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Resource use efficiency in okra in Meerut district of Western Uttar Pradesh

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Abstract
Fruits and vegetables account for nearly 90% of total horticulture production in the country. India is the largest producer of okra in the world next to China with area, production and productivity of 509 thousand hectare, 6095 million tonnes and 120 mt/ha. On the basis of primary data to know resource use efficiency of okra cultivation. The purposive sampling was used to select districts and villages on the basis of highest area under these crops random sampling technique was used to select the 100 farmers and categorized under marginal small and medium farmers. Cobb-Douglas production function, elasticity of production and return to scale were analysed in this study and coefficient of multiple determinations (R^2) on marginal, small and medium size group of farms accounted for 0.93254, 0.88651 and 0.81054, respectively, returns to scale on marginal, small and medium farms were analysed and observed to be 0.89247. 0.91587 and 0.87624, respectively, marginal value productivities are positive and more than unity in case of human labour, seed and plant protection.

Keywords: Resource use efficiency, return to scale, marginal value productivity

Introduction
Fruits and vegetables account for nearly 90% of total horticulture production in the country. India is now the second largest producer of fruits and vegetables in the world and is the leader in several horticultural crops, namely Mango, Banana, Papaya, Cashew, Arecont, Potato and Okra. However the nature of horticulture crops being such It is not easy to make assessment of their production. These crops, especially vegetables are grown in small plots, fields or in the backyard of the houses, do not have single harvesting in most of the cases which makes their assessment difficult. Many horticulture crops have multiple pickings in a single season. India is largest producer of okra in the world next to China with area, production and productivity of 509 thousand hectare, 6095 million tonnes and 120 mt/ha and Uttar Pradesh has an important place in area, production and productivity with 22.93 thousand ha, 307.29 thousand tonnes and 13.41 mt/ha in okra (year 2017-18) and also Meerut district occupy a important place in okra area and production with 1.59 m ha and 23.81 thousand tonnes (year 2016-17) (Anonymous 2018) [1]. The okra cultivation is preponderance of small and marginal farmers and also family labours.

Material and Method
The district Meerut was selected purposively to avoid the operational inconvenience of the investigator. Out of twelve blocks of selected district, one block namely Kharkoda having highest area under okra 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 okra crop therefore; five villages were selected randomly from the list. A separate list of okra growers of selected five villages was prepared along with their size of holdings. Thus, the farm holding categorized into three size groups i.e. (1) Marginal (below 1.0 hectare), (2) Small (1.0 to 2.0 ha.) and (3) Medium (2.0 to 4.0 ha.) from this list a sample of hundred respondents were selected following the proportionate random sampling technique.

Statistical tool
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 plant protection (Rs./ha)
a = Intercept
b_i: (j = 1, 2……4) are the elasticity coefficient of the j^{th}

The marginal value of product Inputs were estimated by following formula:

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

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 b_j
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).

Result and Discussion

The value of coefficient of multiple determinations (R^2) on marginal, small and medium size group of farms accounted for 0.93254, 0.88651 and 0.81054, respectively and indicating that all the explanatory variable *viz*., human labour, seed, manure and fertilizers and plant protection together contributed 93.254, 88.651 and 81.054 per cent. It is observed from that on marginal farms, the elasticity of production with respect to human labour and manure & fertilizer were statistically significant at 1 per cent and 5 per cent level of significance that these input factors contributed to the output significantly. In case of small farms, elasticity of production with respect to human labour and seed were found significant at 1 per cent and 5 per cent level of significance, in medium farms, elasticity of production with respect to human labour, seed, manures and fertilizers 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 input in production of okra.

Table 1: Elasticity coefficient of the production function for Okra

Size group of farms		Production elasticity's			Sum of elasticity's	R^2	Marginal value product of inputs /factors			
	Human labour (X_1)	Seed (X_2)	Manure & fertilizers (X_3)	Plant protection (X_4)			Human Labour (X_1)	Seed (X_2)	Manure & fertilizers (X_3)	Plant protection (X_4)
Marginal below 1 ha	0.249128** (0.076599)	0.016533 (0.046134)	0.2675* (0.0657)	0.2478 (0.2054)	0.89247	0.93254	4.28	1.54	1.57	4.24
Small 1-2 ha	0.184157** (0.073905)	0.1742* (0.0668	0.1079 (0.5590)	0.2395 (0.2481)	0.91587	0.88651	2.84	1.98	0.61	4.38
Medium 2-4 ha	0.0420527* (0.106934)	0.3898* (0.1578)	0.3955* (0.1588)	0.1292 (0.1199)	0.87624	0.81054	3.68	2.31	0.34	5.67

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

Returns to scale on marginal, small and medium farms were analysed and observed to be 0.89247. 0.91587 and 0.87624, respectively, which was 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. Sum of Elasticity's an increasing return to scale. It is evident from that marginal value productivities are positive and more than unity in case of human labour, seed and plant protection on marginal, small and medium farms and in case of manure & fertilizer it was positive on marginal farms only and more than unity which indicates scope for increasing the expenditure on this input variable. In case of manure & fertilizer on small and medium farms it was found less than unity which indicated excess investment on this variable hence, there are need to decrease it, for increasing profitability of farms.

Conclusion

In this study resource use efficiency and marginal value productivity were estimated using Cobb-Douglas production function, elasticity of production and return to scale. Marginal farms indicate the elasticity of production with respect to human labour and manure & fertilizer were statistically significant (at 1% and 5% level) whereas, under small farms, human labour and seed were found statistically significance (at 1% and 5% level) and under medium farms human labour, seeds and manure & fertilizer were found statistically significance (at 5% level) respectively. Returns to scale, inferred that by increasing all factors by one per cent simultaneously results increase of the returns by less than 1 per cent on each farm situation

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