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Research Paper

Economic Efficiency of Resource Use in Sugarcane Production in Haryana

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ABSTRACT

The present study was carried out to study the resource use efficiency in sugarcane cultivation. One block having maximum area under sugarcane namely Radaur and Rohtak from Yamunanagar and Rohtak district respectively was selected purposively. Further three villages of each selected block were selected randomly. From each village, 20 farmers were selected randomly. Finally, 120 farmers of six villages were interviewed to extract all desired information. Cobb-douglas production function was fitted to work out the extent of efficacy of resource use in sugarcane cultivation. The outcomes of study reveal that in planted conditions of Yamunanagar, expenditure on machine labour and seed whereas in Rohtak, expenditure on human labour, seed, chemical fertilizers and plant protection fertilizers were found positive and statistically significant specifying inefficiency of these inputs. In ratoon conditions of Yamunanagar, expenditure on human labour, plant protection chemicals and irrigation was found to be positive and statistically significant indicating that inputs were not used efficiently whereas, in Rohtak, the inputs under-utilized were human labour, plant protection chemicals and chemical fertilizers.

HIGHLIGHTS

- The results of the study reveal that except the machine labour and seed in planted conditions of sugarcane, all the inputs exhibit increasing return to scale.

Keywords : Sugarcane, Cobb- Douglas Production Function, Returns to scale, Marginal Value Productivity

Sugarcane is cultivated in 25.98 million ha of land with cane production of 1.84 billion tonnes and productivity of 70.89 tonnes ha^{-1} in the world in 2017 (FAO, 2019). It is cultivated in 10.02 million ha (38.57%) of area in the whole Asia with total production of 685.78 million tonnes (37.24%) and about 68.41 tonnes ha^{-1} of productivity. Sugarcane is considered as the crop for the future because of its contribution to production of sugar, jaggery, khandsari and many by products like molasses, bagasses and press mud and also certain renewable sources of green energy in the form of bioethanol and many bio-based products (Upreti & Singh, 2017). The major sugarcane growing countries are Brazil, India, China, Thailand, Pakistan, Mexico and Colombia. All these seven countries contributed about 76.42 per cent of total area and 78.52 per cent of total production in the world. Brazil ranked first in the world and contributed about 39.18 and 41.19 per cent of the total area and production in the world, respectively. About 80 per cent of the total world sugar requirement came from sugarcane while 20 per cent came from sugar beet.

Haryana has shown a tremendous progress in the sugarcane cultivation during the last few years mainly due to expanded irrigation facilities. Haryana state is sharing 2.33 per cent of the

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total area and contributing 2.84 per cent of total production of sugarcane in India. Sugarcane alone cultivated on 1.14 lakh ha accounting 2.48 per cent of total cropped area with production of 8.71 million tonnes in the state during 2018. It is an important annual cash crop grown on fertile and irrigated areas of the state. Sugarcane is mainly grown on large farm holdings and it is water guzzling crop having less risk as compared to other crops. However, sugarcane is resource exhaustive crop requiring huge quantity of inputs such as human labour, machine labour, fertilizers, irrigation, capital and management practices etc. for better crop stand and to harness higher productivity. The use of various inputs in sugarcane cultivation varied in both planted and ratoon conditions in Haryana. These variations in use of different combinations of resources affect the production and yield of sugarcane. Furthermore, there is wide yield gap between farmer's field and experimental field indicating the suboptimal use of resources (Ahmad *et al*. 2018). The expenses incurred on the use of inputs largely depend upon mechanization of farm operations like hoeing/weeding, harvesting as well as labour wages. So, keeping in view, the present study was undertaken with objective to examine extent of resource use efficacy in sugarcane cultivation in the state.

MATERIALS AND METHODS

The present study was conducted in Yamunanagar and Rohtak districts of Haryana state. About 120 farmers from six villages (three villages from each block of identified district) were selected randomly. The detailed information related to use of various resources like seed, chemical fertilizers, human labour, machine labour, irrigation, plant protection chemicals etc. was collected from identified farmers through personal interaction using well-structured interview schedule. The prices of inputs and output were reflected as prevailing in markets of study area.

Data analysis

Production function analysis was employed to determine the contribution of different factors of production and also to estimate the extent of efficiency of resource use in cultivation of sugarcane.

The following form of Cobb- Douglas production function was used in the present study:

$$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}$$

Where,

Y = Gross Returns

X_1= Human Labour

X_2= Machine labour

X_3= Seed

X_4= Chemical fertilizers

X_5= Plant protection chemicals

X_6= Irrigation

'a' is the constant term

b_1, b_2 ……b_6 are the estimated regression coefficients.

The resources were taken in value term by multiplying quantity used with prevailing market price. The output was in terms of gross returns calculated by multiplying yield with price offered by sugar mill.

Returns to scale

Returns to scale were calculated by summing production elasticities of all the inputs ($\sum b_i$). If, $\sum b_i$: = 1, $\sum b_i$: > 1 and $\sum b_i$: < 1 it indicates constant, increasing and decreasing returns to scale.

Marginal Value Productivity (MVP)

The marginal value productivity (MVP) of input X_1, X_2……X_6 for Cobb- Douglas production function was computed as follows:

$$MVP_i = b_i . \overline{Y} / \overline{X}$$

Where,

b_i= Estimated regression coefficient of input X_i,

$\overline{Y}$ = Geometric mean value of output,

$\overline{X}$ = Geometric mean value of input being considered.

If inputs are used to the extent so that its MVP is equal to its price (MVP = MIC), there exists efficient use of resources.

Where, MIC = Marginal input cost of X_i

Any deviation of MVP of variable input X_i from its unit price, may be called as the resource use inefficiency. The higher the difference between these two, the higher is the inefficient use of resource and vice-versa. To test the statistical significance of the difference between the MVP of an input and its unit price, t-statistics was used and it was worked out as:

$$t - \text{value} = (MVP_i - MIC) / SE\ (MVP_i)$$

Where,

$SE\ (MVP_i)$ = Standard error of MVP_i

The standard errors computed are as follows:

$$SE\ (MVP_i) = SE\ (b_i).\ \overline{Y} / \overline{X}$$

Where, as stated above,

$\overline{Y}$ and $\overline{X}$ are the geometric means and $SE\ (b_i)$ is the standard error of regression coefficients.

RESULTS AND DISCUSSION

Resource use efficiency in sugarcane cultivation

Sugarcane being an annual crop requires various resources like seed, chemical fertilizers , plant protection chemicals etc. to attain optimum yield at farmers' field. The per hectare seed requirement is about 75-80 quintals and it accounted for about 20 percent of total expenses incurred in sugarcane cultivation. However, in the succeeding year, it is cultivated as ratoon crop and there is no use of seed. The use of chemical fertilizers and other plant protection chemicals is higher in sugarcane as compared to other crops as its crop period is long duration. To estimate and compare the resource use efficiency and to calculate the returns to scale in sugarcane production in planted as well as ratoon conditions, production function approach was used.

The coefficient of multiple determination (R^2) in planted conditions of Yamunanagar was found to be 78 per cent which indicates that the variable inputs viz. human labour (X_1), machine labour (X_2), seed (X_3), chemical fertilizers (X_4), plant protection chemicals (X_5) and irrigation (X_6) were capable of explaining 78 per cent variation in yield. In ratoon conditions of Yamunanagar, R^2 explained 74 per cent of contribution of four variables namely human labour (X_1), chemical fertilizers (X_4), plant protection chemicals (X_5) and irrigations (X_6). The unexplained variation may be attributed to difference in soil fertility level of different farms, management practices adopted and timely application of inputs.

The coefficient of multiple determination (R^2) in planted conditions of Rohtak was found to be 89 per cent which indicates that the variable inputs viz. human labour (X_1), machine labour (X_2), seed (X_3), chemical fertilizers (X_4), plant protection chemicals (X_5) and irrigation (X_6) were capable of explaining 78 per cent variation in yield attained. In ratoon conditions of Rohtak, R^2 explained 81 per cent of contribution of four variables namely human labour (X_1), chemical fertilizers (X_4), plant protection chemicals (X_5) and irrigations (X_6). The unexplained variation may be attributed to difference in soil fertility of different farms, management practices, timely irrigation applied and harvesting month of crop.

Returns to scale ($\sum b_i$) of sugarcane in Haryana

The returns to scale i.e. sum of production elasticities were found to be 0.897 and 1.101 in planted and ratoon conditions in Yamunanagar district depicting decreasing and increasing returns to scale respectively. In case of Rohtak district, the returns to scale was found to be 1.802 and 1.452 in planted and ratoon sugarcane respectively illustrating increasing returns to scale in both conditions.

Marginal value productivity and Marginal input cost of sugarcane in Haryana

In case of planted sugarcane in Yamunanagar, the difference between MVP and unit price of machine labour and seed was positive and statistically significant which specifies that the inputs were under-utilized and further increase in use of these inputs provide opportunity for farmers to increase the production of sugarcane. The difference between MVP and unit price of human labour and plant protection chemicals in cultivation of ratoon sugarcane in Yamunanagar was positive and statistically significant. It recommends that the increase in use of these inputs can raise the productivity of sugarcane in the study area as these inputs were not utilized efficiently. The difference between MVP and unit price of human labour,

Table 1: Regression coefficients and standard error of production function for sugarcane in Haryana

Sl. No.	Parameters	Planted		Ratoon	
		Yamunanagar (N=60)	Rohtak (N=60)	Yamunanagar (N=60)	Rohtak (N=60)
1	Constant	4.802 (1.304)	-6.687 (1.676)	1.011 (0.949)	-3.014 (1.099)
2	Human Labour (X_1)	-0.010 (0.059)	1.486* (0.091)	1.006* (0.084)	1.439* (0.100)
3	Machine Labour (X_2)	0.789* (0.145)	-0.119** (0.037)	—	—
4	Seed (X_3)	0.155** (0.109)	0.238** (0.102)	—	—
5	Chemical Fertilizers (X_4)	-0.019 (0.016)	0.079** (0.046)	0.005 (0.021)	0.036 (0.047)
6	Plant Protection Chemicals (X_5)	0.001 (0.014)	0.110* (0.029)	0.054* (0.016)	0.052** (0.039)
7	Irrigation (X_6)	-0.018 (0.057)	0.007 (0.052)	0.036 (0.035)	-0.075** (0.060)
8	R^2	0.780	0.890	0.740	0.810

Note: *Figures in parenthesis denotes standard error, * denotes Significance at 1% level, ** denotes Significance at 10% level*

Table 2: Marginal value productivity of inputs used in planted sugarcane in Haryana

Inputs	Yamunanagar (Planted), N=60				
	MVP	MIC	Difference	SE	Return to scale
Machine labour (X_2)	47.902	1.000	46.90*	0.145	0.897
Seed (X_3)	1.947	1.000	0.947*	0.110	(decreasing)
	Rohtak (Planted), N=60				
Human labour (X_1)	8.396	1.000	7.396*	0.091	1.802
Machine labour (X_2)	-4.641	1.000	-5.641	0.037	(increasing)
Seed (X_3)	2.445	1.000	1.445*	0.102	
Chemical Fertilizers (X_4)	1.941	1.000	0.941*	0.046	
Plant protection chemicals (X_5)	3.254	1.000	2.254*	0.030	

**- Significance at 1% level.*

Table 3: Marginal value productivity of inputs used in ratoon sugarcane in Haryana

Inputs	Yamunanagar (Ratoon), N=60				
	MVP	MIC	Difference	SE	Return to scale
Human labour (X_1)	6.854	1.000	5.853*	0.084	1.101
Plant protection chemicals (X_5)	2.040	1.000	1.039*	0.016	(increasing)
	Rohtak (Ratoon), N=60				
Human labour (X_1)	8.566	1.000	7.566*	0.100	1.452
Plant protection chemicals (X_5)	1.548	1.000	0.548*	0.040	(increasing)
Irrigation (X_6)	-3.478	1.000	-4.478	0.060	

**- Significance at 1% level.*

seed, chemical fertilizers and plant protection chemicals in planted conditions of Rohtak was found positive and statistically significant which directs that further increase in use of these inputs can enhance production of sugarcane. In all other cases, depicting, optimality in the use of inputs in cultivation of sugarcane in the study area. In ratoon sugarcane conditions in Rohtak, the difference between MVP and unit price of human labour and plant protection chemicals was positive and statistically significant, whereas, the machine use was negatively significant. This infers that sugarcane production can be increased in the district by increasing use of these inputs in ratoon condition.

Ahmad *et al.* (2018) in their study on resource use efficiency in sugarcane production in bihar also reported similar results. Similar results were also recited by Sulaiman *et al*. (2015). Saravanadurai and Kumar (2014) also reported the similar results in their study on economic analysis of resource use and productivity of agricultural farm.

CONCLUSION

The results reveal that in case of planted sugarcane in Yamunanagar, the difference between MVP and unit price of machine labour and seed was positive and statistically significant which indicates that the inputs were under-utilized and further increase in use of these inputs offer opportunity to sugarcane cultivators to enhance productivity. In case of planted sugarcane in Rohtak, the difference between MVP and unit price of human labour, seed, chemical fertilizers and plant protection chemicals was positive and statistically significant showing that further increase in use of these inputs can enhance sugarcane production. The difference between MVP and unit price of human labour and plant protection chemicals in cultivation of ratoon sugarcane in Yamunanagar was found positive and statistically significant revealing under utilization of inputs and further increase in use of these inputs can raise sugarcane production. Whereas, in ratoon sugarcane conditions in Rohtak district, it was found positive and statistically significant for human labour and plant protection chemicals. This implies that sugarcane production can be boosted in the district by increasing use of these inputs. The return to scale for production of planted sugarcane was at increasing level in Rohtak district. Whereas, in Yamunanagar, the sum of regression coefficients of all the variable inputs was less than one depicting decreasing returns to scale. On the basis of findings of the study, it is suggested that there is scope for increase in productivity of sugarcane by using various resources efficiently and adoption of better management practices in the study area. Cultivators need to be educated with latest agronomic practices and use of various inputs timely and efficiently to attain higher productivity from sugarcane cultivation.

REFERENCES

Ahmad, N., Sinha D.K., Singh, K.M., Mishra, R.R. and Singh, S.P. 2018. Resource Use Efficiency in Sugarcane Production in Bihar (India): A Stochastic Frontier Analysis. *An Int. Refereed, Peer Reviewed & Indexed Quarterly J. in Sci., Agric. & Engine.*, **8**(25).

Fernandez, M.D. and Nuthall, P.L. 2009. Technical efficiency in the production of sugarcane in central Negros area, Philippines: An application of data envelopment analysis. *J. Int. Soc. Southeast Asian Agric. Sci.*, **15**: 77-90.

Haque, T. 2006. Resource use efficiency in Indian Agriculture. *Ind. J. Agric. Econ.*, **61**: 65-76.

Jaiswal, U., Nishad, J., Koshta, A.K. and Choudhary, V.K., 2018. Resource use efficiency in sugarcane production in Kawardha and Balod District of Chhattisgarh. *Int. J. Chem. Stud*., **6**: 1223-1226.

Okpe, I.J., Abur, C.C. and Ominyi, S.O. 2012. Resource use efficiency in rice production in Guma Local Government Area of Benue State: An Application of stochastic frontier production function. *Int. Rev. Soc. Sci. Humanities*, **3**: 106-116.

Saravanadurai, A. and Kumar, J.S. 2014. Economic analysis of resource use and productivity: A case study on agriculture farm. *Int. J. Res*., **1**(10): 110-116.

Saravanan, A. 2016. Resource-use efficiency of sugarcane production in Gobichettipalayam Taluk of Erode District of Tamil Nadu: An economic analysis. *Ind. J. Econ. and Develop*., **4**(9): 2320-2328.

Sulaiman, M., Abdulsalam, Z., Damisa, M.A. and Siewe, F. 2015. Resource Use Efficiency in Sugarcane Production in Kaduna State, Nigeria: An Application of Stochastic Frontier Production Function. *Asian J. Agric. Ext., Econ. & Sociol.*, **7**(2): 1-11.

Suresh, A. and Reddy, T.R. 2006. Resource-use efficiency of paddy cultivation in Peechi command area of Thrissur District of Kerala: An economic analysis. *Agric. Econ. Res. Rev.*, **19**: 159-171.

Upreti, P. and Singh, A. 2017.An economic analysis of sugarcane cultivation and its productivity in major sugar producing states of Uttar Pradesh and Maharashtra. *Econ. Aff.*, **62**(4): 711-718.