Adoption Pattern on Sample farm

In order to measure the technology adoption index of paddy 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 in Vidarbha Region of Maharashtra

It can be observed from the Table 1 that at the overall level, per hectare cost of cultivation of paddy *i.e.* Cost 'C' was ₹ 51,645.95. Amongst the different items of cost, charges of hired human labour (26.39 per cent) was the major item of cost followed by rental value of land (21.14 per cent), family human labour (9.26 per cent), machine power (8.93 per cent), bullock labour (5.86 per cent), manures (4.44 per cent), depreciation on farm implement (4.08 per cent), phosphorus fertilizers (3.63 per cent), interest on working capital (3.47 per cent), seed (3.37 per cent) and nitrogenous fertilizers (3.30 per cent). Of the total cost of cultivation of paddy, Cost 'A' was ₹ 29,888.79 (57.87 per cent) and Cost 'B' was ₹ 33,840.76 (65.52 per cent). The per hectare total cost of cultivation of paddy was ₹ 56,235.19, ₹ 52,410.28 and ₹ 49,842.69 for small, medium and large size group of holdings, respectively. Per quintal cost of paddy was ₹ 1,499.90, ₹ 1,364.46 and ₹ 1,203.46 for small, medium and large group of holding, respectively. At the overall level, it was ₹ 1,295.90. Itindicates that per quintal cost of paddy decreased with an increase in size group of holdings.

RESOURCE USE GAP OF PADDY IN VIDARBHA REGION OF MAHARASHTRA

The information about per hectare resource use gap of paddy in Vidarbha region of Maharashtra is given in Table 2.

The per hectare use of human labour on farms of sample cultivators and demonstration plot was 154.44 and 150 man days, respectively. The per cent gap observed in utilization of human labour between farms of sample cultivators and demonstration plot was 2.96 per cent excess use. The per hectare use of bullock power was 9.59 and 7 pairs days on farms of sample cultivators and demonstration plot, respectively and it indicated 37.00 per cent excess use. The per hectare utilization of seed was 101.06 and 40 kg on sample farms and demonstration plot, respectively. The excess use on sample cultivator farms was found 152.65 per cent. The per hectare utilization of manures was found 20.23 and 100 q on farms of sample cultivators and demonstration plot and the per cent gap in the utilization of manures on farms of sample cultivators was found to be 79.77 per cent.

The per hectare use of chemical fertilizers *i.e.* nitrogen, phosphorous and potash was 105.42, 102.93, 18.36 kg on farms of sample cultivatorsand 100,50,50 on demonstration plot, respectively. The per cent excess use was observed more in phosphorous (105.86 per cent) followed by nitrogen (5.28 per cent) and gap of 63.28 per cent in potash and it means that the use of phosphorous was moreon sample cultivator farms. The gap between the yield on sample cultivators farm and demonstration plot was 23.83 per cent.

Table 1
Cost of cultivation of paddy in Vidarbha of Maharashtra (/ha)

		Small			*Medium*			*Large*			*Overall*		
Sr. No.	*Cost items*	*Qty*	*Value*	*Per cent*	*Qty*	*Value*	*Per cent*	*Qty*	*Value*	*Per cent*	*Qty*	*Value*	*Per cent*
I. 1	*Hired Human labour (Mandays)*												
	(a) Male	30.98	4647.66	8.26	34.45	5167.68	9.86	40.87	6130.03	12.30	37.32	5597.54	10.84
	(b) Female	86.46	8645.78	15.37	76.71	7671.41	14.64	80.58	8058.26	16.17	80.30	8029.95	15.55
2	Total hired human labour	117.44	13293.44	23.64	111.16	12839.09	24.50	121.45	14188.29	28.47	117.62	13627.49	26.39
3	Bullock power (Pair days)	5.39	1615.79	2.87	9.59	3356.54	6.40	10.84	3250.54	6.52	9.59	3026.98	5.86
4	Machine power	13.77	6885.42	12.45	10.45	5189.70	9.90	7.21	3606.21	7.24	9.23	4614.24	8.93
5	Seed (Kg)	98.71	1636.59	2.91	99.42	1718.05	3.28	105.05	1785.86	3.58	101.06	1741.30	3.37
6	Manures (Q)	36.58	3657.88	6.51	29.05	2905.15	5.54	10.23	1534.91	3.08	20.23	2295.02	4.44
7	Fertilizers (Kg)												
	N 97.72	1582.09	2.81	108.57	1757.81	3.35	105.84	1713.56	3.44	105.42	1706.71	3.30	
	P 102.07	1857.75	3.30	103.25	1879.19	3.59	102.99	1874.37	3.76	102.93	1873.26	3.63	
	K 20.81	203.91	.36	16.93	165.93	0.32	18.48	181.10	0.36	18.36	179.95	0.35	
8	Irrigation Charges (')		41.31	0.07		20.33	0.04		17.99	0.04		22.38	0.04
9	Plant protection charges (')		321.03	0.57		20.33	0.4		400.00	0.80		269.32	0.53
10	Incidental charges (')		253.54	0.45		389.70	0.74		235.62	0.47		286.44	0.55
11	Repairs (')		294.68	0.52		264.72	0.51		220.09	0.44		245.70	0.48
	Working capital (')		31643.43	56.26		30506.54	58.21		29008.54	58.20		29888.79	57.87
12	Int.on Working Capital		1898.61	3.38		1830.39	3.49		1740.51	3.49		1793.33	3.47
13	Depre.on farm implements		3558.12	6.33		2336.56	4.46		1542.71	3.10		2106.36	4.08
14	Land revenue and taxes		30.68	0.05		50.00	0.10		60.00	0.12		52.28	0.10
	Cost 'A'		37130.84	66.03		34723.49	66.26		32351.76	64.91		33840.76	65.52
15	Rental value of land		11066.69	19.68		11136.90	21.25		10749.54	21.57		10920.00	21.14
16	Int'on fixed capital		2100.00	3.73		1900.00	3.63		2200.00	4.41		2090.84	4.06
	Cost 'B'		50297.53	89.44		47760.39	91.13		45301.30	90.89		46851.60	90.72
17	Family labour												
	a.Male	25.56	3833.71	6.82	21.11	3167.17	6.04	21.94	3290.77	6.60	22.70	3337.48	6.46
	b. Female	21.01	2103.95	3.74	14.83	1482.72	2.83	12.51	1250.62	2.51	14.57	1456.87	2.82
18	Total family labour	46.57	5937.66	10.56	35.94	4649.89	8.87	34.45	4541.39	9.11	37.27	4794.35	9.26
	Cost 'C'		56235.19	100		52410.28	100		49842.69	100		51645.95	100
II	Output (Q)												
	a.Main produce	34.48	62065.63		35.39	62999.46		37.86	60577.65		36.56	61565.72	
	b.Bye-produce	45.19	4518.56		41.22	4121.95		42.80	4279.58		42.68	4267.98	
III	Cost 'C' net of bye produce		51716.63			48288.33			45563.11			47377.97	
IV	Per quintal cost		1499.90			1364.46			1203.46			1295.90	

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

Table 2
Resource use gap of paddy in Vidarbharegion (Per ha)

Sr. No.	*Particulars*	*Demonstration plot (Recommended levels)*	*Sample cultivators*	*Absolute Gap*	*% Gap*
1	Total Human labour (Days)	150	154.44	-4.44	–2.96
2	Bullock power (Pair days)	7	9.59	-2.59	–37.00
4	Seed (Kg)	40	101.06	-61.06	–152.65
5	Manures (Q)	100	20.23	79.77	79.77
6	Fertilizers (Kg)				
	(a) N	100	105.42	-5.42	–5.42
	(b) P	50	102.93	-52.93	–105.86
	(c) K	50	18.36	31.64	63.28
7	Yield (Q)	48	36.56	11.44	23.83

– Gap indicates excess use than recommendation
+ Gap indicates low use than recommendation

Table 3
Results of Cobb-Douglas production function of paddy in Vidarbha region

Sr. No.	*Particulars*	*Small*	*Medium*	*Large*	*Overall*
1	Intercept	1.3291	0.7181	0.8831	0.8560
2	Human labour in days (X_1)	0.2416(0.2245)	0.5849**(0.2760)	0.1105(0.2662)	0.2570(0.3756)
3	Bullock labour in days (X_2)	0.0606**(0.0238)	0.0212(0.0435)	0.0741**(0.0314)	0.0485(0.0624)
4	Seed (X_3)	0.9756(0.9988)	0.8690(0.9801)	0.9756(0.9901)	0.8210(0.9813)
5	Manures in q (X_4)	0.0837**(0.0354)	0.0628**(0.0270)	0.0612**(0.0277)	0.0432***(0.0142)
6	Nitrogen (X_5)	0.0922**(0.0329)	0.0721***(0.0248)	0.0016(0.0571)	0.0011(0.0177)
7	Phosphorus (X_6)	0.0012(0.0567)	0.0038*(0.0020)	0.0908***(0.0320)	0.0045(0.0397)
8	Potash (X_7)	0.0990**(0.0464)	0.0014(0.0011)	0.0672**(0.0259)	0.0651***(0.0216)
9	R^2 0.68	0.60	0.70	0.72	
10	Observation	24	24	24	72
11	D.F.16	16	16	64	
12	F-value	22.93***	19.15***	16.48***	18.39***

(Figures in parentheses are standard errors of respective regression coefficients)
*, ** and *** indicates significance level at 10, 5 and 1 per cent level, respectively

Results of Cobb-Douglas type of Production Function of Paddy in Vidarbha Region of Maharashtra

In case of Vidarbha region, Table 3 indicated that at the overall level human labour (X_1), bullock labour (X_2), seed(X_3), manures (X_4), nitrogen (X_5), phosphorus (X_6) and potash (X_7) included in the production function analysis of paddy have jointly explained 72 percent variation in the yield.

At the overall level,the regression coefficients of manures (X_4) and potash (X_7) were found highly significant at 1 per cent level, whilevariableslike bullock labour (X_2), seed (X_3), nitrogen (X_5) and phosphorus (X_6) were positive but non-significance. It indicates that there is scope to increase the output. If we increase manures and potash by 1 per cent the output will be increased by 0.04 and 0.06 per cent, respectively.

Resource Use Efficiencies of Paddy in Vidarbha Region of Maharashtra

It is revealed from Table 4 that at the overall level, the marginal value product to factor cost ratio (MVP/MC) was greater than unity in case of resources likes manures (X_4) and phosphorus fertilizer (X_6) implying the achievement of higher resource use efficiency in case abovementioned variables, whereas the MVP/MC ratio of human labour (X_1), bullock labour (X_2), seed (X_3), nitrogen (X_5) and phosphorus fertilizer (X_6) were found to be less than unity depicting the inefficient use of these resources.

Cobb-Douglas production function estimate for demonstration plot and sample farms in Vidarbha regionof Maharashtra

The result of Table 5 indicate that the value for the coefficient of multiple determination (R^2) for demonstration plot was 0.64, which suggested that the seven resources included in the production function had jointly explained as high as 64 per cent of total variation in the demonstration plot, whereas it was 72 per cent (R^2 = 0.72) for the sample farms.

It showed that the variables taken into consideration were the factors in demonstration plot than on the sample cultivators farm. In case of demonstration plot method, human labour, manures

Table 4
Resource use efficiencies of paddy in Vidarbharegion

Sr. No.	Particulars	bi Value	MP	MVP	MC	MVP/MC
			Overall			
1.	Human labour (X_1)	0.2570	0.0506	83.91	125.00	0.6713
2.	Bullock labour (X_2)	0.0485	0.2619	434.72	450.00	0.9661
3.	Seed (X_3)	0.8210	0.2272	37.19	40.00	0.9661
4.	Manures (X_4)	0.1432	0.6481	1075.86	100.00	10.7586
5.	N (X_5)	0.0011	0.0022	3.65	16.19	0.2253
6.	P (X_6)	0.0045	0.0105	17.41	18.20	0.9567
7.	K (X_7)	0.0651	0.1655	274.78	9.80	28.0390

Table 5
Cobb-Douglas production function estimate for demonstration plot and samplefarms in Vidarbha region

Sr. No.	Particulars	*Method of cultivation*	
		Sample cultivator farms	*Demonstration plot (Recommended)*
1	Intercept	0.8560	1.4812
2	Human labour (X_1)	0.2570(0.3756)	0.0435**(0.0129)
3	Bullock labour (X_2)	0.0485(0.0624)	0.01629(0.0623)
4	Seed (X_3)	0.8210(0.9813)	0.1375(0.6090)
5	Manures (X_4)	0.0432***(0.0142)	0.00145**(0.0060)
6	Nitrogen (X_5)	0.0011(0.0177)	0.0120*(0.0068)
7	Phosphorus (X_6)	0.0045(0.0397)	0.01142(0.0442)
8	Potash (X_7)	0.0651***(0.0216)	0.0468(0.4122)
9	R^2	0.72	0.64
10	Observation	72	30
11	D.F.	64	22
	F value	18.39***	15.43***

(Figures in parentheses are standard errors of respective regression coefficients)
*, ** and *** indicates significance level at 10, 5 and 1per cent level, respectively

Table 6
Results of decomposition analysis in Vidarbha region of Maharashtra

Sr. No.	Source of productivity difference	Percentage contribution
A	Total difference observed in output	23.83
B	Source of contribution	
	1 Difference in cultural practices (Non neutral technological changes)	12.17
	2. Due to difference in input use level (Neutral technological changes)	
	(a) Human labour	–0.07
	(b) Bullock labour	1.69
	(c) Seed	–5.18
	(d) Manure	1.46
	(e) Nitrogen	0.12
	(f) Phosphorous	8.68
	(g) Potash	4.96
C	Due to all inputs	11.66
D	Total estimated gap from all sources	23.83

and nitrogen were found positively significant. On sample farm cultivators themanures and potash were found positively and highly significant. This means that usage of less than the recommended dose of these inputs would result in increase in production.

Results of Decomposition Analysis in Vidarbha Region of Maharashtra

Table 6 depicted the results of decomposition analysis in Vidarbha region. There was 23.83 per cent yield difference because of adoption of practicing new technology in paddy cultivation. In 23.83 yield gap measurably (12.17 per cent) was contributed by differences in cultural practice, whereas remaining 11.66 percent of yield was due to difference in use of input. The maximum positive difference of input use level was found from phosphorous followed by potash, bullock labour, manures and nitrogen.

Whereas, seed (–5.18 per cent) and human labour (-0.07 per cent) were contributing negatively towards the yield gap. Thus, the total difference in output was measurably caused by difference in cultural practices, rather than differences in input level.

Technology adoption index of paddy on sample farms in Vidarbha regionof Maharashtra

It is revealed from Table 7 that, at the overall level thetechnology adoption index of method of sowing technology component was observed maximum (93.06 per cent) on sample farms followed by nitrogen, date of sowing, seed rate, phosphorus, variety and manures. At the overall level, the lowest technology adoption indices were found in use of application of potashic fertilizers (18.52 per cent) and plant protection measures (13.89 per cent) component.

The composite index of technology adoption was worked out to 54.38 per cent indicated that the sample farmers adopted less than 46 per cent recommended paddy production technology obtaining 36.56 q/ha yield. The highest composite index of technology adoptionin case of large (61.70 per cent) size group

Table 7
Technology adoption index of paddy on sample farms in Vidarbha region (Per cent)

		Size group			Overall
Sr. No.	*Component*	*Small*	*Medium*	*Large*	
1.	Date of sowing	58.33	65.28	79.17	67.59
2.	Seed rate	56.94	63.89	77.78	66.20
3.	Variety	52.08	54.17	66.67	57.64
4.	Method of sowing	90.28	93.06	95.83	93.06
5.	Manures	44.44	50.00	58.33	50.93
6.	Nitrogen	61.11	72.22	75.00	69.44
7.	Phosphorous	55.56	59.72	68.06	61.11
8.	Potash	12.50	19.44	23.61	18.52
9.	Plant protection	8.33	14.58	18.75	13.89
10.	Composite index	48.40	53.04	61.70	54.38
11.	Yield (*q*)	34.48	35.39	37.86	36.56

of farmers followed by medium (53.04 per cent) and small group of farmers (48.40 per cent). Thus, the technology adoption index has increased with an increase in size group of holdings. It is concluded from the table that, all the farmers have adopted the improved paddy production technology more than 50 per cent except application of potassic fertilizer and use of plant protection measures.

Impact of Improved Paddy Production Technology in Vidarbha Region of Maharashtra

The Impact of Improved Paddy Production Technology in Vidarbha Region is Presented in Table 8. The per hectare economic impact of paddy production technology on gross return, cost of cultivation and net returns was 31.30, 22.59 and 63.00 per cent, respectively.

The impact of paddy production technology on net returns was maximum (63.00 per cent) followed by machine power, gross returns and main produce.Per hectare yield has increased from 25.16 to 36.56quintal per hectare over the difference level of adoption. The added yield was 11.40q/ha over the local and improved methodof adoption. Thus, for producing extra yield per hectare costs were also increased 11,666.81 and added returns were also increased 20,604.59.

The ICBR ratio indicates that the high adoption improved production technology adopter farmers were in profit with 1.77 ICBR ratio. It indicates that, the farmers should adopt the improved production technology for paddy to the fuller extent for maximizing returns and minimizing per unit cost.

Identification of Major Constraints in Adoption of Improved Production Technology of Paddy in Vidarbha Regionof Maharashtra

The farmers were asked to offer opinions as per priority-wise major constraints they were facing in adoption of improved production technology of

Table 8
Impact of improved paddy production technology in Vidarbha region

Sr. No.	*Particulars*	*Local method*	*Improved method*	*Per cent impact*
(A)	*Employment*			
	1. Total human labour	129.42	154.44	16.20
	(a) Male	49.19	59.57	17.42
	(b) Female	75.19	94.87	20.74
	2. Bullock labour (Pairs days)	7.14	9.59	25.55
	3. Machine power in hrs	5.49	9.23	40.52
(B)	*Yield (Q/ha)*			
	1. Main produce	25.16	36.56	31.18
	2. By-produce	33.95	42.68	20.45
(C)	*Economics (`/ha)*			
	1. Gross returns	45229.11	65833.70	31.30
	2. Cost of cultivation	39979.14	51645.95	22.59
	3. Net returns	5249.97	14187.75	63.00
(D)	*B : C ratio*	1.13	1.27	
(E)	Cost effectiveness of improved paddy production technology			
	1. Added returns	–	20604.59	–
	2. Added cost	–	11666.81	–
	3. Added yield (Q)	–	11.40	–
	4. % increase in yield	–	45.31	–
	5. Cost (/Q)	1588.99	1412.63	–
	6. Unit cost red. (/Q)	–	176.36	–
	7. % reduction	–	11.10	–
	8. ICBR ratio	–	1.77	–

Table 9
Constraints in adoption of improved production technology of paddy in Vidarbha

Sr. No.	*Particulars*	*Group*	*Overall (N = 72)*		
Small (N = 24)		*Medium (N = 24)*	*Large (N = 24)*		
A.	*Rainfall*				
	1. Excess	12.50	4.17	8.33	8.33
	2. Abnormal distribution of rainfall	58.33	50.00	41.67	50.00
	3. Inadequate	62.50	25.00	37.50	41.67
B.	*Seed rate*				
	4. High cost	95.83	95.83	91.67	94.44
	5. Lack of awareness	58.33	58.33	50.00	55.56
	6. Use of traditional methods	66.67	66.67	45.83	59.72
C.	*Time of sowing and variety*				
	7. Lack of awareness	70.83	79.17	45.83	65.28
	8. Non-availability of proper variety seed	79.17	33.33	45.83	52.78
D.	*Method of Sowing*				
	9. Recommendation not known	66.67	41.67	45.83	51.39
	10. Expensive and more labour required	95.83	87.50	75.00	86.11
E.	*Adopted traditional methods*	79.17	79.17	70.83	76.39
	11. Seed treatment				
	12. Unawareness	62.50	66.67	58.33	62.50
F.	*High cost*	87.50	83.33	87.50	86.11
	13. Line transplanting				
	14. Unawareness	58.33	41.67	25.00	41.67
	15. Labour requirement is more	83.33	54.17	45.83	61.11
	16. It is time consuming method	95.83	66.67	62.50	75.00
G.	*Fertilizer application*				
	17. High cost of fertilizer	95.83	91.67	91.67	93.06
	18. Inadequate supply	54.17	66.67	50.00	56.94
	19. Recommendation not known	62.50	41.67	33.33	45.83
	20. Lack of knowledge about fertilizers	62.50	50.00	29.17	47.22
H.	*Labour*				
	21. Inadequate	70.83	45.83	58.33	58.33
	22. High wage rates	95.83	91.67	91.67	93.06
	23. Non-availability at peak period	58.33	37.50	33.33	43.06
I.	Plant protection				
	24. Inadequate supply	66.67	54.17	29.17	50.00
	25. Higher cost	91.67	91.67	95.83	93.03
J.	*Improved implements*				
	26. High cost	70.83	76.33	66.67	71.28
	27. Poor economic condition	62.33	70.83	58.33	63.83
	28. Small and fragmented land holding	37.50	29.17	25.00	30.56
K.	Lack of technical know-how	70.83	58.33	50.0	59.72
L.	Low price to produce	100.00	87.50	83.33	90.28

paddy cultivation in Vidarbha region.All these were sorted and screened and finally major constraints were identified and are presented in Table 9.

It is revealed that, at the overall level, the major constraint opined were high cost of inputs, abnormal distribution of rainfall, adopted traditional methods, expensive and more labour required, high wage rates, lack of awareness, lack technical knowledge and low price to produce were the major constraints reported by farmers, respectively.

CONCLUSIONS

(i) The Vidarbha region of Maharashtra, cost of production of paddy (*i.e.* cost 'C') was ₹ 51,646 and of this per quintal cost was ₹ 1,296 and the B : C ratio was 1.27. The maximum resource gap was observed in phosphorous and manures application. At the overall level, the regression coefficients of sample farms for manures and potash were also found positively significant. These positive and significant coefficients

indicated that, one unit increase in the use of manures and potash will minimise the gap.

(ii) The decomposition function analysis revealed that 23.83 per cent yield increase was due to adoption of new technologies in paddy, in which, cultural practices had higher role than the input use levels.At the overall level, technology composite index was 54.38 per cent, the contribution of component on impact of paddy production technology in Vidarbha region, net returns were maximum followed by machine power, gross returns and main produce. High level adoption impact of paddy production technologies helped to increase the annual income, employment and standard of livingof the sample farm families.

The major constraint were reported in paddy production technology *viz*;high cost of inputs, lack of awareness, lack technical knowledge, high wage rates, more labour requirement, time consuming methods and low price to produce were the major constraints in adoption of improved paddy production technologies.

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