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Resource use efficiency and constraints of sugarcane production in Ayodhya district of Uttar Pradesh

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Abstract

In the present paper, an attempt has been made to examine the economics analysis of sugarcane cultivation of different categories of the farmers. In Ayodhya district of Eastern Plain zone in Uttar Pradesh. Hundred Sample farmers (marginal 64, Small 22, & medium 14) where interviewed form 5 village Bikapur block & tehsil of Ayodhya district., Data was analysis and found that Average holding Size 1.20 ha. Varying from 0.55 to 3.22 ha. The above co-efficient of multiple determination of marginal, small and medium size group of farms was of all four independent variables *viz*. seed, labour, manure & fertilizer, and irrigation, thus it is clear that all input variable contributed 0.88 percent, 0.92 and 0.95. Percent under marginal and small and medium group of farms. Technical, irrigation, labour availability and finance problems were found as major constraints against Sugarcane cultivation which were suggested to overcome with the constructive support of the Government agencies and financial institution.

Keywords: Cost and return, resource use efficiency, MVP and constraints

1. Introduction

Sugarcane requires a long growing season between 10 – 12 months, because a certain number of heat units are required to bring the plant to mature stage. States like Maharashtra, Andhra Pradesh, Telangana and Karnataka possess the most suited climatic conditions for sugarcane cultivation. Sunlight conditions also influence the growth of sugarcane, as bright sunshine makes stems thicker and shorter while low sunshine makes stems slender. Short day length reduces tillering and hence, affects the yield. Plants which are propagated under longer day length yield better tonnage. (Kumar, 2014) [3].

The majority of sugarcane growing in India takes place in two agro-climatic zones that can be broadly categorised as subtropical and tropical. Four states make up the subtropical zone: 1) Uttar Pradesh 2) Bihar 3) Punjab 4) Haryana. The tropical zone comprises the following states: 1) Maharashtra 2) Andhra Pradesh, 3) Tamil Nadu 4) Gujarat 5) Karnataka.

Nearly 1869.7 million tonnes of sugarcane was produced in the harvesting year 2021 - 22 worldwide. With the production of over 757.11 million tonnes in 2021 - 22, Brazil was the leader in sugarcane production followed by India with 370.50 million tonnes and China with 108.65 million tonnes. Production of raw sugar was 132. 55 million tonnes in world in 2021 – 22 with the highest raw sugar production in India with 20.21 million tonnes, followed by Brazil with 17.10 million tonnes (FAO STAT, 2022).

The information regarding the area, production and productivity of sugarcane cultivation in India shows that the lowest area under sugarcane cultivation in India was 4.4 million hectares in the year 2016 - 17 and the highest area under cultivation was 5.1 million hectares in the year 2021 - 22. The highest production of sugarcane was in the year 2021 – 22, i.e., 431.8 million tonnes and the lowest production was in the year 2016 – 17, i.e., 306.1 million tonnes. The maximum yield was obtained in the year 2021 - 22 which was 84 tonnes/ha and the minimum yield was in the year 2012-13 which was 68.25 tonnes/ha.

The information regarding the area, production and productivity of Sugarcane cultivation in Uttar Pradesh shows that the highest area under sugarcane cultivation in Uttar Pradesh was 22.34 lakh hectares in the year 2017 - 18 and the lowest area under cultivation was 19.77 lakh hectares in the year 2009-10. The highest production of sugarcane was in the year 2019 - 20 i.e. 179.54 million tonnes and the lowest production was in the year 2009-10

i.e. 117.14 million tonnes. The maximum yield was obtained in the year 2021 - 22 which was 81.50 tonnes/ha and the minimum yield was in the year 2010-11 which was 56.73 tonnes/ha. (Agriculture Statistics at a glance, 2021).
Keeping this in the view the present study entitled "Resource Use Efficiency Cultivation in Ayodhya District of Uttar Pradesh" assume special significance. The main objective of study were:

1. To estimate the resource use efficiency and input – output relationship.
2. To identify the problem faced by the farmers in the production and marketing of sugarcane.

2. Materials and Methods

2.1 Sampling technique

Purposive cum random sampling design was used for the selection of district, tehsil, block, villages and respondents.

2.2 Selection of the district

Keeping in view the limitation of resources and time of the investigator district Ayodhya of eastern Uttar Pradesh was selected purposively.

2.3 Selection of tehsil

A list of all the 5 tehsil in Ayodhya district was arranged in ascending order according to number of sugarcane cultivators in the region and one block namely Bikapur tehsil was selected purposively from the bottom.

2.4 Selection of block

All the 11 blocks of bikapur tehsil were again arranged in ascending order according to number of sugarcane cultivators in the region and one block namely Bikapur was selected purposively from the bottom.

2.5 Selection of villages

A list of all villages of selected Bikapur block was prepared separately along with their area under sugarcane cultivation and five villages namely Gundhaur, Oharpur, Patupur, Sherpur and Jalalpur Mafi were selected randomly.

2.6 Selection of farmers

A separate list of farmers growing sugarcane of selected villages was prepared along with their holding size.
Based on size of holding, farmers were classified into three group i.e.

1. Marginal farmer below 1 ha
2. Small farmer 1-2 ha and
3. Medium farmer 2 ha and above

Finally, 100 respondents were selected randomly through proportionate allocation to the population.

2.7 Period of Study

The data was collected for the agricultural year 2021-2022.

2.8 Method of enquiry: For the interpretation of data the following analytical tools were used:

i) Average

The simplest and the most important measures of average mean and weighted mean were applied. The formula of mean and W.A. is given below:

$$\overline{X} = \frac{\sum x}{N}$$

Where,
X= Value of variable
N= Number of observation

$$W.A. = \frac{\sum Wi\ xi}{\sum Wi}$$

Where,
W.A. = Weighted Average
W_i = Weight of X_i
X_i = Variable.

ii) Mathematical form

$$Y = a\ x_1^{b1} x_2^{b2}\ x_3^{b3}\ x_4^{b4}\ x_5^{b5}\ \mu e$$

Log form of the function

$$Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 + \mu$$

Where,
Y = Dependent variable (output values Rs./ha.)
X_i = i^{th} independent variable (input values Rs./ha.)
X_1 = Human labour (Rs./ha.)
X_2 = Manure and fertilizer (Rs./ha.)
X_3 = Seed (Rs./ha.)
X_4 = Irrigation (Rs./ha.)
X_5 = Machinery charges (Rs./ha.)
a = Constant
b_i= Production elasticity with respect to X_i
μ = Error term

The values of the constant (a) and coefficient (b_i) in respect of independent variables in the function have been estimated by using the method of least squares.

iii) Estimation of marginal value product

The marginal value product of input was estimated by taking partial derivatives of returns with respect to the input concerned, at the geometric mean level of inputs.

$$MVPxj = \frac{bi\ \bar{y}}{\overline{Xi}}$$

Where,
bj = Production elasticity with respect to Xj
$\bar{y}$ = Geometric mean of y (output values in Rs./ha.)
$\overline{Xi}$ = Geometric mean of Xj (input values in Rs./ha.)
j = 1, 2, 3, 4, 5

2.9 Analysis of the constraints faced by farmers in production and marketing of flowers in the study area

Constraints faced by farmers have been analyzed through survey based on demographic profile of the farmers like age groups and educational level of the farmers. Garret ranking technique (Henry Garrett) has been used to analyze the constraint faced by the farmers, wholesalers, retailers involve in plant marketing. Constraints faced by farmers in plants value chain is the most important aspects of research

for suggestion to government policy. The respondent has been asked to rank the constraints and these converted in to score.

Percent position = 100*(Rij-0.5)/ Nj

Where,
Rij= Rank given for ith factor by jth individual
Nj= Number of factors ranked by jth individual

3. Results and Discussion

3.1 Average size of holding of sample Farm

The study covers a sample of 100 farmers, which are divided in three size groups, namely marginal (below-1ha), small (1-2ha^{-1}) and medium (2-4ha^{-1}). It is clear from the Table 1. that net cultivated area of sample farms (29.50) percent, (32.80) percent, and (37.69) percent at the gross cropped area marginal, small, and medium farms, respectively. The average size of holding of marginal, small and medium farms comes to 0.55, 1.78 and 3.22 hectare, respectively. On an overall, average size of holding was estimated 1.20 hectares

Table 1: Average size of holding on sample farms under different size group:

S. No.	Size Group of Farms	No. of Sample Farm	Total no Cultivated Area	Average Size of Holding
1	Marginal	64	35.3 (29.50)	0.55
2	small	22	39.2 (32.80)	1.78
3	Medium	14	45.1 (37.69)	3.22
Total		100	119.5 (100)	1.20

Table 2 Cropping Intensity of different size group of farms: Table 2 reveals that the overall average cropping intensity on sample farms was to 203.12 percent which was found highest on marginal farms 241.34% followed by small 208.78%, and medium 191.12% respectively. Cropping intensity was inversely related to size of farms.

Table 2: Cropping intensity of different size group of sample farms

Farm Groups	No. of Farmers	Average Size of Holding	Gross Cropped Area (Ha)	Cropping Intensity (%)
Marginal	64	0.55	1.33	241.34
Small	22	1.78	3.72	208.78
Medium	14	3.22	6.15	191.12
Overall farm	100	1.20	2.41	201.64

Table 3: Per hectare costs of different inputs used in sugarcane crop on different size group of sample Farm: (Rs. in Per Ha.)

S. No.	Particulars	Size group of farms			
		Marginal (64)	Small (22)	Medium (14)	Overall average
1	Human Labour	19339 (20.30)	19313 (19.10)	21512 (19.50)	19637.50 (19.90)
a.	Family Labour	13647 (14.30)	11257 (11.10)	7458 (6.80)	12254.74 (12.40)
b.	Hired Labour	5692 (6.00)	8056 (8.00)	14054 (12.70)	7382.76 (7.50)
2	Machinery Charges	6862 (7.20)	7256 (7.20)	8054 (7.30)	7115.56 (7.20)
3	Seed	20267 (21.30)	23252 (23.00)	26282 (23.80)	21765.80 (22.10)
4	Manure and fertilizer	8648 (9.10)	9268 (9.20)	10280 (9.30)	9012.88 (9.10)
5	Irrigation	8765 (9.20)	9360 (9.30)	9884 (9.00)	9052.56 (9.20)
6	Plant Protection/Intercultural	3340 (3.50)	3667 (3.60)	3890 (3.50)	3488.94 (3.50)
7	Total working capital	67221 (70.60)	72116 (71.40)	79902 (72.40)	70073.24 (71.00)
8	Interest on working capital	2688.84 (2.80)	2884.64 (2.90)	3196.08 (2.90)	2802.93 (2.80)
9	Rental value of land	14000 (14.70)	14000 (13.90)	14000 (12.70)	14000.00 (14.20)
10	Interest on fixed capital	2685.12 (2.80)	2864.32 (2.80)	3250.32 (2.90)	2803.67 (2.80)
11	Sub total	86594.96 (90.9)	91864.96 (90.9)	100348.4 (90.9)	89679.84 (90.9)
12	Managerial Cost @ 10% of sub-total	8659.50 (9.10)	9186.50 (9.10)	10034.84 (9.10)	8967.98 (9.10)
Grand total		95254.46 (100)	101051.46 (100)	110383.24 (100)	98647.83 (100)

Table 4: Per hectare costs and income from the production of Sugarcane crop on different size group of farms: (Rs. in per ha.)

S. No.	Particulars	Size group of farms			
		Marginal (64)	Small (22)	Medium (14)	Overall average
1	Cost A_1/A_2	56262.84	63743.64	75640.08	61896.30
2	Cost B_1	58947.96	66607.96	78890.40	64757.26
3	Cost B_2	61633.08	80607.96	92890.40	71795.74
4	Cost C_1	72594.96	77864.96	86348.40	77237.14
5	Cost C_2	75280.08	91864.96	100348.40	84275.62
6	Cost C_3	83939.58	101051.46	110383.24	93427.33
7	Yield Q/ha.	650	720	760	695.20
8	Gross Income	182000	201600	212800	194656.00
9	Net return over cost C_3	98060.42	100548.54	102416.76	101228.67

10	Family labour Income	120366.92	120992.04	119909.60	122860.26
11	Farm Business Income	125737.16	137856.36	137159.92	132759.70
12	Farm investment income	112090.16	126599.36	129701.92	120279.82
13	Cost of production (q/ha.)	129.14	140.35	145.24	136.67
14	**Input- output ratio**				
a	On the basis of Cost A1/A2	1:3.23	1:3.16	1:2.81	1:3.22
b	On the basis of cost B1	1:3.09	1:3.03	1:2.70	1:3.08
c	On the basis of Cost B2	1:2.95	1:2.50	1:2.29	1:2.81
d	On the basis of Cost C1	1:2.51	1:2.59	1:2.46	1:2.57
e	On the basis of Cost C2	1:2.42	1:2.19	1:2.12	1:2.37
f	On the basis of Cost C3	1:2.17	1:2.00	1:1.93	1:2.14

3.2 Resource use efficiency and Marginal Value Productivity

3.2.1 Resource use efficiency estimator of Sugarcane on different size of sample farms in the study area

The estimated value of elasticity of production, standard error, co-efficient of multiple determinations (R^2) and returns to scale for Potato production by different size group of farms are given in Table 5. It is evident from the Table 6 that co efficient of multiple determinations (R^2) of marginal, small and medium size groups farms were 0.9627, 0.8812 and 0.8604 respectively. The above co-efficient of multiple determination of marginal, small and medium size group of farms was of all four independent variables *viz*. seed, labour, manure & fertilizer, and irrigation, thus it is clear that all input variable contributed 0.88%, 0.92 and 0.95.% under marginal and small and medium group of farms.

Table 5: Resource use efficiency estimator of Sugarcane on different size of sample farms in the study area.

Size group of sample farms (ha)	Production Elasticity				RT Scale	R^2
	X1	X2	X3	X4		
Marginal	0.2621*	0.2116	0.2421**	0.2469	0.9627	0.88
Small	0.2164	0.1624**	0.2584	0.2440	0.8812	0.92
Medium	0.1887*	0.2389	0.2564**	0.1764*	0.8604	0.95

Note *Significant at 1%
**Significant at 5%

Where,
X1, X2, X3, and X4, stand for seed, hired labour, manure & fertilizer, and irrigation (Rs.) respectively

3.2.2 Marginal value productivity

The marginal value productivity of different input factors are also presented in Table 7. It is depicted from the table that in case of all the three categories of farms, for all the four independent variable i.e. seed, labour, manure & fertilizer, and irrigation is the marginal value of productivity to factor cost were found positive, indicating that there is future scope for increasing the investment on all these factor in each farm situation to realize more return than the existing use of input.

Table 6: Marginal value productivity (MVP) of included factors of production process in Sugarcane production

Size group of farms	Marginal value productivity (MVP) on different size group farms.			
	X1	X2	X3	X4
Marginal	2.68	0.95	1.88	0.88
Small	3.08	1.26	2.02	3.84
Medium	2.42	2.76	1.34	2.64

Where,
x1, x2, x3, and x4, stand for seed, hired labour, manure & fertilizer, and irrigation (Rs.) respectively.

Table 7: Major constraints faced by the sugarcane growers in the study area.

S. No.	Sugarcane Production Constraints	Average score	Garrett Rank
1	Scarcity of labour	46.95	10th
2	Lack of financial problem	49.56	9th
3	Lack of irrigation system	51.17	7th
4	Lack of fertilizer problem	52.57	3rd
5	Unavailability of machines and tractor	53.05	1th
6	Problem of plant protection chemicals and weedicide	51.51	6th
7	Non adoption of improved method of nursery	51.52	5th
8	Non availability of improved varieties of seed	52.60	2nd
9	Adequacy of funds	50.49	8th
10	Related with decision taking	51.72	4th

The rankings depicted in the table conclude that availability of lack of technical knowledge was the biggest problem faced by 53.05 farmers in the study sample. In availability of labour and machinery shortage on peak time was the second constraints faced by 52.60 farmers in the study sample the third, fourth, fifth, sixth, seventh, eighth, ninth, and tenth constraints were in availability of in availability of credit issue, lack of increased variety, irrigation shortage, lack of understanding about fertilizer and planting methods, lack of expertise in seed care and weed management, lack of

understanding of seed rate and sowing period, blue bull's problems, lack of good pesticides available and natural disasters respectively which were faced by 52.57, 51.72, 51.52, 51.51, 51.17, 50.49, 49.56, and 46.95 farmers, respectively in the study sample. The last and the most minor constraint of lack of understanding about fertilizer and planting methods was faced by only 51.51 farmers.

4. Conclusion

The production function analysis showed in marginal household the production elasticities of seed, irrigation, fertilizer and labor were 0.2621, 0.2116, 0.2421 and 0.2469, respectively. The return to scale in marginal farm was 0.9627 which shows decreasing return to scale i.e. marginal farmers were gaining less than what they were spending. The R2 value of marginal household was 0.88 i.e. the considered variable explains 88.00 percent of the variation in depending variable i.e. return from sugarcane. It can be concluded that cost of fertilizer at 5 percent level of significance had significant influence on the returns.

In small household the production elasticity's of seed, irrigation, fertilizer and labor were 0.2164, 0.1624, 0.2584 and 0.2440, respectively. The return to scale in small farm was 0.8812 which shows increasing return to scale i.e. small farmers were gaining more than what they were spending. The R2 value of small household was 0.91 i.e. the considered variable explains 91.00 percent of the variation in depending variable i.e. return from sugarcane. The cost of seed at 5 percent level of significance and cost of irrigation at 1 percent level of significance had significant influence at the returns from sugarcane.

In medium household the production elasticity's of seed, irrigation, fertilizer and labor were 0.1887, 0.2389, 0.2564 and 0.1764, respectively. The return to scale in medium farm was 0.8604 which shows increasing return to scale i.e. medium farmers were gaining more than what they were spending. The R2 value of medium household was 0.95 i.e. the considered variable explains 95.00 percent of the variation in depending variable i.e. return from sugarcane. It was found that the cost of seed at 5 percent level of significance and cost of irrigation at 1 percent level of significance had significant influence at the returns from sugarcane.

In marginal the MVP of seed was 2.68, irrigation was 0.95, fertilizer was 1.88 and labour was 0.88 this shows that for production of one additional quintal of sugarcane the additional cost incurred for different is equal to the respected MVP. In small the MVP of seed was 3.08, irrigation was 1.26, fertilizer was 2.02 and labour was 3.84 this shows that for production of one additional quintal of sugarcane the additional cost incurred for different is equal to the respected MVP. In medium the MVP of seed was 2.42, irrigation was 2.76, fertilizer was 1.34 and labour was 2.64 this shows that for production of one additional quintal of sugarcane the additional cost incurred for different is equal to the respected MVP.

Major recommendations made by the respondent side to address the aforementioned issues included strengthening the extension services to better inform farmers about emerging methodologies to address technological issues and practise system following conventional wisdom to obtain advancement for better use of machinery, to substitute labour issues, to address issues with the lack of receipts from sugar mills, and to address problems with financial support from financial institutions. Various government programmes should make detailed information regarding input management, crop planning and budgeting, disposal of farm produce, and market data available.

Thus, it can be stated that sugarcane cultivation is advantageous in the research area and can reap significant rewards with the application of right technology and improved extension services.

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