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Resource Use Efficiency of Chakhao Cultivation in Manipur

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Abstract
This research was conducted to determine the resource use efficiency of Chakhao production in Manipur. The primary information was collected from 140 farmers, randomly selected from the sampling frame, using the pre-tested semi-structured interview schedule. Cobb-Douglas production function was used for the data analysis. The calculated overall return to scale of Chakhaoproduction was1.16 indicating that the production function exhibited an increasingreturn to scale. All over, 51.2 per cent of the total variation in the dependent variable was explained by the selected independent variables. The allocative efficiency indices revealed that in the study area the resources have been overutilized by the farmers. To ensure an optimum allocation of resources and increased the profitability of Chakhao production, the expenses on the seed, machinery and labour should be decreased respectively. In addition, the inefficiency use of resources could be addressed by conducting various awareness programmes to enhance farmers knowledge and skills.

Keywords: Cobb Douglas production function, organic Chakhao, efficiency

I. Introduction

Chakhao (black scented rice) refers to a variety of rice from the species Oryza sativa L. Subspecies indica, a unique rice variety of Manipur characterised by its special aroma and its glutinous nature which is not commonly found in other black rice grown in the world. It bagged the Geographical Indication (GI) tag on 20th April, 2020 (GI No. 602) for its uniqueness characteristic feature and nutritional benefits It has high levels of nutrients, high antioxidant property. Chakhao is also known as PoireitonChakhao because it was first domesticated by king Poireiton in his land of Poi. Poi is the first generation of Manipur society.

The high adoption of advanced technology and the presence of large players in the European region are likely to create ample growth opportunities for the market. The demand for good quality Chakhao has been increasing in international market because of its organic in character. The government of India also emphasising on the promotion of organic farming through Parampargat Krishi Vikas Yojana and Organic Value Chain Development in North East India. Under the Start-up policy of India Manipur state would have an opportunity to organise Chakhao based agri-business activity.

It constitutes around 10 per cent of Manipur's total rice production. It is normally eaten during community feasts and is also served as Chakhao kheer. Chakhao has also been used by traditional medical practitioners as part of traditional medicine. It is sold at Rs 100-150 a kilogram on an average in the Imphal market.

The research on agricultural production is very limited and the empirical investigations are needed to study the resource use efficiency of input factors in inter-size crop models. Hence, in the present study an attempt has been to study the resource use efficiency of Chakhao cultivation in Imphal East and Imphal West district of Manipur.

II. Methodology

To gather the information regarding production efficiency, simple proportionate random sampling was employed to select a total of 140 Chakhao farmers from the twelve villages of the two district namely Imphal East and Imphal West. In regards to the analytical tools, it has been revealed that Cobb-Douglas production function is useful in computation of marginal value product (MVP) which is the important component to determine optimum, over and underuse of resources (Gujarati, 2009). The CobbDouglas production function of the

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following form was fitted to examine the resource productivity, efficiency and return to scale.

$Y= b_0X_i^{bi}e^u$

Transformed to linear form for ease in computation by taking logarithm on both sides, we have,

$lnY = lna + b1lnX_1 + b2lnX_2 + b3lnX_3 + b4lnX_4 + u$

Where, Y = Gross return from rice production (Rs/ha)

X_1 = Seed expenses (Rs/ha)

X_2 = Labour expenses (Rs/ha)

X_3 = Organic manure expenses (Rs/ha)

X_4 = Irrigation charges (Rs/ha)

X_5 = Machinery expenses (Rs/ha)

u = Random disturbance term or error term

a = Intercept or constant term

e = Base of natural logarithm

ln = Natural logarithm

b1, b2, b3 and b4 = Coefficients of respective variables.

The return to scale of rice production was calculated by summing the coefficients of all the explanatory variables estimated from the linearized Cobb-Douglas production function. Dhakal*et al.* (2015) had also calculated the return to scale in a similar manner. The allocative efficiency of a resource used was estimated taking the ratio of Marginal Value Product (MVP) of variable input and the Marginal Factor Cost (MFC) for the input and tested for its equality to one. A ratio equal to unity indicated the optimum use of that factor, a ratio more than unity indicated that the yield could be increased by using more of the resources. A value of less than unity indicated the unprofitable level of resource use, which should be decreased to minimize the losses because farmers over used this variable. The negative value of MVP indicated the indiscriminate and inefficient use of resource.

Taking reference of Goni*et al.* (2007), the resource use efficiency was calculated using the formula;

r = MVP÷ MFC

Where, r = Efficiency ratio,

MVP= Marginal value product of a variable input;

MFC= Marginal factor cost Furthermore,

MVP= dy÷ dx, which is the product of regression coefficient with ratio of geometric mean of gross return to the level of use of respective resource.

Again, following (Mijindadi, 1980), the relative percentage change in MVP of each resource required to obtain optimal resource allocation, i.e. r =1 or MVP = MFC was estimatedusing the equation below;

D = (1- MFC÷MVP) × 100

Or, D = (1-1÷r)× 100

Where, D = absolute value of percentage change in MVP of each resource

r = efficiency ratio

III. Result & Discussion

1.Cobb Douglas Production function

For Chakhao cultivation different kind of inputs, such as labour, organic manures, seed, irrigation and machinery expenses were employed which were considered as a prior explanatory variable responsible for variation in Chakhao cultivation. The F value, F = 28.09, Prob>F = 0.0000 showed the stability of the overall regression equation and joint significant at 1% level. The value of the coefficient of multiple determination, R square (R^2) was estimated 51.2 which indicated that 51.2 per cent of variation in the total Chakhao income was explained by the explanatory variables included in the model.

Table1: Estimated value of Co-Efficient of Cobb-Douglas Production Function Model

Sl. No.	Explanatory variables	Farm size category		
		Marginal Farmers	Small Farmers	Overall
1.	No. of observations	122	15	140
2.	Seed (X_1)	0.296**	-0.528**	0.189*
3.	Labour (X_2)	0.564**	-0.114	0.571**
4.	Organic Manures (X_3)	0.341**	-0.048	0.151
5.	Irrigation (X_4)	-0.002	0.009*	0.000

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6.	**Machinery (X_5)**	0.312**	-0.100	0.255**
7.	**R^2 (%)**	56.9	82.0	51.2
8.	**Adjusted R^2 (%)**	55.1	72.0	49.4
9.	**F-value**	30.66	8.20	28.09

(** denotes significant at 1 %, * denotes significant at 5%)

The overall return to scale (sum of the regression coefficients of all the inputs) of Chakhao production was calculated 1.16 per cent which indicated that the production function exhibited an increasing return to scale; implies that if all the inputs specified in the function are increased by 1 per cent, income from Chakhao production will increase by 1.16 per cent. This finding coincides with the result revealed by Devi G L and Singh CY (2013) in regards to the cultivation of paddy in Manipur.

The results indicated that the overall value of R^2 (coefficient of multiple determination) of Chakhao was 0.512 where marginal and small farmers obtained a value of 0.569 and 0.820 respectively. This implied that overall, 51.2 per cent percent of the variation in the dependent variable of Chakhao were accounted for by the independent variables selected for the study. And on marginal and small farmers, all the explanatory variables viz., seed, labour, irrigation, organic manures and lastly machinery together contributed 56.9 and 82.0 per cent respectively.

The estimated value of production of Chakhao of different farmers categories is presented at the above table. The above table explained the overall farmers regression co-efficient and its significance. The estimated regression co-efficient on expenses in seed, labour and machinery were found to be positive and statistically significant with a total explained variation of 0.189, 0.571 and lastly 0.255 respectively at 5 per cent level and 1 per cent level each which signifies an increase of 0.189 per cent on the gross return which will be brought by 1 per cent increase on seed expenses keeping other constant. And on same manner, increasing the expenditure on labour would increase the gross return from Chakhao cultivation by 0.571 per cent. Moreover a 1 per cent increase on expenditure on machinery would increase the gross yield of Chakhao by 0.255 per cent with other variables remaining constant. In case of irrigation and organic manures, the estimated regression co-efficient were detected to be positive and statistically insignificant bearing a value of 0.000 and 0.151.

The above table reveals that as for marginal farmers out of the five explanatory variables given, the regression co-efficient of seed, labour, organic manures and machinery expenses were found to be positive and statistically significant at 1 per cent level with a value of 0.296 for expenses on seed, 0.564 on labour expenses while organic manures and machinery expenses obtained a value of 0.341 and 0.312 respectively. From these values it can be thus interpreted that with 1 per cent increase in the expenditures on seed and labour, keeping other constant, it will increase the gross return of Chakhao by 0.296 and 0.564 per cent. Likewise with the 1 per cent increase on the expenditure in organic manures whilst other variables remained constant, Chakhao cultivation gross return will be increased by 0.341 per cent. Further with the increased in expenditure on machinery the gross return would increase by 0.312 per cent keeping other constant. On the other note, with a value of -0.002, the estimated regression co-efficient of irrigation was found to be negative and statistically insignificant.

For small farmers category, as per the result from the above table, the regression co-efficient of seed expenditure were found to be negative and statistically significant with a value of -0.528 at 1 per cent level indicating an increase of 0.528 per cent of gross return of Chakhao cultivation with every 1 per cent increase on the expenses on seed while others remained constant. And if the expenses on the irrigation was increased by 1 per cent, keeping other explanatory variables constant the gross return from Chakhao cultivation would be increased by 0.009 per cent as the estimated regression co-efficient of irrigation was detected to be positive and statistically significant with an explained variation of 0.009 at 5 per cent. While that of labour, organic manures and machinery expenses regression co-efficient holds a value of -0.114, -0.048 and -0.100 which was discovered to be both negative and statistically insignificant.

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2.Estimation of Resource Use Efficiency

From the analysis of the regression equation, the ability of farmers to allocate resources in Chakhao cultivation in the study area can be found out. Those inputs which were statistically significant on the dependent variable were estimated.

Table2: Estimated resource use efficiency (MVP to MFC ratio) of Chakhao cultivation.

Sl. No.		Marginal farmers	Small farmers	Overall farmers
	Inputs	MVP/MFC Ratio		
1.	Organic manures	0.1308**	…….	…….
2.	Seed	0.2885**	-0.5843**	0.1842*
3.	Machinery	0.0031**	…….	0.0026**
4.	Labour	0.0047**	…….	0.0047**
5.	Irrigation	……..	0.0006 *	……

(** indicates significant at 1 %, * indicates significant at 5%)

By analysing the table given above, the ratio of MVP to MFC concerning the overall farmers were all less than unity. The observed efficiency ratio of labour and were found to be 0.0047 and 0.0026 respectively while that of seed was found to be 0.1842. The result signified that the respective inputs viz. seed, machinery and lastly labour were overutilized by the farmers. The results are in line with findings of Subedi*et al.* (2020) who have reported overutilization the given inputs namely labour and machine on the production of paddy in Nepal. Also, the finding regarding the overutilization of seed is synonymous to the results of Singh *et al.* (2020) concerning paddy cultivation in Manipur. The results indicate a strong lack of knowledge and real scientific information by the framers regarding Chakhao which was due to lack of communication from the extension personnel or agents of the KVKs or NGOs on giving responses to the farmers inquiries. Used of seed was overutilized as most of the farmers used broadcasting method of sowing irrespective of their farm size. And other reason may be the improper storage system of seed which decreases the viability of seed. The reason why the expenses on machinery was overutilized was mainly due to the high charges charged by the owner per usage per time against the farm size. This causes more expenses as farm size were smaller. The farmers employed more family labour in addition to the hired labour to ensure lower loss caused by rough handling against their insecurities regarding low yielding property of Chakhao. In-addition majority of the farmers uses traditional method of cultivation

In regards to marginal farmers, the efficiency ratio estimated were 0.1308 for organic manures, 0.2885 in case of seed and 0.0031 and 0.0047 as in for machinery and labour. The estimated values indicates that the usages of these input were overutilized. The result aligns to the finding of Shruti *et al.* (2018) that reported the overutilization of manures by the paddy farmer. Similar result was obtained by Karingu*et al.* (2022) on the overutilization of seed, labour and machinery usage. The possible reason attributable for it may the lack of knowledge regarding the suitable agronomic practices for Chakhao which was brought by the lack of awareness regarding efficient and organic cultivation of Chakhao in in the study area. Chakhao being a naturally grown organic crop, fertilization was not required but due to the pertaining low yield as compared to other rice variety, the farmers used more than needed to boost the growth of Chakhao in hopes of yielding more production.

The calculated resource use efficiency of small farmers signifies that the usage of seed and irrigation expenses were overutilized as indicated by the efficiency ratio of -0.5843 and 0.0006 respectively. In line of finding in this study, Rajeev *et al.* (2013) revealed the overutilization of irrigation expenses. Like marginal farmers, majority of farmers uses broadcasting method of sowing instead of line sowing which causes more expenses against their farm sizes. The over usage of irrigation expenditure owes to the reason being rainfed crop which does not require extra irrigation and most importantly drought and stress tolerant. However,

pertaining to the low rainfall and mostly dry condition, farmers have been irrigating Chakhao excessively in fear of yield loss which in turn as no avail on the yield as being a drought tolerant crop. This results from farmers lack of real knowledge of Chakhao both genetically and scientifically.

Nevertheless, for optimum allocation of resources, expenses on seed, organic manures, labour, machinery and irrigation needs to be decreased. The opportunity of doing adjustment in seed expenses could be well utilized by purchasing quality improved seeds and by engaging SRI method of cultivation; similarly, the dose and quantity of quality organic manures and irrigation should be decreased by the farmers as per the estimates of resource use efficiency. Moreover, the cost on human labour could be decreased by introducing low costs mechanization while the machinery expenses could be decreased by adopting minimum tillage technologies and by charging the machinery cost per farm size.

IV. Conclusion

The study reveals that despite being profitable, Chakhao cultivated farmers has been overutilizing the inputs used in Chakhao production. For the optimum allocation of resources, expenses on seed, machinery and labour need to be decreased. Reason why farmers are overutilizing the inputs has been mainly caused by the lack of awareness and knowledge in regards to organic cultivation of Chakhao. Thus, if rational uses of resources could be ensured by organising farmers friendly and efficient training programmes to encourage and convinced the farmers in adopting the newly introduced technology and methods that are more economically efficient instead of following the traditional way of cultivation, Chakhaoproduction would be an economically more viable commercial enterprise with increased profitability and food availability.

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