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Resource use efficiency and constraints analysis of sugarcane cultivation in Ahmednagar district of Maharashtra

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Abstract
Present investigation was carried out to assess resource use efficiency and constraints in sugarcane cultivation in Ahmednagar district of Maharashtra. Primary data collected from 120 farmers consisting 30 farmers of each planting type of sugarcane i.e Adsali, Pre-seasonal, Suru and Ratoon. The Cobb-Douglas production function is used to estimate the resource use efficiency. The nine resource variable included in the model explained 78, 75, 87, and 62, percent variation in output of adsali, pre-seasonal, suru, and ratoon planting type Sugarcane cultivation respectively. The constraints in sugarcane cultivation was analysed using Garrett's ranking technique. Majority of sugarcane grower perceived that labour problems, irregular electricity supply and unknown about recommendation i.e. timely and proper use of inputs in a scientific manner were the main constraints.

Keywords: Sugarcane, resource use efficiency, constraints

Introduction
Sugarcane is a tropical plant and grow as cash crop in the world. Historically Sugarcane (*Saccharum barberi*) is native of India as well as New guinea (*Saccharum officinarum*).
The sugarcane area are broadly classified into tropical and sub-tropical region. In world sugarcane is grown between the latitude 36.7° N and 31.0° S of the equator extending from tropical to sub-tropical zone. They known to thriving well in Brazil, India, Australlia, Cuba, USA, Philippines, USSR, Indonesia, China, and Thailand. About 80% sugar is obtained from sugarcane and the remaining 20% is produced through sugarbeet.
Sugarcane was cultivated in India on an area of 50.58 lakh hectares which harvested 430.50 million tonnes with a productivity 85.11 tonnes\ha in the year 2021-2022. The sugarcane cultivation and sugar industry in India plays a vital role towards socio-economic development of the rural areas by mobilizing rural resources and generating higher income and employment opportunities.
Sugarcane is a most important cash crop of Maharashtra. Sugarcane provides raw material for the second largest agro-based industry after textile. Sugar industry is the Second largest agro based industry in rural India and act as focal point for socio- economic development. It alone produce 35 percent of total sugarcane production in the country (Patidar M and *et al*. 2003) [3].
In Maharashtra Ahmednagar, Solapur, Kolhapur, Pune, Satara are the major sugarcane producing districts. This year in Maharashtra about 93 co-operative and 97 private sugar factories generating employment, electricity, ethanol production, bio-compost and number of other chemicals. Thus, sugarcane and sugar industry is the backbone for economic development of Maharashtra. The sugarcane crop plays a key role in the process of development as it generates income and employment. It is also noteworthy for being labour intensive, needing rapid investment, and giving high returns as compared to other crops and its significant contribution to the country's as well as the state economics.
Maharashtra ranks second in the list of largest sugarcane producing state in India. Maharashtra rank second in area (14.88 lakh hectare) and production (132.03 million tonnes) of sugarcane and rank third in sugarcane productivity (88.00 tonnes/ha) during the year 2021-2022.

Materials and Methods
The present study on resource use efficiency and constraints analysis of sugarcane crop was be purposively undertaken in Ahmednagar district of Maharashtra state. Two tehsils *viz*. Karjat and Shrigonda having maximum area under sugarcane cultivation were selected purposively

for the study. In all six villages i.e. three villages each from Karjat and Shrigonda tehsils, were selected randomly.

The list of sugarcane growers from the selected villages were obtained form the revenue records maintained at selected villages and then categorized into four groups according to planting types of sugarcane. Five farmers of each type i.e Adsali, suru, pre-seasonal, and ratoon sugarcane were selected separately from each village from both the tehsils by simple random sampling technique. Thus, 20 farmers were selected from each village. In all 120 sugarcane growers comprising 30 farmers from each planting type of sugarcane were selected separately for the present study.

The primary data was collected from sample sugarcane growers by the survey method in a year 2021-22. The sample sugarcane growers were contacted individually for collection of required information.

The field level data on the use of various inputs *viz*. seed, manures, fertilizers, number of irrigation, labour use pattern and yield obtained from sugarcane cultivation, constraints in the use of inputs etc. and general information of sample cultivators, such as family composition, land utilization, cropping pattern and assets position of the farmers etc. were collected from the sample sugarcane growers.

Resource use efficiency of sugarcane

The resource use efficiency of sugarcane was workout by using Cobb- Douglas production function. The mathematical form of Cobb-Douglas production function is:

$$\text{Cobb-Douglas} = Y = ax_1^{b1} x_2^{b2} x_3^{b3} x_4^{b4} \ldots\ldots x_n^{bn} e^u$$

Where,

Y = Per hectare Yield (tonnes/ha)

a = Constant intercept

b_1-b_n = Regression coefficient of the respective factors fitted as below.

X_1 = Human labour (Days /ha)

X_2 = Bullock pair (Days/ha)

X_3 = Machinery charges (Hr/ha)

X_4 = Planting material (tonnes/ha)

X_5 = Fertilizers (kg/ha)

X_6 = Manure (tonnes/ha)

X_7 = Plant Protection measures (Rs/ha)

X_8 = Number of irrigation (number)

X_9 = Area under Crop (ha)

e^u = Error term

Marginal value of product to factor cost ratio

The Cobb-Douglas function estimates and geometric levels of inputs were used to estimates the marginal value of product. The ratio of MVP to factor cost indicates the optimum resource use efficiency of particular inputs.

$$\text{MVP} = bi \frac{\bar{y}}{\bar{x}_i}$$

Where,

$\bar{x}_I$ - Geometric mean of x

$\bar{y}$ - Geometric mean of y

bi - The elasticity of output with respect to xi

Constraint Analysis

The constraint in the sugarcane production was analysed by using Garrett's ranking technique. The ranks given by each respondent was converted into percent position by using formula.

$$\text{Percent position} = \frac{100 \times (Rij - 0.5)}{Nj}$$

Where,

R_{ij} = Rank given to i^{th} constraint by the j^{th} individual.

N_j = Number of constraint.

The estimated percent positions were converted into scores using Garrett's table. The mean of scores was estimated for each constraint and these means score was arranged in a descending order. The constraint with highest mean score value was considered as the most important and ranked as one and remaining mean scores have given rank in descending order.

Results and Discussion

The Cobb-Douglas production function was applied to find out the efficiency of various resources use in production of sugarcane. Cobb-Douglas production function was estimated on per hectare basis for adsali, Preseasonal, Suru, and Ratoon planting type of Sugarcane. The elasticity of production and selected parameters are presented in Table 1 (Anitha P and *et al.* 2019) [1].

It is observed from Table 1 that, in adsali planting type, the regression coefficients for bullock labour (0.01), number of irrigation (0.03), were observed to be non-significant positive elasticities. The regression coefficient for manure (0.19) planting materials (0.12), was positive and found to be significant at 5% and 10% level respectively. Also fertilizer (0.18) of sugarcane was significant at 1% level. This implies that 1 percent increase in this variable would increase the yield of sugarcane cultivation. About 78% variation was explained by the variables included in function.

Table 1: Resource use efficiency in Sugarcane

Particulars	Planting Type			
	Adsali	**Preseasonal**	**Suru**	**Ratoon**
Constant Intercept	1.42	1.68	1.18	-1.85
Human labour (X_1)	-0.07	-0.15	0.13**	0.09
Bullock labour(X_2)	0.01	0.01	0.02	0.10***
Machine charges(X_3)	-0.05	0.03	-0.12	-0.06
Manure(X_4)	0.19**	0.13**	0.03	0.10
Planting materials(X_5)	0.12*	-0.03	-0.02	-
Fertilizer(X_6)	0.18***	0.10	0.13***	1.09***
Plant Protection (X_7)	-0.002	0.02	0.01	-0.04
Number of irrigation (X_8)	0.03	0.16**	0.27***	0.11
Area Under Crop (X_9)	-0.06	-0.05	0.08**	0.02
Coefficient of determination (R^2)	0.78	0.75	0.87	0.62

(Note: ***, **, * denotes significant at 1%, 5%, 10% level of significance)

In Preseasonal Planting type Sugarcane the regression coefficients for machinery (0.03), bullock labour (0.01), fertilizer (0.10) and plant protection (0.02) were observed to be non-significant positive elasticities. The regression coefficient for manure (0.13), and Irrigation (0.16) was positive and found to be significant at 5% level respectively.

The all explanatory variable explain about 75% of the variation in depending variable.

In Suru Planting type Sugarcane the regression coefficients for bullock labour (0.02), manure (0.03) and and plant protection (0.01) was observed to be non-significant positive elasticities. The regression coefficient for human labour (0.13) and area (0.08) was positive and found to be significant at 5% level. Fertilizer (0.13) and irrigation (0.27) was positive and significant at 1% level. About 87% variation was explained by the variables included in function

In Ratoon Planting type Sugarcane, fertilizer (1.09) and bullock labour (0.10) was significant at 1% level. Human labour (0.09), manure (0.10), irrigation (0.11), and Area (0.02) were observed to be non-significant positive elasticities. About 62% variation was explained by the variables included in function.

Marginal value of product to factor Cost ratio

The Cobb-Douglas function estimates and geometric levels of inputs were used to estimates the marginal value of product. The ratio of MVP to factor cost indicates the optimum resource use efficiency of particular inputs. The marginal value of product to factor cost ratio of resources in sugarcane cultivation are presented in Table 2.

Table 2: Marginal value of product to factor Cost ratio

Particulars	M.V. P. to factor Cost			
	Adsali	Preseasonal	Suru	Ratoon
Human labour (X_1)	-0.07	-0.12	0.10	0.07
Bullock labour(X_2)	0.65	0.43	0.98	3.57
Machine charges(X_3)	-0.22	0.10	-0.42	-0.37
Manure(X_4)	1.26	0.77	0.16	0.51
Planting materials(X_5)	3.22	-0.70	-0.45	-
Fertilizer(X_6)	0.02	0.01	0.01	0.08
Plant Protection (X_7)	-0.04	0.34	0.12	-0.55
Number of irrigation (X_8)	0.21	0.95	1.65	0.53
Area Under Crop (X_9)	-7.26	-5.04	8.68	2.13

It observed from Table 2 that, in Adsal planting type sugarcane, the Marginal Value Product to factor cost ratio was more than unity for manure (1.26) indicate that the resources are under utilized; hence there is scope for increasing these inputs in adsali planting type sugarcane in the study area. The MVP to factor cost ratio is less than unity for human labour, bullock labour, machine, fertilizer, plant protection, and irrigation indicates the over utilization of these resources.

In case of preseasonal planting type sugarcane the Marginal Value Product to factor cost ratio of human labour, bullock labour, manure, machinery, fertilizer, plant protection, irrigation, planting material and area are less than unity indicates the over utilization of these resources.

In case Suru planting type sugarcane the Marginal Value Product to factor cost ratio for irrigation and Area under crop was greater than unity hence there is scope for increasing these inputs in suru sugarcane cultivation in the study area. The MVP to factor cost for human labour, bullock labour, machinery, planting materials, fertilizer, plant protection, and manure are less than unity indicated that the factor used at higher level than recommended, resulting in a losses due to excess use.

In Ratoon planting type sugarcane the Marginal Value Product to factor cost ratio of human labour, manure, machinery, fertilizer, plant protection and number of irrigation was less than unity indicates the over utilization of these resources. MVP to factor cost ratio for bullock labour and area under crop are greater than unity hence there is scope for increasing these inputs in ratoon sugarcane cultivation in the study area.

Constraints Analysis

The constraints in sugarcane production was analysed using Garrett's ranking technique. Garrett's ranking technique was employed to find out the constraints faced by the sugarcane cultivating farmers in production of sugarcane were explained in term of ranks and total mean (score) presented in Table 3.

The result inferred that the most important constraints in cultivation of sugarcane which rank first was labour problems during peak crop season with total mean score 64.03, followed by unknown about recommendation i.e. the timely and proper use of inputs in a scientific manner and irregular electricity supply which ranks II and III with total mean score 62.48 and 61.64 respectively.

Table 3: Constraints encountered by growers in production of sugarcane

Sr. No.	Constraints in Production of Sugarcane	Total mean (Score)	Rank
1	Labour problems during peak crop season	64.03	I
2	Irregular electricity supply	61.64	III
3	Unknown about recommendation	62.48	II
4	Non-availability and costly manure	48.91	IV
5	High cost of fertilizer	42.59	V
6	Poor source irrigation	30.28	VII
7	High wage rate	36.60	VI

The other constraints in production of sugarcane were, non-availability and costly manure (IV), High cost of fertilizer (V), High wage rate (VI), Poor source of irrigation (VII) with total mean score 48.91, 42.59, 36.60, and 30.28 respectively.

Summary and Conclusions

In Adsali planting sugarcane manure, planting materials and fertilizer are significant and other variable are non-significant. In preseasonal planting sugarcane manure and irrigation are significant. In suru planting sugarcane human labour, fertilizer, irrigation, and area under crop are significant. In Ratoon planting type sugarcane farmer bullock labour and fertilizer are significant and other variable show non-significant result.

In Adsali planting type sugarcane manure and planting material were positive and greater than unity that means there is a scope to increases levels of these inputs in adsali planting type sugarcane. In preseasonal sugarcane all inputs variable are less than unity indicate the over utilization of these resources. Suru planting sugarcane irrigation and area under crop were positive and greater than unity. In ratoon sugarcane bullock labour and area are positive.

Majority of sugarcane grower perceived that labour problems, irregular electricity supply and unknown about recommendation i.e. timely and proper use of inputs in a scientific manner were the main constraints.

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