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## Economic study on costs and returns of sugarcane in Ghazipur district of Uttar Pradesh

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### Abstract

In the present paper, an attempt has been made to examine the cost of cultivation of sugarcane and associated profit measures, utilizing primary data collected from Ghazipur district, Uttar Pradesh, during the agricultural year 2022-2023. Employed multi-stage cum purposive random sampling technique, 100 respondents (Marginal-59, Small-31, & Medium-10) were selected from two blocks i.e., Mardah and Birno block based on sugarcane acreage. Findings revealed an average farm size of 1.20 hectares, with varied cropping patterns and intensities across marginal, small, and medium-sized farms. Marginal farms exhibited the highest cropping intensity (194.53%). The gross income per hectare in sugarcane was observed maximum under medium farms of Rs. 172945.90 due to intensive cultivation & more use of human labour. Whereas on overall average, net income was found Rs. 62292.41 per hectare in the study area. The average cost of cultivation was Rs. 95453.88 per hectare, with the maximum cost incurred in the sugarcane crop due to human labor, accounting for 16.27% of the overall cost. Input-output ratio related to cost C<sub>3</sub>, was highest on medium farms (1:1.72). Medium farms emerged with the highest gross and net incomes, indicating their economic efficiency in sugarcane production. Policy implications underscore the necessity for tailored support mechanisms to enhance resource access and income levels, particularly for small and marginal farmers. Such support may involve improving access to inputs, technology, and markets, as well as providing financial assistance and strengthening agricultural extension services. These measures are crucial for promoting equitable agricultural development and socio-economic progress in rural communities, ultimately fostering sustainable livelihoods.

**Keywords:** Cropping pattern, cropping intensity, costs, returns, CACP

### Introduction

Agriculture is an essential sector of the Indian economy. It is the sole source of sustenance for nearly two-thirds of the Indian populace. The agricultural sector of India occupies 43% of the country's geographical area and accounts for approximately 20.20% of the country's GDP. Numerous commodities were cultivated by the producers. These encompass a variety of sustenance crops, commercial commodities, and oil seeds, among others. Sugarcane (*Saccharum officinarum* L.) is a member of the gramineae family and is indigenous to tropical South Asia and Southeast Asia. (Sankhwar and Chandra, 2019) [6].

Sugarcane is a natural, renewable agricultural resource that provides a variety of byproducts, including biofuel, fiber, fertilizer, and sugar, all of which are ecologically sustainable (Singh and Katiyar, 2016; Takale and Bhosale, 2012) [7, 8]. White sugar, brown sugar (Khandhasari), jaggery (Gur), and ethanol are all produced using sugarcane liquid (Mahadik *et al.*, 2023) [2]. Sugarcane is cultivated in a variety of climatic conditions. India is one of the world's major producers of sugarcane, with an annual production of approximately 300 million tonnes. The country's second-largest agro-processing industry is the production of sugar, following textiles and cotton. In contrast to other nations that produce unprocessed, refined, or both types of sugar, India is the sole producer of plantation sugar (Ranjan *et al.*, 2020) [5].

In India, over 50 million cultivators are dependent on sugarcane cultivation, harvesting, and ancillary activities, which employ a significant number of agricultural laborers. This sector employs 7.5% of the rural population, and many people are indirectly engaged in the processing

industry. Molasses serves as the main raw material for alcohol production and other related industries in India, while also being the primary byproduct of the sugar industry. Information from the 1970s (1970-73), when sugarcane covered 2480,000 hectares, can be utilized to assess the significance of the crop in the country. This figure increased to 4550,000 hectares during 2008-11, a 1.83-fold increase from the previous period. In 2022-23, sugarcane occupies an area of 5464,000,000 hectares, with a production of 465049 thousand tons and a yield of 85,000 kg per hectare (Agricultural Statistics at a Glance, 2023). In terms of the U.P. state, sugarcane is a commercial commodity that occupies an area of 2.17 thousand hectares and produces a total production of 176706 thousand tonnes with a yield of 83900 kg per hectare in 2022-23 (Agricultural Statistics at Glance, 2023). Ghazipur District, which boasts the most optimal agro-climatic conditions for sugarcane cultivation, accounts for a substantial portion of the state's sugarcane production and cultivation area. The total production of sugarcane was 425741 tonnes, with a productivity of 53.73 tonnes per hectare, and it occupies an area of 7924 hectares (District Statistical Bulletin, Ghazipur 2020-21). With this background the study was conducted with the following objectives include to study the farm structure, cropping pattern, and cropping intensity of sample farm. Also to work out the cost and returns of sugarcane production.

## Materials and Methods

This examination of cultivation costs and profit measures relied heavily on source data. The pre-structured and pre-tested schedules were utilized to collect information from the farmers in the sample size. The population sample was obtained by a multi-stage stratified purposive cum random sampling strategy. The sample procedure has commenced with the purposeful selection of Ghazipur districts.

Firstly, a list of 16 blocks lying under Ghazipur districts of Uttar Pradesh was prepared. Based on the highest acreage in sugarcane cultivation two blocks were purposively selected from Ghazipur viz., *Birno* and *Mardah*.

## Selection of Respondent

A list of sugarcane grower was prepared according to the size of holdings and all farmer were categories into three categories viz.

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

Twenty five percent of sugarcane grower from each category were selected randomly. The details are presented in following table 1.

**Table 1:** Village wise number of the selected farmers under different size group of farms.

S. No.	Name of the village	Categories of the farmers			Total
		Marginal (< 1 ha)	Small (1-2 ha)	Medium (2 ha. & above)	
<b>Birno</b>					
1.	Devkathia	6	3	1	10
2.	Baghol	6	3	1	10
3.	Bhikharpur	6	4	1	11
4.	Dandi Khurd	5	3	1	9
5.	Taranpur	6	3	1	10
<b>Mardah</b>					
1.	Bijwanpur	6	3	1	10
2.	Singera	5	3	1	9
3.	Mardah	6	3	1	10
4.	Boeri	7	3	1	11
5.	Palahipur	6	3	1	10
Grand Total		59	31	10	100

## Period of Enquiry

The data pertained to agricultural year 2022-2023 to estimate costs and returns of Sugarcane.

### i) Tabular Analysis

A tabular analysis was conducted to compare various aspects of the cost and return analysis for the various categories of sample farms (Mishra *et al.*, 2023a) [4].

### ii) 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.

$$\bar{X} = \frac{\sum X}{N}$$

Where,

X= Value of variable

N= Number of observation

$$W.A. = \frac{\sum W_i X_i}{\sum W_i}$$

Where,

W.A. = Weighted Average

$W_i$  = Weight of  $X_i$

$X_i$  = Variable

b) Percentage = Simple comparisons have been made on the basis of percentage.

### iii) Cropping intensity

Cropping intensity refers to the quantity of crops planted on a farm throughout the year using land as a fixed resource. It is calculated as.

$$C.I. = \frac{\text{Total Cropped Area}}{\text{Net Cultivated Area}} \times 100$$

Where,

C. I. = cropping intensity

### iv) Measures of Cost Concepts

**Cost A<sub>1</sub>:** It includes total cash expenses incurred by cultivators which are as follows (Mishra *et al.*, 2023b;

Verma *et al.*, 2023) [3, 10].

- Wage of hired human labour.
  - Charges for bullock labour.
  - Hired labour charges of implements and machinery.
  - Cost incurred on manures and fertilizers.
  - Seeds.
  - Plant protection chemicals.
  - Irrigation charges.
  - Land revenue.
  - Depreciation.
  - Repair charges on farm assets.
- Cost A<sub>2</sub>:** Cost A<sub>1</sub> + Rent paid for leased in land.
  - Cost B<sub>1</sub>:** Cost A<sub>2</sub> + Interest on owned fixed capital assets.
  - Cost B<sub>2</sub>:** Cost B<sub>1</sub> + Rental value of owned land.
  - Cost C<sub>1</sub>:** Cost B<sub>1</sub> + Imputed value of family labour.
  - Cost C<sub>2</sub>:** Cost B<sub>2</sub> + Imputed value of family labour.
  - Cost C<sub>3</sub>:** Cost C<sub>2</sub> + 10% of cost C<sub>2</sub> (managerial cost)
- Measures of Farm Profit**
    - Gross Income** = Yield in quintal × Price per quintal.
    - Net Income** = Gross Income – Cost C.
    - Farm Business Income** = Gross Income - Cost A<sub>2</sub> or Net Income + imputed value of family labour
    - Family labour income** = Gross Income-Cost C
    - Farm investment income** = Net Income + Rental value of owned land+ Interest on fixed capital
    - Benefit-cost ratio** = Cost C / Gross Income

#### vi) Imputation procedure for inputs costs

The cultivators' reported value of the purchased input was considered after thorough verification. Family sources provided some of the inputs utilized in the production process. The procedure for determining the imputed value of these inputs is as follows.

- The wage rates that were in effect for various agricultural operations per day in the selected village were used to

calculate the cost of family labor.

- The rates that were in effect in the municipalities in question were used to calculate the value of farm-produced manure, own-farm-produced seeds, and seedlings.
- The current market rates were used to determine the cost of irrigation and tractor charges.
- The kind contributions were assessed based on the prices that were in effect in the communities at the time of the operation.
- A rate of 7% per annum was imposed on interest on working capitals.
- The rental value of the land possessed by the farmer was assessed at the rate that was currently in effect in the village.
- Management charges were determined at a rate of 10% of the entire cost (Cost C<sub>2</sub>).

### Results and Discussion

It is crucial to investigate the structure of sample farms and families, as these factors significantly impact the pattern of resource utilization on farms. The farm families' organizational structure underscores the general state of the farms, which encompasses the size of the holding, the number of the family, the cropping pattern, and the intensity of the cropping.

The characters existing on sample farms are discussed below.

#### 1) Average size of holding

It was anticipated that the volume of sugarcane production would be positively correlated with the extent of the holding. The farmers who possess a larger holding are economically more advantageous and are able to more easily implement the better farm practices. Conversely, farmers with lesser farm units are motivated to increase their production in order to enhance their economic status and market their produce. This is necessary to enable them to meet both ends of the equation.

**Table 2:** Average size of holding on different size-group of sample farms (ha.)

S. No.	Size groups of farm	No. of Farmers	Net Cultivated land (ha.)	Average size of holding
1.	Marginal	59	45.19 (37.62)	0.77
2.	Small	31	50.27 (41.85)	1.62
3.	Medium	10	24.65 (20.52)	2.47
Grand Total		100	120.11 (100.00)	1.20

The table 2 depict that the average size of farms was 1.20 ha, with a range of 0.77 ha for marginal, 1.62 ha for small, and 2.47 ha for medium farms. The total cultivated area of the sample farms was 120.11 ha.

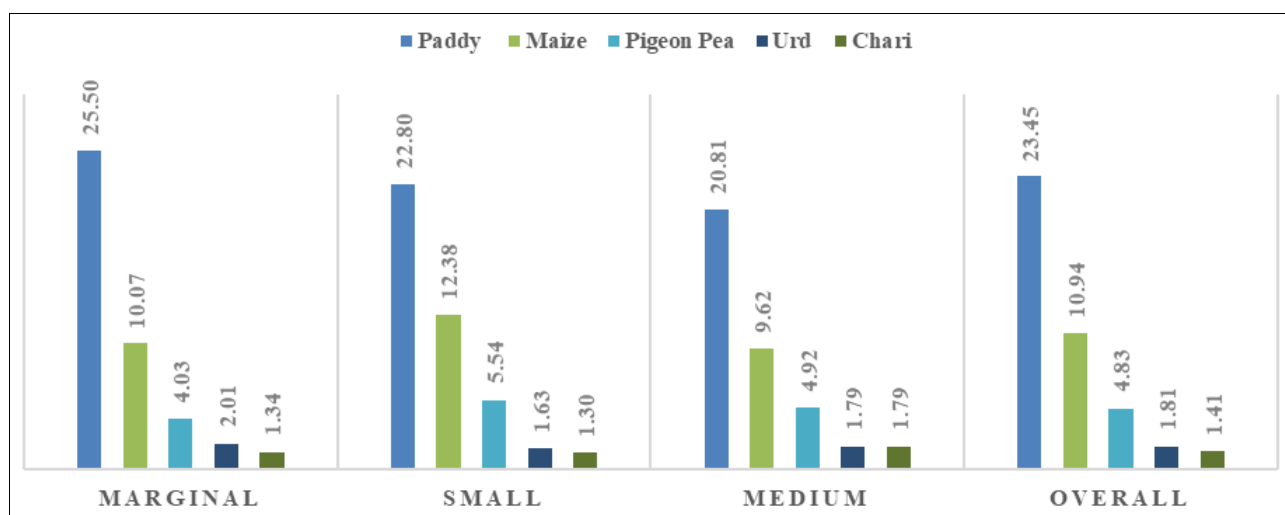
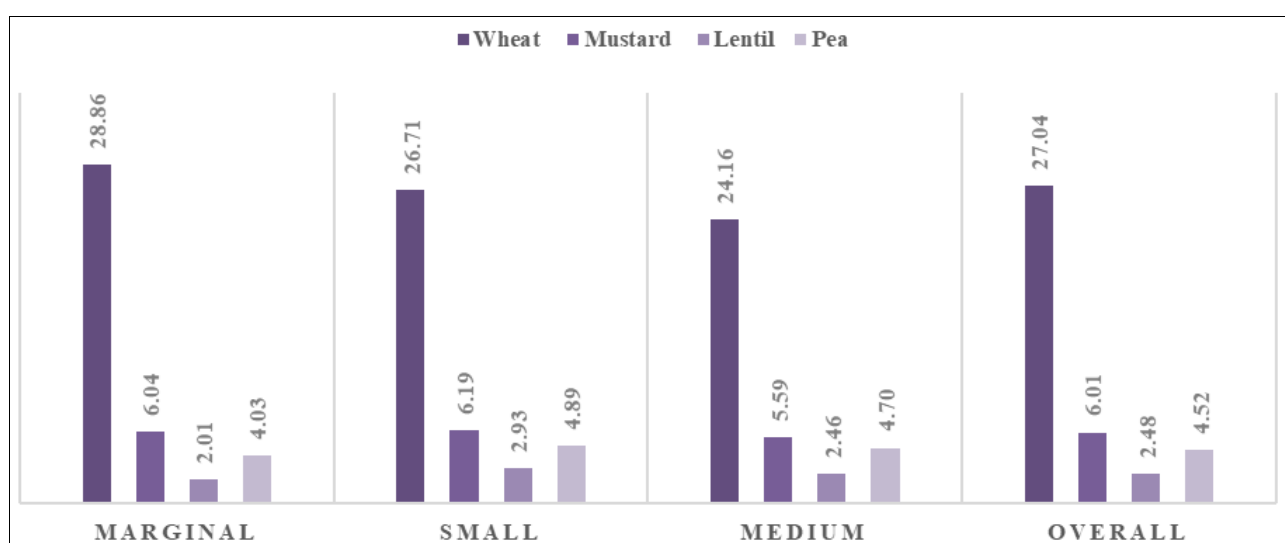
#### 2) Cropping pattern

The cropping pattern denotes to the allocation of land for the cultivation of several commodities during a specific season of the year. The most critical factor that dictates the investment for various inputs on a farm and the income of producers is the

availability of resources and their utilization under a variety of agro-climatic conditions. Table 2 provides the cropping pattern of the sample farms. It is clear from Table 3 that the net cultivated area of marginal, small, and medium-sized farms was 0.77, 1.62, and 2.47 ha, respectively. The gross cropped area of marginal, small, and medium-sized farms was 1.49, 3.07, and 4.47 ha, respectively. The area under sugarcane on marginal, small, and medium-sized farms was determined to be 0.13, 0.28, and 0.73 ha, respectively. The total percentage proportion of sugarcane among all commodities was observed to be 10.38%.

**Table 3:** Cropping Pattern of sample farms in the study area (ha.)

S. No.	Crops	Marginal (59)	Small (31)	Medium (10)	Overall Average
A.	Kharif	0.64 (42.95)	1.34 (43.65)	1.74 (38.93)	0.97 (42.45)
1.	Paddy	0.38 (25.50)	0.70 (20.80)	0.93 (20.81)	0.53 (23.45)
2.	Maize	0.15 (10.07)	0.38 (12.38)	0.43 (9.62)	0.25 (10.94)
3.	Pigeon Pea	0.06 (4.03)	0.17 (5.54)	0.22 (4.92)	0.11 (4.83)
4.	Urd	0.03 (2.01)	0.05 (1.63)	0.08 (1.79)	0.04 (1.81)
5.	Chari	0.02 (1.34)	0.04 (1.30)	0.08 (1.79)	0.03 (1.41)
B	Rabi	0.61 (40.94)	1.25 (40.72)	1.65 (36.91)	0.91 (40.06)
1.	Wheat	0.43 (28.86)	0.82 (26.71)	1.08 (24.16)	0.62 (27.04)
2.	Mustard	0.09 (6.04)	0.19 (6.19)	0.25 (5.59)	0.14 (6.01)
3.	Lentil	0.03 (2.01)	0.09(2.93)	0.11 (2.46)	0.06 (2.48)
4.	Pea	0.06 (4.03)	0.15 (4.89)	0.21 (4.70)	0.10 (4.52)
C	Zaid	0.24 (16.11)	0.48 (15.64)	1.08 (24.16)	0.40 (17.49)
1.	Sugarcane	0.13 (8.72)	0.28 (9.12)	0.73 (16.33)	0.24 (10.38)
2.	Chari	0.04 (2.68)	0.08 (2.61)	0.10 (2.24)	0.06 (2.56)
3.	Vegetable	0.07 (4.70)	0.12 (3.91)	0.25 (5.59)	0.10 (4.54)
Gross Cropped Area (A+B+C)		1.49 (100.00)	3.07 (100.00)	4.47 (100.00)	2.28 (100.00)

**Fig 1:** Different crops grown during Kharif season (%)**Fig 2:** Different crops grown during Rabi season (%)

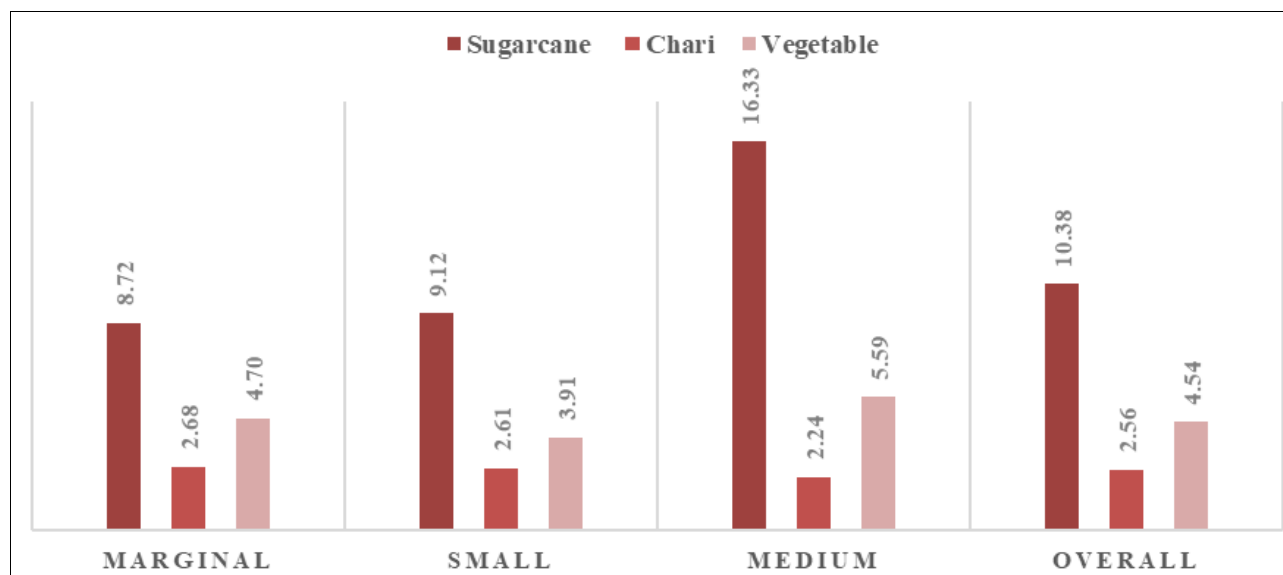


Fig 3: Different crops grown during Zaid season (%)

### Cropping intensity

Cropping intensity of sample farms were calculated & given in Table 4.

Table 4: Cropping intensity of different size group in the study area

S. No.	Size groups of farm	No. of Farmers	Net Cultivated land (ha.)	Gross Cropped Area (ha.)	Cropping Intensity (%)
1.	Marginal	59	0.77	1.49	194.53
2.	Small	31	1.62	3.07	189.32
3.	Medium	10	2.47	4.47	181.34
	Overall Average	100	1.20	2.28	189.83

Table 4 reveals the greatest cropping intensity was observed (194.53 percent) on marginal size of sample farms, followed by small (189.32 percent) and medium (181.34 percent), while the average on sample farms reached to 189.83 percent.

**Economics of Sugarcane:** Costs and returns of sugarcane per hectare on sample plantations have been calculated and presented in this section. Sugarcane production employed various cost concepts. Gross income, net income, and family labor income were used to estimate and value per hectare output. Consequently, farm business income was used to represent measures of agricultural profits.

### Inputs

Input estimates have taken into account a variety of factors that contribute to cost, including planting material, human labor (both family and hired), machinery charges, manures and fertilizer, plant protection, irrigation, interest on working capital, rental value of land, interest on fixed capital, and 10% covered managerial cost against  $C_2$ .

### Cost of Cultivation of sugarcane

Per hectare costs on various input factors in sugarcane production were worked out. The details of input costs are shown in Table 5.

Table 5: Per hectare costs of different inputs for sugarcane production (Rs.)

S. No.	Particulars	Size group of farms			Overall average
		Marginal (59)	Small (31)	Medium (10)	
1.	Planting Material	14059.00 (15.01)	14287.00 (14.70)	15024.00 (14.92)	14226.18 (14.90)
2.	Machinery Charge	5989.00 (6.39)	6210.00 (6.39)	6718.00 (6.67)	6130.41 (6.42)
3.	Human Labour	15055.00 (16.07)	16045.00 (16.51)	16715.00 (16.60)	15527.90 (16.27)
a.	Family Labour	8999.00 (9.60)	3289.00 (3.38)	1626.00 (1.61)	6491.60 (6.80)
b.	Hired Labour	6056.00 (6.46)	12756.00 (13.13)	15089.00 (14.98)	9036.30 (9.47)
4.	Manure and fertilizer	14829.00 (15.83)	15087.00 (15.53)	15203.00 (15.10)	14946.38 (15.66)
6.	Plant Protection	948.00 (1.01)	981.00 (1.01)	1030.00 (1.02)	966.43 (1.01)
7.	Irrigation	10359.00 (11.06)	11385.00 (11.72)	12057.00 (11.97)	10846.86 (11.36)
8.	Total operation cost	61239.00 (65.38)	63995.00 (65.86)	66747.00 (66.29)	62644.16 (65.63)
9.	Interest on working capital	2449.56 (2.61)	2559.80 (2.63)	2669.88 (2.65)	2505.77 (2.63)
10.	Rental value of land	18000.00 (19.21)	18000.00 (18.52)	18000.00 (17.88)	18000.00 (18.86)
11.	Interest on fixed capital	3458.35 (3.69)	3785.14 (3.90)	4125.05 (4.10)	3626.32 (3.80)
12.	Sub total	85146.91 (90.90)	88339.94 (90.91)	91541.93 (90.91)	86776.25 (90.91)
13.	Managerial Cost@10% of sub-total	8514.69 (9.09)	8833.99 (9.09)	9154.19 (9.09)	8677.63 (9.09)
	Grand total	93661.60 (100.00)	97173.93 (100.00)	100696.12 (100.00)	95453.88 (100.00)

(Figure in parenthesis indicate percentage to the total cost)



According to Table 5, the average cost of cultivating one hectare of sugarcane was Rs. 95453.88. Marginal farms had the lowest cultivation costs (Rs. 93661.60), followed by small and medium farms (Rs. 97173.93) and Rs. 100696.12).

Medium farms had the greatest per hectare cultivation costs (Rs. 100696.12), mostly as a result of their larger fixed capital investment than small and marginal farms. On average, the study also shows that the main expenses that resulted in the highest costs were found to be related to human labor (16.27 percent), which was followed by manure and fertilizer, planting supplies, irrigation, machinery fees, and plant protection (15.66, 14.90, 11.36, 6.42, and 1.01 percent, respectively). Additionally, a same pattern was seen in all sample farm groups.

The expenses for interest on working capital, rental value of owned land, interest on fixed capital, and managerial cost were calculated as a percentage of the total costs. These expenses amounted to 2.63%, 18.86%, 3.80%, and 9.09% of the total costs, respectively. The largest portion of these costs was attributed to the rental value of owned land, accounting for 18.86% of the total cost per hectare.

### Measures of costs and income of sugarcane

#### Costs of cultivation

Costs and income of sugarcane production per hectare is given in Table 6.

**Table 6:** Measures of per- hectare costs and returns of sugarcane cultivation (Rs.)

S. No.	Particulars	Size group of farms			Overall average
		Marginal	Small	Medium	
1.	Cost A <sub>1</sub> /A <sub>2</sub>	54689.56	63265.80	67790.88	58658.33
2.	Cost B <sub>1</sub>	58147.91	67050.94	71915.93	62284.65
3.	Cost B <sub>2</sub>	76147.91	85050.94	89915.93	80284.65
4.	Cost C <sub>1</sub>	67146.91	70339.94	73541.93	68776.25
5.	Cost C <sub>2</sub>	85146.91	88339.94	91541.93	86776.25
6.	Cost C <sub>3</sub>	93661.60	97173.93	100696.12	95453.88
7.	<b>Yield (qtl/hac.)</b>				
a.	Main Product	509.25	536.81	561.43	523.01
b.	By Product	107.71	120.18	126.64	113.47
8.	Gross Income	151206.80	165289.30	172945.90	157746.29
a.	Main Product	142590	155674.9	162814.7	148668.79
b.	By Product	8616.8	9614.4	10131.2	9077.50
9.	Net return over C <sub>3</sub>	57545.20	68115.37	72249.78	62292.41
10.	Family labour Income	75058.89	80238.36	83029.97	77461.63
11.	Farm Business income	96517.24	102023.50	105155.02	99087.96
12.	Farm Investment Income	87518.24	98734.50	103529.02	92596.36
13.	Cost of production (Rs. /Qtl.)	183.71	180.80	179.13	182.35
14.	<b>B:C Ratio</b>				
a.	Cost A <sub>1</sub> /A <sub>2</sub>	1:2.76	1:2.61	1:2.55	1:2.70
b.	Cost B <sub>1</sub>	1:2.60	1:2.47	1:2.40	1:2.54
c.	Cost B <sub>2</sub>	1:1.99	1:1.94	1:1.92	1:1.97
d.	Cost C <sub>1</sub>	1:2.25	1:2.35	1:2.35	1:2.29
e.	Cost C <sub>2</sub>	1:1.78	1:1.87	1:1.89	1:1.82
f.	Cost C <sub>3</sub>	1:1.61	1:1.70	1:1.72	1:1.65

Table 6 revealed that, on an average cost A<sub>1</sub>/A<sub>2</sub>, cost B<sub>1</sub>, cost B<sub>2</sub>, cost C<sub>1</sub>, cost C<sub>2</sub> and cost C<sub>3</sub> came to Rs. 58658.33, Rs. 62284.65, Rs. 80284.65, Rs. 68776.25, Rs. 86776.25, Rs. 95453.88, respectively. On an average, gross income was recorded Rs. 157746.29 and net income came to Rs. 62292.41. The gross income of medium farms was the highest, at Rs. 172945.90. Small farms and marginal farms followed, with gross incomes of Rs. 165289.30 and Rs.151206.80, respectively.

The net income of medium farms was the highest at Rs.62292.41, while tiny farms had the second highest at Rs.68115.37. The average estimated family labor income, farm business income, and farm investment income were Rs. 77461.63, Rs. 99087.96, and Rs. 92596.36, respectively. The family labor income was highest on medium-sized farms, with a total of Rs. 83029.97. Small farms came in second place, with a total income of Rs. 80238.36. The farm business income was highest on medium farms, with a total of Rs.105155.02. Small farms followed closely behind with an income of Rs.102023.50. On average, the cost of production per quintal was estimated at Rs. 182.35, with a yield per hectare of 523.01 quintals for the main product and 113.47 quintals for the by-product.

Input - Output ratio for marginal, small and medium farms were 1:1.61, 1:1.70, and 1:1.72 on cost C<sub>3</sub>. In respect of overall

average of farm, input-output ratio were 1:2.70, 1:2.54, 1:1.97, 1:2.29, 1:1.82, and 1:1.65 on basis of cost A<sub>1</sub>/A<sub>2</sub>, B<sub>1</sub>, B<sub>2</sub>, C<sub>1</sub>, C<sub>2</sub> and cost C<sub>3</sub> respectively.

The result reveal that return over all cost increase as farm size increase. Marginal farm got lower return and highest return was obtained by medium farm.

#### Conclusion

From above discussion, it is evident that the cost of cultivation of sugarcane was found to be highest among medium-sized sample farms, primarily due to the higher charge for human labor. The calculated average cost of cultivation is Rs. 95453.88. The highest total income per hectare was observed in medium farms, reaching Rs. 172945.90. Small farms followed closely behind with an income of Rs. 165289.30, while marginal farms had the lowest income at Rs. 151206.80. Medium farms showed the highest aggregate income per hectare due to their utilization of human labor, planting material, manure, fertilizer, and irrigation. The farmers' improved management was found to be directly linked to the increase in productivity. On average, the gross income per hectare was Rs. 157746.29, with a net income of Rs. 62292.41. The total average income, including family labor income, farm business income, and farm investment

income, was calculated to be Rs. 77461.63, Rs. 99087.96, and Rs. 92596.36, respectively. The cost of production per quintal of sugarcane was found to be Rs. 183.71, Rs. 180.80, and Rs. 179.13 on marginal, small, and medium plantations, respectively. Medium farms had the highest input-output ratio at 1:1.72, followed by small farms at 1:1.70 and marginal farms at 1:1.61. This ratio was related to cost C3.

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