Resource use efficiency and constraint analysis for paddy production in North Konkan region of Maharashtra (India)

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ABSTRACT-

The Present study is an attempt to examine resource use efficiency and constraint analysis for paddy production in North Konkan region of Maharashtra (India). The primary data was collected from 180 sample farmers during the year 2022-23. Farmer were divided into low, medium and high as per level of adoption. Cobb- Douglas production function was used to obtain input use efficiencies of paddy crop. The gross expenditure on Nitrogen (0.86), Potassium (0.07**) contributed positively towards gross income for paddy. Whereas phosphorous (-0.10) and labour (-0.35) indicated negative relation to yield. The Cobb- Douglas production function estimates indicated that the ratio of MVP/MFC in case of labour, Nitrogen, Potassium, Potash indicated under utilization of input. The sum of elasticity was 0.41, which implies that there is decreasing return to scale. Farmers in the study area faced constraints such as a less amount of capital and unavailability of good quality seed. Suggestions received from paddy growers included developing innovative, low-cost equipment to reduce labour expenses and encourage research in rice cultivation.**

***Key words*: Rice, Resource use efficiency and constraints.**

1. INTRODUCTION

Rice is one of the important field crop in country and it is staple crop of Konkan region of Maharashtra. In India Rice cultivated in about 40 per cent of the gross sown area, and cost and returns structure of those can help for deciding future price policies. The production and productivity of rice are critical in the current scenario of population growth and food security with sustainable resource use. In agriculture, resource use efficiency is critical in determining farm production and profitability. Irrigation, manures and fertilizers, seeds, bullock labour, human labour, working capital, and farm machinery as well as machinery and crop protection measures are most important inputs in agriculture. The income from agriculture is mainly determined by the efficiency with which farmers can make use of these resources. This study focuses mainly on the profitability of Rice Crop in North Konkan region of Maharashtra state through estimation of the extent of resource use allocation and efficiency as reflected by production function analysis.

2. METHODOLOGY

The study was conducted in the North Konkan Region, where primary data was gathered from three districts (Raigad, Thane, and Palghar). From each district, three tahsils and from each tahsil, two villages were selected randomly. Finally, 10 rice growers were selected randomly from each of the chosen villages, resulting in a sample of 180 rice growers from 18 villages in 9 tahsils across 3 districts.

2.1 Estimation of resource use efficiency

Cobb-Douglas function was used for estimation of input use efficiency of rice crop in the study area, considering it's suitable for present data.

It is specified as,

$$Y= aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}\ldots\ldots\ldots X_n^{bn}$$

It is expressed to logarithmic form in order to solve by using the least square method. The logarithmic form is expressed as,

$$\text{Log } Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + \ldots\ldots\ldots + b_n \log X_n$$

Where, Y= dependent variable (gross income)

a = value of intercept
b_1 to b_n= regression coefficients of the respective dependent variables
X_1 to X_n = dependent variables (expenditure on inputs used)

Marginal Variable Product (MVP) = MPP × P_y

Marginal Physical Product (MPP) = $b_i \frac{\overline{Y}}{\overline{X_i}}$

Where,

b_i = regression coefficient of i^{th} input
$\overline{Y}$ = geometric mean of the dependent variable
$\overline{X_i}$ = geometric mean of i^{th}independent variables
P_y = unit price of output

The input use efficiency is measured by equating the marginal value product with the marginal cost of the individual input ie. Marginal Factor Cost (MFC).

When,

MVP = MFC depicts the efficient utilization of the input
MVP < MFC represents over utilization of the input
MVP > MFC implies the underutilization of the input

2.2 Garrett's Ranking Technique

To know the acceptance of value chain actors and to study the different constraints faced by Rice farmers, Garrett's ranking technique was used. Basically, it gives the change of orders of constraints and advantages into numerical scores. The major advantage of this technique as compared to simple frequency distribution is that the constraints and advantages are arranged based on their importance from the point of view of respondents. Hence the same number of respondents on two or more constraints may have been given different rank.

Garrett's formula for converting ranks into per cent is given by

Per cent position = 100 × (Rij-0.5) / Nj

Where,

Rij= rank given for i^{th} factor by j^{th} individual
Nj= number of factors ranked by j^{th} individual

The per cent position of each rank then converted into scores referring to given by Garret. Individual respondents was added together and divided by the total number of the respondents for whom response received. These mean scores for all the factors was arranged in descending order, ranks were given and most important factors could be identified. Garrett's ranking technique was adopted for studying the problems faced by the value chain actors in processing of value added products.

3. RESULTS AND DISCUSSION

3.1 Cropping pattern of sample farm

Table 1: Cropping pattern of sample farms

Sr. No.	Particulars	Group			
		Marginal (n=65)	Small (n=68)	Medium (n=47)	Overall (n=180)
1	***Kharif***				
	Paddy	0.44 (61.97)	0.85 (42.28)	0.89 (33.45)	0.71 (42.26)
	Finger millet	0.11 (15.49)	0.45 (22.38)	0.41 (15.41)	0.31 (18.43)
	Little millet	0.00	0.20 (9.95)	0.30 (11.27)	0.15 (8.92)
	Sub total	0.55 (77.46)	1.50 (74.62)	1.60 (60.15)	1.17 (69.64)
2	***Rabi / summer***				
	Paddy	0.08 (11.26)	0.23 (11.44)	0.60 (22.55)	0.27 (16.07)
	Pulses	0.02 (2.81)	0.06 (2.98)	0.12 (4.51)	0.06 (3.57)
	Vegetables	0.03	0.05	0.08	0.05

		(4.22)	(2.48)	(3.00)	(2.97)
	Sub total	0.13 (18.30)	0.34 (16.91)	0.85 (31.95)	0.39 (23.21)
3	**Perennial crop**	0.03 (4.22)	0.15 (7.46)	0.21 (7.89)	0.12 (7.14)
	Gross cropped area	0.71	1.99	2.66	1.68
	Net cropped area	0.68	1.84	2.45	1.56
	Cropping intensity (%)	**104.41**	**109.23**	**108.57**	**107.45**

(Figures in parentheses indicate percentage to gross cropped area)

Table 1 outlines the cropping pattern of sample farms, indicating that 42.26% of the total cropped area (0.71 ha) was devoted to paddy, followed by 18.43% each for finger millet and little millet. Rabi season saw the cultivation of pulses (16.07%), vegetables (3.57%), and 2.97% of the total cropped area. Kharif and Rabi crops covered 69.64% (1.17 ha) and 23.21% (0.39 ha) of the land, while perennial crops occupied 7.14% (0.12 ha). Paddy was the primary crop at 41.76%. Marginal, small, and medium farmers allocated 61.97% (0.44 ha), 42.28% (0.85 ha), and 33.45% (0.89 ha) to kharif paddy, respectively. For rabi/summer crops, marginal, small, and medium farmers utilized 18.30% (0.13 ha), 16.91% (0.34 ha), and 31.95% (0.85 ha) of the land. Perennial crops had minimal areas across farmer categories. The average net cropped area was 1.68 hectares, with cropping intensities of 104.41%, 109.23%, and 108.57% for marginal, small, and medium farmers, resulting in an overall cropping intensity of 107.45%. Paddy dominated, covering 41.52% of the total cropped area, with an average net cropped area of 0.68 hectares.

3.2 Per hectare quantity of Input used in paddy cultivation

Table 2: Per hectare quantity of input used for different adopter group in paddy cultivation

Sr. No.	**Items**	**Unit**	**Group**			
			Low (n=39)	**Medium (n=98)**	**High (n=43)**	**Overall (n=180)**
1	Hired human labour					
	i) Male	Days	31.12	32.12	30.15	31.43
	ii) Female	Days	43.21	42.14	43.09	42.59
2	Bullock labour	Pair days	0.77	1.10	1.50	1.01
3	Machine hrs.	Hrs.	8.60	8.84	8.58	8.72
4	Seed	Kg	40.36	42.76	43.83	42.50
5	FYM	Quintal	4.18	4.37	5.76	4.48
6	Rab Material	tons	0.22	0.23	0.23	0.22
7	Fertilizer (kg)	N	71.81	75.76	77.86	75.28
		P	15.71	17.36	18.89	17.39
		K	7.12	7.06	9.44	7.66
8	Family Labour					
	i) Male	Days	65.03	63.15	56.11	61.87
	ii) Female	Days	75.06	73.09	69.15	72.57
9	Total Labour day					
	Male	Days	96.15	95.27	86.26	93.30
	female	Days	118.27	115.23	112.24	115.16
	Total		214.42	210.50	198.50	208.46

Table 2 provides insights into the per-hectare utilization of inputs in rice production. The overall per-hectare utilization of seed, FYM (Farm Yard Manure), and fertilizers N, P, K were 42.50 kg, 4.48 quintals, 75.28 kg, 17.39 kg, and 7.66 kg, respectively. For rice production, the per-hectare labor utilization in low, medium, and high adopter groups stood at 214.42 human days, 210.50 human days, and 198.50 human days, respectively. Total machine hours utilized were 8.60 hrs, 8.84 hrs, and 8.58 hrs for low, medium, and high adopters, respectively. Notably, across all groups and at the overall level, family labor was observed to be more extensively utilized than hired labor. This data highlights the varying patterns of input utilization among different adopter groups in rice production.

3.3 Resource use efficiency in production of rice

Table 3: Resource use efficiency in production of rice

Paddy						
Sr. No	**Production variables**	**coefficient**	**P-value**	**SE**	**Efficiency ratio (MVP/MFC)**	**Utilization**
	Intercept	4.21	1.6285	0.62		
1	Labour (X1)	-0.35**	0.0003	0.09	-2.0881	Under utilized
2	Seed (X2)	-0.05	0.1798	0.03	-0.5094	Over utilized
3	FYM (X3)	-0.005	0.7467	0.01	-0.097	Over utilized
4	Nitrogen (X4)	0.86**	1.0802	0.12	135.546	Under utilized
5	Phosphorous (X5)	-0.10**	0.0057	0.03	-7.2587	Under utilized
6	Potassium (X6)	0.07**	0.0065	0.02	13.0812	Under utilized
Returns to scale		0.41				
R^2		0.50				
F TEST		29.97*				

*significance at 5% level of significance, ** significance at 1% level of significance

The information of resource use efficiency of rice cultivation in study area is presented in table 3. The result indicated that the potassium (0.07) and Nitrogen (0.86) indicated the positive influence on yield. These values were statistically significant. The MVP/MFC ratio for labour, Potassium, Nitrogen, Phosphorous indicated the underutilization of these resources.

The higher ratio of MVP to MFC for nitrogen (135.54) and potassium (13.08) suggests that increasing the use of these resources can optimize the current level of returns. Table also shows that the coefficient of determination (R^2) was 0.50, indicating that these variables accounted for 50 per cent of the variation in rice production. The sum of elasticity was 0.41, which implies that there is decreasing return to scale.

3.4 Constraints and Suggestions

Table 4: Constraints faced by the rice Growers in study area

Sr. No	**Constraints**	**Total Garette score**	**No. of respondent**	**Mean score**	**Rank**
1	Unavailability of good quality seed	8350	25	83.50	2
2	Less amount of capital	8684	30	86.84	1
3	High Cost of Input	5700	45	57	5
4	Unawareness of Technology	7154	55	71.54	4
5	Non-availability of labour	4560	50	45.6	6
6	Higher wage rate	7350	56	73.5	3

Table 4 provides insights into the constraints encountered by rice growers in the study area, employing Garrette's ranking technique to assess respondents' preferences. Six constraints, identified during survey, included the unavailability of good quality seed, insufficient capital, high input costs, limited technology awareness, labor shortages, and elevated wage rates. The most significant challenge was the scarcity of capital, leading with a mean score of 86.84, followed closely by year-round unavailability of good quality seed, securing the second rank at 83.50. High wage rates claimed the third position with a mean score of 73.50. Technology unawareness held the fourth position (mean score: 71.54), while the high cost of inputs ranked fifth with a mean score of 57.00. Addressing these challenges is crucial for seed supply agencies, extension services, and the government to incentivize rice cultivation. The study concluded that insufficient capital and the unavailability of good quality seed were the primary constraints faced by rice growers.

Table 5: Suggestions given by the rice grower in study area

Sr. No.	Suggestion	Group			
		Low (n=39)	Medium (n=98)	High (n=43)	Overall (n=180)
a)	Pure genuine seed material Should be made available to farmers	15 (38.46)	30 (30.61)	23 (53.48)	68 (37.77)
b)	Conduct demonstration on advance rice cultivation technology	12 (30.76)	20 (20.40)	29 (67.44)	61 (33.88)
c)	Innovative low cost equipment should be developed to reduce the cost of labour in operations	15 (38.46)	26 (26.53)	32 (74.41)	73 (40.55)
d)	Research on rice cultivation should be promoted and encouraged	14 (35.89)	32 (32.65)	23 (53.48)	69 (38.33)

(Figures in the parentheses indicate percentages to total respondents in respective group)

Table 5 outlines key suggestions from rice growers in the study area, with notable recommendations including ensuring the availability of pure and genuine seed material, conducting demonstrations on advanced rice cultivation technology, developing innovative, low-cost equipment to reduce labor expenses, and promoting research in rice cultivation. The significance, 40.55 per cent respondents emphasized the development of cost-effective equipment to alleviate labor costs, while 37.77 per cent advocated for the availability of high-quality seed material. Additionally, there was a shared consensus on the importance of promoting research in rice cultivation, with 38.33 per cent respondents expressing this viewpoint. The study concluded that developing innovative, low-cost equipment to reduce labor expenses and promoting research in rice cultivation were the major suggestions put forth by rice growers.

4. Conclusion

The study focused on analyzing the resource use efficiency and constraints in paddy production in the North Konkan region of Maharashtra, India. It revealed that expenditures on Nitrogen (0.86**) and Potassium (0.07**) positively contributed to gross income in paddy production, but these inputs were underutilized. Major constraints identified included higher wage rates, high input costs, and the unavailability of labor in paddy production. The study recommends ensuring the availability of pure seed material and conducting demonstrations on advanced rice cultivation technology to address these challenges. Farmers are advised to optimize the use of Nitrogen and Potassium, while also addressing issues related to seed quality and labor management for enhanced paddy production efficiency in the North Konkan region.

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