Asian Journal of Agricultural Extension, Economics & Sociology

39(8): 64-67, 2021; Article no.AJAEES.65669
ISSN: 2320-7027

Resource Use Efficiency and Marginal Value Productivity of Sugarcane Cultivation in Sant Kabir Nagar District, India

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Authors' contributions

This work was carried out in collaboration among all authors. Author BY designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors RRK, HPSC and PKS managed the analyses of the study. Author V. Yadav managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAEES/2021/v39i830626
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Complete Peer review History: https://www.sdiarticle4.com/review-history/65669

Original Research Article

Received 24 May 2021
Accepted 29 July 2021
Published 04 August 2021

ABSTRACT

Sugarcane is one of the important commercial crops and plays a crucial role in the agro-industrial economy of India. The present study was undertaken on hundred farmers of sugarcane cultivation in Sant Kabir Nagar district of Eastern Uttar Pradesh. Based on the nature of data, Cobb-Douglas production function was used for estimation resource use efficiency of sugarcane cultivation. The results revealed that return to scale on marginal, small and medium farms were 0.812, 0.912 and 0.962 respectively which are less than unity. It means, sugarcane cultivation is characterized by decreasing return to scale and the Coefficient of multiple determinations (R^2) were 82.50, 84.10 and 87.50 percent the variation of output by dependent variable viz. seed, irrigation, plant protection and manure and fertilizers. The marginal value productivity of seed, irrigation, plant

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protection and manure and fertilizers measure were considerably high on all size groups of farms except fertilizers and seed on marginal farms. It indicates that positive relation is further scope for increase in the investment to realize more return.

Keywords: Sugarcane; resource; efficiency; elasticity; R2; MVP.

1. INTRODUCTION

Sugarcane is a tropical, perennial grass that forms lateral shoots at the base to produce multiple stems, typically 3 to 4 m high and about 5 cm in diameter. The stems grow into cane stalk which, when mature, constitutes around 75% of the entire plant. A mature stalk is typically composed of 11–16% fiber, 12–16% soluble sugars, 2–3% non-sugars, and 63–73% water. India is one of the most important sugarcane producers within the world, producing around 300 million tonnes of cane per a year. It is a major source of raw material not only for sugar industry but also other allied group of industries. In the current day rural economy set up, sugarcane cultivation and sugar industry has been focal point for socio-economic development in rural areas by mobilizing rural resources, generating employment and higher income, and contributing to the development of transport and communication facilities.

Sugarcane is an important cash crop grown in India. About 7 million sugarcane farmers and large number of agricultural laborers are involved in sugarcane cultivation and ancillary activities. Additionally, the sugar industry employs 5 lakh skilled and semi-skilled workers in rural areas. In Indian economy agriculture shares 17.76 per cent in GDP. India is second largest producer of agricultural products; it accounts for 7.39 per cent of total global agricultural output . Sugarcane is cultivated in about 25.98 million hectares of land with cane production of 1.84 billion tones and productivity of 70.89 tonnes per hectares in world in 2017 (FAO, 2109). India is the second-largest sugarcane producer in the world, which occupies 5.06 million hectare area, producing 341.20 million tones of sugarcane production and 27.25 million tones sugar production during 2017-18 (Govt. of India, 2018). The major sugarcane and sugar producing states are Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu etc. For several regions of U.P., Basti is one of the major producer of sugarcane which alone produced 660.20 Q/ha (Cane development & sugar industry deptt., 2017). Despite sufficient resources, technologies etc., a continuous and severe fall in production and land acquiring sugarcane cultivation can be seen in past years. It seems there is a genuine demand to study the economic aspects of sugarcane cultivation. The study on, "Resource Use Efficiency and Marginal Value Productivity of Sugarcane Cultivation" was undertaken with the following objectives-

- To analyze the resource use efficiency in sugarcane cultivation.
- To analyze the marginal value of productivity of sugarcane.

2. METHODOLOGY

Purposive cum random sampling techniques were used for the selection of district, block, villages and respondents. Sant Kabir Nagar district of eastern Uttar Pradesh was selected purposively in order to avoid the operational inconvenience of investigator. Out of 9 blocks, one block namely Haisar was purposively selected for the study. A list of 225 villages of the selected block was prepared separately along with their area under sugarcane cultivation and five villages namely Ashrafpur, Debri, Malhepur, Vishunpura and Hakimpur were randomly selected. A separate list of sugarcane respondents of selected villages was prepared along with their size of holding and further, it was grouped into three categories i.e. Marginal farmer (below 1 ha), Small farmer (1-2 ha) and Medium farmer (2-4 ha & above). Finally, 100 sugarcane growers were selected randomly. Primary data was collected through personal interview with use of pre-structured schedule and secondary data was taken from official records available at block, tehsil, and district offices.

2.1 Analytical Tools

The data collected from the sample farmers were analyzed and estimated with certain statistical techniques.

2.2 Functional Analysis

To study the effect of various independent variables on the output, various forms of production function have been dealt. However, Cobb-Douglas function was found more suitable to the data; therefore, it was used for measuring resource use efficiency.

The mathematical form of Cobb-Douglas function is:

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

Where,

Y= per hectare output (Rs/ha)
X_1= seed (Rs/ha)
X_2= Irrigation charge (Rs/ha)
X_3= Plant protection charges (Rs/ha)
X_4= Manure and fertilizers (Rs/ha)
a = constant
b_i(i =1,2,3,4)=Elasticity coefficient of the respective input variables
e=Error term or disturbance term
μ=Random variables

2.3 Cobb-Douglas Production Functions in Log Form

$$\text{Log } Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 \, \mu \log e.$$

This form was used for estimating the parameters of the function based on sample data.

2.4 Estimation of Marginal Value Product

The marginal value product of inputs was estimated by following formula:

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

Where,

b_j =Production elasticity with respect to X_j
Y=Geometric mean of the dependent variable (Y)
X_j=Geometric mean value of $X_j$independent variable
MVP_j=marginal value production J^{th} input
j=1,2,3,4 variable

3. RESULTS AND DISCUSSION

3.1 Resource Use Efficiency for Sugarcane Crop

Resource use efficiency, elasticity of production, return to scale and other qualities of interest in sugarcane crop at different size group of farms are presented in table 1. High value of R^2 of the fitted function indicates that sufficient and maximum proportion of the total variation in the dependent variable was explained by the included factors in the production process. The four variables *viz.*, seed, irrigation, plant protection and manure & fertilizers explained 82.50, 84.10 and 87.50 per cent variation of the dependent variable on marginal, small, and medium farms, respectively. In case of marginal farms, plant protection and manure & fertilizers were found to be statistically significant at 5 percent probability level and irrigation factor was found significant at 1 per cent probability level while two factorviz. seed and manure & fertilizer were not significant. In case of small farms, manure & fertilizers were found statistically significant at 5 percent probability level and seed and plant protection were significant at 1 per cent probability level while seed and irrigation were found to be non-significant. Where in case of medium farms, irrigation and manure & fertilizers were found statistically significant at 1 percent probability level, whereas seed and plant protection chemicals were found statistically non-significant. Return to scale on marginal, small, and medium, were found to be 0.812, 0.912 and 0.962, respectively, which are less than unity. It is, therefore, concluded that the cultivation of sugarcane crop is characterized by decreasing return to scaleon marginal,small and medium-size group of farms. It is therefore, inferred that increasing all the included factors by 1 percent simultaneously result in an increase of returns by less than 1 percent.

Table 1. Production elasticity of sugarcane cultivation group on different size group of farms

Size group of sample farms (ha)	Production elasticities				Sum of elasticities/ return to scale	R^2
	X_1	X_2	X_3	X_4		
Marginal	0.079 (0.197)	0.513* (0.160)	0.164** (0.217)	0.056 (0.107)	0.812	0.825
Small	0.251* (0.637)	0.037 (0.533)	0.508* (1.148)	0.116** (0.597)	0.912	0.841
Medium	0.082 (0.349)	0.364* (2.439)	0.068 (1.591)	0.448* (0.791)	0.962	0.875

*** Significant at 5% significance level; * Significant at 1% significance level*

Table 2. Marginal value productivity (MVP) of included factors in the production process of sugarcane crop

Size group of farms	Marginal value productivity of input/factors			
	X_1	X_2	X_3	X_4
Marginal	0.983	9.199	5.121	0.836
Small	5.393	1.287	21.938	6.030
Medium	1.950	31.468	3.638	37.743

Where, x_1, x_2, x_3 and x_4 stand for seed, irrigation, plant protection and manure & fertilizers (Rs.) respectively.

3.2 Marginal Value Productivity (MVP) of Sugarcane Crop

It is clear from Table 2 that the MVP of seed, irrigation, plant protection chemicals and fertilizers measure were considerably high on all size group of farms except fertilizers and seed on marginal farms. The MVP more than one indicates that there is a chance to spend an additional cost on these factors to received additional income.

4. CONCLUSION

The functional analysis was carried out to know the contribution of independent variables in yield of sugarcane. From the estimated Cobb-Douglas production function, it was observed that the sugarcane coefficient of determination (R^2) was 0.825, 0.841 and 0.875, indicating 82.5, 84.1 and 87.5 per cent of the variation in the yield explained by dependent variables viz. seed, irrigation, plant protection and manure & fertilizers, respectively. The resource use efficiency in sugarcane production was found to positively affect yield and production was found decreasing return to scale. The marginal value productivity (MVP) of each farms except fertilizers and seed on marginal farms were more than unity in sugarcane cultivation, revealing that there is a need to invest in these factors to obtain optimum production from sugarcane crop in the study area.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/65669