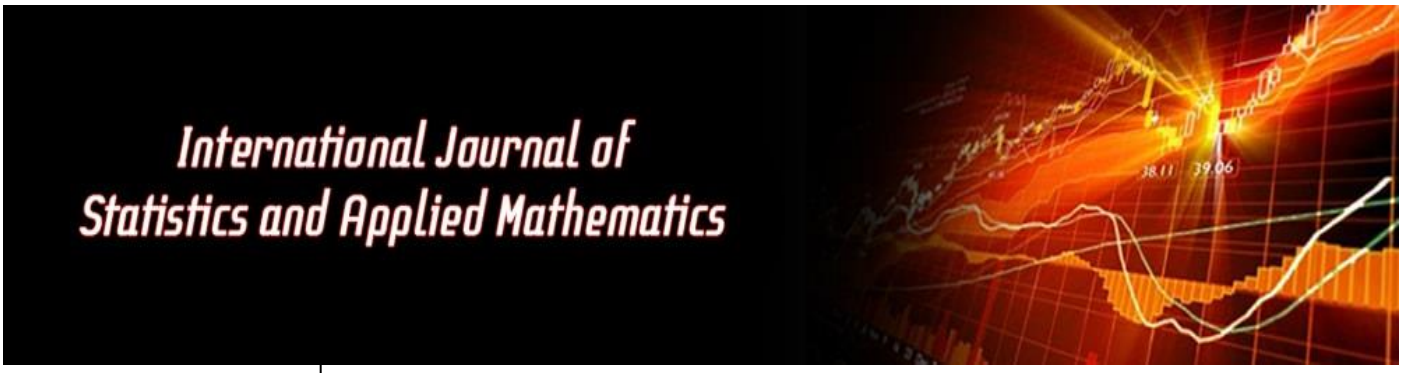

ISSN: 2456-1452
Maths 2023; SP-8(1): 01-05

https://www.mathsjournal.com
Received: 01-10-2022
Accepted: 10-12-2022

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Measures resource use efficiency of paddy cultivation and constraints in Gonda district of Uttar Pradesh

Santosh Tiwari and Dr. Amit Kumar Mishra

Abstract
The present study was conducted in Gonda district of Uttar Pradesh due to higher concentration of area and production under paddy cultivation from the selected district. The study was based on the primary data collected through well-structured Survey schedule with the help of personal interview from 100 respondents who selected from five villages of Tarabganj block, in Agricultural Year 2022-23 with aid of proportionate allocation method. The main focus of the study was to find out the resource use efficiency of the paddy cultivation Cobb –Douglas production function was fitted tofound out resource use efficiency and also find out the major constraints in cultivation of paddy crop in study area. For the constraints analysis Garett ranking technique was applied. The major findings of this study were that returns to scale on marginal, small and medium size group of sample farms characterized by decreasing returns to scale. On the other hand, major findings in constraints analysis top fiveproblem faced by the farmers were Higher interest rate with a score of 55.78 (rank I), labour problem (overall Garrett score 54.63), Inadequate application of manure and fertilizer (overall Garrett score 52.85 rank III), Lack of storage facilities (overall Garrett mean score 51.39 with rank IV) and Lack of awareness about the benefits of scheme overall Garrett score 50.89 (rank V).

Keywords: Cobb-Douglas, garett ranking technique, multiple determination (R^2), resource use efficiency, proportionate allocation method

Introduction
Agriculture is the main occupation in India (Kushwaha *et al*., 2019 and Upadhyay *et al*., 2021) [5, 12]. Mostly two-third of population is dependent on agriculture directly or indirectly. It is the main source of food, fodder and fuel. It is the basic foundation of economic development and provides highest contribution to national income. (Sri *et al*., 2022) [10]. Paddy (*Oryza sativa* L.) belongs to the Graminae family is it the most important food crops of India and is likely to be continued as dominant food crop in future also. The highest percentage of people of the country is engaged in the processing and marketing of paddy. Besides rice consumption as food the by-product of rice that i.e., paddy husk is also used for different purpose conventionally, husk is used as fuel, soil conditioner, packaging material animal feed and for insulation purpose. It is also used for manufacturing the building material and other chemicals, Rice barn is used for extraction of edible oil, industrial oil and animal feed. However, it has been recognized as a very useful source of proteins, carbohydrates and vitamins, paddy straw is one of the major sources of dry fodder in animal feed. Rice is the most important food crops of India in terms of area, production and consumption. In India rice is grown in an area of 43.95 m ha with the production and productivity levels of 106.29 mt and 2416 kg/ha respectively during 2013-14 (Hari Prasad *et al*., 2014) [3]. It's also recognized that these countries have rice as their staple food. Rice is grown under four different ecologies, with irrigated ecology accounting for the largest area (431.94 million/hectare) and highest production (110.15 metric tons) and productivity (25.50 tons/hectare) closely followed by rainfed shallow lowlands. Rainfed upland, which accounts for nearly one fourth of the rainfed low land area, records one seventh of production. Region wise, the predominantly rainfed eastern zone accounts for 29.5 million hectare which is the largest area under rice in the country with highest production of 51.6 metric tons but with the lowest productivity of 1.62 tons/hectare. While the irrigated north and south zones together accounting for nearly 12 million hectare, produce 37.5 metric tons recording a distinct yield edge over eastern India.

The distribution pattern of rice growing districts based on productivity range reveal that of 563 districts, 115 districts (20.4%) contribute to 36.9 million tons production with an average yield of 3.15 tons/hectare. They are largely located in the high productive states of Punjab, Tamil Nadu, Haryana and Andhra Pradesh. Around 103 (18.3%) districts falling in the range of 2 to 2.5 tons/hectare are in Kerala, Karnataka and Uttar Pradesh. Over 345 (61.3%) districts with yield levels less than that of the national average are distributed largely in the rainfed eastern, central and western states *viz*., Arunachal Pradesh, Assam, Bihar, Sikkim, Uttar Pradesh and Uttarakhand (Nirmala, 2011 and Upadhyay *et al*., 2021) [7, 12]. The main reason for the cultivation of hybrid rice is to obtain better yield followed by higher profitability, suitable for parboiling, better resistance to pests and diseases. The increase in rice yields due to hybrid rice has, in turn, improved food security for an estimated 60 million additional people per year (Singh *et. al*., 2018) [8]. Keeping this in view the proposed study entitled "Measures Resource Use Efficiency of Paddy Cultivation and Constraints in Gonda District of Uttar Pradesh" assumes special significance. The main objective of studied were.

1. To work out the resource use efficiency of the paddy crop.
2. To find out the constraints in paddy cultivation.

Materials and Method

The current study was carried out in Gonda district of Uttar Pradesh. Purposive cum random sampling technique was applied for selection of district, tehsil, villages and paddy growers. One tehsil, the Gonda tehsil, was chosen on purpose for the study. Tarabganj, a block in this tehsil, was purposefully chosen for the study. In this chosen block, five villages were chosen at random namely Karnipur, Rampur, Narayanpur, Girdhapur, and SemraKamalkhani.100 respondents were selected randomly through proportionate allocation to the population. The data was collected from cultivars with the help of well-structured schedule through personal interview method. The data pertain for the year 2022-23.

Analytical Tools

Production function

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 and underuse of resources (Subedi *et al*., 2020) [11]. The Cobb Douglas production function of the following form was fitted to examine the resource productivity, efficiency and return to scale:

$$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}\ldots\ldots\ldots\ldots X_n^{bn}e^{\mu}$$

Where,
Y = per hectare output (₹/ha)
X_1 = Labour Cost (₹/ha)
X_2 = Machinery Charge (₹/ha)
X_3 = Seed Cost (₹/ha)
X_4 = Manure and fertilizers (₹/ha)
X_5 = Irrigation Charge (₹/ha)
X_6 = Plant Protection (₹/ha)
b_i = Elasticity coefficient of the respective input variables
e = Error term or disturbance term
μ = Random variables

Cobb-Douglas Production function in log form

Log Y = log a+b_1 log X_1+$b_2$log X_2+$b_3$log X_3+b_4 logX_4 +b_5 logX_5+b_6…….$b_n$logX_n+ μlog e.
This form was used for estimating the parameters of the function based on sample data.

Estimation of Marginal Value Product

The marginal value product of inputs was estimated by following formula (Maurya *et al*., 2021) [6].

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

Where,
MVP = Marginal Value Product
b_j = Production elasticity with respect to X_j
$\bar{Y}$ = Geometric mean of the dependent variable (Y)
$\bar{X}_j$ = Geometric mean value of X_j independent variable
MVP_j = marginal value production j^{th} input
j = 1, 2, 3, 4, 5, 6 variables included in the study

Significance tests of the sample regression coefficients:

After estimating the elasticity coefficient, reliability of these estimates was worked out. The most commonly used "t" test was applied to ascertain whether the sample production elasticity coefficient, b_j is significantly different from zero or not at some specified probability level.

$$'t'\ cal = \frac{b_j}{S.E.\ of\ b_j}$$

If calculated 't' value was greater than table value of "t" at specified probability level at 'n-k-1' degree of freedom, $b_j$was statistically and significantly different from zero 'k' is number of independent factors and 'n' is sample size (Kant and Singh, 2020) [4].

Constraints analysis in production of paddy crop:

In order to achieve the objective, i.e. to study the constraints in production and rice, Garrett's ranking technique was used to rank the causes responsible for the rice growers.

$$\text{Percent position} = \frac{100\ (R_{ij} - 0.5)}{Nj}$$

Where, R_{ij} = Rank given for i^{th} preference by j^{th} farmer
N_j = Number of preferences ranked by j^{th}farmer
The per cent of rank, for a single variable (reason) were added up for total sample paddy growers to give the overall per cent position of that preference. The overall per cent position thus calculated was divided by the number of respondents in order to derive the average per cent position, which was then converted to scores by referring to the transmutation table, given by Garrett (Upadhyay *et al.* 2021; Gautam *et al.* 2022) [12, 2].

Results and Discussion

Resource use efficiency in paddy crop

The production function analysis was carried out to determine the efficiency of prime included resources *viz*. human labour, machinery charges, seed, manures and fertilizers and irrigation as explanatory variables used in production of paddy. The Cobb-Douglas production function as best fit was explored and respective results.

Elasticity of production

The value of elasticity of production, standard error, coefficient of multiple determination and returns to scale of paddy production by different size group of farms have been worked out and presented in Table: 1

Table 1: Production elasticity of Paddy on different size group of farms

Size group of farms	Production of elasticity					Return to Scale	R^2
	X_1	X_2	X_3	X_4	X_5		
Marginal	0.077 (0.401)	0.133 (0.251)	0.236** (0.174)	0.388* (0.195)	0.146 (0.209)	0.9801	0.8408
Small	0.639* (0.163)	0.045 (0.123)	0.115** (0.090)	0.098 (0.100)	0.057 (0.115)	0.9541	0.8699
Medium	0.358* (0.168)	0.158 (0.156)	0.205** (0.168)	0.030 (0.226)	0.129 (0.161)	0.8803	0.9063

*Significant at 1% level of probability
**Significant at 5% level of probability
Where,
X_1, X_2, X_3, X_4 and X_5 stand for human labour, machinery charges, seed, manure and fertilizers and irrigation (Rs.), respectively.

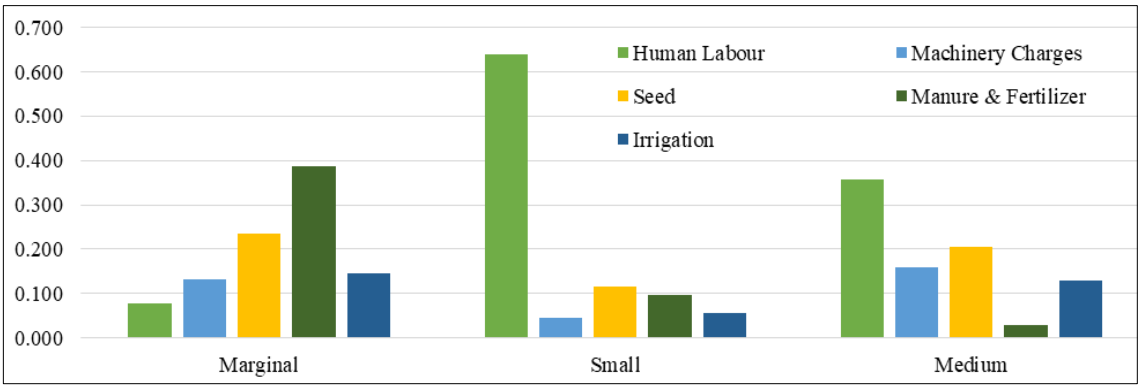

Fig 1: Production elasticity of Paddy on different size group of farms

Coefficient of multiple determinations (R^2)

Table: 1 reveals that coefficient of multiple determinations (R^2) on marginal, small and medium size group of farms accounted for 0.8408, 0.8699 and 0.9063, respectively and indicating that all the explanatory variable *viz*., human labour, machinery charges, seed, manure and fertilizers and irrigation together contributed 84.08, 86.99 and 90.63 per cent, respectively.

Significance of factors of production

It is observed from Table: 1 that marginal farms, seed cost was found statistically significant at 5 per cent probability level while manure and fertilizer were found significant at 1 per cent while three factor *viz;* human labour, machinery charges and irrigation charges were found statistically non-significant. In case of small and medium farms, seed cost was found statistically significant at 5 per cent probability level while human labour was found significant at 1 per cent level of significance while three factor *viz;* machinery charges, manure and fertilizers and irrigation charges were found statistically non-significant. It can be inferred that there was no further scope for application of these inputs in production of paddy.

Returns to scale

Returns to scale on marginal, small and medium farms were analyzed and observed to be 0.9801, 0.9541 and 0.8803, 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:2 that the variable showed in marginal, small and medium farms was greater than unity revealed that these variables can be used in future for making more profit but except for the variable which was less than unity *i.e.*, small farms in machinery charges, as well as medium farms in manure and fertilizers, means the excess use of this variable hence, there needed to decrease it, for increasing profitability of farms.

Table 2: Marginal Value Productivity (MVP) of included factors in production process of Paddy cultivation

Size group of farms	Marginal value productivity of input/factors				
	X_1	X_2	X_3	X_4	X_5
Marginal	1.42	1.97	4.42	6.36	2.27
Small	5.98	0.78	2.86	1.99	1.13
Medium	3.57	2.40	4.40	0.67	2.94

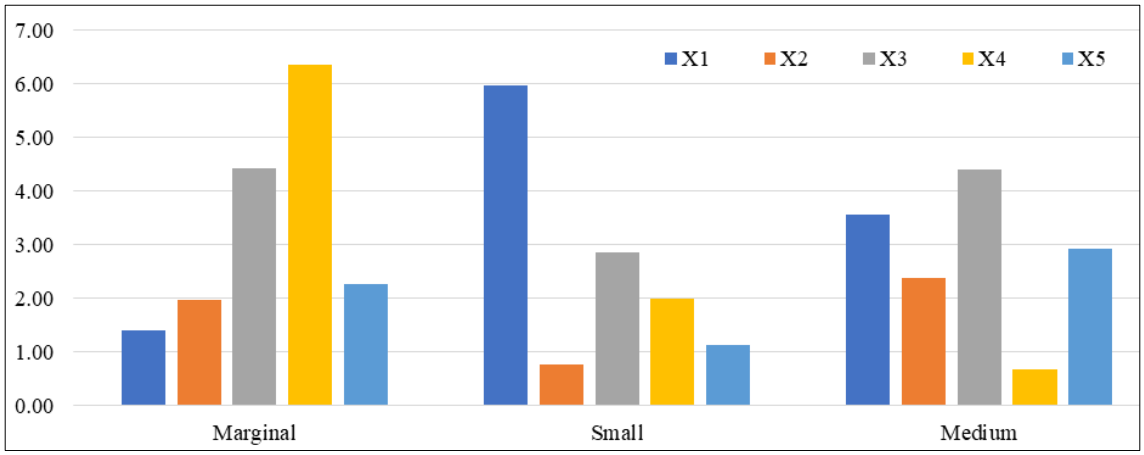

Fig 2: MVP of included factors in the production process of paddy cultivation

In marginal farms the MVP of human labour was 1.42, machinery charges were 1.97, seed was 4.42, manure and fertilizer were 6.36 and irrigation was 2.27 this shows that for the production of one additional quintal of paddy the additional cost incurred for different is equal to the respected MVP.

In small farms the MVP of human labour was 5.98, machinery charges were 0.78, seed was 2.86, manure and fertilizer were 1.99 and irrigation was 1.13 this shows that for the production of one additional quintal of paddy the additional cost incurred for different is equal to the respected MVP.

In medium farms the MVP of human labour was 3.57, machinery charges were 2.40, seed was 4.40, manure and fertilizer were 0.67 and irrigation was 2.94 this shows that for the production of one additional quintal of paddy the additional cost incurred for different is equal to the respected MVP.

B. Major Constraints in Production of Paddy Cultivation:

Problems faced by producers on different size group of farms are given in Table: 3 The response of sample farms about the problems faced by them have been classified mainly under three types:

A. Management Problem
B. Financial Problem
C. Marketing Problem

The ranking was done by using Garrett's rank technique for different types of constraints. It is clear from the table that the major constraint faced by most of the paddy growers was Higher interest rate with a score of 55.78 (rank I). Keeping this in view, the government takes action to offer credit at a low-interest rate and assist farmers in selling their prior crops at higher prices. The second most important constraint faced by the paddy growers was labour problem (overall Garrett score 54.63). The other most important constraints reported by the paddy growers were Inadequate application of manure and fertilizer overall Garrett score 52.85 (rank III), Lack of storage facilities overall Garrett mean score 51.39 with rank IV and Lack of awareness about the benefits of scheme overall Garrett score 50.89 (rank V). In addition to the above problems, the minor problems faced by also Problem of bulkiness of produce(VI), Untimely available of loan (VII), Constraints related to middlemen (VIII), Unavailability of proper irrigation facilities (IX), Lack of market information and prices (X), Problem of PP chemicals and weedicide (XI), Lack of support the Institutional agencies (XII),Unavailability of quality seeds (HYV) (XIII), Unavailability of machines and tractor (XIV) and Weighing errors (XV) in the study area.

Table 3: Constraints on different size group of farms in the study area.

S. No.	Particulars	Percent Position	Garrett Value	Total	Average Score	Rank
A.	**Management problems**					
i	Labour problem	10.00	75	5463	54.63	2nd
ii	Inadequate application of manure and fertilizer	16.67	69	5285	52.85	3rd
iii	Unavailability of proper irrigation facilities	56.67	47	4998	49.98	9th
iv	Unavailability of quality seeds (HYV)	83.33	31	4765	47.65	13th
v	Problem of PP chemicals and weedicide	70.00	40	4799	47.99	11th
vi	Unavailability of machines and tractor	90.00	25	4613	46.13	14th
B.	**Financial problems**					
vii	Lack of awareness about the benefits of scheme	30.00	60	5089	50.89	5th
viii	Higher interest rate	3.33	85	5578	55.78	1st
ix	Lack of support the Institutional agencies	76.67	36	12	47.89	12th
x	Untimely available of loan	43.33	53	5056	50.56	7th
C.	**Marketing problems**					
xi	Lack of storage facilities	23.33	64	5139	51.39	4th
xii	Lack of market information and prices	63.33	43	4837	48.37	10th
xiii	Problem of bulkiness of produce	36.67	57	5065	50.65	6th
xiv	Weighing errors	96.67	15	4473	44.73	15th
xv	Constraints related to middlemen	50.00	50	5051	50.51	8th

Conclusion

In case of paddy, returns to scale on marginal, small and medium size group of sample farms characterized by decreasing returns to scale. Out of total variation in dependent variable explained by human labour, machinery charges, seed, manure and fertilizers, and irrigation under entire size of sample farms for crop varied from minimum of 88.03 per cent to maximum of 98.01 per cent.

It was observed during the investigation that in the production of paddy top five problem faced by the farmers were Higher interest rate with a score of 55.78 (rank I). The second most important constraint faced by the paddy growers was labour problem (overall Garrett score 54.63). The other most important constraints reported by the paddy growers were Inadequate application of manure and fertilizer overall Garrett score 52.85 (rank III), Lack of storage facilities overall Garrett mean score 51.39 with rank IV and Lack of awareness about the benefits of scheme overall Garrett score 50.89 (rank V).

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