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*Research Note*

## Resource Productivity of Rice Cultivation in Tripura: A Spatial Analysis<sup>§</sup>

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### Abstract

The paper has reported the resource productivity of rice cultivation in Tripura. The study was conducted in both hill and valley regions of the state by selecting a sample of 120 rice growers. The productivity of resources of rice of individual farms has been estimated through Cobb-Douglas production function. The major resources for productivity of rice were human labour, fertilizer and manures in hill region and agrochemicals human labour, fertilizer and manures in the valley region. The use of small farm machinery like power-operated tiller and cono-weeder has been suggested as an intervention in the form of technology introduced for enhancement of labour efficiency. Further, the state government should provide necessary region-specific trainings and education to the farmers for judicious use of resources like fertilizers and agro-chemicals in rice cultivation in Tripura.

**Key words:** Resource productivity, rice, hill region, valley region, Tripura

**JEL Classification:** Q12, Q15, Q19

### Introduction

Tripura, one of the seven states in the North-Eastern Hill Region is predominantly an agrarian state where rice is grown in both hills and valleys regions. *Jhum* or shifting cultivation is practised in the hill region and settled farming in the plains. Rice is grown in three seasons, viz. *aush*, *amon* and *boro*. Rice is also cultivated through *jhum* which adds to the total rice production of the state. The rice cultivation in hill region depends on rainfall, whereas, in valley region, it mainly depends on canal irrigation. Rice contributed 96 per cent of the total cereals production of the state during 2013-14 (GoT, 2015). With a cropping intensity of 186 per cent during 2013-14 (GoT, 2013), the state produced 711.8 thousand tonnes rice from an area of

254.3 thousand ha with an average productivity of 2.8 t/ha (GoI, 2016). During 2013-14, the yield of rice in Tripura (2.80 t/ha) was 16.18 per cent higher than the national average yield (2.41 t/ha) and 33.33 per cent higher than the average yield of NEHR region (2.10 t/ha) (GoI, 2016); but, in global context, the yield is lower by 36.65 per cent (1.62 t/ha), indicating a wide scope to increase the yield (USDA, 2015).

The availability of agricultural inputs including irrigation facilities, is very poor in the state; and the percentage of gross irrigated area to total cropped area is only 35 per cent, making it a matter of serious concern (GoI, 2013). Presently, there is a gap of 0.19 lakh tonnes between consumption and requirement of food grains (GoT, 2013). The increasing population and decreasing farm land have posed a serious threat to agriculture in the state. Under these circumstances, allocation of resources plays a key role in improving the production of rice. The limited availability of production resources to the small and marginal rice growers of the state

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demands their efficient use for better return from rice cultivation.

The study on resource productivity of inputs in rice cultivation will help in better understanding of use of different inputs for rice production in the hill and valley districts of Tripura. This will guide on use of resources in a judicious way to enhance rice production and make rice cultivation a more profitable venture to the farmers. The present paper has estimated the productivity of different resources in rice cultivation in hill and valley regions of Tripura.

### Data and Methodology

The study was conducted in Tripura state as it ranked first in area, production and productivity of rice among the states in the North-East hilly region in the year 2012-13 (GoI, 2013). The state comprises hill and valley regions and therefore appropriate size of sample respondents were selected from each of these regions as the rice is the major crop in both the regions.

For study, the districts, Dhalai and North Tripura were selected from the hilly region on the basis of highest area (32.67 % and 26.55 %, respectively) under upland rice. From the valley region, Sipahijala and South Tripura districts were selected on the basis of highest area under lowland rice (33.89% and 29.26%, respectively) (GoT, 2014). One block from each of the selected districts was selected purposively on the basis of highest area under rice cultivation and a total of four blocks, viz. Manu, Youbrajnagar, Bishalgarh and Jolaibari were selected. Two villages were selected randomly from each selected block. Thus, 120 growers were selected by using probability proportional to size sampling technique from eight selected villages under study. For categorization of rice growers, the norms of Government of Tripura were adopted and accordingly rice growers were categorized as marginal (< 1 ha), small (1-2 ha) and medium and large (>2 ha). Since the number of farmers in medium and large category was negligible (hardly 1 or 2), the farmers were categorized into marginal (104) and small (16) categories. The data were collected for the *kharif* season 2014-15 using well structured schedule through personal interview method.

### Analytical tools

In the study, Cobb-Douglas production function was used which was found better in terms of value of

coefficient of multiple determination ( $R^2$ ), logical signs of regression coefficient and its level of significance. It was estimated by ordinary least squares (OLS) technique using model given in Equation (1) (Suresh and Reddy, 2006):

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + \mu \quad \dots(1)$$

where,

$Y$  = Total returns from paddy cultivation (₹/ha)

$X_1$  = Human labour (₹/ha)

$X_2$  = Machine labour charges (₹/ha)

$X_3$  = Cost on fertilizer (₹/ha)

$X_4$  = Cost on manure (FYM) (₹/ha)

$X_5$  = Cost on agrochemical (₹/ha)

$X_6$  = Cost on seed (₹/ha)

$X_7$  = Cost on irrigation (₹/ha), and

$\mu$  = Random error-term

While estimating the model, several problems like multicollinearity, omitted variables, wrong functional form, etc. were taken into account (Gujarati *et al.*, 2012). The values of Variance Inflation Factor (VIF), which were all less than 10, indicated that there was no multicollinearity problem among the explanatory variables. The coefficients of regression were tested for statistical significance by using 't'-test.

## Results and Discussion

### Resource Productivity in Paddy Cultivation

#### Hill Region

The resource productivity of inputs was estimated in the hill region of Tripura and is presented in Table 1. It was found that the coefficients of human labour, fertilizer and manure were statistically significant and were supported by the earlier findings of Sekhon *et al.* (2010); Srinivasan (2012) and Gautam *et al.* (2014). The human labour had the elasticity of 0.22 which indicated that one per cent increase in the value of human labour would bring 0.22 per cent increase in the total value of production. Similarly, fertilizer and manure (FYM) had elasticity of 0.01 and 0.01 which indicated that one per cent increase in value would bring 0.01 per cent and 0.01 per cent increase in the total value of production, respectively. These results

**Table 1. Resource productivity in paddy cultivation in hill region of Tripura**

Variables	Coefficient/ Elasticity	Standard error	P- value
Intercept	9.079***	1.139	0.000
Human labour (₹/ha)	0.226**	0.107	0.041
Machine labour (₹/ha)	-0.028	0.050	0.581
Fertilizer (₹/ha)	0.012**	0.005	0.021
Manure (FYM) (₹/ha)	0.017*	0.009	0.065
Agrochemical (₹/ha)	0.001	0.007	0.928
Seed (₹/ha)	-0.079	0.095	0.410
Irrigation (₹/ha)	0.007	0.006	0.286
R <sup>2</sup> value	0.71		

Note: \*, \*\* and \*\*\* denote significance at 10 per cent, 5 per cent and 1 per cent levels, respectively

were similar with the findings of Ogundari (2008); where value of human labour and fertilizer had positive effect in the total value of production. The findings were also supported by the study of Fakayode (2009) where value of human labour had positive effect in total value of production of rice. The coefficient of multiple determinations was 0.71 which indicated that 71 per cent of the total variation in the return from paddy cultivation was explained by the factors taken into consideration for analysis. The remaining variation in returns from paddy might be due to factors like climate, date of sowing, transplanting and harvesting of paddy etc. which were not considered in analysis (Gujarati *et al.*, 2012).

#### Valley Region

The variables found significant in the hill region were also significant in the valley region, except

manure. Moreover, unlike hill region, machine labour had a significant but negative effect in the value of rice production in the valley region. Thus, in the valley region, human labour, machine labour, fertilizer and agrochemicals were found statistically significant (Table 2). The human labour had the elasticity of 0.16 which indicated that one per cent increase in the value of human labour would bring 0.16 per cent increase in total value of production. The elasticities of fertilizer and agrochemical were estimated at 0.03 and 0.01 which were relatively elastic and indicated that one per cent increase in the value of fertilizer and agrochemicals would bring 0.03 per cent and 0.01 per cent increase in the total value of production of paddy, respectively.

Unlike hilly region, the machine labour had negative elasticity (-0.11), which indicated that one per cent increase in the value of machine labour would

**Table 2. Resource productivity in paddy cultivation in valley region of Tripura**

Variables	Coefficient/ Elasticity	Standard error	P- value
Intercept	9.718***	0.928	0.000
Human labour (₹/ha)	0.168**	0.079	0.037
Machine labour (₹/ha)	-0.117***	0.041	0.005
Fertilizer (₹/ha)	0.039***	0.014	0.005
Manure (FYM) (₹/ha)	0.001	0.005	0.791
Agrochemical (₹/ha)	0.013**	0.007	0.050
Seed (₹/ha)	-0.003	0.018	0.848
Irrigation (₹/ha)	-0.001	0.004	0.787
R <sup>2</sup> value	0.65		

Note: \*, \*\* and \*\*\* denote significance at 10 per cent, 5 per cent and 1 per cent levels, respectively

**Table 3. Overall resource productivity in paddy cultivation in Tripura**

Variables	Coefficient/ Elasticity	Standard error	P- value
Intercept	8.569***	0.645	0.000
Human labour (₹/ha)	0.195**	0.059	0.001
Machine labour (₹/ha)	-0.027	0.028	0.333
Fertilizer (₹/ha)	0.015***	0.005	0.001
Manure (FYM) (₹/ha)	0.002	0.004	0.543
Agrochemical (₹/ha)	0.010**	0.005	0.047
Seeds (₹/ha)	0.004	0.010	0.543
Irrigation (₹/ha)	0.003	0.003	0.400
R <sup>2</sup> value	0.66		

Note: \*, \*\* and \*\*\* denote significance at 10 per cent, 5 per cent and 1 per cent levels, respectively

bring 0.11 per cent decrease in the value of production. Therefore, use of machine labour should be reduced in the region. Due to small size of farms, the use of farm machinery was not much economical which in turn had a negative effect on the value of production of rice in the region. The coefficient of multiple determinations was 0.65 which indicated that 65 per cent of the total variation in the return from paddy cultivation was explained by the factors taken into consideration in the model.

### Overall

The resource productivity of inputs used in paddy cultivation in Tripura is presented in Table 3. The inputs like human labour, fertilizer and agrochemicals were found statistically significant. The human labour had the elasticity of 0.19 which indicated that one per cent increase in the value of human labour would bring 0.19 per cent increase in the value of production, since all the intercultural activities were performed by the human labour. The elasticities of fertilizer and agrochemical were estimated at 0.01 and 0.01 which indicated that one per cent increase in the respective value of fertilizer and manure would bring 0.01 per cent and 0.01 per cent increase in the value of production, respectively. The coefficient of multiple determinations was 0.66, which indicated that 66 per cent of the total variation in the return from paddy cultivation was explained by the model.

### Conclusions and Policy Implications

The study has revealed that the judicious use of resources could enhance the income of rice growers

through increase in productivity and saving of costs on unnecessary use of inputs in rice cultivation. It has also revealed that human labour, fertilizer and agrochemicals contribute positively to rice production. With specific reference to region, it is worth to increase manure application in the hill region, whereas, use of fertilizers and agrochemicals should be increased as per recommended doses and machine labour should be used in a judicious manner in the valley region of the state. Since landholding size is very small in the state, use of machines like big tractor is not advised. To increase labour-use efficiency, use of small farm machinery like power-operated tiller and cono-weeder is suggested as an intervention in the form of technology. Further, the state government should provide necessary region-specific trainings and education to the farmers for judicious use of resources like fertilizers and agro-chemicals in rice cultivation.

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