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Sanjay Kumar
Department of Agricultural Economics, Acharya Narendra Deva Uni. of Agri. and Tech., Kumarganj, Ayodhya, Uttar Pradesh, India

Shiv Kumar
Department of Agricultural Economics, J.V. (P.G.) College, Baraut, Baghpat, Uttar Pradesh, India

Hargovind Bhargava
Department of Agricultural Economics, Kulbhaskar Ashram PG College, Prayagraj, Uttar Pradesh, India

Archana Shukla
Department of Economics, D.B.S. PG College, Govind Nagar, Kanpur, Uttar Pradesh, India

Pukhraj Singh
Department of Agricultural Economics, J.V. (P.G.) College, Baraut, Baghpat, Uttar Pradesh, India

Lalit Kumar Verma
Department of Agricultural Economics, J.V. (P.G.) College, Baraut, Baghpat, Uttar Pradesh, India

Correspondence Author; Shiv Kumar
Department of Agricultural Economics, J.V. (P.G.) College, Baraut, Baghpat, Uttar Pradesh, India

Assessment of resource use efficiency of rice cultivation in Lakhimpur Kheri district (U.P.)

Sanjay Kumar, Shiv Kumar, Hargovind Bhargava, Archana Shukla, Pukhraj Singh and Lalit Kumar Verma

Abstract
Rice (*Oryza sativa* L.) is the most important staple food crop in Asia. More than 90% of the world's rice is grown and consumed in Asia, where 60% of the world's population lives. The Present Study deals with the Resource Use Efficiency in the Lakhimpur Kheri district of Uttar Pradesh. The Lakhimpur Kheri district was selected purposively in order to avoid operational in convenience. One block (Phoolbehar) having highest area under rice crop was selected purposively and from selected block five villages were selected randomly. The primary data were collected through a personal interview and pretested schedule. The Cobb-Douglas production function is used to estimate the input use efficiency. The coefficient of multiple determinations (R^2) on marginal, small and medium size group of farms accounted for 0.906627, 0.938600 and 0.961252, respectively and indicating that all the explanatory variable *viz*., human labour, seed, manure and fertilizers and irrigation together contributed 90.66, 93.86 and 96.12 per cent, respectively. Returns to scale on marginal, small and medium farms were analyzed and observed to be 0.818528, 0.795708 and 0.813943, respectively, which were found to be less than unity.

Keywords: Rice, cost & return, resource use efficiency

Introduction
Rice (*Oryza sativa* L.) is the most important staple food crop in Asia. More than 90% of the world's rice is grown and consumed in Asia, where 60% of the world's population lives. Rice accounts for between 35-60% of the caloric intake of three billion. Over 150 million hectares of rice are planted annually, covering about 10% of the world's arable land. Rice is grown in the tropical and sub-tropical regions of the world. The global requirement of rice by 2050 AD world by 800 million tones, which is 26% higher than the present level of production.

Rice is the main staple food and the first cultivated crop in Asia long before the area of which we have the historical evidences. No one really knows exactly where first seed of rice originated. Cultivation of rice in Tropical Asia probably began about 10,000 years ago. In India, oldest specimen of rice was found in Hasthinapur (UP) in a carbonized form during excavation (1000-750 BC). Domestication process first took place in China and later transmitted to South East Asia. It is also believed that wild rice first cultivated in Bangladesh, Assam, Orissa or its surrounding areas. It is also cultivated in most countries of west and North Africa (Egypt), east and central Africa. Its cultivation further extended to south and Central American countries (Latin America), Australia, USA and Southern European countries like Spain, Italy, and France. Rice is therefore, on the frontline in the fight against world's hunger and poverty. Rice is also a symbol of both cultural identity and unity. For all these reasons, "Rice is life" and therefore, the United Nations General Assembly (UNGA) during its 57th session on 16th December 2002 declared 2004 as the International Year of Rice. Rice is the major food of more than 70% of total population. In India rice is cultivated in an area of about 43.95 million hectares with on annual production of about 106.54 million tonnes with average productivity of 23.91 quintal / hectare 2013-14 *Anonymous* 2012. In Uttar Pradesh the area of rice is about 13.84 million hectares and production are 14.41 million tonnes, with productivity of 23.58 quintal per hectare (Anonymous 2013). It has second position in country where as first West Bengal is (14.96 mt).

In India rice is grown in almost all over the states. Kerala, Bihar, Uttar Pradesh, Madhya Pradesh and West Bengal lead in area while Punjab, West Bengal and Tamil Nadu have the highest rice production.

The average yield per hectare is highest in Punjab. Rice is the most prominent among the food crop of India and is likely to continue to dominance agricultural economy of the country because of its largest consumption. It is a crop of very wide physiological adaptability. It is being grown in tropical and temperate conditions, from sea level to about 7000 feet and from semi-arid tracts of Rajasthan and Punjab to very wet areas of Assam, West Bengal, Kerala and Mysore. A large number of varieties differing in morphological characters are in cultivation. The higher percentage of people of country is engaged in its production, processing, storage and marketing.
Lakhimpur Kheri district is also an important rice producing district of U.P. The area under rice in the district during 2014-15 was reported 175292 hectares with production of 486623 metric tonnes while productivity was 27.79qt/ha. (Arth Evam Sankhya Prabhag, Lakhimpur Kheri district, U.P. 2015-16). The Study area district Lakhimpur Kheri is one of the leading district of U.P. so far as production of rice is concerned. The climate and other factors are suitable for rice production in the area.

Materials and Methods

The Shady was based on the input-output data obtained from sample rice growing farmers in up to district of Lakhimpur Kheri Selected through multistage sampling design. At the First stage the major rice growing district Lakhimpur Kheri was purposively selected out of 15 block of the selected district block namely Phoolbehar having highest area under rice crop was selected purposively A list of all the villages falling under selected block was prepared and arranged in ascending order according to area covered by rice crop and five villages were selected randomly from the list A separate list of rice growers of selected five villages was prepared along with their size of holdings. Thus, the farm holding categorized in to three sizes of groups *viz.,* (1) Marginal below hectare (ii) small 1–2-hectare (iii) Mediums 2-4 hectare. The Primary data were collected through personal interview method on well-structured pretested schedule specially designed for this study. The data pertained for the agriculture year 2013-2014.

Analytical Tools: Suitable statistical tools used for analysis of data.

Regression analysis

To study the effect of various independent variables on the dependent variables, various forms of production function were explored. However, Cobb-Douglas production function, elasticity of production and return to scale, was found to be best fit for the analysis of data.

The mathematical form of Cobb-Douglas function (power function) is as follows:

$$Y = ax_1^{b_1}.x_2^{b_2}.................Xn^{bn}$$

Where
Y = Dependent variable (output value in rupees/hectare)
X_1 = i^{th} independent variable (input value rupees/hectare)
a = Constant
b_1 = Production elasticity with respect to $X_{i's}$

The value of the constant (a) and coefficient (bi) in respect of independent variable in the function have been estimated by using the method of least square. The Cobb-Douglas production function in log form is as follows:

$$\text{Log } Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + \ldots\ldots + u \log e$$

Where,

Y = Value of gross returns of crops (Rs./ha)
X_1 = Expenditure on human labour (Rs./ha)
X_2 = Expenditure on seed (Rs./ha)
X_3 = Expenditure on manures and fertilizers (Rs./ha)
X_4 = Expenditure on irrigation (Rs./ha)
a = Intercept
b_i: (j = 1, 2………4) are the elasticity coefficient of the j^{th}

Marginal Value Product (MVP): The marginal value of product Inputs were estimated by following formula:

$$(MVP)\ X_j = b_j \frac{\overline{Y}}{\overline{X}_j}$$

Where
b_j = Production elasticity with respect to X_j
Y = Geometric mean of the dependent variable Y
X_j = Geometric mean value of X_j
MVP = Marginal value product of j^{th} input, significance test of the simple regression coefficient.

Having estimates of the elasticity coefficients, it is desirable to ascertain the reliability of these estimates. The most commonly used't' test was applied to ascertain whether the sample production elasticity Coefficient; bj is significantly different from zero or not at some specified probability level.

't' cal = b_j/standard error of bj

If cal. 't'is greater than table value of t-distribution at (n-k-1) degree of freedom and specified probability level of significance, b_j is said to be statistically significant from zero (K is number of independent variable and n is sample size).

Results and Discussion

Resource use efficiency of rice: The production function analysis was carried out to determine the efficiency of prime included resources *viz.* human labours, seeds, manures and fertilizers and irrigation as explanatory variables used in production of rice. The Cobb-Douglas production function as best fit was explored and respective results are summarized in this section.

Elasticity of production: The value of elasticity of production, standard error, coefficient of multiple determination and returns to scale of rice production by different size group of farms have been worked out and presented in Table no.1

Coefficient of multiple determinations (R^2): Table no. 1 reveals that coefficient of multiple determinations (R^2) on marginal, small and medium size group of farms accounted for 0.906627, 0.938600 and 0.961252, respectively and indicating that all the explanatory variable *viz*., human labour, seed, manure and fertilizers and irrigation together contributed 90.66, 93.86 and 96.12 per cent, respectively.

Table 1: Elasticity coefficient of the production function for rice

Size group of farms	Production Elasticities				Sum of elasticities	R^2	Marginal value product of inputs /factors			
	Human Labour (X_1)	Seed (X_2)	Manure & fertilizers (X_3)	Irrigation (X_4)			Human Labour (X_1)	Seed (X_2)	Manure & fertilizers (X_3)	Irrigation (X_4)
Marginal	0.250122** (0.076599)	0.523027** (0.060602)	0.016533 (0.046134)	0.028846 (0.016751)	0.818528	0.906627	1.10	0.52	0.07	1.41
Small	0.190903** (0.073905)	0.490342** (0.084605)	0.051178 (0.252378)	0.063286 (0.10174)	0.795708	0.9386	1.56	0.49	0.42	1.93
Medium	0.042922* (0.106934)	0.366685 (0.113899)	0.368974 (0.199889)	0.035362 (0.042084)	0.813943	0.962592	0.41	0.36	3.52	1.00

(Figures in parentheses show standard error of respective variable) **1% level of significance. *5% level of significance.

Significance of factors of production

It is observed from Table no. 1 that on marginal farms, the elasticity of production with respect to human labour and seed were statistically significant at 1 per cent level of significance that these input factors contributed to the output significantly. In case of medium farms, elasticity of production with respect to human labour were found significant at 5 per cent level of significance, respectively, Rest factors of production included in production process were found statistically non-significant. It can be inferred that there was no further scope for application of these inputs in production of rice.

Returns to scale

Returns to scale on marginal, small and medium farms were analyzed and observed to be 0.818528, 0.795708 and 0.813943, respectively, which were found to be less than unity. It is therefore, inferred that increasing all factors by one per cent simultaneously results increase of the returns by less than 1 per cent on each farm situation. Less than unity return to scale indicated that the functional analysis is of diminishing return in nature.

Marginal value productivity

It is evident from Table 4.10 that marginal value productivities are positive in case of all included factors of functional analysis. M.V.P. of seed factor of functional analysis for all category of farms were less than unity indicator that excessive investment was made by the farmers in the study area on seed. M V P of irrigation factor were observed more than unity in case of all category of farms indicated that there is further scope of investment on irrigation in the study area for obtaing optimum return. M V P of human lalour was more than unity in case of marginal and small farmers where as it is less than unity on medium farms. MVP of fertilizer was observed less than unity on marginal and small forms and more than unity on medium farms.

Conclusion

The cost of cultivation was maximum on medium sample farms and minimum on marginal farms. This is due to more expenditure occurring on human labour and seed charges by medium farms as compared to other categories of farms. The coefficient of multiple determinations (R^2) on marginal, small and medium size group of farms accounted for 0.906627, 0.938600 and 0.961252, respectively and indicating that all the explanatory variable *viz*., human labour, seed, manure and fertilizers and irrigation together contributed 90.66, 93.86 and 96.12 per cent, respectively.

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