South Asian Journal of Agricultural Sciences

**E-ISSN:** 2788-9297
**P-ISSN:** 2788-9289
https://www.agrijournal.org
SAJAS 2023; 3(1): 14-17
Received: 08-09-2022
Accepted: 12-10-2022

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# Assessment of efficiency of resources used in sugarcane production of Baghpat district of western Uttar Pradesh

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**Abstract**
The present study was undertaken to assess the Resource Use Efficiency of Sugarcane production in Baghpat district of western Uttar Pradesh. The district is purposely selected for this study because the Sugarcane crop is dominated the farming system in this region for a long time. 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 0.8079, 0.8147 and 0.8167 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.

**Keywords:** Sugarcane, cost and return, benefit-cost ratio (BCR), resource use efficiency

## Introduction
Sugarcane (*Saccharum* spp.) is the most important commercial crop in the world and at present Brazil, Mexico, India and Thailand are the leading producer country of sugarcane. Sugarcane is grown in diversified climatic conditions *i.e*., tropical and sub-tropical. Sugarcane cultivation and development of the sugar industry run parallel to the growth of human civilization and are as old as agriculture. The importance and use of sugarcane and sugar in the country's socio-economic milieu are deeply rooted and immense. In the current day, the rural economy set up sugarcane cultivation and the sugar industry has been a focal point for socioeconomic development in rural areas by mobilizing rural resources, generating employment and higher income, transport and communication facilities.

Sugarcane plays a pivotal role in the agricultural and industrial economy of our country. Sugarcane Production was 431.81 million tonnes during the reported period, a similar trend was also observed for other crops [1], and indirect employment to 40 million farmers, 3.5 lakhs skilled and unskilled workers in the manufacturing of sugar.

The Agricultural sector also plays a considerable role in the economy of western Uttar Pradesh and predominantly it is an agricultural economy. Among different states of the country, Uttar Pradesh occupies first place in the area of 21.80 lakhs hectares and production of 177.67 million tonnes (2020-21) but in terms of productivity, it ranks eight [3]. The input utilization pattern of the farmers among the various crops has also changed and depends upon its price and availability, which directly or indirectly affect the cost of production and profit margin of the farmers.

Sugarcane is an important cash crop in the Baghpat district of western Uttar Pradesh. It's dominated the farming system in this region for a long time. Sugarcane crop covers a large area of 76387 thousand hectares in this district with a production of 5718.88 million tonnes (2016-17) [2]. In this district, the main commercial activities of the people living in this region are making and selling Sugar, Gur and Khandsari, which is an agro-based industry. The factor responsible for the cultivation of sugarcane crop increase was irrigation facilities, easy availability of input resources, more profitability in comparison to other crop, availability in the local market, availability of good processing facilities, high-yield variety, and the application of a modern package of practices changed. Sugarcane is an intensive input utilization and varies from region to region and farmer to farmer. The input utilization pattern of the farmers among the various crops has also changed and depends upon its price and availability, which directly or indirectly affect the cost of production and profit margin of the farmers.

Besides that, farmers are facing the problem of marketing processes of the cane untimely and late payment of the produce by the sugar mills.
Therefore, to explain the possibilities of raising farm production and farm income in this region, there is a need to understand cost and return, resource-use efficiency of sugarcane production.

## Materials and Methods

### Sampling procedure

To assess the economics of cost and profit and resource-use efficiency through Sugarcane cultivation, a primary survey was undertaken in the Baghpat district of western Uttar Pradesh using the multi-stage stratified random sampling technique. The Baghpat district was selected purposively because the Sugarcane crop is dominated the farming system in this region for a long time.
Leading blocks of sugarcane cultivators falling under Baghpat district of Uttar Pradesh with acreage in sugarcane cultivation was prepared using village-level record and arranged in descending order, out of which two blocks namely Baraut and Chhaprauli having the highest area in sugarcane cultivation were selected. Further, a list of villages under the selected blocks was prepared. Out of which total of four villages namely Malakpur, Baoli, from Baraut Block and Basoli and Sherpur Luhara from Chhaprauli Block (two villages from each block) was selected randomly. Farmers from these selected villages were arranged in descending order according to the acreage under sugarcane crops of which, 20 farmers were selected from each village randomly making a total size of 80 farmers, which further classified the farmers into three groups *viz.* marginal (below 1 hectare) small (1-2 hectare), and medium (2-4 hectare) categories based on their land holding. The primary data were collected for the agriculture crop year 2021-22 in the study area, and the required secondary data were also collected.

### Analytical Tools

The tabular analysis was used to compare the different parameters among the marginal, small and medium sized groups of the farmer.

### 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 $X_{i's}$

### Production function

To study the resource use efficiency in sugarcane production, Cobb-Douglas production function was used. The mathematical form of Cobb Douglas production function is:

$$Y = aX_1^{b1}\ X_2^{b2}\ X_3^{b3}\ X_4^{b4} + e^{\mu}$$

Where,
Y = Gross returns (in Rs/ha)
$X_1$ = Expenditure on Seed (in Rs/ha)
$X_2$ = Expenditure on Human labour & Irrigation Cost (in Rs/ha)
$X_3$ = Expenditure on Plant protection chemicals (in Rs/ha)
$X_4$ = Expenditure on Manures and Fertilizers (in Rs/ha)
bi = Elasticity coefficient of the respective input variables
e = Error term or disturbance term
μ = Random variables

### 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

The Cobb- Douglas’s production function was applied to find out the efficiency of various resources used in the production of sugarcane. It indicated that four variables *viz.* human labor, manure and fertilizer, irrigation and plant protection jointly explained 91.49, 94.26 and 95.49 percent variation accused in the dependent variable on marginal, small and medium farms, respectively. The value of production, standard error, coefficient of multiple determination and returns to scale for sugarcane production on different size groups of farms are presented in Table 1.

### 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 0.9149, 0.9426 and 0.9549, 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 percent respectively.

**Table 1:** Resource use Efficiency in Sugarcane on Different Size of selected farmers

| 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 | 0.2111** (0.0735) | 0.3667** (0.0339) | 0.0652 (0.1439) | 0.1223 (0.0823) | 0.8079 | 0.9149 | 1.10 | 0.52 | 0.07 | 1.41 |
| Small | 0.1823* (0.0809) | 0.3979** (0.0665) | 0.1721 (0.7660) | 0.0920 (0.1046) | 0.8147 | 0.9426 | 1.46 | 0.49 | 0.43 | 1.93 |
| Medium | 0.2765 (0.3114) | 0.2481 (0.0661) | 0.2803 (0.1192) | 0.0656 (0.0772) | 0.8167 | 0.9549 | 0.41 | 0.36 | 3.54 | 1.00 |

** Significant at 5% probability level

*Significant at 1% probability level

X1, X2, X3 and X4 stands for human labor, Manure & Fertilizer, Irrigation and Plant Protection, respectively.

**Returns to scale**

Returns to scale on marginal, small and medium farms were analyzed and observed to be 0.8079, 0.8147 and 0.8167 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 no.1 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 obtain 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. Returns to scale on marginal, small and medium farms were analyzed and observed to be 0.8079, 0.8147 and 0.8167 respectively, which were found to be less than unity. This is due to more expenditure occurring on human labour and seed charges by medium farms as compared to other categories of farms.

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