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Comparative Economics of Rice Cultivation in Himachal Pradesh and Manipur States of India

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ABSTRACT

Rice is an important food crop of India and with almost no scope in increasing the area under this crop and recent trends of declining growth rates and increasing shortages in inputs, the aim should be at eliminating the spatial differences in yield and production to augment rice production. Due to various differences, the average yield of paddy are quite different between Himachal Pradesh (1.55 t/ha) and Manipur (2.26 t/ha). Therefore, the present study was conducted in Kangra district of Himachal Pradesh and Imphal-West district of Manipur to compare the economics of rice cultivation in the two states during the growing season of 2011-12. Stratified simple random sampling technique was used to select 50 paddy growing farmers from each district and then categorised into small and large farmers. Gross returns were found to be higher on large farms than on small farms in both the states. Small farms of Manipur were not viable, as the price they received for a quintal of the main product (Rs 1200) did not cover the cost of production (Rs 1202). Cobb-Douglas production function analysis revealed that the factors affecting paddy production on small farms were use of manures and fertilizers and plant variety in Himachal Pradesh and use of seed and plant variety in Manipur. The factors responsible for paddy production on large farms were use of seed, plant protection chemicals and plant variety in Himachal Pradesh, while they were use of manures and fertilizers, seed, plant protection chemicals and plant variety in Manipur.

1. Introduction

Rice is the staple food for 65 per cent of the total population in India, where 43.97 million hectares are under rice, which accounts for 24 per cent of the global rice area (2011-12). Despite being the second largest producer and consumer of rice in the world, India's yield of this crop (2.38 t/ha) is only nearly half of the world's average yield (4.21 t/ha). Rice is one of the largest traded commodities in the world with a total quantity touching 16.4 million tonnes. In India, rice is cultivated in vastly diverse conditions, from below the sea level in some parts of Kerala, to over an elevation of 3000 m above sea level in the hills of Himachal Pradesh and Jammu and Kashmir.

The by-products of rice *viz.* rice straws are used as animal fodder, in brick kilns and paper and packaging industries. Rice straws are also used by biomass power plants for electricity generation and can also be used for preparation of compost. The compost preparation from rice straws takes about 45 days and it can increase the crop yield by 4-9% and if applied as mulch helps in maintaining soil fertility. This is a better alternative for the paddy farmers than burning the excess straw in their rice fields as it will decrease the pollution and also reduce the cost incurred in fertilizers. In Himachal Pradesh, paddy was cultivated on an area 78.6 thousand hectares during 2007-2008, with a production of 121.4 thousand tonnes and productivity of 1546 kg/ha. Kangra and Mandi districts alone accounted for 71.2% of area and 69.7% of production.

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In Himachal Pradesh, paddy is cultivated under diverse agro-climatic conditions, extending from foot-hills (350m) to high hills (upto 2300 m). It is cultivated under two main ecosystems in different districts in the state- Irrigated ecosystems, where 58% of rice is grown and rain-fed upland ecosystem, where 42% of rice is grown. The farmers in the state do not find cultivation of paddy a lucrative alternative, mostly due to the intensive labour requirements. But it has an important place in the daily diet of the hill people and also an important part of all religious ceremonies. Most of the paddy farmers in the state have been consuming their own produce. But with the introduction of high yielding varieties and hybrids, the paddy farmers have started to sell their surplus produce in the local markets and sometimes in the adjoining states. In Manipur, paddy was cultivated in an area of about 212.68 thousand hectares with an average productivity of 2.26 tonnes/hectare in 2010-11. There are nine districts in Manipur and paddy is grown in all the districts because rice is the fundamental staple food for the people of the state. *Jhum* cultivation or shifting cultivation and terrace farming of paddy is followed in the hilly districts of the state covering an area of 88.82 thousand hectares producing about 16.25 per cent of the total paddy production in the state. In the valley districts of the state, paddy is grown in pre-*kharif* and *kharif* season covering a total area of 123.86 thousand hectares and constituting 83.75 per cent of the total paddy production in the state. The farmers of Manipur also grow paddy for their own consumption and they hardly look at paddy cultivation from commercial point of view. Because of this attitude of the paddy farmers, they might not be operating at the profit maximising level of production and a potential profitability from this crop might have been foregone. So, with this backdrop, an attempt was made to study the economics of rice cultivation in the states of Himachal Pradesh and Manipur with the following objectives

1. To estimate the profitability of rice cultivation by examining the gross returns and cost of cultivation of the sample farmers.
2. To examine the input output relationship in paddy production.

2. Methodology

A three-stage stratified random sampling technique was employed to select the sample. The stratification was done on the basis of districts, blocks, villages and farmers. Himachal Pradesh and Manipur were selected purposively considering the availability of resources in terms of both money and time and also a representation of two different agro-ecological regions of India. In the stage, a list of districts was prepared along with the area under paddy and the district with highest area under paddy was selected in both the states. Kangra district of Himachal Pradesh and Imphal-West district of Manipur were thus selected for the study. In the second stage, lists of development blocks were prepared in the selected districts and two blocks were randomly chosen from the two selected districts namely, Bhawarna and Nagrota blocks from Kangra district and Imphal-West I and Imphal-West II from Imphal-West district. In the third stage, lists of paddy farmers along with their area under paddy were made in each selected blocks and a sample of 25 farmers in each block was selected at random. Thus, in total a sample of 100 farmers was selected. The farmers were categorised into small and large farmers with the help of cumulative square root frequency method according to the size of land holdings. The size and number of each category of farmer is presented in the Table 1 below:

Table 1. Classification of sample farmers

Sr. No	Category	Class size (Hectare)	Number of farmers	
			Himachal Pradesh	Manipur
1.	Small	< 1	23	25
2.	Large	>1	17	25
	Total		50	50

The data for the study pertained to the agricultural year 2011-12. The net profitability of rice crop was estimated using the following relationship:

NR = GR – VC

Where,

NR = Net returns over variable cost

$GR = Y_m . P_m + Y_b . P_b$

Where,

GR = Gross returns.

Y_m = Yield of main product.

P_m = Price per unit of the main product.

Y_b = Yield of the by-product.

P_b = Price per unit of the by-product

$$VC = \sum_{i=1}^{n} P_i \, X_i$$

Where,

P_i = Per unit price of i^{th} input

X_i = Quantity of i^{th} input

The various inputs selected were seed, manures and fertilisers, chemicals and insecticides, family and hired human labour and bullock labour or tractor hours.

In order to examine the input-output relationship in paddy production, both linear and Cobb-Douglas production functions were fitted. The Cobb-Douglas production function was selected for the presentation of analysis as it gave a better fit to the data. The mathematical form of the function was

$$Y = b_0 \, X_1^{b_1} \, X_2^{b_2} \, X_3^{b_3} \, X_4^{b_4} \, X_5^{b_5} \, e^{(b_6 D + Y)}$$

Where,

Y= Gross value of paddy output (Rs/ha)

X_1 = Human Labour (Rs/ha)

X_2 = Bullock Labour (Rs/ha)

X_3 = Manures and Fertilisers (Rs/ha)

X_4 = Seed (Rs/ha)

X_5 = Plant Protection Chemicals (Rs/ha)

D = Dummy for variety (value 1 was given for high yielding varieties and 0 for local varieties)

U = Error Term

The Cobb-Douglas production function was estimated using ordinary least square (OLS) approach after converting it into log-linear form. The estimable form of the equation is given below:

$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 D + U$

Adjusted co-efficient of multiple determination ($\overline{R}^2$) was calculated in order to correct the problem of decreasing degrees of freedom as follows:

$$\overline{R^2} = 1 - (1 - R^2)\frac{n-1}{n-K-1}$$

Where,

$\overline{R}^2$ = Adjusted Co-efficient of multiple determination

R^2 = Co-efficient of multiple determination

n = Number of observations

K = Total number of parameter to be estimated including constant term

The significance of $\overline{R}^2$ was tested with the help of F-test as:

$$F_{(k-1),(n-k)d.f.} = \frac{\overline{R^2}/(K-1)}{(1-\overline{R^2})/(n-K)}$$

The returns to scale were obtained by summing up of elasticity co-efficients ($\sum_{i=1}^{5} b_i$) in Cobb-Douglas production function. The returns to scale were tested by F-test for its statistical significance.

$$F_{(1,n-k)d.f.} = \frac{(\sum b_i - 1)^2}{\sum V(b_i)}(n-K)$$

Where,

$\sum b_i$ = Returns to scale

$V(b_i)$ = Variance of regression co-efficient of the i^{th} variable input

n = sample size

K = Total number of parameters used in regression analysis including intercept

3. Results and Discussion

The living standard of the rural population can be raised by increasing their farm income, as their major occupation is farming. But most of the times, the farmers fail to treat farming as another business enterprise from which they can earn profits. As found in case of many of the sample paddy farmers in Manipur, they just cultivated paddy for own home consumption, and thus, did not consider the economic viability. So, different economic indicators of paddy cultivation, *viz.,* gross returns, variable and fixed costs of the sample farmers were analysed to work out the net returns and cost of production. The results will help in determining whether the sample farmers are economically viable or not in paddy cultivation.

Table 2. Cost and Returns from Paddy in Himachal Pradesh and Manipur. (Rs/ha)

Sl.no.	Particulars	Himachal Pradesh		Manipur	
		Small	Large	Small	Large
1	Average yield (q/ha)	21.33	21.75	30.46	32.41
2	Price of paddy (Rs/q)	1400	1400	1200	1200
3	By-products (q/ha)	19.58	19.65	28.37	36.24
4	Price of straw(Rs/q)	300	300	250	250
5	Gross Returns	35736	36345	43645	47952
6	Variable cost	28789	26215	36606	34005
7	Fixed cost	6069	6069	8994	8994
8	Total cost	34858	32284	45600	42999
9	Net Returns over variable cost	6947	10130	7039	13947
10	Cost of production(Rs/q)	1350	1205	1202	1049

The details are presented in Table 2 for different farm categories in the two states. Gross returns were found to be higher on large farms (Rs. 36345/ha) than on small farms (Rs. 35736/ha) in Himachal Pradesh. This was due to the economies of scale that existed on large farms for monoculture. The same was true for Manipur too. Thus, the net returns over variable cost were higher on large farms than on small farms in both the states. The cost of production was highest on small farms of Himachal Pradesh (Rs 1350/q) and lowest on large farms of Manipur (Rs 1049/q). Through examination of the cost of production, it was observed that small farms of Manipur were not viable, as the price they received for a quintal of the main product (Rs 1200) did not cover the cost of production (Rs 1202). This was due to the reason that the sample farmers on small farms of Manipur produced paddy solely for consumption purpose and were not profit-driven, in the process of which they used the variable resources inefficiently. Both the farm categories of Himachal Pradesh were found to be economically viable and so was the large farms of Manipur.

3.1 Input-output Relationship

The results of the Cobb-Douglas production function analysis for paddy on small farms of both the states have been given in Table 3. The adjusted coefficients of multiple determination ($\bar{R}^2$) were significant at one per cent level of significance for both the states. $\bar{R}^2$ were observed to be 0.6016 and 0.7327 for Himachal Pradesh and Manipur respectively. This meant that the explanatory variables included in the regression equation explained around 60 percent and 73 per cent variation in the gross returns of farmers of Himachal Pradesh and Manipur respectively. Significant decreasing returns to scale (0.5342) were found to be operating on small farms of Himachal Pradesh while in Manipur, increasing returns to scale (1.62) were observed. This indicated that one per cent increase in the investment of all the inputs simultaneously will increase the gross returns of paddy by less than one per cent in Himachal Pradesh and by more than one per cent in Manipur. Singh (1993), on analysing the production functions of paddy overall in Himachal Pradesh and Manipur, obtained significant decreasing returns to scale (0.8334) and increasing returns to scale (1.2251) respectively. In Himachal Pradesh, the expenditure made on manures and fertilizers and the dummy for High Yielding Varieties (HYVs) were found to have positive significant effect on the gross returns of paddy, indicating that one per cent increase in the expenditure on manures and fertilizers will increase the gross returns by 0.13 per cent. This implied that the small paddy farmers of Himachal Pradesh have been underutilizing manures and fertilizers and that there was still scope for increasing the gross returns by increasing the investment in manures and fertilizers. The dummy variable for HYVs captured the positive effect of cultivating HYVs on the gross returns of the farmers (0.0634). In Manipur, expenditure on seed and the dummy for HYVs were found to have positive significant effect on the gross returns from paddy, indicating that one per cent increase in the expenditure on seed will increase the gross returns by 0.58 per cent.

Table 3. Elasticity Coefficients of Production Functions for Paddy on Small Farms in the Selected States, 2011-12.

Sl. No.	Parameters		Himachal Pradesh	Manipur
1	Intercept	b_0	535.6207	0.0661
2	Human Labour (X_1)	b_1	0.1943 (0.1469)	0.6515 (0.3999)
3	Bullock/ tractor labour (X_2)	b_2	0.0985 (0.0813)	0.1585 (0.1393)
4	Manures and fertilizers (X_3)	b_3	0.1344* (0.0613)	0.1484 (0.1257)
5	Seed (X_4)	b_4	0.0409 (0.1136)	0.5764** (0.1341)
6	Chemicals (X_5)	b_5	0.0028 (0.0037)	0.0080 (0.0080)
7	Dummy (D)	b_6	0.0634** (0.0128)	0.0775** (0.0230)
8	Adjusted coefficient of multiple determination	$\overline{R^2}$	0.6016**	0.7327**
9	Returns to scale	$\sum b_i$	0.5342**	1.6200**

Note: 1. ** and * indicate significance at 1 and 5 per cent respectively.

2. Figures in parenthesis indicate standard errors of elasticity coefficients.

This result finds it necessary that the small paddy farmers of Manipur should invest more on better quality seed. The results of the Cobb-Douglas production function analysis for paddy on large farms of both the states have been given in Table 4. The adjusted coefficients of multiple determination ($\bar{R}^2$) were significant at one per cent level of significance for both the states. $\bar{R}^2$ were observed to be 0.6759 and 0.7281 respectively for Himachal Pradesh and Manipur respectively. This meant that the explanatory variables included in the regression equation explained around 68 per cent and 73 per cent variation in the gross returns of farmers of Himachal Pradesh and Manipur respectively. Decreasing returns to scale (0.4765) were found to be operating on large farms of Himachal Pradesh while in Manipur, increasing returns to scale (1.62) were observed, but it was not found to be significant. The returns to scale in Himachal Pradesh were significant at one per cent level of significance. This indicated that one per cent increase in the investment of all the inputs simultaneously will increase the gross returns of paddy by less than one per cent in Himachal Pradesh. In Himachal Pradesh, the expenditure made on seed, plant protection chemicals and the dummy for High Yielding Varieties (HYVs) were found to have positive significant effect on the gross returns from paddy. This indicated that one per cent increase in the expenditure on seed and plant protection chemicals will increase the gross returns by 0.39 per cent and 0.30 per cent respectively. Thus, the large farmers of Himachal Pradesh should invest more on quality seed and plant protection chemicals. The elasticity coefficients of human labour and bullock labour were found to have negative regression coefficients, indicating overutilization of these inputs in value sense, but they were not significant. In Manipur, expenditure on manures and fertilizers, seed, plant protection chemicals and the dummy for HYVs were found to have positive significant effect on the gross returns from paddy. This implied that the large paddy farmers of Manipur can get more gross returns from paddy if they invest more on manures and fertilizers, better quality seed and plant protection chemicals.

4. Summary and Conclusion

The study revealed that large farms in both Himachal Pradesh and Manipur were more profitable in paddy cultivation than small farms. However, the cost per quintal was lower in Manipur in both small and large farms than that in Himachal Pradesh. The net income from paddy cultivation was much lower in Himachal Pradesh mainly because of low productivity. Concerted efforts should be made towards yield enhancement through better utilization of significant inputs and research efforts should be directed towards it. The input-output analysis revealed that the farmers can augment their income by investing more on manures and fertilizers and plant variety on small farms of Himachal Pradesh and seed and plant variety in Manipur. Also, more investments on seed, plant protection chemicals and plant variety on large farms of Himachal Pradesh and manures and fertilizers, seed, plant protection chemicals and plant variety in Manipur could augment their income. In both the categories of land (small and large) in Himachal Pradesh, diminishing returns to scale were in operation. On small farms in Manipur, increasing returns to scale were in operation, but it was inconclusive on large farms because the returns to scale were found to be non-significant.

Table 4. Elasticity Coefficients of Production Functions for Paddy on Large Farms in the Selected States, 2011-12.

Sl. No.	Parameters		Himachal Pradesh	Manipur
1	Intercept	b_0	3388.1380	5.3971
2	Human Labour (X_1)	b_1	-0.3674 (0.4341)	0.3158 (0.2905)
3	Bullock/ tractor labour (X_2)	b_2	-0.0354 (0.1199)	0.0147 (0.1431)
4	Manures and fertilizers (X_3)	b_3	0.1442 (0.1028)	0.3616** (0.1133)
5	Seed (X_4)	b_4	0.3917* (0.2020)	0.3699* (0.1481)
6	Chemicals (X_5)	b_5	0.2985* (0.1139)	0.0283** (0.0095)
7	Dummy (D)	b_6	0.0449* (0.0192)	0.0720* (0.0312)
8	Adjusted coefficient of multiple determination	$\overline{R^2}$	0.6759**	0.7281**
9	Returns to scale	$\sum b_i$	0.4765**	1.1623

Note: 1. ** and * indicate significance at 1 and 5 per cent respectively.
2. Figures in parenthesis indicate standard errors of elasticity coefficients

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