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Economic analysis and impact assessment of production technology of paddy of Marathwada region in Maharashtra

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ABSTRACT

The study has assessed the economic analysis and impact assessment of production technology of paddy cultivation in Marathwada 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 paddy technology have been estimated in the study. It has shown that the per hectare cost 'C' was Rs. 35,801.52 and BCR is 1.14, whereas the per quintal cost production was Rs. 1,145.57 at the overall level for improved paddy cultivation methods. Further, there was a 19.97 per cent yield gap between actual yield and yield of demonstration plot, in which cultural practices (13.90) have shown a stronger effect than input use (6.07). The composite index of technology adoption was worked out to 60.24 per cent indicated that the sample farmers adopted less than 39 per cent recommended paddy production technology and obtained 36.54 q/ha yield. The contribution of different components on impact of paddy production technology in Marathwada region, net returns was maximum (17.46 %) followed by gross returns and main produce. The most important constraint in improved method of paddy cultivation has been identified as 'high cost of seed, fertilizers and labour charges, lack of knowledge about fertilizers application, seed treatment small fragmented holding and low price to produce. The improved paddy production technology method being more skill oriented, the study has observed that yields can be made on adoption and impact sustainable if constraints are addressed on war-footing basis.

INTRODUCTION

India is one of the leading rice producing countries of 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 states in India. Paddy is grown on 15.40 million ha 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). It is grown mainly on high lying or upland soils and on low lying lands (Nirban, 2006). Among the various agronomic practices judicious use of manures and fertilizers is one of the important strategy's 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 chemcal fertilizers.

More specially, 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.

The present study is an attempt 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 it was necessary to the "Economic analysis and impact assessment of production technology of paddy of Marathwada in Maharashtra".

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 view as.

- To study the regionwise resource use efficiency and cost and returns of paddy
- To study regionwise technology adoption and its impact on production of paddy and
- To examine the constraints in adoption of paddy production technologies.

MATERIAL AND METHODS

The study was conducted in the Marathwada region of Maharashtra. Two districts from the region *viz.*, Nanded and Parbhani and from each district two tahsils were selected on the basis of maximum area under study. Two villages from each tahsil were selected. Among each village, 6 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, 36 farmers were selected who were practicing improved production technology of paddy of cultivation. Thus, there were a total of 45 farmers with a sample size of 72 farms. 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 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 factor 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 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 :

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

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) :

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

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 :

$$\text{Log } (Y_2/Y_1) = [\text{Log } (b_0/a_0)] + [(b_1-a_1) \text{ Log } H_1 + (b_2-a_2) \text{ Log } B_1$$

$+(b_3-a_3)\ Log\ M_1 + (b_4-a_4)\ Log\ N_1 + (b_5-a_5)\ Log\ P_1] + [b_1\ Log\ (H_2/H_1) + b_2\ Log\ (B_2/B_1) + b_3\ Log\ (M_2/M_1) + b_4\ Log\ (N_2/N_1) + b_5\ Log\ (P_2/P_1)] + [\ U_2-U_1]$

Technological adoption pattern on sample farm :

In order to measure the technology adoption, index the adoption 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,

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

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

OBSERVATIONS AND ANALYSIS

The cost of cultivation of paddy includes the fixed cost and working cost. The per hectare cost of cultivation of paddy was worked out by using standard cost concepts. The information on various items of cost of cultivation of paddy for different size groups of holdings is presented in Table 1.

It can be seen from the table that at the overall level, per hectare cost of cultivation of paddy *i.e.* Cost 'C' was Rs. 35,801.52. Amongst the different items of cost, hired human labour charges was the major item of cost which accounted to Rs. 7,214.29 (20.15 %) followed by rental value of land Rs. 6,787.20 (18.96 %) and family human labour Rs. 3,798.17 (10.33 %). Of the total cost of cultivation of paddy, the Cost 'A' was Rs. 23,024.90 (64.31 %) and cost B was Rs. 32,103.35 (89.67 %).

Among the size group of holdings, the per hectare yield was 26.95 quintals, 27.18 quintals and 28.82 quintals in small, medium and large size groups, respectively. It indicated that the per hectare yield of paddy increased with an increase in the size of holdings. The gross income received from paddy was observed to be Rs. 46, 546.61, Rs. 41,310.93 and Rs. 38,880.79 in small, medium and large size groups, respectively, While at overall level, it was Rs. 41,015.59. The per hectare net profit decreased with the increasing size of group. At the overall level B: C ratio was 1.14. From the above discussion it is indicated that per unit cost of cultivation was declining as size group increased.

Per hectare resource use levels of paddy in Marathwada region:

The quantities of various inputs used directly affected the cost of cultivation and therefore, utilization 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 paddy owing to the higher requirement of inputs, except manure. This might be because of organic nature of the improved method of paddy cultivation. Inputs played a significant role for boosting production of paddy. The production and productivity of paddy depend on the judicious and the balanced use of inputs. The adoption level of production technologies for paddy was primarily influenced by the human labour, bullock power, seed, manures, fertilizer etc. Besides this, the balance use of these inputs was also very important.

Per hectare resource use gap of paddy in Marathwada region:

Table 3 presents the per hectare resource use gaps of paddy cultivation in recommended and actual use levels of input 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 Marathwada region, the inputs *viz.*, human labour, bullok power maures and potash were utilized less than the recommended. At the overall level, the per hectare excess use of phosporus was more than recommendation in Marathwada region (177.60 %) followed by seed (142.78 %), manures (88.80 %) and bullock power (53.72 %) for maintaining the plant population and to increase the grain production.

In case of manures, the recommendation is 10 tons/ha for the crop. The farmers used the more than recommended dose due to the availability and increasing cost of manures. The gap between actual and recommended yield was 19.97 per cent. It was maximum in phosphorus (177.60 %) and it was followed by seed (142.78 %), manures (88.80 %), nitrogen (60.95 %), bullock labour (53.72 %) human labour (35.97 %) and potash (28.77 %).

Production function estimates of demonstration plot and sample cultivators :

The Cobb-Douglas type of production function was fitted to the observations for the estimation of elasticities of important variables contributing to the yield of paddy in both demonstrations plot and sample farms. 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). The value for the co-efficient of multiple determination (R^2) for demonstration plot was 0.70, which suggested that the six resources included in the production function had jointly explained as high as 70 per cent of total variation in the demonstration plot, whereas it

Table 1 : Itemwise per hectare cost of cultivation paddy in Marathwada region **(Value in Rs.)**

Sr. No.	Cost items	Small			Medium			Large			Overall		
		Qty.	Value	Per cent	Qty.	Value	Per cent	Qty.	Value	Per cent	Qty.	Value	Per cent
1.	Hired Human labour (Mandays)												
	Male	7.20	1079.98	2.34	7.43	1113.85	3.21	9.27	1390.21	4.26	8.36	1254.35	3.50
	Female	42.53	4252.87	9.20	54.92	5491.87	15.84	68.16	6815.79	20.86	59.60	5959.94	16.65
2.	Bullock power (pair days)	23.18	6954.02	15.05	15.09	4528.01	13.06	9.83	2949.42	9.03	13.84	4150.52	11.59
3.	Machine power	4.85	2426.56	5.25	2.01	1002.77	2.89	2.57	1308.55	4.00	2.85	1436.45	4.01
4.	Seed (kgs.)	88.70	2217.43	4.80	83.75	1674.97	4.83	84.28	2191.18	6.71	84.97	2052.74	5.73
5.	Manures (qtls.)	21.07	2107.28	4.56	7.61	760.72	2.19	4.28	427.63	1.31	8.40	839.98	2.35
6.	Fertilizers (kgs.)												
	N	96.30	1559.04	3.37	97.30	1575.33	4.54	96.29	1558.89	4.77	96.57	1563.49	4.38
	P	71.48	1300.96	2.82	77.46	1409.68	4.07	90.55	1648.00	5.04	83.28	1515.70	4.23
	K	16.67	163.37	0.35	25.58	250.73	0.73	20.85	204.29	0.63	21.37	209.40	0.58
7.	Irrigation charges (Rs.)		15.33	0.03		26.28	0.08		15.13	0.05		18.27	0.05
8.	Plant protection charges (Rs.)		289.27	0.63		238.87	0.69		369.08	1.13		317.70	0.89
9.	Incidental charges (Rs.)		215.97	0.47		224.46	0.65		237.30	0.73		229.67	0.64
10.	Repairs (Rs.)		262.04	0.57		293.22	0.85		291.28	0.89		286.25	0.80
	Working capital (Rs.)		22844.13	49.44		18590.76	53.63		19406.75	59.40		19834.46	55.40
11.	Int.on working capital		1370.65	2.97		1115.45	3.22		1164.41	3.56		1190.07	3.32
12.	Depre. on farm implements		5640.54	12.21		2369.52	6.84		412.41	1.26		1951.64	5.45
13.	Land revenue and taxes		30.00	0.06		40.00	0.12		60.00	0.18		48.73	0.14
	Cost 'A'		29885.31	64.67		22115.73	63.80		21043.57	64.41		23024.90	64.31
14.	Rental value of land		7727.77	16.72		6845.15	19.75		6420.13	19.65		6787.20	18.96
15.	Int .on fixed capital		2400.00	5.19		2200.00	6.35		2300.00	7.04		2291.25	6.40
	Cost 'B'		40013.08	86.59		31160.88	89.89		29763.70	91.11		32103.35	89.67
16.	Family labour												
	Male	31.74	4760.54	10.30	16.75	2512.97	7.25		2000.82	6.12		2668.57	7.45
	Female	14.37	1436.78	3.11	9.90	989.80	2.86		904.61	2.77		1029.60	2.88
	Cost 'C'		46210.40	100		34663.65	100		32699.13	100		35801.52	100
II	Output (qtls.)												
	Main produce	26.95	42038.31		27.18	37832.37		28.82	35328.16		28.01	37301.59	
	Bye-produce	45.08	4508.30		34.79	3478.56		35.53	3552.63		37.14	3714.00	
III	Total gross produce		46546.61			41310.93			38.880.79			41015.59	
IV	Cost 'C' net of bye produce		41702.10			31185.09			29146.50			32087.52	
V	Per quintal cost		1547.39			1147.35			1011.32			1145.57	
VI	B:C ratio at cost		1.01			1.19			1.19			1.14	

Figures in parentheses indicate percentage to the respective cost C

was 72 per cent ($R^2 = 0.72$) 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, bullock labour, nitrogen and manures 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, human labour,

Table 2 : Per hectare resource use levels of paddy in Marathwada region

Sr. No.	Particulars	Size group			
		Small	Medium	Large	Overall
1.	Total human labour (Days)	95.84	89.00	99.81	96.05
	Male	38.94	24.18	22.61	26.15
	Female	56.90	64.82	77.20	69.90
2.	Bullock power (pair days)	23.18	15.09	9.83	13.84
3.	Machine power in hrs.	4.85	2.01	2.57	2.85
4.	Seed (kg.)	88.70	83.75	84.28	84.97
5.	Manures (qtls.)	21.07	7.61	4.28	8.40
6.	Fertilizers (kg.)				
	N	96.30	97.30	96.29	96.57
	P	71.48	77.46	90.55	83.28
	K	16.67	25.58	20.85	21.37
7.	Irrigation Charges (Rs.)	15.33	26.28	15.13	18.27
8.	Plant protection charges (Rs.)	289.27	238.87	369.08	317.70

Table 3 : Per hectare resource use gap of paddy in Marathwada region

Sr. No.	Particulars	Actual use	Demon. plot	Gap	% Gap
1.	Total human labour (Days)	96.05	150	53.95	35.97
2.	Bullock power (pair days)	13.84	9	-4.84	-53.72
3.	Seed (kg.)	84.97	35	-49.97	-142.78
4.	Manures (Qtls.)	8.40	75	66.60	88.80
5.	Fertilizers (kg.)				
	N	96.57	60	-36.57	-60.95
	P	83.28	30	-53.28	-177.60
	K	21.37	30	8.63	28.77
6.	Yield (Qtl.)	28.01	35	1.99	19.97

(-ve sign indicates excess use)

Table 4 : Results of cobb-douglas production function in Marathwada region

Sr. No.	Particulars		Regression co-efficients	
			Sample cultivators	Demon
1.	Human labour (Days)	X_1	0.1362 (0.0822)	0.1543*** (0.0113)
2.	Bullock labour (Days)	X_2	0.1634*** (0.0586)	0.1288 (0.1623)
3.	Seed (kgs.)	X_3	0.1337 (0.1182)	0.1182 (0.9360)
4.	Manures (kgs.)	X_4	0.0276** (0.0128)	0.0178** (0.0393)
5.	Nitrogen (kgs.)	X_5	0.1403** (0.1697)	0.13497** (0.0168)
6.	Phosphorous (kgs.)	X_6	0.0056 (0.0984)	0.0048 (0.1740)
7.	Potash (kgs.)	X_7	0.1843** (0.0822)	0.1680 (0.1224)
8.	Co-efficient of multiple determination	R^2	0.72	0.70
9.	Number of observation	N	72	30
10.	D.F.		64	22

Figures in parentheses are standard errors of respective regression co-efficients
*, ** and *** indicate significance of values at P=0.1, 0.05 and 0.01, respectively

bullock labour and manure were positively significant. Thus, the sample cultivator's farms were more labourintensive and exhaustive as it responded more to labour usage and manure application.

Results of decomposition analysis of paddy for Marathwada region :

Barah (2009) in his study in Tamil Nadu during 2006-07, has concluded that SRI has potential to increase rice production by 26 per cent or even more depending on the extent of adherence to its basic principles.

In the present study, the yield gap between actual farms and demonstration methods was to the tune of 19.97 per cent (Table 5).

Among other sources of yield gap, cultural practices (13.90%) 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 13.90 per cent in paddy. The appropriate usage of inputs can reduce the yield gap between actual farm and demonstration methods to the extent of 6.07 per cent.

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 (68.52 %) to be on sample farms followed by seed rate (50.00 %), nitrogen (48.61 %), date of sowing (47.69), and phosphorus (44.91 %) and plant protection (33.33 %). The lowest

Table 5 : Results of decomposition analysis in Marathwada region

Sr. No.	Source of productivity difference	Percentage contribution
1.	Total difference observed in output	19.97
2.	Source of contribution	
	Difference in cultural practices	13.90
	(Non - neutral technological changes)	
	Due to difference in input use level	
	(Neutral technological changes)	
	Human labour	-5.92
	Bullock labour	10.44
	Seed	9.13
	Manure	-5.98
	Nitrogen	4.35
	Phosphorous	0.39
	Potash	-6.34
3.	Due to all inputs	6.07
4.	Total estimated gap from all sources	19.97

Table 6 : Technology adoption index on sample farm in Marathwada region **(%)**

Sr. No.	Name of the component	Size groups			Overall
		Small	Medium	Large	
1.	Date of sowing	44.44	47.22	51.39	47.69
2.	Seed rate	47.22	48.61	54.17	50.00
3.	Method of sowing	75.00	58.33	72.22	68.52
4.	Manures	8.33	19.44	22.22	16.67
5.	Nitrogen	45.83	47.22	52.78	48.61
6.	Phosphorous	37.50	50.00	47.22	44.91
7.	Potash	15.28	23.61	25.00	21.30
8.	Plant protection	20.83	29.17	50.00	33.33
9.	Composite Index	36.81	41.84	46.88	41.84
	Yield (qtls.)	26.95	27.17	28.82	28.10

technology was noticed in case of potash (21.30 %) and manures (16.67 %) component of technology, respectively. The lower of technology adoption index were found in use of manures application.

The composite index of technology adoption was worked out to 41.84 per cent indicated that the sample farmers adopted less than 60 per cent recommended paddy production technology obtaining 28.10 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 decreased as size of holding increased. The same trend was observed in adoption of seed rate, 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.

Impact of improved paddy production technology for Marathwada region :

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

It is noted from the table that, on an average the total employments for male, female, bullock power and machine hours was 15.49, 18.28, 17.77 and 16.56 per cent impact, respectively. Impact regarding yield of main produce and by-produce were found to be 17.14 per cent and 18.79 per cent, respectively. Among the economic impact paddy production technology of gross return, cost of cultivation and net returns was 19.66 per cent, 19.98 per cent and 17.46 per cent, respectively.

The maximum impact of paddy production technology in Marathwada region was on net returns (17.46) amongst the components considered.

Identification of major constraints in adoption improved production technology of paddy for Marathwada :

The farmers were asked to offer opinions as per priority-wise major constraints they were facing in adoption improved production technology of paddy cultivation in Marathwada 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 constraints was opined were high cost of seed, untimely supply of fertilizers, expensive and more labour required, high cost of plant protection measures, high wage rates, unawareness, low price to produce, labour require more and high cost of fertilizer were reported by farmers, respectively. Similar work related to the topic was also done by Kiresur *et al.* (1996); Patole *et al.* (2008); Rajendra Prasad (2008); Rama Rao (2011) and Ravi Kumar *et al.* (2004).

Conclusion :

With the foregoing discussion the following conclusions can be drawn :

At the overall, level cost of production of paddy (*i.e.* cost 'C') was worked out Rs. 35,801.52, and of this cost A was 55.40 per cent and cost B was 64.31 per cent. The per quintal cost of production cost of paddy was Rs. 1,145.52, while B:C ratio was 1.14 ,at the overall level. The per hectare resource use gap of paddy in Marathwada region, human labour, manures and potash were having low use as compared with the recommended resource use level. Other factors such as seed, nitrogen and phosphorous showed excess use as compared with the recommendation of Agricultural Universities. The maximum resource use gap was observed in application of phosphorous and seeds. Whereas per hectare resource use gap of paddy in Marathwada region the yield gap was to be found 19.97 per cent.

The result of Cobb-Douglas production function for the

Table 7 : Impact of improved paddy production technology in Marathwada region

Sr. No.	Particulars	Local method	Improved method	% to impact
1.	**Employments**			
	Total human labour (Man days/ha.)			
	Male	45.76	54.15	15.49
	Female	66.84	81.79	18.28
	Bullock labour (Pairs days)	8.93	10.86	17.77
	Machine power in hrs.	6.3	7.55	16.56
2.	**Yield (qtl./ha.)**			
	Main produce	23.21	28.01	17.14
	By-produce	30.16	37.14	18.79
3.	**Economics (Rs./ha.)**			
	Gross returns	32951.17	41015.99	19.66
	Cost of cultivation	28647.39	35801.52	19.98
	Net returns	4303.78	5214.47	17.46

Table 8 : Constraints in adoption improved production technology of paddy in Marathwada

Sr. No.	Particular	Group			Overall (n=72)
		Small (n=24)	Medium (n=24)	Lagre (n=24)	
Constraints regarding rainfall					
1.	Excess	0.00	0.00	0.00	0.00
2.	Abnormal distribution of rainfall	91.67	83.33	91.67	88.89
3.	Inadequate	87.50	62.50	54.17	68.06
Recommended seed rate					
4.	High cost	100.00	100.00	100.00	100.00
5.	Lack of awareness	79.17	66.67	41.67	62.50
6.	Use of traditional methods	95.83	87.50	83.33	88.89
7.	Non availability in time	62.50	58.33	45.83	55.56
Recommended time of sowing and recommended variety					
8.	Lack of awareness	62.50	54.17	83.33	66.67
9.	Consideration of qualitative aspect of variety	66.67	41.67	50.00	52.78
10.	Non-availability of proper variety seed	66.67	50.00	41.67	52.78
Method of sowing					
11.	Recommendation not known	79.17	45.83	50.00	58.33
12.	Expensive and more labour required	95.83	100.00	62.50	86.11
13.	Adopted traditional methods	95.83	95.83	91.67	94.44
Fertilizer application					
14.	High cost of fertilizer	100.00	100.00	75.00	91.67
15.	Inadequate supply	79.17	58.33	79.17	72.22
16.	Recommendation not known	87.50	62.50	58.33	69.44
17.	Lack of knowledge about fertilizers	83.33	83.33	54.17	73.61
18.	Untimely supply	62.50	45.83	58.33	55.56
Labour constraints					
19.	Inadequate	75.00	50.00	79.17	68.06
20.	High wage rates	100.00	100.00	95.83	98.61
21.	Non-availability at peak period	70.83	70.83	58.33	66.67
Plant protection measures					
22.	Inadequate supply	79.17	95.83	87.50	87.50
23.	Higher cost	100.00	100.00	100.00	100.00
24.	Non availability in time	54.17	41.67	41.67	45.83
Seed treatment					
25.	Unawareness	70.83	75.00	75.00	73.61
26.	High cost	100.00	100.00	75.00	91.67
Line transplanting					
27.	Unawareness	70.83	33.33	41.67	48.61
28.	Labour requirement is more	79.17	66.67	58.33	68.06
29.	It is time consuming method	100.00	79.17	66.67	81.94
Improved implements					
30.	High cost	100.00	100.00	95.83	98.61
31.	Poor economic condition	79.17	70.83	62.50	70.83
32.	Small and fragmented land holding	45.83	37.50	29.17	37.50
33.	It requires trained man power	0.00	1.7	3.4	5.10
Lack of technical know-how		83.33	66.67	58.33	69.44
Low price to produce		95.83	79.17	75.00	83.33

Marathwada region revealed that the co-efficients of multiple demonstration plots for human labour, bullock labour, manures, and nitrogen were found positively significant, whereas, regression co-efficient of sample farms for human labour, bullock labour and manures were also found positively significant. The decomposition function analysis revealed that 19.97 per cent yield increase was to adoption of new technologies in paddy. In which, cultural practices (13.90 %) had higher role than the input use levels (6.07 %).

At the overall level, the technology adoption index (TAI) was found high for method of sowing fallowed by date of sowing, plant protection measures, application of nitrogen, use of seed rate and phosphorous. At the overall level, technology composite index was worked out to 41.84 per cent. The contribution of component on impact of paddy production technology in Marathwada region, cost of cultivation was maximum (19.98 %) followed by gross returns and by- produce. High level adoption impact of paddy production technologies helped to increase the annual income and employment of the sample farm families. The major constraint were reported in paddy production technology *viz.*, 'high cost of inputs, unawareness and low price to produce.

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