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RESOURCE USE AND TECHNICAL EFFICIENCY OF RICE PRODUCTION IN MANIPUR

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ABSTRACT

Rice is regarded as the first cultivated crop in Asia as well as important food crop of India. The cost and return structure and technical efficiency in rice production has been reported in different regions as well as in the state of Manipur to show different regions have adopted the latest technology. Primary data have been collected from the sample rice farms with the help of pre-tested scheduled through personal interview with respondent farmers. Technical efficiency of individual farms has been estimated through stochastic production function analysis. The total cost of cultivation on small farms was much higher than the large farms. Imputed rental value for owned land was the major cost items for all the farms. On an average majority (40 per cent) of the rice growing farmers were operating at the technical efficiency level of (99-100) per cent in relation to frontier output level. Gross return as well as net return per hectare have been observed to be highest for category I followed by category II. Most of the farms have been observed to be potential to expand production and productivity, increasing technical efficiency as majority has been performing with increasing returns to scale.

INTRODUCTION

Rice is the most important cereal food crop of India, and is cultivated in 43.81 million hectares. It plays a vital role in the national food grain supply and is the main driver of India's food security. Rice occupies about 23 percent of the gross cropped area in the country. It occupies 35 per cent of the total area under food grains and contributes around 43 percent to the total food grain production in the country (Ghatak and Inerscent, 1984). The effect of technological breakthrough has been significant in almost all the states. However many agricultural scientists and farm experts have endorsed the view that the performance of agriculture is yet to reach its potential level. Rice is the only important food crop in respect of area, production and consumption in the state Manipur. In 2006-07, total area under rice crop is 165.37 thousand hectares and production 389.17 thousand tones, with the average productivity of 2353.33 kg/ha in the state (GoMa, 2007). Although, rice is cultivated both in hills and valley district of the state, its area and production is largely concentrated in the valley districts which is commonly known as "Rice bowl of Manipur".

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The hills and valley districts occupies about 52 and 60 per cent of states' acreage and production respectively. Among the four valley districts in the state, Thoubal district has the highest rice acreage of about (32 per cent) followed by Imphal East (28 per cent), Imphal West (22 per cent) and Bishnupur (18 per cent) respectively (GoMb, 2007). Agriculture policy of the Government primarily aims to encourage sustainable increased in production of food-grains to attain self-sufficiency and food security in general and to improve socio-economic conditions of the farmers / rural people in particular.

Increased in rice production can be achieved by expanding the acreage under rice and / or by increasing the productivity of the resources. It is observed that agricultural land in the state is found sinking during the last few years due to various factors viz. industrialization, expansion of roads, airfield, and construction of social institutions etc. Thus, acreage expansion in the state is constrained by the increasing population pressure. Hence, increasing productivity through either technological innovation or efficient use of resources remains as the only option for increasing rice production in the state. Yield of rice can be increased with the introduction and adoption of new technology. New technologies are designed to enhance farm output and income hence, use as a means of accelerating economic development. For a wide adoption by

the farmers', the technology should be in consistent with topography, agro-climate conditions, irrigation facilities, agricultural infrastructures, credit facilities, availability of inputs, agricultural extension services etc. of the state, besides socio-economic conditions and educational levels of the farmers. The results of the technology should also be observable in the short run. Introduction of a new rice technology in a developing economy has found only partially successful in improving production efficiency because of lack of ability due to institutional and socio-economic constraints and / or willingness to adjust input level due to familiarity with the existing technology (Ghatak and Inerscent, 1984).

However, output growth may be achieved not only through technological innovation but also through the efficiency in which such technologies are used (Kibaara, 2005). Efficiency is the relative performance of the processes used in transferring the given inputs into outputs. Improvement in rice production efficiency by proper resource management within the existing technological framework to increase production hence, becomes an alternative viable solution to achieve self-sufficiency, food security and socio-economic development for the agrarian economy of the state. The resource use efficiency differs from region to region due to the variations in land, fertilizers, availability of resources, irrigation facilities, financial condition and extent of adopting agricultural practices.

The inadequacy of capital and other resource inputs combined with their in-efficient use is being commonly reported to be the prime causes of low crop productivity under the given set of ecological, management and technological conditions at a particular point of time. The consumption of rice is increasing at a rapid rate due to its high income elasticity of demand. So, an increase in production has to come from a breakthrough in productivity and increased efficiency. Efficiency is concerned with a relative performance of the processes used in transferring given inputs into outputs.

The Governments goal of achieving self-sufficiency in rice production to a large extent will depend on the level of farmers' productivity which can be determined by their rates of adoption of improved technologies and efficiency of resource use. Analysis and examination of resource use and production efficiency (technical efficiency) of rice using stochastic frontier production function model in the existing technological environment is of paramount importance to achieve the goals of sustainable production, self sufficiency, food security and overall development of rural economy. Hence, research project entitled "Resource use and technical efficiency of rice production in Manipur" is proposed to be undertaken with the following objectives:

1) To examine cost and returns of rice production.
2) To analyze the resource use efficiency in rice production.
3) To determine technical efficiency in rice production.
4) To determine the production problems and solution in rice production.

MATERIALS AND METHODS

Sampling Procedure

(A) Selection of study area

The study carried out in the state of Manipur. It comprises of nine districts of which four districts are in the valley region and the remaining five districts are in the hilly region. Rice is grown in all the 9 districts of the state, however due to topographical nature of land; its cultivation is more concentrated in the valley region of the state. Perusal of district-wise distribution of rice acreage and production during 2007-08, observed that among the valley districts Imphal East district has highest production *i.e.,*74.17 thousand tonnes followed by Imphal East district *i.e.,*74.17 thousand tonnes, Imphal West district *i.e.*,67.99 thousand tonnes and Thoubal district *i.e.,*61.95 thousand tonnes (GoM, 2008). On the basis of higher yield and production of rice, Bishnupur and Imphal East districts were selected randomly for the study.

Sampling Plan

Three stage sampling techniques were employed for constructing sampling plan of the study.

(A) Selection of blocks

With the help of officials of respective district Agricultural Departments blocks having highest acreage under rice were identified for selection of blocks.

(B) Selection of villages

Matai village of Imphal East district and Leimaram village of Bishnupur district were selected purposively**.** The second stage of sampling is the selection of villages from the selected blocks. For selection of villages a list of villages falling under each block where rice is extensively grown was prepared in consultation with the respective Block Development Officers. From the list of villages under each block, the sample villages were selected by proportionate allocation and simple random sampling without replacement for further selection of respondent farmers.

(C) Selection of respondent farmers

In the third stage of sampling plan, a complete list of farmers along with their land holding size of each selected village prepared with the help of respective village Pradhans and /or Panchayat members. From the prepared list by adopting proportionate allocation and simple random sampling technique the respondent farmers were drawn using pre-tested schedule. A total of 100 farmers were selected and categorized as:

Farm size and category

Category	Category I	Category II
Size (ha)	= 0.25	**>0.25**
Size (ha)	= 0.25	**>0.25**

Data Collection

To meet the objectives of the study, both primary and secondary data were collected.

(A) Primary data: Primary data were collected on pre-tested schedule by adopting personal interview method from the selected respondents farmers.

(B) Secondary data: Secondary data pertaining to the locals of the study area were collected from the various publications of the Directorate of Economics and Statistics, Department of Agriculture, and Directorate of Settlement and Land Revenue, Government of Manipur.

RESULTS AND DISCUSSION

Costs and returns structure

Analysis of cost and returns is basic to any economic analysis. In order to gauge the magnitude of investment required for the inputs and technology for a farm enterprise, it becomes important to analyze the cost structure in detail. Cost structure is determined by the nature of the productive services, the level of prices, and the nature of the market for productive services. It relates to a specific time period, within which the value of the resource service is transformed into the desired product. The subject of cost of cultivation of crops is thus of critical importance to farm planners and policy makers. A systematic look at the magnitude of costs incurred on a farm activity plays a guiding role, both in the short and long run. While in the short run it helps in reallocation of the resources, in the long run it acts as a guide to the farmers in reformulating their production plans. Along with the returns from different farm activities the cost are thus the important tools in examining the relative profitability and efficiency of different crop enterprises. This section dealt with the analysis of cost and returns, and examined the efficiency for the rice.

Cost of cultivation of rice

Table 4.5 shows the per hectare cost of cultivation of rice for different category of sample farms. Overall the average cost of cultivation worked out to be Rs. 68924.64. The total cost of cultivation on small farms (Category I) was much higher than the large farms (Category II), which was estimated at Rs. 72951.50 and Rs. 63555.21 respectively for these two categories of farms. A perusal of the Table also revealed that out of the total cost of cultivation, imputed rental value for owned land was the major cost item for all the farms. This item accounted for about 27 & 28 per cent of the total cost of cultivation on category I and category II farms respectively. The hired human labour charges was the next important cost component on the sample farms contributing about 25 & 27 per cent of the total cost of cultivation on category I and category II farms respectively. The cost incurred on machine labour was sizeable as the rice farmers needed it and it was worked out to be Rs. 8361.00 and Rs. 7229.00 in category I and category II farms respectively. The cost on this account formed about 11.46 and 11.37 per cent of the respective total cost of cultivation for category I and category II farms.

Seed, fertilizers and plant protection chemical were other important inputs in the cultivation of rice and they formed about 3, 6 and 1 per cent respectively of the total cost of cultivation. Table 4.6 shows the per farm cost of cultivation for different category of sample farms. Overall the average cost of cultivation was worked out to be Rs. 17106.16. The total cost of cultivation on small farms (category I) was much higher than the large farms (category II), which was estimated as Rs. 18237.87 and Rs. 15888.80 respectively for these two categories of farms. The Table also reveals that out of the total cost of cultivation, imputed rental value for owned land was the major item for all the farms. This item accounted for about 27 and 28 per cent of the total cost of cultivation on category I and category II farm respectively. The hired human labour was the next important cost component on category I and category

Table 4.5. Cost of cultivation of rice for different categories of farms (Rs./ha)

Particulars		Farm Category					
		Category I		Category II		Overall	
A. Variable cost							
1.	Hired Human labour	18488	(25.34)	17488	(27.51)	18180	(26.37)
2.	Machine labour	8361	(11.46)	7229	(11.37)	7908	(11.47)
3.	Seed	2567	(3.51)	2514	(3.95)	2546	(3.69)
4.	Fertilizer	4741	(6.49)	3951	(6.21)	4425	(6.42)
5.	Plant protection chemical	1387	(1.90)	853	(1.34)	1174	(1.70)
6.	Interest on working capital	888.6	(1.21)	850.87	(1.33)	873.51	(1.26)
7.	Rental value for lease in land	0		0		0	
B. Fixed cost							
1.	Family labour	3725.6	(5.10)	2204.57	(3.46)	3117.66	(4.52)
2.	Depreciation	4584	(6.28)	2956	(4.65)	3533	(5.12)
3.	Land revenue	140	(0.19)	139.3	(0.21)	140	(0.20)
4.	Interest on fixed capital	337.98	(0.46)	172.03	(0.27)	271.62	(0.39)
5.	Imputed rental value of owned Land	19500	(26.73)	18000	(28.32)	19000	(27.56)
6.	Managerial cost	4115.66	(5.64)	3598.21	(5.66)	3877.95	(5.62)
7.	Risk margins	4115.66		3598.21		3877.95	
	Cost A_1	41156.6		35982.17		38779.51	
	Cost A_2	41156.6		35982.17		38779.51	
	Cost B	60994.58		54154.20		58051.13	
	Cost C	64720.18		56358.77		61168.79	
	Cost D	72951.50		63555.21		68924.64	

Note: Figures in parentheses denote the percentage to the cost D

Table 4.6. Cost of cultivation of rice for different categories of farms (Rs./farm)

Particulars	Farm Category					
	Category I (= 0.25 ha)		Category II (> 0.25 ha)		Overall	
A. Variable cost						
1. Hired Human labour	4622	(25.34)	4372	(27.51)	4545	(26.56)
2. Machine labour	2090.19	(11.46)	1807.25	(11.37)	1977	(11.55)
3. Seed	642	(3.52)	628.5	(3.95)	636.5	(3.72)
4. Fertilizer	1185.25	(6.49)	987.75	(6.21)	1106.25	(6.46)
5. Plant protection chemical	347	(1.90)	213.25	(1.34)	293.50	(1.71)
6. Interest on working capital	222.15	(1.21)	212.72	(1.33)	218.37	(1.27)
7. Rental value for lease in land	0		0		0	
B. Fixed cost						
1. Family labour	931.40	(5.10)	551.14	(3.47)	779.42	(4.55)
2. Depreciation	1146	(6.28)	739	(4.65)	883.25	(5.16)
3. Land revenue	35	(0.19)	34.82	(0.21)	35	(0.20)
4. Interest on fixed capital	84.49	(0.46)	43	(0.27)	67.9	(0.39)
5. Imputed rental value of owned Land	4875	(26.73)	4500	(28.32)	4750	(27.76)
6. Managerial cost	1028.91	(5.64)	899.55	(5.66)	969.48	(5.66)
7. Risk margins	1028.91	(5.64)	899.55	(5.66)	969.48	(5.66)
Cost A_1	10289.15		8995.54		9694.87	
Cost A_2	10289.15		8995.54		9694.87	
Cost B	15248.64		13538.55		14512.78	
Cost C	16180.04		14089.69		15292.19	
Cost D	18237.87		15888.80		17106.16	

Note: Figures in parentheses denote the per cent to the Cost D

Table 4.7. Variable and fixed cost for different category of sampled farm (Rs./ha.)

Particulars	Farm Category					
	Category I		Category II		Overall	
A. Variable cost						
1. Hired Human labour	18488	(50.74)	17488	(53.17)	18180	(51.78)
2. Machine labour	8361	(22.94)	7229	(21.98)	7908	(22.52)
3. Seed	2567	(7.05)	2514	(7.64)	2546	(7.25)
4. Fertilizer	4741	(13.01)	3951	(12.01)	4425	(12.60)
5. Plant protection chemical	1387	(3.80)	853	(2.59)	1174	(3.34)
6. Interest on working capital	888.6	(2.43)	850.87	(2.58)	873.51	(2.48)
7. Rental value for lease in land	0		0		0	
Total variable cost	36432.6		32885.87		35106.51	
B. Fixed cost						
1. Family labour	3725.6	(10.24)	2204.57	(7.18)	3117.66	(9.21)
2. Depreciation	4584	(12.60)	2956	(9.63)	3533	(10.44)
3. Land revenue	140	(0.38)	139.3	(0.45)	140	(0.41)
4. Interest on fixed capital	337.98	(0.92)	172.03	(0.56)	271.62	(0.80)
5. Imputed rental value of owned Land	19500	(53.60)	18000	(58.69)	19000	(56.18)
6. Managerial cost	4115.66	(11.31)	3598.21	(11.73)	3877.95	(11.46)
7. Risk margins	4115.66	(11.31)	3598.21	(11.73)	3877.95	(11.46)
Total fixed cost	36378.9		30668.32		33818.18	

Note: Figure in parentheses denotes the per cent to Cost D.

Table 4.8. Variable and fixed cost of rice cultivation for different category of sample farm (Rs./farm)

Particulars	Farm Category					
	Category I		Category II		Overall	
A. Variable cost						
1. Hired Human labour	4622	(50.74)	4871.58	(55.33)	4721.54	(52.21)
2. Machine labour	2090.19	(22.94)	1889.53	(21.46)	2066.95	(22.85)
3. Seed	642	(7.04)	628.71	(7.14)	636.69	(7.04)
4. Fertilizer	1185	(13.01)	987.58	(11.21)	1105.98	(12.22)
5. Plant protection chemical	347	(3.80)	213.37	(2.42)	293.66	(3.24)
6. Interest on working capital	222.15	(2.43)	212.71	(2.41)	218.36	(2.41)
7. Rental value for lease in land	0		0		0	
Total variable cost	9108.34		8803.48		9043.18	
B. Fixed cost						
1. Family labour	931.40	(10.20)	551.14	(7.83)	779.42	(9.66)
2. Depreciation	1146	(12.55)	739	(10.50)	883.25	(10.95)
3. Land revenue	35	(0.38)	34.82	(0.49)	35	(0.43)
4. Interest on fixed capital	84.49	(0.92)	43.00	(0.61)	67.90	(0.84)
5. Imputed rental value of owned Land	4875	(53.39)	4500	(63.99)	4750	(58.89)
6. Managerial cost	1028.91	(11.26)	899.55	(12.79)	969.48	(12.02)
7. Risk margins	1028.91	(11.26)	899.55	(12.79)	969.48	(12.02)
Total fixed cost	9129.71		7032.06		8064.53	

Note: Figure in parentheses denotes the per cent to Cost D.

II farm contributing about 25 & 27 per cent of the total cost of cultivation respectively. The cost incurred on machine labour was sizable as the farmer used this input in large quantity. The cost of this input was worked to be Rs. 2090.19 and Rs. 1807.25 in category I and category II and formed about 11.46 and 11.37 per cent of the respective total cost of cultivation for these farms respectively.

Table 4.7 shows per hectare variable and fixed cost incurred in the cultivation of rice. Total variable and fixed costs had been estimated at Rs. 36432.60 and Rs. 32885.87 respectively on category I and category II farms. The variable cost was of immediate concern to the rice farmers as it constituted the major paid- out cost in the cost of cultivation. Under the variable cost, the most important cost items were the human labour, machine labour and fertilizers The shared for hired human labour constituted 50.74 and 53.17 percent of the total variable cost of category I and category II farms respectively. Machine labour accounted for 22.94 and 21.98 percent of the total variable cost respectively. Among the items of fixed cost, imputed rental value of owned land was the most important one, which constituted 53.60 and 58.69 percent of the total fixed cost of category I and category II respectively.

Table 4.8 shows per farm variable and fixed cost incurred in the cultivation of rice. Total variable and fixed costs had been estimated at Rs. 9129.71 and Rs.7032.06 respectively on category I and II farms. The variable cost was of immediate concern of the rice farmers as it constituted the major paid out cost in the cost of cultivation under variable human labour, machine labour and fertilizers. Hired human labour constituted 50.74 and 55.33 per cent of the total variable cost of category I and II farms respectively. Machine labour accounted for 22.94 and 21.46 per cent of the total variable cost respectively. Among the fixed cost, imputed rental value of owned land was the most important, which constituted 53.39 and 63.99 per cent of the total fixed cost of category I & II respectively.

Farm efficiency measures

Table 4.9 presents the comparative status of the two farm categories under consideration, with regards to various farm efficiency measures. An analytical look at gross farm income of the two farm categories allows a quick comparison of their efficiency.

Table 4.9. Return from rice farming for different category of sample farm (Rs./ha)

Efficiency Measures	Farm Category		
	Category I	Category II	Overall
1. Gross farm income	89644.32	74247.66	81342.96
2. Net farm income	12692.82	10692.45	12418.32
3. Farm business income	44487.72	33091.06	42563.45
4. Owned farm business income	44487.72	33091.06	42563.45
5. Family labour income	24649.74	20093.46	23291.83
6. Farm investment income	32530.80	28864.48	31689.94
7. Output/Input ratio over;			
i) Total cost	1.22	1.16	1.18
ii) Paid out cost	2.18	2.06	2.09

However, it is to be noted that such a comparison does not fully projects the technological, managerial or other such input use differences among the farms being compared. On an average, rice growing farmers were noted to earn a gross income of about Rs. 81,342.96 per hectare. Gross farm income of category I and category II farms were Rs. 89644.32 and Rs. 74247.66 respectively. So far as the net farm income was concerned, it was evident from the table that category I farmers performed better in this regard and net farm income of an average category I farmer exceeded the net farm income of an average category II farms by about Rs.2000.37. Farm business and owned farm business income of the sampled rice farmers were noted to be the same, implying thereby the absence of any leased-in land on the sample farms. Owned farm business income of category I farms exceeded the owned farm business income of the other category II farms by about Rs. 11396.66.

Similarly the family labour income of category II was also noted to be less than the family labour income of category I and of average farm. The Table also presents the input-output ratios of the two farm categories and for overall average farm situation in the area. The input-output ratios had been worked out by considering i)total cost i.e. cost D and ii) paid out cost i,e. Cost A_1. Output-input ratios were the important measures of efficiency and it was evident from the Table that so far as input used was concerned the category I farms seemed to have performed better than category II farms. Table 4.10 presents the similar information for different efficiency measures for rice growing farms of the study area. Perusal of the Table clearly suggested that category I farms were more efficient as compared to category II farms. The position of the category I farms remained unchanged even when these farms were compared with an average farm situations in the area. Output-input ratio on category I farms worked out to 1.12 as against 1.10 for category II farms when this ratio was calculated over cost D.

Table 4.10. Return from rice farming for different category of sample (Rs. / farm)

Efficiency measures	Farm category		
	Category I	Category II	Overall
1. Gross farm income	20410.08	17561.91	19035.74
2. Net farm income	2172.21	1673.11	1929.58
3. Farm business income	10120.93	8566.37	9340.86
4. Owned farm business income	10120.93	8566.37	9340.86
5. Family labour income	5161.44	4023.36	4522.96
6. Farm investment income	7131.70	6216.11	6747.48
7. Output/Input ratio			
i) Total cost	1.12	1.10	1.11
ii) Paid out cost	1.98	1.94	1.96

Production function analysis

In order to analyze resource use efficiency of different input resources, a production function approach was used. From the result of the functional analysis, resource use efficiency for two farm categories of rice growing farmers has been analyzed by working out marginal value productivity to factor cost ratios. Further, technical efficiency of different categories of rice growing farms has been worked out by using frontier production function. The results of the production function analysis for rice have been presented in table 14.11. In the analysis of this regression equation, as pointed out earlier, five explanatory variables were included, based on the consideration of their theoretical importance.

Table 4.11. Production function coefficients

Variables	Category I n = 60	Category II n = 40	Overall n = 100
Intercept	4.689*	7.710	3.930*
Seed (X_1)	0.167	-0.366*	0.015
Chemical fertilizers (X_2)	0.164*	0.321*	0.199*
Plant protection chemicals (X_3)	0.394	0.020	0.017
Human labour (X_4)	0.173*	-0.328	-0.008
Machine labour (X_5)	-0.333*	0.379*	0.307*
$\sum b_i$	0.565	0.41	0.53
F	55.974	31.213	104.956
$\bar{R}^2$	0.823	0.795	0.840

Note: * significant at 1 per cent probability level
** significant at 5 per cent probability level
*** significant at 10 per cent probability level

A perusal of the Table shows that, in case of category I, category II and overall farms, the value of adjusted co-efficient of multiple determinations were 0.823, 0.795 and 0.840 respectively and found statistically significant. This indicated that the explanatory variables included in the regression model were responsible for 82, 79 and 84 per cent of the variation in per ha rice output. The regression co-efficient for fertilizer and human labour in case of category I turned out to be positive and statistically significant (fertilizer at 1%, and human labour at 1%). It indicated that1 per cent increase in the expenditure will increased each unit of fertilizer and human labour. In category II sample farms the co-efficient of fertilizer and machine labour were found to be positive and significant (fertilizer at 1%, and machine labour at 1%) respectively. It indicated that 1per cent increase in the expenditure of these inputs on an average increased the output by 0.32 and 0.37 per cent respectively by taking one input at a time and keeping others constant. In overall farms, the co-efficient of fertilizer and machine labour were found to be positive and significant at 1 per cent probability level.

It indicated that 1 per cent increase in the expenditure of fertilizer and machine labour, on an average increased the output by 0.19 and 0.30 per cent respectively by taking one input at a time and keeping other inputs constant. In category I farms, the co-efficient of machine labour was found to be negative but significant at 1 per cent. It indicated decrease in the gross return due to the increase in the use of the machine labour. In category II farm the co-efficient of seed was also found to be negative but significant at 1 per cent. It indicated decreased in gross return due to the more use of the seed. The sum of co-efficient elasticity ($\sum$bi) are 0.56, 0.41 and 0.53 in category I, category II and overall farm respectively and significantly different from unity, thus indicated decreasing return to scale. This means that, if all the variables were decreased together by 1 per cent the gross output would also decreased by 0.56, 0.41 and 0.47 per cent respectively on category I, category II and overall farms. It implies the rational to use more of the input factors included in the analysis except machine labour in category I and seed in category II farms to get higher output of rice.

Resource use efficiency

A perusal of the Table 4.12 found that the marginal value product and marginal factor cost ratios of fertilizer are 2.06, 4.40, 2.59 in category I, category II and overall farms and that of plant protection chemical were 16.88, 1.30 and 0.86 in category I, II and overall farms and that of machine labour were 2.36, 2.84 and 2.23 in category I,II and overall farms, seed and human labour were 1.94, 3.62, 0.55 and 0.91 in category I and II respectively. Seed were significant and more than unity in both category I and II, implying that increasing use of this resource would bring more income to the farmers. In category I, category II, human labour variable was found to be non significant and less than unity and in overall plant protection chemicals was found to be non significant and less than unity. It implied that the rice growing farmers were using these inputs excessively.

Table 4.12. Marginal value productivity to factor cost ratio of rice of different categories of sample farms

Sl. No.	Particulars	Seed	Fertilizer	Plant protection chemicals	Human labour	Machine labour
1.	Category I	1.940**	2.060***	16.883*	0.556	2.366
2.	Category II	3.626	4.409*	1.302	0.913	2.848**
3.	Overall	-	2.591**	0.861	-	2.231

Note: * significant at 1 per cent probability level
** significant at 5 per cent probability level
*** significant at 10 per cent probability level

Technical efficiency of rice

The calculated technical efficiency of rice sample farmers is presented in Table 4.13.

Table 4.13. Technical efficiency rating for different categories of rice sample farms

Technical Efficiency Rating (%)	Farm Category					
	Category I		Category II		Overall	
	No. of farms	%	No. of farms	%	No. of farms	%
91-92						
92-93					4	4
93-94					8	8
94-95					18	18
95-96					12	12
96-97	12	20	8	20	20	20
97-98			4	10	14	14
98-99	24	40	16	40	18	18
99-100	24	40	12	30	6	6
Total	60	100	40	100	100	(100)
Mean		98.62		98.25		96.30
Standard Deviation	1.06		1.18		1.91	

The category I farmers had a mean efficiency level of 98.62 with a standard deviation 1.06. from the Table it can be noted that about 40 per cent of the sample farmers were operating at 98-99 and 99-100 percent efficiency, thereby indicating a wider scope for improvements in the rice cultivation. And only 20 percent of the sample farmers were operating at 96-97 per cent efficiency. Amongst the category II sampled farmers, 40 per cent were found to be 98-99 per cent efficiency level. The estimated mean efficiency was 98.25 with 1.18 standard deviation. Overall, 20 per cent of the sample farmers were operating at 96-97 per cent efficiency level, while about 18 per cent of the farmers were operating at 94-95 and 98-99 per cent efficiency level. One important indication given by the Table was that only 6 per cent of the overall farmers were

operating in the efficiency range of 99-100 per cent against 40 and 30 per cent of category I and II farmers.

Conclusion

From the above finding, it was concluded that the total cost of cultivation (Rs.72951.50) on category I farms was higher than (Rs.63555.21) on category II farm in per hectare and in per farm basis it was higher (Rs.18237.87) on category I farm than (Rs.15888.80) on category II farms and the study also concluded that the gross income was higher in category I farms (Rs.89644.32) than the category II farms (Rs.74247.66) and the net income for the category I farm (Rs12692.82) was higher than the category II farms (Rs.10692.45) in per hectare basis. Increasing use of inputs viz. fertilizer would bring more output to the sample farms. Therefore, the input fertilizer was the more important to the rice growing farmers of Manipur. The study also concluded that the regression coefficients for fertilizer was found to be 0.82 in category I farms ,0.79 in category II and 0.84 in overall farms. Chemical fertilizers were found to be positively significant on rice yield in category I, II and overall farms as (0.164), (0.321) and (0.199). Allocative efficient for the rice production revealed that fertilizer was under-utilized in the entire three categories. On an average majority (40 %) of the rice growing farmers were operating at the technical efficiency level of 99-100 per cent in relation to the frontier output level. Mean efficiency level for category II farmers was found to be 98.25 per cent as compared to 98.62 per cent of category I farmers.

REFERENCES

Al-hassan Seidu, 2008. "Technical efficiency of rice farmers in northern Ghana". AERC Research Paper 178. African Economic Research Consortium, Nairobi. April 2008.

Anonymous, 2007. "Statistical Abstract Manipur 2007." Directorate of Economics and Statistics, Government of Manipur.

Anupama, J., R. P. Singh and Ranjit Kumar, 2005. "Technical efficiency in maize production in Madhya Pradesh: Estimation and implications". *Agricultural Economics Research Review*. 18(5):305-315.

Arindam Banik, 1994. "Technical efficiency of irrigated farms in a village of Bangladesh". *Indian Journal of Agricultural Economics*. 49(1):70-78.

Ashok Kumar, H. A., 2005. "Contract farming in hybrid vegetable seed production in Northern Karnataka – an Economic analysis". M.Sc. Thesis, Department of Agricultural Economics, University of Agricultural sciences, Dharwad.

Baliyan, S. P., Bhogal, T. S. and Archna, 1998. "A Study of costs and returns in sugarcane production vis-à-vis its competing crops in Muzaffarnagra district, Western Uttar Pradesh". Agricultural Situation in India, 55(4):209-214.

Bhalerao, M. M., Ansari, S. I. and Venkateswar, M. 1983. "Efficiency of resource use in vegetable production". The *Andhra Journal*. 30(2):112115.

Bhople, R. S. and Ambarkar, K. S. 1996. "Production, storage and marketing constraints of vegetable growers". *P. K. E. Research Journal*. 20(1):31-33.

Bonny, B. P. and Prasad, R. M. 1996. "Constrain in commercial production of vegetables". *Journal of Tropical Agriculture*. 34(1):156-160.

Chahal, T. S. and Chahal, J. S., 1989. "Measurement of irrigation water through crop diversification in Punjab". *Indian Journal of Agricultural Economics*, 44(2):299-305.

Das, R. 1985. "Resource productivity and allocative efficiency on farm in Bajali development block of Assam". M.Sc. (Agri.) Thesis, Assam Agriculture University, Jorhat.

Dawit, L. and Basavaraja, H., 2004. "Production and marketing of wheat in Dharwad district: An economic analysis". *Indian Journal of Agricultural Marketing*, 18(1):74-79.

Desai, B. M. 1973. "Economics of Resource-use on sample farms", *Indian Journal of Agricultural Economics*, 47(4):677-682.

Devi, Uma K. and Eswara Prasad, 2004. "Technical efficiency in shrimp production in Coastal Andhra Pradesh". *Journal of Agricultural and Food Economics*. 1(3):123-125.

Dutta, K. C. and Sarmah, A. K. 2001. "A Statistical study of area, production and productivity of rice in Assam during 1951-52 to 1997-98." *Journal of the Agricultural Science Society in North- East India*.

Ghatak and Inerscent, 1984. "Economic analysis of farming systems in Mahaweli system B & C". M. phil. Thesis, Post Graduate Institute of Agriculture, University of Peradeniya, SriLanka.

GoMa, 2007. "Statistical Abstract of Manipur, Directorate of Economics and Statistics" Government of Manipur.

GoMb, 2007. "Statistical Abstract of Manipur, Directorate of Economics and Statistics" Government of Manipur.

GoM, 2008. "Statistical Abstract of Manipur, Directorate of Economics and Statistics" Government of Manipur.

Kibaara Betty Wambui, 2005. "Technical efficiency in Kenyan's maize production: An application of the stochastic frontier approach." M.Sc. Thesis (Unpublished). Department of Agriculture and Resource Economics. Colorado State University, Fort Collins, Colorado.

Idiong, I. C. 2007. "Estimation of farm level technical efficiency in small scale swamp rice production in cross river state of Nigeria: A stochastic frontier approach". *World Journal of Agricultural Sciences*. 3(5):653-658.

Jayasuriya, M. R. T. 1989. "Economics of cropping patterns in Mahaweli System C". M. phil. Thesis, Post Graduate Institute of Agriculture, University of Peradeniya, Sri Lanka.

Jeevika, W., 2004. "Impacts of trade liberalization and market reforms on the paddy/rice sector in Sri Lanka". Discussion paper, No. 76, International Food Policy Research Institute, USA.

Job Elsamma and George, M. V. 2002. "Technical efficiency in rice production – A frontier production function approach". *Agricultural Economics Research Review*. 15(1):50-55.

Johl, S. S. and Chadla, V. K. 1994. "Potato: the problem crop for market clearance". In: Proc. Natl. Symp. Potato present and future Sekhawat, G.S.; Khurana, S.M.P and Pandey, K., Edsa, Madipurum: 59-63.

Kale, N. K.; D. S. Navadkar; A. V. Gavali and D. L. Sale. 2005. "Resource Use Structure and Efficiency in Chilli Cultivation in Thane District of Konkan Region, Maharastra". *Indian Journal of Agricultural Economics*. 60(3):528-529.

Karagiannis Giannis and Vangelis Tzouvelekas, 2009. "Technical efficiency of olive farm of Greece". *Journal of Agricultural and Food Economics*. 1(2):112-116.

Kehar Singh et al. 2009. "Technical efficiency of freshwater aquaculture and its determinants in Tripura". *Indian Agricultural Economics Research Review*. 22(7):185-195.

Keerthipala, 1987. "Economic analysis of farming systems in Mahaweli system B & C". M. phil. Thesis, Post Graduate Institute of Agriculture, University of Peradeniya, Sri Lanka.

Kibaara Betty Wambui, 2005. "Technical efficiency in Kenyan's maize production: An application of the stochastic frontier approach." M.Sc. Thesis (Unpublished). Department of Agriculture and Resource Economics. Colorado State University, Fort Collins, Colorado.

Koutsoyiannis, A. 2001. "Theory of Econometrics." Palgrave Publishers Ltd. 175 Fifth Avenue, New York 10010.

Krishna, V. V., 2001. "Sustainability and economic efficiency of rice farming in the agroecological problem area zone of Kerala". M.Sc. Thesis, Department of Agricultural Economics, University of Agricultural Sciences, Bangalore.

Kumar, P. 1972. "Economic analysis of village irrigation system in Sambalpur district (Orissa)". Ph. D. thesis, Division of Agricultural Economics, IARI, New Delhi.

Maharjan, A., Hiremath, G. K. and Patil, B. L., 2003. "Profitability of grain in Northern Dry Zone of Karnataka". Agricultural Situation in India, 59(11):729-735.

Mali, B. K., Bhosale, S. S, Shendage, P. N. and Kale, P. V., 2003. "Economics of production and marketing banana in Jalgan district of Maharastra". *Indian Journal of Agricultural Marketing*, 17(1):173-181.

Mehta, B. K. and P. D. Sharma, 2004. "Milling and Dehusking efficiency in processing of different varieties of paddy." *Journal of Applied Biology*. 14(1):60-62.

Mishra, J. P; Bihari, B. and Pandey, S. N. 1976. "Resource use and Farm Productivity". *Indian Journal of Agricultural Economics*. 66(25):13-32.

Mohandas, K. and Thomas, E. K., 1997. "Economic analysis of rice production in Kuttanad areas of Kerala". Agricultural Situation India, 43(3):555-561.

Muraleedharan, 1987. "Resource–use efficiency in Rice production." *Indian Journal of Agricultural Economics*. 42(4):578-586.

Murthy, D. Sreenivasa et al. 2009. "Technical and scale efficiencies of tomato production in India using DEA". *Agricultural Economics Research Review*. 22(6):123-126.

Mythili, G. and K. R. Shanmugam, 2000. "Technical efficiency of rice growers in Tamil Nadu: A study based on panel data." *Indian Journal of Agricultural Economics*. 55(1):15-25.

Nair, R. V., K. H. Mohammed and P. Bensan, 1975. "Prawn and fish culture for increased yields." *Indian Farming*. 25(6):28-33.

Nasurudeen, P. 2009. "Efficiency of rice production in Union Territory of Pondicherry". *Agricultural Economics Research Review*. 22 (Conference Number) 361-364.

Neelappa, S., 2002. "Technical and allocative efficiency of paddy production in TBP area – An Economic analysis". M.Sc. Thesis, Department of Agricultural Economics, UAS, Dharwad.

Ogundele, O. Olorunfemi and Victor O. Okoruwa, 2006. "Technical efficiency differentials in rice production technologies in Nigeria". AERC Research Paper 154. African Economic Research Consortium, Nairobi, April 2006.

Pant, D. C. and B. L. Nagar, 2005. "Resource Use Efficiency of Soybean in Rajasthan". *Indian Journal of Agricultural Marketing.* 60(3):542-543.

Patel, N. T. and Patel, M. S. 1976. "Production functions for dry and irrigated wheat in Gujarat". Financing Agriculture. 8(2):1-3.

Pillai, R. 2004. "An analysis of paddy productivity growth in West Bengal and Orissa." *Indian Journal of Agricultural Economics*. 56(4):613-630.

Prasad Eswara, Y., R. Ramanna and LalithAchoth, 1991. "Analysis of technical efficiency of subsidised credit for poverty alleviation in Anantapur, Andhra Pradesh". *Indian Journal of Agricultural Economics*. 46(1):64-70.

Radha, Y. and Prasad, E. 2001. "Economics of production and marketing of vegetables in Karimnagar district, Andhra Pradesh". *Indian Journal of Agricultural Marketing*. 15(1):55-61.

Rahman, M. Mizanur et al. 2006. "The application of frontier approaches to model the efficiency of rice producers in Bangladesh". *Journal of Agricultural and Food Economics.* 1(2):133-154.

Rajashekharappa, M. T., K. B. Umesh and N. Sivaramane, 2004. "Technical, allocative and cost efficiency in arecanut production". *Agricultural Economics Research Review*. 22(5):374-377.

Ravi Kumar, K. N., Bapuji Raw, B. and Lakshmi, K. R, 2004. "Economics of major farming systems in North Costal Zone of Andhra Pradesh. *Manage Extension Research Review*, 5(1):10-32.

Santha, A.M., 1993. "A Comparative analysis on cost and returns of paddy cultivation for different seasons in Trichur Kerala". *Madras Agricultural Journal*, 80(2):41-44.

Sandeep, B., 2002. "An Economic analysis of cropping systems in Bidar district of Karnataka". M.Sc. Thesis, Department of Agricultural Economics, University of Agricultural Sciences, Dharwad.

Shaik, H., Ramorao, C. A., Katyal, J. C. and Reddy, Y. V. R., 1998. "Costs and returns analysis of different crops under different agro-climatic zones in Andhra Pradesh: A Comprehensive study". Agricultural Situation in India, 50(2):77-84.

Sharma, H. C., Dahiya, P. S. and Nayar, N. M. 1992. "Price analysis of potatoes vis-à-vis vegetable and pulses in India". Agricultural Marketing. 34(4):8-12.

Sharma, K. K and A. K. Rathore, 1985. "Factor use efficiency in Haryana Agriculture." Asian Economic Review. 27(3):115-130.

Shehu, J. F. and S. L. Mshelia, 2007. "Productivity and Technical efficiency of small-scale rice farmers in Adamawa State, Nigeria". *Journal of Agriculture and Social Sciences*. 3(4):117-120.

Sikander, K. and Sandeep, K., 2004. "Resource use efficiency and returns from selected food grain crops of Himachal Pradesh". Agricultural Situation in India, 60(7):475-485.

Sreeja, M., 2004. "Land use dynamics in Kerala- An economic analysis". M.Sc. Thesis, Department of Agricultural Economics, University of Agricultural Sciences, Dharwad.

Sileshi, D., Bant, S. and Jasdev, S., 2003. "Changes in costs and returns of major crops in Punjab". *Agricultural Situation in India*, 60(1):11-17.

Singh, R. V. and R. K. Patel, 1974. "Resource Productivity Allocation Efficiency and farm size in U.P." *Agricultural Situation in India*. 28(12):629-827.

Singh, K. M. and Singh, R. K. P., 2000. "Rice in Bihar – An economic analysis with special reference to Boro rice". Agricultural Situation in India, 56(11):677-681.

Squires Dale and Steven Tabor, 1991. "Technical efficiency and future production gains in Indonesian agriculture". *The Developing Economics*, XXIX-3, September.

Subramanian, S. R. 1967. "Farm size and Resource-use Relationship". *The Madras Agricultural Journal*. 54(4): 228-232.

Thakur, A. P.; Singh, B. K. and Singh, R. P. 1996. "Resource use, return to scale and farm size production in Kanke block of Ranchi district, Bihar". *The Bihar Journal of Agricultural Marketing*. IV(4): 396-406.

Thakur, D. S., Empila and Chandar, S. 1985. "Economic of vegetable production and diversification of farming in Himachal Pradesh". *Himachal Journal of Agriculture Research*. 11(2):71-79.

Umashankara, C., 1998. "Production efficiency and marketing constraints of rice in hilly zone of Karnataka". M.Sc. Thesis, Department of Agricultural Marketing and Cooperation, University of Agricultural Sciences, Bangalore.

Verma, A. R. 2005. 'Economic Analysis of Production and Resource Use Efficiency of Potato in Indore District of Madhya Pradesh". *Indian Journal of Agricultural Economics*. 60(3):514-515.

Wadear, P. R., 2003. "Animal based farming system for long-term sustainability in Northern Karnataka". A Socio-economic assessment. MSc. Thesis, Department of Agricultural Economics, University of agricultural Sciences, Dharwad.

XiaosongXu and Scott R. Jeffrey, 1995. "Efficiency and technical progress in traditional and modern agriculture: Evidence from rice production in China". Rural economy staff paper 95-02. Department of Rural Economy. Faculty of Agriculture, Forestry and Home Economics. University of Alberia. Edmonton, Canada.

ZaibetLokman, Salah Rezgui and AbderrazakDaaloul, 2006. "Farmers' adoption of certified seeds and technical efficiency: The case of durum wheat in Tunisia". *Journal of Agricultural and Food Economics*. 1(2).177-195.

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