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ADOPTION AND IMPACT ASSESSMENT OF PRODUCTION TECHNOLOGY OF PADDY IN MARATHWADA REGION OF MAHARASHTRA

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Abstract-The Adoption and impact assessment of production technology of paddy cultivation in Marathwada region of Maharashtra for the year 2013-14 has been analyzed and it is based on costs and returns structure, production function analysis, resource use efficiencies, yield gap analysis, adoption index and impact of improved paddy technology have been estimated in the study. It has been found that per hectare cost 'C' was 35,801.52 and BCR is 1.14, whereas, per quintal cost of production was 1,145.57 at the overall level for improved paddy cultivation methods. Further, there was a 19.97 percent yield gap between actual yield and demonstration plot yield. The composite index of technology adoption was worked out to 38.62 percent indicated that the sample farmers adopted less than 61 percent recommended paddy production technology and obtained 28.10 q/ha yield. The contribution of different components on impact of paddy production technology in Marathwada region, net returns was maximum (49.91 percent). The added yield was 6.98 q/ha over the local and improved method of adoption. Thus, for producing extra yield per hectare, costs were also increased 7,154 and added returns were also increased 9,756.80. The ICBR ratio indicates that the high adoption of improved production technology adopter farmers were in profit with 1.36 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. Farmers were not fully aware of some of the components of improved paddy production technologies. Therefore, the efforts are required to be made to intensify extension education activity to increase awareness among the paddy growers so as to accelerate the process of adoption.

Keywords- Decomposition model, Technology Adoption, Impact, Added cost and Added returns, and ICBR ratio.

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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 [1].

The present study is an attempt to analyze the impact of improved technologies on paddy production in Marathwada 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 "Adoption and impact assessment of production technology of paddy in Marathwada region of Maharashtra" With this background, present study was undertaken with the view as:

I. To study the resource use efficiency and cost and returns of paddy.
II. To study technology adoption and its impact on production of paddy.

Methodology

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 number of sample sizes 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.

Methodology

Production function analysis

The data were therefore, subjected to functional analysis by using the following Cobb-Douglas type of production function,

$$Y=aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}.....X_n^{bn}e^u$$

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 = Seed (kg) per hectare
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 MVP of individual resources was estimated by using the following formula,

Marginal value of product of $X_i = b_i * Y/X * P_y$

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 [2].

$$Y = a_0 H^{a1} B^{b2} M^{a3} N^{a4} P^{a5} e^u$$

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** [3]. The following functional form was used to work out the yield gap. The Chow test was conducted for checking the production elasticity of the two functions.

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

Technological Adoption Index

Technology Adoption Index (TAI) was worked out with the help of following formula. [4]

$$TAI = Ai/Mi * 100$$

Where,

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

V. Constraints in adoption of improved production technology of paddy in Marathwada

The constraints were estimated with help of percentages.

Results and Discussion

Per hectare cost of cultivation of paddy in Marathwada

The overall level, per hectare cost of cultivation of paddy i.e. Cost 'C' was ₹ 35,801.52 presented in [Table-1]. Amongst the different items of cost, hired human labour charges was the major item of cost followed by rental value of land, bullock labour, family human labour, interest on fixed capital, seed, depreciation on farm implements, nitrogenous , phosphorus fertilizers, machine power, interest on working capital and manures . The total cost of cultivation of paddy the Cost 'A' was ₹ 23,024.90 (64.31 percent) and Cost 'B' was ₹ 32,103.35 (86.67 percent).

Over the size group of holding, per hectare total cost of cultivation of paddy was ₹ 46,210.40, ₹ 34,663.65 and ₹ 32,699.13 for small, medium and large size group of holdings, respectively. At the overall level, per quintal cost of paddy was ₹ 1,145.57. Per hectare cost of cultivation decreased with an increasing of size group of holdings. The per quintal cost of paddy was ₹ 1,547.39, ₹ 1,147.35 and ₹ 1,011.32 for small, medium and large group of holding, respectively. It indicates that the per quintal cost of paddy decreased with increase in size group of holdings. These finding confirmed the results reported by Basavaraja *et al.* (2008), [5].

Resource Use Gap of Paddy in Marathwada

The gap between the yield on sample cultivators farm and demonstration plot was presented in [Table-2] and it was 19.71 percent. The per hectare use of inputs like human labour, manures and potash fertilizers was utilized less on sample cultivators farm. The percent gap utilized of bullock labour, seed, nitrogen and phosphorus was excess use between the sample cultivators and demonstration plot. Similar findings were noted by Reddy *et al.* (1996) [6].

Table-2 *Resourceuse gap of paddy in Marathwada* (Per ha)

Sr. No.	Particulars	Demonstration plot	Sample cultivators	Absolute Gap	% Gap
1	Total Human labour (Days)	150	96.05	53.95	35.97
2	Bullock power (Pair days)	9	13.84	-4.84	-53.77
4	Seed (Kg)	35	84.97	-49.97	-142.77
5	Manures (Q)	75	8.40	66.60	88.80
6	Fertilizers (Kg)				
a.	N	80	96.57	-16.57	-20.71
b.	P	50	83.28	-33.28	-66.56
c.	K	50	21.37	28.63	57.26
7	Yield (Q)	35	28.01	6.90	19.71

\- Gap indicates excess use than recommendation
\+ Gap indicates low use than recommendation

Table- 1 *Itemwise per hectare cost of cultivation paddy in Marathwada*

(₹/ha)

Sr. No.	Cost items	Small			Medium			Large			Overall		
		Qty	Value	Per cent	Qty	Value	Per cent	Qty	Value	Per cent	Qty	Value	Per cent
I.1	Hired Human labour (Man days)												
	a. 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
	b. 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 (Kg)	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 (Q)	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 (Kg)												
	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 (₹)		15.33	0.03		26.28	0.08		15.13	0.05		18.27	0.05
8	Plant protection charges (₹)		289.27	0.63		238.87	0.69		369.08	1.13		317.70	0.89
9	Incidental charges (₹)		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 (₹)		**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												
	a.Male	31.74	4760.54	10.30	16.75	2512.97	7.25		2000.82	6.12		2668.57	7.45
	b. 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 (Q)**												
	a. Main produce	26.95	42038.31		27.18	37832.37		28.82	35328.16		28.01	37301.59	
	b. 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)

Results of Cobb-Douglas production function of paddy in Marathwada

The overall level the value of R^2 were 0.72, which indicated that the seven resource variables included in the production function have jointly explained as high as 72 percent of the total variation in the production of paddy, respectively. From [Table-3]. It can be revealed that At the overall level, regression coefficients of human labour (X_1), bullock labour (X_2), manures (X_4) and potash (X7) were found positive and significant. The variables like seed (X_3), nitrogen (X_5) and phosphorus (X_6) were positive and non-significant which indicates no scope to increase their use in production of paddy on sample farms. It indicates that there is scope to increasing the quantity of manures and potash to increase the output. If we increase manures and potash by 1 percent, the output will be increased by 0.02 and 0.18 percent, respectively. This result has confirmed with the findings of Ghosh (1992) [7] and Rao (2011) [8].

Table-3 *Results of Cobb-Douglas production function of paddy in Marathwada*

a	Particulars	Small	Medium	Large	Overall
1	Intercept	1.6801	0.4939	1.5333	1.7001
2	Human labour in days (X_1)	0.2985** (0.1126)	0.6635*** (0.2285)	0.8117** (0.2761)	0.6451*** (0.2119)
3	Bullock labour in days (X_2)	0.2235* (0.1142)	0.0435 (0.2463)	0.1228 (0.4613)	0.1634* (0.0880)
4	Seed (X_3)	0.0560 (0.0936)	0.8764 (0.9109)	0.6458 (0.8245)	0.8766 (0.7118)
5	Manures in q (X_4)	0.0278** (0.0126)	0.3239** (0.1290)	0.3614*** (0.1249)	0.0276** (0.0128)
6	Nitrogen (X_5)	0.0332** (0.0132)	0.2831** (0.1164)	0.0120 (0.2714)	0.0052 (0.0102)
7	Phosphorus (X_6)	0.0021 (0.1449)	0.0014 (0.1897)	0.0967** (0.0345)	0.0036 (0.0139)
8	Potash (X_7)	0.1431*** (0.0464)	0.3658*** (0.1074)	0.6178*** (0.1590)	0.1843** (0.0822)
9	R^2	0.68	0.65	0.73	0.72
10	Observation	24	24	24	72
11	D.F.	16	16	16	64
12	F-value	23.53***	24.18***	19.33***	21.50***

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

Resource use efficiencies of paddy in Marathwada

It is observed from [Table-4] that the marginal value product to factor cost ratio (MVP/MC) was greater than unity in case of resources like human labour (X1), bullock labour (X2), manures (X3) and potash fertilizers (X6) at the overall level implying the achievement of higher resource use efficiency in case of above mentioned variables, whereas the MVP/MC ratio of seed (X3), nitrogen (X5) and phosphorus fertilizer (X6) were found to be less than unity depicting the inefficient use of these resources. Thus, the findings of the resource productivities and resources use efficiency in production of paddy confirmed the results of some of previous investigations of Koshta (2006) [9] and, Suresh and (2006) [10].

Table-4 *Resource use efficiencies of paddy in Marathwada*

A	Particulars	bi Value	MP	MVP	MC	MVP/ MC
			Overall			
1	Human labour (X_1)	0.6451	0.1149	151.54	125.00	1.2124
2	Bullock labour(X_2)	0.1634	0.8823	1164.04	450.00	2.5868
3	Seed(X_3)	0.8766	0.2886	38.89	40.00	0.9723
4	Manures (X_4)	0.0276	0.1248	164.61	100.00	1.6461
5	N (X_5)	0.0052	0.0104	13.71	16.19	0.8466
6	P (X_6)	0.0036	0.0084	11.14	18.20	0.6121
7	K (X_7)	0.1843	0.4686	618.30	9.80	63.0916

Results of decomposition analysis in Marathwada

In Marathwada region [Table-5], there was 19.71 percent yield difference because of adoption of practicing new technology in paddy cultivation. In 19.71 yield gap measurably (13.64 percent) was contributed by differences in cultural practice. Whereas, the remaining 6.07 percent of yield was due to difference in use of input. The maximum difference of input use level measures (10.18 percent) from bullock labour followed by manures (9.13 percent), nitrogen (4.35 percent) and phosphorous (0.39 percent). Whereas, the potash (-6.34 percent), seed (-5.98 percent) and human labour (-5.92 percent) contributing negatively towards the yield gap. Thus the total difference output was measurably caused by difference in cultural practices, rather than differences in input level.

Technology Adoption Index of Paddy on Sample Farms in Marathwada

It is seen from the [Table-6], at the overall level, the adoption of method of sowing

Table- 5 *Results of decomposition analysis in Marathwada*

Sr. No.	Source of productivity difference	Percentage contribution
A	Total difference observed in output	19.71
B	Source of contribution	
	1.Difference in cultural practices (Non neutral technological changes)	13.64
	2.Due to difference in input use level (Neutral technological changes)	
	a. Human labour	-5.92
	b. Bullock labour	10.18
	c. Seed	-5.98
	d. Manure	9.13
	e. Nitrogen	4.35
	f. Phosphorous	0.39
	g. Potash	-6.34
C	Due to all inputs	6.07
D	Total estimated gap from all sources	19.71

Table- 6 *Technology adoption index of paddy on sample farms in Marathwada*

(Percent)

Sr. No.	Component	Size group			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.	Variety	29.17	35.42	43.75	36.11
4.	Method of sowing	70.83	72.22	73.61	72.22
5.	Manures	8.33	19.44	22.22	16.67
6.	Nitrogen	45.83	47.22	52.78	48.61
7.	Phosphorous	37.50	50.00	47.22	44.91
8.	Potash	15.28	23.61	25.00	21.30
9.	Plant protection	6.25	8.33	10.42	8.33
10.	Composite index	33.81	40.22	41.83	38.62
11.	Yield (q)	26.95	27.17	28.82	28.01

technology component was observed maximum (72.22 percent) followed by seed rate (50.00 percent), nitrogen (48.61 percent), date of sowing (47.69 percent), phosphorus (44.91 percent) and variety (36.11 percent). At the overall level, the lowest of technology adoption index were found in case of application of manures component (16.67 percent) and plant protection measures (8.33 percent) of technology. At the overall level, the composite index of technology adoption was worked out to 38.62 percent indicated that the sample farmers adopted less than 61.00 percent recommended paddy production technology obtaining 28.01 q/ha yield. Among the different size group of holdings, the composite indices were adopted maximum on large group of farmers (41.83 percent) followed by medium (40.22 percent) and small group of farmers (33.81 percent). Thus, the technology adoption index has increased with an increase in size group of holdings. In this region, farmers adopt technology not more than 72 percent except method of sowing. Hence, that there is great scope to increase the adoption improved paddy production technology through extension workers on farmer's field. The similar findings were noticed by Goankar (2000) [11]., Chithra (2002) [12]. and Sita (2009) [13].

Impact of improved paddy production technology in Marathwada

It is noted from the [Table-7] that, the impact of technology on per hectare yield of main produce and by-produce was found to be 24.92 and 21.43 percent, respectively. Among the per hectare economic impact of paddy production technology on gross return, cost of cultivation and net returns was 23.79, 19.98 and 49.91 percent, respectively. The impact of paddy production technology on net returns was maximum (49.91 percent) followed by gross returns and by-produce. The per hectare yield has increased from 21.03 to 28.01 quintal per hectare over the difference level of adoption.

The added yield was 6.98 q/ha over the local and improved method of adoption. Thus, for producing extra yield per hectare costs were also increased ₹ 7,154.13 and added returns were also increased ₹ 9,756.80. The ICBR ratio indicates that the high adoption improved production technology adopter farmers

Table- 7 *Impact of improved paddy production technology in Marathwada*

Sr.No.	Particulars	Local Method	Improved method	Per cent impact
A)	**Yield (Q/ha)**			
	1.Main produce	21.03	28.01	24.92
	2.By-produce	29.16	37.14	21.49
B)	**Economics (`/ha)**			
	1.Gross returns	31259.19	41015.59	23.79
	2.Cost of cultivation	28647.39	35801.52	19.98
	3.Net returns	4303.78	5214.07	49.91
C)	**B:C ratio**	1.09	1.14	
D)	**Cost effectiveness of improved paddy production technology**			
	1.Added returns	-	9756.80	-
	2.Added cost	-	7154.13	-
	3.Added yield (Q)	-	6.98	-
	4.% increase in yield	-	33.18	-
	5.Cost (₹/Q)	1362.15	1278.70	-
	6. Unit cost red. (₹/Q)	-	83.98	-
	7.% reduction	-	6.17	-
	8.ICBR ratio	-	1.36	-

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)**	
A.	**Constraints regarding rainfall**				
1	Abnormal distribution of rainfall	91.67	83.33	91.67	88.89
2	Inadequate	87.50	62.50	54.17	68.06
B.	**Recommended seed rate**				
3	High cost	98.00	96.00	92.00	95.33
4	Lack of awareness	79.17	66.67	41.67	62.50
5	Use of traditional methods	95.83	87.50	83.33	88.89
C.	**Recommended time of sowing and recommended variety**				
6	Lack of awareness	62.50	54.17	83.33	66.67
7	Non-availability of proper variety seed	66.67	50.00	41.67	52.78
D.	**Method of Sowing**				
8	Recommendation not known	79.17	45.83	50.00	58.33
9	Expensive and more labour required	95.83	100.00	62.50	86.11
10	Adopted traditional methods	95.83	95.83	91.67	94.44
E.	**Fertilizer application**				
11	High cost of fertilizer	100.00	100.00	75.00	91.67
12	Recommendation not known	87.50	62.50	58.33	69.44
13	Lack of knowledge about fertilizers	83.33	83.33	54.17	73.61
F.	**Labour constraints**				
14	High wage rates	100.00	100.00	95.83	98.61
15	Non-availability at peak period	70.83	70.83	58.33	66.67
G.	**Plant protection measures**				
16	Higher cost	100.00	100.00	100.00	100.00
H.	**Seed treatment**				
17	Unawareness	70.83	75.00	75.00	73.61
18	High cost	100.00	100.00	75.00	91.67
I.	**Line transplanting**				
19	Labour requirement is more	79.17	66.67	58.33	68.06
20	It is time consuming method	100.00	79.17	66.67	81.94
J.	**Improved implements**				
21	High cost	100.00	100.00	95.83	98.61
22	Poor economic condition	79.17	70.83	62.50	70.83
23	Small and fragmented land holding	45.83	37.50	29.17	37.50
K.	**Lack of technical know-how**	83.33	66.67	58.33	69.44
L.	**Low price to produce**	95.83	79.17	75.00	83.33

were in profit with 1.36 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. These results confirm the results noticed by Borah *et al.* (1986) [14]. and Sinha (2007) [15].

Constraints in Adoption Improved Production Technology of Paddy in Marathwada

It is revealed that [Table-8], at the overall level, the major constraints was opined were high cost of seed, fertilizers, expensive and more labour required, high cost of plant protection measures, high wage rates, unawareness, low price to produce were reported by farmers, respectively.

Conclusions

i. The per quintal cost of production cost of paddy was ₹ 1, 145.52, while B:C ratio was 1.14 . 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. The maximum resource use gap was observed in application of phosphorous and seeds. The functional analysis has indicated that 3 variables *viz;* human labour, bullock labour, manures and potash were significant variables for which the output is responsive. The decomposition analysis revealed that, the total contribution of 19.71 percent to the difference in total productivity due to cultural practices was 13.64 percent while due to input use level was 6.07 percent.

ii. The Technology Adoption Index (TAI) were found positive and significant indicating that it was the important variable for increasing the output. The high-level adoption of paddy production technologies helped to increase the output maximization and cost reduction.

The impact of paddy production technology on per hectare net return had maximum (49.91 percent) impact followed by bullock labour and machine power. The per hectare yield has increased from 21.03 to 28.01 quintal per hectare over the difference level of adoption. The added yield was 6.98 q/ha over the local and improved method of adoption. Thus, for producing extra yield per hectare costs were also increased ₹ 7,154.13 and added returns were also increased ₹ 9,756.80 with 1.36 ICBR ratio. This indicated that the adoption of improved crop production technology helped to reduce the cost and increases the returns.

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