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Resource use efficiency in production of wheat on sample farms

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Abstract
It is revealed from the table that co-efficient of multiple determination (R_2) of marginal/small, medium and large size group of farms were 0.8162, 0.8111 and 0.8468 respectively. The co-efficient of multiple determination of all four independent variables *viz*. seed, manure & fertilizer and irrigation and human labour indicate 81.62, 81.11 and 84.68 percent variation in dependent (output) variable in marginal /small medium and large categories of sample farms. The independent variable X_4 (human labour) was found statistically significant at 1.00% level of probability in all the categories of sample forms. Similarly the variable X1 (seed) was also found significantly related with output at 1.00% probability level in all cases of farm groups.
Returns to scale (Sum of elasticity) in case of Marginal/ small, medium and large farms were 0.7665, 0.8157 and 0.8242. Which were less than unity. The values of sum of elasticity indicates that the production of wheat is characterized by decreasing returns to scale in all three categories of the farms. It is therefore, inferred that increasing all the Factors by one percent simultaneously increase the return by less than 1 percent and each farm situation.

Keywords: Resource use efficiency in production of wheat on sample farms

Introduction
India is one of the world's largest producers of wheat; accounting for 20% of all world wheat production. The area under wheat in India was reported 30.00 million hectares with total production of 93.50 million tonnes, while productivity was recorded 3.11tonnes per hectare.
Wheat (*Triticum aestivum* L.) is the world's most widely cultivated staple food crop being grown since pre historic period and being consumed in various forms by more than one thousands million people in the world .Wheat plays an important role in shaping agriculture and food security mission.
India is the second largest producer of wheat next to China. Globally wheat is grown in 122 countries over an area of 215 million hectare and producing nearly 676 million tons during 2011-12.Uttar Pradesh (UP) located in northern part of India is surrounded by Uttarakhand, Himachal Pradesh, Haryana, Delhi in the North and in west Rajasthan, Madhya Pradesh and Chhattisgarh in the South -West and South; and Jharkhand and Bihar in the East. It is the fifth largest state in India in terms of geographical area covering roughly 240,928 square kilo meters. This is nearly 7.33 percent of total area of the country. In terms of population, UP is the largest state of India with a population of about 199.8 million people (Census 2011) accounting for nearly 16.5 percent of the total population of country.
The demand for wheat is expected to increase due to population increases by 1.6 per cent, and area under wheat is expected to reduce. Hence, there is a need to increase yield and productivity of wheat with reduces inputs to feed the burgeoning population. Because of high productivity, stability and less risk the wide adoption of wheat cropping will have to play a major role in future planning to sustain self sufficiency of food grains in coming years. Despite a substantial size of area and production of wheat in Laltipur district of Bundelkhand region, U.P. seeing the importance of the crop it become necessary to analyze the costs of cultivation of wheat, since the input costs rise every year which increases the total cost of cultivation and ultimately affects the net profit gained by the producer.

Methodology

Selection of the district

Lalitpur district of Uttar Pradesh was selected purposively to avoid the inconvenience of investigation.

Selection of the block

A list of 6 blocks of Lalitpur district was prepared and one block namely Mahrauni having highest area coverage under gram crop was selected purposively for the study

Selection of the villages

A list of all the villages falling under selected block was prepared from official records available at block Head Quarter and 5 villages were selected randomly for the study.

Methods of the study

Functional Analysis

Production function analysis was carried out to examine the productivity and efficiency of different resources used in wheat cultivation. Multiple regression analysis was done to examine the output - input relationship and productivity of farm inputs on different size group of sample farms.

Different types of production function were explored, out of them only cobb-Douglos production function was found best fit. The form of the function used for the analysis is:

$$Y = ax_1^{b1} x^{b2} \ldots\ldots\ldots x^{bn} \qquad 2n$$

Where,

Y= Dependent variable (value of output Rs/ha) x_i= i^{th} independent variable (value of input Rs/ha) a = Constant b_i = Production elasticity with respect to x_i

Estimation of marginal value productivity

The marginal value product of inputs was estimated by taking partial derivatives of returns with respect to the input concerned, at the Geometric mean level of inputs

$$MVP = \frac{b_i \bar{y}}{X_i}$$

Where,

b_i = Production elasticity with respect to X_i

$\bar{y}$ = Geometric mean of y (output values in rupees per hectare)

X_i = Geometric mean of X_i (input values in rupees per hectare)

Significant test of the sample regression analysis

Having estimated the elasticity of coefficient, 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 the same specified probability level.

$$t\ cal. = \frac{bj}{S.E.\ of\ bj}$$

Where,

t cal = calculated t value

b_j =Production elasticity of X_j

S.E = Standard Error

If calculated‘t’ value is greater than the table value of ‘t’ at specified probability level and n-k-1 degree of freedom, b_j is said to be statistically different from Zero. K is the number of independent factors and n is the sample size.

Result and Discussion

The production function analysis was carried out to determine the efficiency of various resources (seed manure and fertilizer, irrigation, and human labour) used in the process of wheat production. Cobb- Douglas production function was found best fit to the data and applied for the functional analysis.

Elasticity of Production

The estimated value of elasticity of production, standard error coefficient of multiple determination (R_2), returns to scale and marginal value of productivity for production of wheat on size group of farms are given in Table 1.

It is revealed from the table that co-efficient of multiple determination (R_2) of marginal/small, medium and large size group of farms were 0.8162, 0.8111 and 0.8468 respectively. The co-efficient of multiple determination of all four independent variables *viz*. seed, manure & fertilizer and irrigation and human labour indicate 81.62, 81.11 and 84.68 percent variation in dependent (output) variable in marginal /small medium and large categories of sample farms. The independent variable X_4 (human labour) was found statistically significant at 1.00% level of probability in all the categories of sample forms. Similarly the variable X_1 (seed) was also found significantly related with output at 1.00% probability level in all cases of farm groups. Third important factor of production having significant effect on output was manure & fertilizer which showed statistically significant relation at 1.00% level of probability in case of marginal and small farms. It is also clear from the table that irrigation (X_3) did not show any significant impact on yields in any of the farm situationReturns to scale (Sum of elasticity) in case of Marginal/ small, medium and large farms were 0.7665, 0.8157 and 0.8242. Which were less than unity. The values of sum of elasticity indicates that the production of wheat is characterized by decreasing returns to scale in all three categories of the farms.

Table 1: Production elasticity of wheat crop on different size group of farms

Size group of sample (hectares)	Production elasticity				Sum of elasticity return to scale	R2	Marginal value productivity input/factors			
	X_1	X_2	X_3	X_4			X_1	X_2	X_3	X_4
small farmer(below 1ha)	0.1575** (0.1270)	0.4800** (0.0813)	0.1197 (0.0996)	0.0092** (0.066)	0.7665	0.8162	4.1762	7.0565	1.6257	0.0709
Medium Farmer (1-2ha)	0.1887** (0.1538)	0.4975** (0.1075)	0.1014 (0.1199)	0.0279** (0.0916)	0.8157	0.8111	4.5089	6.2478	1.3092	0.3638
Large farmer (Above2 ha.)	0.2153** (0.2212)	0.4639 (0.1361)	0.1369 (10.181)	0.0079** (0.1148)	0.8242	0.8468	5.0890	11.0626	2.2169	0.1208

(Note: Figures in parentheses indicate the standard error of respective variables).

** - Significant at 1% probability level

*- Significant at 5% probability level.

X1, X2, X3 and X4 symbolized for seed, manure fertilizer, irrigation charges and human labour cost respectively

Factors by one percent simultaneously increase the return by less than 1percent an each farm situation.

Marginal value Productivity

The MVP of different input factors are also presented in table. It is indicated in the table that in case of all the three categories of farms, the MVP values of all the input factors included in the study were positive which indicates that there is further scope of increasing the expenditure on all these factor in each farm situation to realize more return than the use of input.

Conclusion

It is revealed from the table that co-efficient of multiple determination (R2) of marginal/small, medium and large size group of farms were 0.8162, 0.8111 and 0.8468 respectively. The co-efficient of multiple determination of all four independent variables *viz*. seed, manure & fertilizer and irrigation and human labour indicate 81.62, 81.11 and 84.68 percent variation in dependent (output) variable in marginal /small medium and large categories of sample farms. The independent variable X4 (human labour) was found statistically significant at 1.00% level of probability in all the categories of sample forms. Similarly the variable X1 (seed) was also found significantly related with output at 1.00% probability level in all cases of farm groups.

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