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Resource Use Efficiency in Basmati and Non-basmati Rice Production in the J&K

Rupali Kaundal*, Sudhakar Dwivedi and Neer Somakka A.N.

Division of Agricultural Economics & ABM, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu Main Campus, Chatha, Jammu, India

*Corresponding author: rupali-2159010@pau.edu

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ABSTRACT

The present study was conducted in order to determine the resource use efficiency in basmati and non-basmati rice production in Jammu district. The multistage random sampling technique was used for the selection of respondents. The analysis was based on data collected from 100 households in Jammu district in the year 2020-21. The Cobb Douglas production function was employed to work out the resource use efficiency because it was found the best fit for the study. The production function analysis revealed that seed, manures and fertilizers, irrigation and machine labour had a positive and significant ($p<0.01$) influence on the basmati rice production. The regression coefficients of expenditure on human labour and manures and fertilizers were found positive and significant ($p<0.01$) in non-basmati rice production implies further scope for increasing the productivity and return by using more of these inputs. The MVP to MIC ratio of all the explanatory variable except plant protection chemical were found more than one indicating that still their scope of higher utilization of these resources and which is turn would increase the gross income. Whereas MVP to MIC ratio of plant protection chemicals was found less than unity indicating overutilization of the input and needs rationalization.

Keywords: Resource-use efficiency, Basmati and Non-basmati Rice, Multistage random sampling technique, Cobb-Douglas production

Agriculture is the backbone of the Indian economy, with the primary goal of meeting the food, nutrition, and input needs of the country's massive population. It provides a source of income for approximately 69 per cent of the rural population and contributes approximately 44 per cent of total employment generation in the country. Food grain production had increased from 51 million tonnes in 1950-51 to 275 million tonnes in 2017-18 as a result of the green revolution. India is the world's largest producer (25 per cent of global production), the consumer (27 per cent of global consumption), and the importer (14 per cent) of pulses in the world. It is the world's second-largest producer of rice, wheat, sugarcane, cotton, and groundnuts, as well as fruits and vegetables, accounting for 10.9 per cent and 8.6 per cent of global output, respectively. Rice is the chief grain of India and has the largest area under cultivation. India is a significant producer of this crop. Because rice is a tropical plant, it thrives in hot, humid climates. India is one of the world's leading white rice producers, accounting for 20 per cent of global rice output (FAO, 2020). Rice straw is one of the abundant lignocelluloses biomasses which is used for energy

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production, bio-fuel and biogas production, livestock fodder, organic fertilizer and mulching, mushroom production, thatching, packaging, traditional cooking, brick-kilns and various other purposes. It is grown on 44.6 million hectares, with a total yield of 116.48 million tonnes and average productivity of 2638 kg/ha. (Anonymous, 2020). Major rice producing states in India are West Bengal, Andhra Pradesh, Uttar Pradesh and Punjab. In Jammu and Kashmir, agriculture is the most important sector of the state's economy and has a significant impact on farming families. Agriculture and its allied sectors contribute appreciably toward family income and employment generation in the region. In the Jammu district, basmati rice is mostly grown in the irrigated belt of R.S. Pura and Bishnah and is world-famous for its high aroma, particularly the one grown in the R.S Pura belt and very much gainful for predominant growers of this region. However, over time the farmers are diversifying towards high-value cash crops. R.S. Pura is one of the agriculturally leading blocks of Jammu district of Union Territory, having 55480 ha cultivated area under irrigated and rainfed conditions. The most important crops in the R.S. Pura block are rice and wheat, having more cultivated areas as compared to other crops (Anonymous, 2020). The business from basmati rice annually fetches more than 45 crore rupees; thus, its cultivation in this region offers a great potential for its further improvement. The implications and suggestions thereof will be of immense importance in improving the resource utilization and allocation pattern to safeguard the farmers' interest in the production of their produce.

MATERIALS AND METHODS

Study Area

The present study was carried out in Jammu district of Jammu and Kashmir Union Territory. The study area was selected purposively as it has the highest area sown under Basmati rice, non-basmati rice and wheat crops as compared to other districts of Jammu region. Two blocks namely R.S. Pura and Bishnah of Jammu district were selected purposively on the basis of the highest area sown under targeted crops. A list of villages falling in each selected block was prepared and five villages from each block were selected randomly to constitute a total of 10 villages from 2 blocks. Ten farmers were selected randomly from each village to constitute a sample size of 100 farmers.

Data Collection

Primary and secondary data were collected to accomplish the objectives of the study. The primary data were collected through a survey method by interviewing the farmers with the help of a pre-tested schedule. The required secondary data were collected from various published sources/agencies such as Economic Survey (various issues), Regional Digest of Statistics, Annual Reports and other relevant government publications.

Data Analysis

In order to study the relationship between output and various inputs used, Cobb-Douglas production function was used. This function was used extensively in agricultural production function analysis. The functional form applied is given as under:

$$Y_t = \beta_0 \left(\prod_{i=1}^{n} X_i^{\beta} \right) u^t \qquad (i = 1, 2, 3 \ldots n)$$

Where, Y and X_i (i = 1, 2, 3...n) are the output and level of inputs. The constant β_0 and $\beta_i{}'_s$ (i=1, 2, 3...n) represent the efficiency parameters and the production elasticities of the respective input variables for the given population at a particular period, t.

The fitted Cobb-Douglas production may be written for the present case with five input variables:

$$y = a_0 X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5}$$

On log transformation, the above function can be transformed to a linear form as:

$$Log\ y = log\ a_0 + b_1 log\ x_1 + b_2\ log\ x_2 + b_3\ log\ x_3 + b_4 log\ x_4 + b_5 log\ x_5$$

Or

$$Log\ y = log\ a_0 + b_i \sum_{i=1}^{5} \log X_i$$

Where,

y = Output (QTLs/ha)

X_1 = Human labour (man-days/ha)

X_2 = Manure + Fertilizer (kg/ha)

X_3 = Expenditure on plant protection (₹/ha)

X_4 = Expenditure on irrigation (₹/ha)

X_5 = Expenditure on seeds (₹/ha)

a_0 = Constant

$b's$ = Elasticities of production of respective resource categories

To examine the productivity of different inputs used in the production of various crops, marginal value productivities of inputs were estimated at geometric mean levels of inputs. To calculate the Marginal Value Productivity (MVP) of resource x_i, the following formula was used:

$$MVP = \hat{b}_i \frac{GM(Y)}{GM(X_i)} \times P_y$$

where,

$MVP(X_i)$ = marginal value productivity of i^{th} resource

$\hat{b}_i$ = regression coefficient (estimated)

$GM(Y)$ = geometric mean output.

$GM(X_i)$ = geometric mean of inputs

P_y = Price of output

Resource-use efficiency

The resource-use efficiency showed whether a particular input is efficiently used or not. The input is used efficiently if the MVP of the input is equal to its unit price.

$$MVP_i = P_i$$

where,

P_i = Unit price of the i^{th} input

To estimate the resource use efficiency, the marginal value productivity of various inputs was calculated for significant regression coefficients in the estimated production function. Any deviation of MVP of input from its unit price represents the inefficiency of the resource use. The higher the difference between the MVP of an input and its unit price, the higher the resource use inefficiency and *vice versa*.

RESULTS AND DISCUSSION

The result of the Cobb-Douglas type of production function (Table 1) reveals that the value of R^2 was 0.98 which indicated that 98 per cent of the total variation is due to independent variables viz., seed, human labour, machine labour, manures and fertilizers, plant protection chemicals and irrigation. The finding revealed that among the explanatory variables, the regression coefficient of seed, human labour, machine labour and irrigation was found positive and significant at 1 per cent level of probability with regression coefficient values at 0.573, 0.239,0.246 and 0.396 respectively. It implies that a one per cent increase in the application of these factors will bring about 0.573, 0.239,0.246 and 0.396 per cent increase in the production of basmati rice. The production function analysis indicated that there is further scope for increasing the productivity and return by using more of these independent variables in basmati rice production. While, the regression coefficient of plant protection chemicals turned out to be negative (-0.101) at 1 per cent level of significance it implies that 1 per cent increase in plant protection will bring out 0.101 per cent decrease in production. This conforms with earlier studies carried out (Singh and Bera, 2016) in Manipur, Prakash *et al*. 2017 in Uttarakhand and Singh *et al*. (2015) in Uttar Pradesh.

Table 1: Estimated parameters of Cobb Douglas production function for Basmati Rice

Variables	Regression Coefficients	Standard Error
Constant (α)	0.911**	0.092
Seed	0.573**	0.127
Human labour	0.239**	0.044
Machine labour	0.246**	0.069
Manures and Fertilizers	-0.047	0.090
Plant protection chemicals	-0.101**	0.035
Irrigation	0.362**	0.049

Coefficient of Determination (R^2) = 0.98

Note: ** Significant ($p < 0.01$) and *Significant ($p<0.05$).

The estimated production function for non-basmati rice has been given in Table 2. The results revealed that the R^2 value was 0.90 which indicated that 90 per cent of the total variation is due to independent variables viz., seed, human labour, machine labour, manures and fertilizers, plant protection chemicals and irrigation. The value of R^2 was reasonably high given the obvious fact that there are other explanatory variables such as climate change, farmers' experience and managerial activity of farmers etc.

Table 2: Estimated parameters of Cobb Douglas production function for non-basmati rice

Variables	Regression Coefficients	Standard Error
Constant(α)	1.85**	0.243
Seed	0.468	0.292
Human labour	0.039**	0.014
Machine labour	0.011	0.082
Manure and fertilizers	0.375**	0.074
Plant protection chemicals	-0.017	0.044
Irrigation	0.108	0.105

Coefficient of Determination (R^2) = 0.90

Note: ** Significant ($p < 0.01$) and *Significant ($p<0.05$).

The findings further revealed that among the independent variables, the regression coefficient of human labour and manures and fertilizers was found to be significant at 1 per cent level of probability with regression coefficient values at 0.039 and 0.375, respectively. The regression coefficient of machine labour, plant protection chemicals and irrigation turned out to be non-significant with values of 0.011, 0.017 and 0.108, respectively. Similar results have also been reported by Dwivedi *et al*. (2011) in Jammu & Kashmir and Bapar (2016) in Bangladesh.

Resource-use efficiency in basmati and non-basmati rice

To examine the resource use efficiency, the marginal value productivity (MVPs) of inputs whose regression coefficients were found statistically significant in production function were compared with their respective unit price. A significant higher MVP of input than its price shows that more of the input can be used to increase productivity, while a significant lower MVP of input than its unit price indicates that the input is in excess and needs rationalisation. The marginal value products (MVP) of significant inputs for both basmati and non-basmati rice are given in Table 3.

In the case of basmati rice, on the overall basis MVP to MIC ratio of seed quantity (3.02), human labour (1.76), machine labour (1.35), expenditure on manure & fertilizer (2.06), expenditure on plant protection (1.36) and irrigation water (1.82) were more than one indicating that still their scope of higher utilization of these resources and which is turn would increase the gross income. This would help to maximise their profit in basmati rice cultivation, but the MVP to MIC ratio of expenditure on plant protection chemicals was less than unity (-1.36) indicating excessive use of plant protection chemicals.

In the case of non-basmati rice, MVP to MIC ratio of seed (2.78), human labour (1.89), machine labour (1.27), expenditure on manure & fertilizer (1.16), plant protection chemicals (-1.14) and irrigation

Table 3: Marginal Value Product for basmati and non-basmati rice

Variables	Crop							
	Basmati Rice				Non-basmati rice			
	MVP	MIC	MVP/MIC	Efficiency	MVP	MIC	MVP/MIC	Efficiency
Seed	3.02	1	3.02	Underutilized	2.78	1	2.78	Underutilized
Human labour	1.76	1	1.76	Underutilized	1.89	1	1.89	Underutilized
Machine labour	1.35	1	1.35	Underutilized	1.27	1	1.27	Underutilized
Manure and fertilizers	2.06	1	2.06	Underutilized	1.16	1	1.16	Underutilized
Plant protection chemicals	-1.36	1	-1.36	Overutilized	-1.14	1	-1.14	Overutilized
Irrigation	1.82	1	1.82	Underutilized	1.06	1	1.06	Underutilized

water (1.06) were more than one indicating that there's further scope of increasing the productivity and return by using more of these inputs. Whereas MVP to MIC ratio of plant protection chemicals was found less than unity indicating over-utilization of the input and needs rationalization.

CONCLUSION

India is the leading exporter of Basmati Rice to the global market and it holds the second position in rice production after China. The country has exported 3,948,161.03 MT of basmati rice to the world for the worth of ₹ 26,416.49 crores during the year 2021-22. As far as rice productivity is concerned it is almost half of the world's average rice productivity. In the last few years, the use of chemicals in rice cultivation has increased significantly that increasing the cost of cultivation. The best way to increase productivity in emerging economies like India, where resources are scarce and opportunities to adopt capital-intensive new technologies are few, is by making efficient use of the production resources. Resource use efficiency has been identified as a key factor in raising the productivity level of crops. The current level of rice production is not enough to meet the increasing demand for food from the growing population. The average productivity of rice can be increased only through the adoption of modern technology because the scope for expansion of area under rice has already been exhausted. The basmati rice may have the potential to enhance the average productivity level of rice in the country. It is observed that resources were efficiently used efficiency in basmati rice production in comparison to the non-basmati rice. In the case of non-basmati rice, the marginal value product was found negative for the plant protection chemical which indicates that MVP was declining but farmers are still using chemicals that needs rationalization. Therefore, the National food security mission has accomplished its goal by using seeds of hybrid varieties. There is a need to optimise the resources to maximise the profit and income of the farmer due to the underuse of seeds, fertilisers and overuse of plant protection measures. There is a need to aware the farmer regarding optimal resources-use and new varieties of both crop through extension services.

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