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An Economic Analysis of Terrace Rice Cultivation in Senapati District of Manipur, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Rice is the way of life, culture and staple food for the people of the NEH Region. Terrace farming is the only practical solution for hilly agricultural land. This study seeks to estimate the cost and returns and resource-use efficiency in Senapati district of Manipur. Using a probability proportional to size sampling technique, 90 farmers from two blocks were surveyed for the study. The results of cost structure analysis revealed that the total cost of cultivation on per hectare basis was estimated at ₹45662.20, ₹47119.94 and ₹46083.33 in marginal, small and overall farms respectively in which hired human labour accounted for about 53.63 and 45.16 per cent of the total cost of cultivation on marginal and small farms. Analysis revealed that terrace rice farming was profitable activity with

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output-input ratio of 1.23, 1.24 and 1.23 on marginal, small and overall farms. Cobb-Douglas production function analysis revealed that the regression coefficient for seed and fertilizers in case of marginal farms were found to be positive and significant. In small farms seed, plant protection chemicals and human labour turned out to show positive and significant effect on yield. The resource use efficiency analysis revealed that the inputs such as fertilizers and human labour were underutilized in overall farms. Seed and fertilizers were underutilized in marginal farms and seed, plant protection chemicals and human labour were underutilized in small farms. The deviations from the optimal level of resource use resulted in low productivity and inefficiency of various inputs. Research efforts should be focused on this area in order to maximize yield through more effective use of significant inputs.

Keywords: Terrace; rice; cost of cultivation; cobb-douglas function; resource use efficiency.

1. INTRODUCTION

The main occupation of the people of Manipur is agriculture. Agriculture accounts for a significant portion of the entire State Domestic Product (SDP). Cultivation is almost entirely mono-crop with rice accounting for about 98 per cent of food-grains production in an area of 175.62 thousand ha [1]. According to the 2011 Population Census, cultivators and agricultural labourers account for 52.81 per cent of all workers in Manipur. Out of the total geographical area of the state, only 7.41 per cent of the total area is used for cultivation. Manipur has a population of 28.56 lakhs, an increase from 22.94 lakhs in the 2001 census [2]. The valley districts account for 57.2 per cent of the population, while the hill districts account for 42.8 per cent. Manipur's staple diet is rice, which is farmed in both the valley and hill regions. Agriculture in hills is very complex and is practised under risky conditions. There is no scope of increasing the area under valley districts. As rice is the staple diet of the people of the state, it is essential to increase the production to feed the rapidly growing population [3]. The production of terrace rice in 2020-21 was 19.05 MT while in 2000-01 it was 22.50 MT [4]. It's clear that terrace rice production in hill districts of Manipur is not keeping pace with the population increase. The cost of cultivation is an essential factor in determining the crop's profitability. Therefore, farmers have to account the costs of various inputs which are used in the cultivation. Rice production is aided by certain inputs that increase productivity. The productivity of rice can be enhanced by using the resources efficiently. Resource use efficiency differs from farmer to farmer due to variation in access to inputs and socio-economic condition of the farmers because of non-availability of suitable high yielding varieties seed, low, unbalanced and untimely use of chemical fertilizers, irrigation, plant protection measures etc. These variations, combined with an inefficient use of various resources resulted in low productivity, lowering farmer's returns. Thus, a study is required to know the scope for attaining higher productivity. Hence the present study was undertaken to estimate the cost and returns to understand whether the farmers are operating in loss or profit and study of resource use efficiency will be used to determine how the existing resources are being used and what are the ways to improve the resource use efficiency.

2. MATERIALS AND METHODS

The present study was conducted in the Senapati district of Manipur state. Multi-stage sampling technique was used for the present study. Among the five hill districts of Manipur, Senapati district was purposively selected as it has the highest area and production under terrace rice. There are six blocks in this district, and two of them, Sadar Hills West and Mao-Maram, were purposively chosen because they had the highest acreage under terrace rice. For the selection of villages, a list of villages falling under each block where terrace rice is extensively grown was prepared in consultation with the respective Block Development Officers and KVK (Hengbung, Senapati) and then two major terrace rice growing villages were selected from each block. A list of all terrace rice growing farmers was prepared and a sample of 90 farmers were selected from the selected four villages namely Tumuyon khullen, Ningthoumpan, Tingsong khullen and Song song by using Probability proportional to size sampling technique (PPS) technique. The majority of the respondents fell into the categories of marginal farmers (< 1 ha) and small farmers (1-2 ha), which is how the selected farmers were classified.

To achieve the objectives of the research study, both primary as well as secondary data were collected. Primary data were collected from the sample farmers through personal interview method with the help of a pre-tested and well-structured schedule. Secondary data pertaining to the locale of the study area were collected from the various publications of the Department of Agriculture, Government of Manipur, Directorate of Economics and Statistics and from various government offices like District Agriculture office, KVK (Hengbung, Senapati).

To meet the objectives of the study, various mathematical and statistical tools such as SPSS and R language were employed for the analysis of the data.

2.1 Estimation of Cost and Returns in Terrace Rice Cultivation

Cost concept given by Special Expert Committee on Cost of Production Estimates (1979) was used to calculate the cost of cultivation for different categories of terrace rice farmers.

Cost A_1 = All paid out cost components
Cost A_2 = Cost A_1 + Rent paid for leased in land
Cost B_1 = Cost A_1 + Interest on value of owned fixed capital assets (excluding land)
Cost B_2 = Cost B_1+ rental value of owned land less land revenue and rent paid for leased in land
Cost C_1 = Cost B_1+ Imputed value of family labour
Cost C_2 = Cost B_2+ Imputed value of family labour
Cost C_3 = Cost C_2+10% of Cost C_2 on account of managerial functions performed by the farmer

For returns analysis, following measures were used:

Gross Farm Income (GFI) = Value of main product + Value of by-product
Net return including family labour = GFI - Total cost including family labour
Net return excluding family labour = GFI - Total cost excluding family labour
Farm business income = GFI - Cost A_2
Family level income = GFI - Cost B_2
Net farm income = GFI - Cost C_2
Farm investment income = Farm business income-wages of family labour

$$\text{Output -Input- Ratio} = \frac{\text{Gross income}}{\text{Respective Cost}}$$

2.2 Estimation of Production Function

Cobb-Douglas production function was used for studying the relationship between output and input variables to estimate production elasticities in the study.

$$y = b_0 x_i^{bi} e^u$$

Where,

y = yield (kg / ha)
x_1 = expenses on seed (₹/ha)
x_2 = expenses on chemical fertilizers (₹/ha)
x_3 = expenses on plant protection chemicals (₹/ha)
x_4 = expenses on human labour (₹/ha)
b_0 = constant term
b_i = elasticity coefficients (i = 1, 2, 3, 4)
e^u = error term

2.3 Test for Significance

a) t-test: The estimated regression coefficients (b_i) was tested for their significance at the chosen level of probability using student t-test:

$$t = \frac{b_i}{SE(b_i)}$$

Where;

b_i = regression coefficients of an i^{th} input
SE (b_i) = standard error of an i^{th} input

b) F-test: Overall significance of regression coefficients was tested using F-test. The calculated value of F is compared with the tabulated value of F at v_1 = (k-1) and v_2 = (n - k) degrees of freedom.

$$F = \frac{R^2 (n-k)}{\left(1- \bar{R}^2\right)(k-1)}$$

Where,

R^2 = coefficient of unadjusted multiple determinations
$\bar{R}^2$ = coefficient of adjusted multiple determinations
n = number of observations in the sample
k = number of b_i (including the intercept b_0)

In order to ascertain the goodness of fit, coefficient of multiple determinations (R^2) was calculated using the formula;

$R^2 = \frac{RSS}{TSS}$

Where,

RSS = regression sum of squares
TSS = total sum of squares

The adjusted value of R^2 is denoted as $\bar{R}^2$ and has been calculated as;

$\bar{R}^2 = 1-(1-R^2)\frac{n-1}{n-k}$

Where,

R^2 = Unadjusted multiple correlation coefficient
n = number of sample observations
k = number of parameters estimated

2.4 Estimation of Resource Use Efficiency

Economic rationale of resource use on different categories of farms was examined by comparing the marginal value product of a given resource with the marginal factor cost (allocative efficiency).

$AE_{xi} = \frac{MVP_{xi}}{MFC_{xi}}$
$MVP_{xi} = MPP_{xi}\ (P_y)$
$MVP_{xi} = b_i \frac{\bar{y}}{\bar{x_i}}(P_y)$ ($\because MPP_{xi} = bi\ \frac{\bar{y}}{\bar{x_i}}$)

Where,

MPP_{xi} = marginal physical product of i^{th} input
P_y = price of output per unit (Rs.)
$\bar{y}$ = geometric mean of the output
$\bar{x_i}$ = geometric mean of i^{th} input
b_i = regression coefficients (i = 1,2,.....,4)

$MFC_{xi} = P_{xi}$

Where,

MFC_{xi} = marginal factor cost of i^{th} input
P_{xi} = unit price of i^{th} input

3. RESULTS AND DISCUSSION

3.1 Cost and Return Structure

The profitability of a crop depends on the level of cost and returns. Analysis of cost and returns is basic to any economic analysis.

3.1.1 Cost of cultivation of terrace rice based on variable costs and fixed costs

Table 1 shows the per hectare cost of cultivation for different categories of sample farms. A perusal of the table reveals that out of the total cost of cultivation and among variable costs, hired human labour charges were the major cost item for all the farms. This item accounted for about 53.63, 45.16 and 51.13 per cent of the total cost of cultivation in marginal, small and overall farms respectively. Similarly, Suresh and Reddy [5] in their study conducted in Thrissur district in the Kerala reported that the share of hired human labour constituted the major proportion within the variable cost. The family labour and rental value of owned land were the next important cost components contributing about 14.98 and 13.02 per cent of the total cost of cultivation respectively. Fertilizers, depreciation on farm implements, seed, plant protection chemicals are other important inputs in the cultivation of terrace rice.

The share of variable costs constituted the major proportion i.e., 71.57, 61.69 and 68.65 per cent in marginal, small and overall farms respectively. Similarly, Nirmala and Muthuraman [6] in their study conducted in Kathial district of Haryana reported the major contribution of variable costs in the total cost of cultivation. Within the total variable cost, the most important cost items were hired human labour, fertilizers, seed and plant protection chemicals in marginal farms. The cost incurred on these items were 53.63, 9.83, 4.23 and 1.86 per cent of the respective total. Similarly in the case of small farms the most important cost items were hired human labour, fertilizers, seed and plant protection chemicals which accounted to 45.16, 9.23, 3.76 and 1.79 per cent of the respective total.

The total variable cost has been estimated at ₹32681.62, ₹29066.95 and ₹31637.39 in marginal, small and overall farms respectively and is higher in case of marginal farms than small farms. The average expenditure made on seed was observed to be higher in marginal farms (₹1930.31) than small farms (₹1772.31). Farmers pointed out that the use of fertilizers were in higher quantities only when enough rainfall was there. If the rainfall was good; farmers had used more quantities of fertilizers. In the surveyed area per hectare expenditure on fertilizers was ₹4486.78, ₹4348.46 and ₹4446.82 on marginal, small and overall size groups of

farms respectively and was higher in case of marginal than small farms. The per hectare expenditure made on plant protection measures were ₹850.83, ₹842.42 and ₹848.4 on marginal, small and overall size groups of farms respectively. The per hectare cost of hired human labour as on overall basis was ₹23560.89 and on marginal, small farms were ₹24487.5 and ₹21280 respectively.

In the total cost of production of a crop enterprise besides variable costs, fixed costs constitute an important component. The total fixed cost has been estimated at ₹12980.58, ₹18052.99 and ₹14445.95 in marginal, small and overall farms respectively and is higher in case of small farms than marginal farms. The share of fixed costs in total cost was found to be 28.43, 38.31 and 31.35 per cent in marginal, small and overall farms respectively. Among the items of fixed cost, family labour and rental value of owned land were the most important one which constituted about 12.39 and 13.14 per cent followed by depreciation in marginal farms and family labour, rental value of owned land and depreciation in small farms which constituted about 21.16, 12.73 and 1.42 per cent respectively.

Overall, the average cost of cultivation works out to ₹46083.33/ha. The total cost of cultivation on marginal farms was lower than the small farms, which was estimated at ₹45662.20 and ₹47119.94 respectively for these two categories of farms. Churpal et al. [7] also found similar results in Dhamatri district of Chhattisgarh. But the total cost of cultivation excluding family labour was higher in marginal farms (₹40005.95) than small farms (₹37150.71).

Table 1. Cost of terrace rice cultivation based on variable and fixed costs for different categories of sample farms

(₹/ha)

Sl. No.	Particulars	Marginal	Small	Overall
A. Variable cost				
1	Seed	1930.31 (4.23)	1772.31 (3.76)	1884.67 (4.09)
2	Fertilizers	4486.78 (9.83)	4348.46 (9.23)	4446.822 (9.65)
3	PPC	850.83 (1.86)	842.42 (1.79)	848.4 (1.84)
4	Hired human labour	24487.5 (53.63)	21280 (45.16)	23560.89 (51.13)
6	Interest on working capital	926.20 (2.03)	823.76 (1.75)	896.61 (1.95)
	Subtotal (A)	32681.62 (71.57)	29066.95 (61.69)	31637.39 (68.65)
B. Fixed cost				
1	Family labour	5656.25 (12.39)	9969.23 (21.16)	6902.22 (14.98)
2	Depreciation	307.42 (0.67)	669.47 (1.42)	412.01 (0.89)
3	Land revenue	0 (0.00)	0 (0.00)	0 (0.00)
4	Rental value of owned land	6000 (13.14)	6000 (12.73)	6000 (13.02)
5	Interest on fixed capital	1016.91 (2.23)	1414.29 (3.00)	1131.71 (2.46)
	Subtotal (B)	12980.58 (28.43)	18052.99 (38.31)	14445.95 (31.35)
C.	Total cost including family labour	45662.20	47119.94	46083.33
D.	Total cost excluding family labour	40005.95	37150.71	39181.11

Note: Figures in parentheses denotes the percentage to the total cost of cultivation (C)

3.1.2 Cost of cultivation of terrace rice using cost concepts

The per ha cost of cultivation of terrace rice using cost concepts for different categories of farms is presented in Table 2.

Cost A_1 which is also called as out of pocket expenses (cash expenses) was ₹32049.40/ha for overall size group of farms. However, per hectare cost A_1 on marginal and small farms were found to be ₹32989.04 and ₹29736.42 respectively. The practice of 'leasing in' or 'leasing out' of land was not prevalent in the study area; hence cost A_1 and cost A_2 were same for all categories of farms. Cost B_1 constituted ₹34005.95, ₹31150.71 and ₹33181.11 on marginal, small and overall farms respectively. Whereas cost B_2 was constituted ₹40005.95, ₹37150.71 and ₹39181.11 on corresponding categories of farms respectively. As far as cost C_2 was concerned, it was found to be ₹45662.20, ₹47119.94 and ₹46083.33 on marginal, small and overall farms respectively. Per hectare 'cost C_3' is the total cost of cultivation which included the managerial cost of farmers. It came out to be ₹50228.42, ₹51831.94 and ₹50691.67 on marginal, small and overall size of farms respectively.

3.1.3 Returns from terrace rice cultivation

Table 3 presents the comparative study of the two farm categories under consideration, with regards to farm efficiency measures on per hectare basis. The average yield of main product in overall farms was found to be 2.65 MT/ha. The yield of by-product in overall farms was worked out to be 1.44 MT/ha. The average yield of main product was found to be significantly higher in case of small farms (2.7 MT/ha) in comparison to marginal farms (2.64 MT/ha). Similar pattern was also found in the quantity of by-product on sample farms. Quantity of by-product (paddy straw) was found to be higher in small farms (1.65 MT/ha) than marginal farms (1.01 MT/ha). Similar findings have been reported by Saipriya and Maurya [8] in production of paddy in Mahbubnagar district of Telangana.

On an average, terrace rice growing farmers were noted to earn a gross income of about ₹56760.51/ha in overall farms. Gross farm income of small farms (₹58200.26) was found to be marginally higher than marginal farms (₹56175.61). The net returns per hectare was ₹10677.18 in overall farm situation which ranged from ₹11080.32/ha as highest on small farms to ₹10513.41/ha as lowest on marginal farms. Similarly, Maurya et al. [9] in his study conducted in Mau district of eastern Uttar Pradesh reported that gross farm income and net farm income were higher in the category of small farms in comparison to marginal farms. So far as the net income was concerned, it was evident from the table that small farms performed better than marginal farms and the net farm income of an average small farm exceeded the net farm income of an average marginal farm by about ₹566.91.

The Farm business income, family level income and farm investment income in overall farms were calculated to be ₹24711.11, ₹17579.40 and ₹17808.89 respectively. The farm business income was higher in case of small farms (₹28463.84) as compared to that of marginal farms (₹23186.57). Similar trends were found in case of family level income and farm investment income.

Table 4 presents the output-input ratios for different categories of farms. It's evident from the above table that the output-input ratios for overall size group at Cost A_1, Cost A_2, Cost B_1, Cost B_2, Cost C_1 and Cost C_2 were 1.77, 1.77, 1.71, 1.45, 1.42 and 1.23 respectively. The output-input ratio calculated were greater than unity in all the size groups indicating there by the production of terrace rice was profitable. Small farmers were having better output-input ratio 1.24 against the ratios of 1.23 for marginal farmers reflecting better management on small farm. Similarly, Kumar [10] in his study conducted in udham singh nagar district of Uttarakhand reported that small farms were having better output-input ratio than marginal farms.

3.2 Production Function Analysis

To meet the analytical requirements of the second objective of the study, production function was estimated for marginal, small and overall sample farms by fitting Cobb Douglas production function. The results of the production function analysis for terrace rice have been presented in Table 5.

A perusal of the table shows that, in the case of marginal, small and overall farms, the value of adjusted co-efficient of multiple determinations ($\bar{R}^2$) are 0.84, 0.88 and 0.85 respectively and found statistically significant. This indicates that the explanatory variables included in the regression model were responsible for 84, 88

and 85 per cent of the variation in per hectare terrace rice output. The remaining 16,12 and 15 per cent of variation in farms could be due to some other factors which have not been included in the production function.

The regression co-efficient for seed and fertilizers in case of marginal farms turned out to be positive and statistically significant (significant at 1%). It indicates that 1 per cent increase in the expenditure of each unit of seed and fertilizers, on an average increased the output of terrace rice by 0.124 and 0.246 per cent respectively, by taking one input at a time and keeping other inputs constant. Plant protection chemicals and human labour were found to be statistically non-significant.

In small farms, the regression co-efficient on expenditure of seed, plant protection chemicals and human labour were found to be positive and statistically significant (seed at 5%, plant protection chemicals at 5% and human labour at 5%) respectively. It indicates that 1 per cent increase in the expenditure of seed, plant protection chemicals and human labour on an average increased the output of terrace rice by 0.212, 0.069 and 0.658 per cent respectively by taking one input at a time and keeping other inputs constant. Similar finding has been reported by Ralte [11] in category II (small) farms in his study conducted in wet rice cultivation in Champhai district of Mizoram. The estimated regression coefficient of fertilizers was -0.081 which was negative and statistically non-significant.

In overall farms, the coefficient of fertilizers was found to be positive and significant at 5 per cent probability level while human labour charges were found to be positive and significant at 1 per cent. It indicates that with 1 per cent increase in

Table 2. Cost of terrace rice cultivation using cost concepts for different categories of sample farms

(₹/ha)

Sl. No.	Particulars	Marginal	Small	Overall
1	Seed	1930.31 (4.23)	1772.31 (3.76)	1884.66 (4.09)
2	Fertilizers	4486.78 (9.83)	4348.46 (9.23)	4446.822 (9.65)
3	PPC	850.83 (1.86)	842.42 (1.79)	848.4 (1.84)
4	Hired human labour	24487.5 (53.63)	21280 (45.16)	23560.89 (51.13)
6	Depreciation	307.42 (0.67)	669.47 (1.42)	412.01 (0.89)
7	Land revenue	0 (0.00)	0 (0.00)	0 (0.00)
8	Interest on working capital	926.20 (2.03)	823.76 (1.75)	896.61 (1.95)
9	Cost A_1	32989.04	29736.42	32049.40
10	Rent paid for leased in land	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
11	Cost A_2	32989.04	29736.42	32049.40
12	Interest on value of owned fixed capital assets	1016.91 (2.23)	1414.29 (3.00)	1131.71 (2.46)
13	Cost B_1	34005.95	31150.71	33181.11
14	Rental value of owned land less land revenue and rent paid for leased in land	6000 (13.14)	6000 (12.73)	6000 (13.02)
15	Cost B_2	40005.95	37150.71	39181.11
16	Imputed value of family labour	5656.25 (12.39)	9969.23 (21.16)	6902.22 (14.98)
17	Cost C_1	39662.20	41119.94	40083.33
18	Cost C_2	45662.20	47119.94	46083.33
19	Cost C_3	50228.42	51831.94	50691.67

Note: Figures in parentheses denotes the percentage to the Cost C_2

Table 3. Returns from terrace rice cultivation for different categories of sample farms

(₹/ha)

Particulars	Marginal	Small	Overall
Output (MT/ha)			
Main Product – Paddy (MT/ha)	2.64	2.7	2.65
Byproduct – straw (MT/ha)	1.01	1.65	1.44
Main Product – Paddy (₹/ha)	54960.61	56217.95	55323.84
Byproduct – straw (₹/ha)	1215.00	1982.31	1436.67
Gross Farm Income (GFI)	56175.61	58200.26	56760.51
*Total cost ©	45662.20	47119.94	46083.33
Net return (GFI-C)	10513.41	11080.32	10677.18
*Total cost (D)	40005.95	37150.71	39181.11
Net return (GFI-D)	16169.66	21049.55	17579.40
Income over cost using cost concepts			
Farm business income (GFI-Cost A2)	23186.57	28463.84	24711.11
Family level income (GFI-Cost B2)	16169.66	21049.55	17579.40
Net farm income (GFI-Cost C2)	10513.41	11080.32	10677.18
Farm investment income (Farm business income-wages of family labour	17530.32	18494.61	17808.89

Note: Total cost © is including family labour and total cost (D) is excluding family labour

Table 4. Output – Input ratio for different categories of sample farms

Sl. No.	Particulars	Marginal	Small	Overall
1	Cost A_1	1.70	1.96	1.77
2	Cost A_2	1.70	1.96	1.77
3	Cost B_1	1.65	1.87	1.71
4	Cost B_2	1.40	1.57	1.45
5	Cost C_1	1.42	1.42	1.42
6	Cost C_2	1.23	1.24	1.23

the expenditure on fertilizers and human labour, on an average increased the output of terrace rice by 0.143 and 0.498 per cent respectively by taking one input at a time and keeping the others constant. The estimated regression co-efficient of seed and plant protection chemicals were found to be positive and statistically non-significant. Similarly, Prakash [12] in his study conducted in Udham singh nagar district of Uttarakhand reported that the estimated regression coefficients of fertilizers and human labour were found positive and statistically significant in overall farms.

The sum of co-efficient elasticity (Σbi) was 0.571, 0.858 and 0.711 in marginal, small overall farms respectively and significantly different from unity, thus indicates decreasing returns to scale in marginal, small and overall farms. This means that, if all the variables were increased together by 1 per cent the gross output would also increase by 0.571, 0.858 and 0.711 per cent respectively on marginal, small and overall farms.

3.3 Resource Use Efficiency

Resource use efficiency in production of terrace rice was studied by comparing the marginal value productivity of a resource with the respective factor cost. The resource use efficiency was studied only for those variables, which had a statistically significant and positive effect on the dependent variable. The ratio of marginal value product and the marginal factor cost of different variables under marginal, small and on overall farm for sample farmers are presented in Table 6.

A perusal of the Table 6 found that the marginal value product and marginal factor cost ratios of seed and fertilizers (3.58 and 3.02 respectively) were found positive and more than unity, implying that increasing use of these resources will bring more income to the farmer in marginal farms. In case of small farms, the marginal value product and marginal factor cost ratios of seed, plant protection chemicals and human labour were 6.83, 4.64 and 1.19 respectively. These were significant and more than unity, implying

Table 5. Estimated Production function coefficients for different categories of sample farms

Farm Category	No. of Obs.	Intercept	Regression co-efficient						
			X_1 (Seed)	X_2 (Fertilizers)	X_3 (PPC)	X_4 (Human labour)	Σb_i	F	$\bar{R}^2$
Marginal	64	3.124(3.051)*	0.124(2.755)*	0.246(2.996)*	-0.033(-0.687)	0.234(1.224)	0.571	125.827	0.84
Small	26	5.241(3.859)*	0.212(2.293)**	-0.081(-1.379)	0.069(2.248)**	0.658(2.433)**	0.858	60.660	0.88
Overall	90	1.113(2.352)**	0.045(1.282)	0.143(2.035)**	0.025(0.854)	0.498(8.070)*	0.711	97.478	0.85

Note: figure in the parentheses indicates t-calculated value
**significant at 1 per cent probability level*
***significant at 5 per cent probability level*

Table 6. Resource use efficiency of different categories of sample farms

Variables	MVP			MFC			RUE		
	Marginal	Small	Overall	Marginal	Small	Overall	Marginal	Small	Overall
Seed	3.58	6.83		1	1		3.58	6.83	
Fertilizers	3.02		1.78	1		1	3.02		1.78
Plant protection chemicals		4.64			1			4.64	
Human labour		1.19	1.18		1	1		1.19	1.18

that increasing use of this resource will bring more income to the farmers. Reddy and Reddy [13] also found similar results in the case of small farms in Nellore district of Andhra Pradesh. In overall farms, the marginal value product and marginal factor cost ratio of fertilizers and human labour (1.78 and 1.18 respectively) were found positive and more than unity which indicates under-utilization of inputs variables.

4. CONCLUSION

The rice cultivation in Senapati district of Manipur state yielded an average gross return of ₹56760.51/ha on overall farm level in which the small farmers (₹58200.26/ha) had the highest return in comparison to marginal farms (₹56175.61/ha). Small farms were having better output-input ratio of 1.24 against the ratio of 1:23 on marginal farms reflecting better management on small farms. It can be concluded that rice cultivation was economical and profitable venture in the study area. The rice was not grown as per the recommended package of practices in the study area. The deviation from the optimum level of use of various inputs have been found in terrace rice cultivation on different categories of farms in the area. Since the ratio of MVP/MFC was greater than one in all categories of farms so there is scope to increase the input use in order to increase the yield. Resource use efficiency of the study area was low, so the concerned authority should frame some policies regarding on-farm demonstration and dissemination of new technology through extension agencies. Concerted efforts should be made towards yield enhancement through better utilization of significant inputs and research efforts should be directed towards it.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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