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# An economic analysis of sugarcane cultivation in Ayodhya district of Uttar Pradesh

# <sup>1</sup>Avinash Pratap, <sup>2</sup>RR Kushwaha, <sup>3</sup>Manish Kumar, <sup>4</sup>Sugriv Kumar Maurya and <sup>5</sup>Mahima Priyanka Neerugatti

<sup>1,5</sup>Ph.D. Scholar, Department of Agricultural Economics, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

<sup>2</sup>Associate Professor, Department of Agricultural Economics, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

<sup>3</sup>Assistant Professor, Department of Agricultural Statistics, Acharya Narendra Deva University of Agriculture and Technology Kumarganj, Ayodhya, Uttar Pradesh, India

<sup>4</sup>Assistant Professor, Department of Agriculture Economics, Janta Mahavidyalaya Ajitmal Auraiya, Uttar Pradesh, India

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#### Corresponding Author: RR Kushwaha, E-mail: rrkushwahauat@gmail.com

#### Abstract

In the present paper, an attempt has been made to examine various sugarcane production in different categories of the farmers. An Economic Analysis of Sugarcane Cultivation 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 analysised and found that Average holding Size 1.20 ha. Varying from 0.55 to 3.22 ha. Cropping intensity of sample farms was to 201.64 percent which was found highest on marginal farms 241.34 percent followed by Small 208.78 percent and medium 191.12 percent respectively. On an Average cost of cultivation was rupees 93427.33 per/ha. The gross & Net income on over all farms where found to be rupees 194656.00 and 101228.67 per ha respectively. The input and output ratio was found to be 1:2.14 On cost C<sub>3</sub> the study was characterized by decreasing return to scale.

Keywords: Farm structure, cropping pattern, cropping intensity, cost & return etc.

#### 1. Introduction

Sugarcane (*Saccharum officinarum*) is a common term used for a number of species and hybrids of tall perennial grasses belonging to the family of Graminae, genus Saccharum and tribe Andropogon, which contain sugar in the form of sucrose. The cultivation of sugarcane dates back to the Vedic period, between 1400 - 1000 B.C. The mentioning of sugarcane is present in various Indian literary sources, as an essential sugar crop. The word 'sugar' has derived from the Sanskrit word '*Sakara*' meaning sweet. Alexander, king of Macedonia, who invaded India in 327 B.C., called sugarcane as 'honey reed'.

In 600 A.D. Chinese emperor Tsai Heng sent his courts men to Bihar in India to acquire the knowledge of the art of manufacturing sugar from sugarcane. According to Barber, thin Indian canes had originated in the humid climate of the North Eastern India, relating to *Saccharum spontaneum* (Kans). Tropical canes are supposed to have originated in the tropical humid climate of New Guinea.

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. Sugarcane was 370.50 million tonnes in the year 2021 - 22 with Uttar Pradesh being the highest producer (177.43 million tonnes) followed by Maharashtra (110.54 million tonnes) and Karnataka (61.15 million tonnes).

The area under sugarcane cultivation is around 5.10 million hectare with an average yield of 84.00 tonnes/ha. Uttar Pradesh had the highest area under sugarcane cultivation in 2016 - 17 (2.16 million hectare). Tamil Nadu had the highest productivity of 86.99 tonnes/ha.

Sugarcane is a crucial source of energy for the 1.4 billion population in the country. It is a crop next to rice, wheat, maize and pulses which can be kept as one of the most beneficial crops for the society. Sugar obtained from sugarcane, is an indispensable product in this era of human society and is very much the part of the staple diet of people all across the world. Sugarcane can also be treated as an important commercial crop owing the same value as any other cash crop like tobacco, banana and other plantation crops.

Ayodhya district has seen a subsequent increase in the production of sugarcane. In the past 30 years, the area under sugarcane has increased to 47,284 million hectare in the district alone. About 0.11 million farmers in Ayodhya are involved in sugarcane production every year. In the agriculture year of 2022-23, the farmers in Ayodhya had

cultivated sugarcane in an area of 44,294 hectare. The sugarcane development authority cultivated sugarcane in an area of 31,830 hectares while Raujagaon produced sugarcane in an area of 12,464 hectare, in the agriculture year 2022 - 23 (Statistical report, U.P. 2021). With this background the study was conducted with the following objectives.

- 1. To study the socio-economic profile of farmers and their farms.
- 2. To study the cost of cultivation of sugarcane production.

# 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) Tabular Analysis

Tabular analysis was made to compare different aspects of analysis of costs and returns on different categories of the sample farms.

### 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:

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

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

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

Where,

$$\label{eq:W.A.} \begin{split} & W.A. = Weighted \ Average \\ & W_i = Weight \ of \ X_i \\ & X_i = Variable \end{split}$$

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

# iii) Measures of Cost Concepts

**Cost**  $A_1$  = this gives the total cash expenses incurred by the grower. It includes the following items

- 1. Cost of hired labour
- 2. Cost of bullock labour and tractor charges
- 3. Cost of planting materials
- 4. Cost of manures, fertilizers and plant protection chemicals
- 5. Irrigation charges
- 6. Interest on working capital
- 7. Land revenue
- 8. Depreciation on fixed capital

**Cost**  $A_2 = Cost A_1 + rent paid for leased land$ 

**Cost**  $B_1$  = Cost  $A_2$  + interest on fixed capital + rental value of owned capital assets (Excluding Land)

**Cost B**<sub>2</sub> =Cost B<sub>1</sub> + Rental Value of owned land (Net land Revenue)

Cost  $C_1 = \text{Cost } B_1$ + imputed value of family labour Cost  $C_2 = \text{Cost } B_2$  + imputed value of family labour Cost  $C_3 = \text{Cost } C_2$  + 10 percent of the managerial cost

# iv) 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

# **Cropping Intensity**

Cropping intensity index refers to the changes in the

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cropping intensity of crop compared to a given base year. Cropping intensity is the number of times a crop is planted per year in a given agricultural area. It is the ratio of effective crop area harvested to the physical area.

C. I. = 
$$\frac{\text{Total cropped area}}{\text{Net sown area}} \times 100$$

#### 3. Results and Discussion

S. No.	Momborg	S	Overall everage		
	Members	Marginal (64)	Small (22)	Medium (14)	Overall average
1	Male	2.76 (51.87)	2.01 (50.75)	1.79 (59.27)	2.45 52.34
2	Female	2.56 (48.12)	1.95 (46.24)	1.23 (40.73)	2.24 (47.66)
Grand Total		5.32 (100)	3.96 (100)	3.02 100)	4.69 (100)

Table 1: Average size and composition of family of different households

**3.1 Average size and composition of family of different households:** Farmers group are mainly classified in three groups i.e. marginal, small and medium one but marginal section constitute maximum share among Indian farmer population. The table 2 shows that the average percentage of males in the study sample was 52.34 percent and female was

47.66 percent. In marginal household male was 51.87 percent and female was 48.12 percent. 50.15 percent male and 46.24 percent female were in small household. Medium household comprised of 59.27 percent male and 40.73 female.

Table 2: Average size of holding or	n sample farems	under differen	t size group
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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

# 3.2 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) and medium (2-4ha). It is clear from the Table 3. 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 3: Per hectare investment of various assets of different size groups of farm (value in Rs)

C N.	Dentionland		0		
5. NO.	Particulars	Marginal (64)	Small (22)	Medium (14)	Overall Average
А	Buildings	320857 (65.61)	130619.60 (59.73)	101669.26 (55.28)	248318.25 (64.19)
	Residential	282570 (57.78)	118859.58 (54.35)	95955.86 (52.17)	220427.65 (56.98)
	a. Kaccha	42911 (8.77)	15784.60 (7.22)	4705.00 (2.56)	31594.40 (8.17)
I.	b. Pakka	239659 (49.01)	103074.98 (47.13)	91250.85 (49.61)	188833.25 (48.81)
	Cattle Shed	26751 (5.47)	7093.95 (3.24)	2799.19 (1.52)	19073.43 (4.93)
	Go-down	11535 (2.36)	4666.07 (2.13)	2914.21 (1.58)	8817.17 (2.28)
В	implements and machinery	95162 (19.46)	60108.88 (27.49)	64135.84 (34.87)	83106.35 (21.48)
	Major Implements	86561 (17.70)	56900.33 (26.02)	62093.88 (33.76)	76610.13 (19.80)
	tractor	49967 (10.22)	42890.34 (19.61)	51107.86 (27.79)	48570.07 (12.56)
<b>D</b> (:)	trolley	13494 (2.76)	5023.01 (2.30)	3802.92 (92.07)	10273.41 (2.66)
D(1)	cultivator	6817 (1.39)	2697.27 (1.23)	2260.49 (1.23)	5272.55 (1.36)
	thresher	12000 (2.450	4189.58 (1.92)	3025.80 (1.65)	9025.32 (2.33)
	harrow	4283 (0.88)	2100.12 (0.96)	1896.80 (1.03)	3468.78 (0.90)
	Minor Implements	8601 (1.76)	3208.55 (1.47)	2041.96 (1.11)	6496.22 (1.68)
D(:;)	chaff	4633 (0.95)	1772.37 (0.81)	1173.76 (0.64)	3519.62 (0.91)
D(11)	Khurpi	149 (0.03)	52.76 (0.02)	36.68 (0.02)	111.99 (0.03)
	Kudal	171 (0.03)	64.54 (0.03)	41.96 (0.02)	129.26 (0.03)
	sprayer	3648 (0.75)	1318.89 (0.60)	789.56 (0.43)	2735.36 (0.71)
С	Other implement	1397 (0.29)	499.49 (0.23)	299.66 (0.16)	1046.21 (0.27)
D	Irrigational	29644 (6.06)	11518.69 (5.27)	7669.26 (4.17)	22580.15 (5.84)
Е	Live stock	41978 (8.58)	15939.50 (7.29)	10151.38 (5.52)	31793.95 (8.22)
(i)	a. Cow	14759 (3.02)	5070.72 (2.32)	3001.87 (1.63)	10981.34 (2.84)
(ii)	b. Buffalo	22584 (4.62)	9271.52 (4.24)	6202.67 (3.37)	17362.12 (4.49)
(iii)	c. Goat	4635 (0.95)	1597.26 (0.73)	946.84 (0.51)	3450.49 (0.89)
Grand total		489038 (100.00)	218686.16 (100.00)	183925.40 (100.00)	386844.90 (100.00)

#### **3.3 Per hectare investment**

The per hectare investment on farm assets on different size group of sample farms presented in Table 4. It revealed depicted from the per hectare average investment on buildings was higher on marginal farm (Rs.320857) followed by small (Rs.130619.60) and medium (Rs101669.26) farms, where as in case of implement & machineries it was higher at medium (Rs.64135.84) followed by small farm (Rs.60108.88) and marginal (Rs.95162.00) farms, in case of irrigation structure, it was higher (Rs.29644) at marginal farm followed by small (11518.69) and medium (Rs.7669.26), in case of other implements, it was higher (Rs.1397) at marginal far followed by small (Rs.499.49) and medium (Rs.299.99) farms, respectively. As far as per hectare investment on livestock is concerned, it was higher in case of marginal farm (Rs.41978) followed by small farm (Rs.15939.50) and medium farm (Rs.10151.38.90). The overall investment per hectare computed higher (Rs.489038) at marginal farm followed by small (Rs.218686.16) and medium (Rs.183925.40).

Table 4: Cropping pattern	under different size grou	p of sample farms	(area in hectare)
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S No	Cron		Cropping pattern			
5. INO.	Сгор	Ave	Overall farm			
		Marginal (64)	Small (22)	Medium (12)		
Α	Kharif	0.70 (52.6)	1.81 (48.70)	2.86 (46.50)	1.19 (49.40)	
1	paddy	0.30 (22.6)	0.89 (23.90)	1.32 (21.50)	0.55 (22.70)	
2	Sugarcane	0.32 (24.1)	0.71 (19.10)	1.12 (18.20)	0.50 (20.60)	
3	Til	0.02 (1.50)	0.06 (1.60)	0.14 (2.30)	0.04 (1.80)	
4	maize	0.06 (4.50)	0.15 (4.00)	0.28 (4.60)	0.11 (4.40)	
В.	Rabi	0.42 (31.60)	1.38 (37.10)	2.31 (37.60)	0.85 (35.30)	
1	Wheat	0.30 (22.60)	0.72 (19.40)	1.15 (18.70)	0.49 (20.30)	
2	mustard	0.04 (3.00)	0.26 (7.00)	0.42 (6.80)	0.13 (5.50)	
3	lentil	0.02 (1.50)	0.12 (3.20)	0.18 (2.90)	0.06 (2.50)	
4	potato	0.04 (3.00)	0.16 (4.30)	0.38 (6.20)	0.11 (4.40)	
5	Bar seem	0.02 (1.50)	0.12 (3.20)	0.18 (2.90)	0.06 (2.50)	
С.	Zaid	0.21 (15.80)	0.53 (14.20)	0.98 (15.90)	0.37 (15.30)	
1	Chari	0.04 (3.00)	0.12 (3.20)	0.18 (2.90)	0.07 (3.10)	
2	moong	0.05 (3.80)	0.11 (3.00)	0.18 (2.90)	0.08 (3.20)	
3	mentha	0.05 (3.80)	0.14 (3.80)	0.36 (5.90)	0.11(4.40)	
4	vegetable	0.07 (5.30)	0.16 (4.30)	0.26 (4.20)	0.11 (4.60)	
0	bross total	1.33 (100)	3.72 (100)	6.15 (100)	2.41 (100)	

# 3.4 Cropping pattern

Cropping pattern presents the area devoted to the various crop during the given period, conventionally in a single year. It indicates the yearly sequence and arrangement of crops grown by farmer in a particular area. The cropping patterns followed by the sample farms are presented in table 5. It is depicted from the table 5 that on an average the highest area was covered under paddy 22.70 percent followed by

wheat 20.30 percent, sugarcane 20.60 percent, mustard 5.50 percent, maize 4.40 percent, lentil 2.50 percent, vegetables 4.60 percent, til 1.80 percent, potato 4.40 percent, mustard 5.50 percent, lentil 2.50 percent, Chari 3.10 percent, bar seem 2.50 percent, moong 3.20 percent, mentha4.40 percent, of total cropped area on sample farm. Sugarcane crop was allotted a considerable area by the sample farmer after two major food grain crops i.e. paddy and wheat.

Table 5: 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 5 Cropping Intensity of different size group of farms

Table 5 Reveals that the overall average cropping intensity on sample farms was to 201.64 percent which was found highest on marginal farms 241.34 percent followed by small 208.78 percent, and medium 191.12 percent respectively. Cropping intensity was inversely related to size of farm. **6.9 4. Structure of cost and Returns:** Per hectare cost and return from the cultivation of sugarcane crop on different categories of farm were worked out and present in table 6. The per hectare cost "C3" was worked to Rs. 83939.58 on marginal, Rs. 101051.46 on small and Rs. 110383.24 on medium farm with and overall average of Rs. 93427.33 respectively. Cost of production per quintal had the negative relation with the size of farms.

Table 6: Per hectare costs of different inputs used in sugarcane crop on different size group of sample Farms: (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 7: 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				
5. INO.		Marginal (64)	Small (22)	Medium (14)	Overall average	
1	Cost A <sub>1</sub> /A <sub>2</sub>	56262.84	63743.64	75640.08	61896.30	
2	Cost B <sub>1</sub>	58947.96	66607.96	78890.40	64757.26	
3	Cost B <sub>2</sub>	61633.08	80607.96	92890.40	71795.74	
4	Cost C <sub>1</sub>	72594.96	77864.96	86348.40	77237.14	
5	Cost C <sub>2</sub>	75280.08	91864.96	100348.40	84275.62	
6	Cost C <sub>3</sub>	83939.58	101051.46	110383.24	93427.33	
7	Yield Q/ha.	650.00	720.00	760.00	695.20	
8	Gross Income	182000.00	201600.00	212800.00	194656.00	
9	Net return over cost C <sub>3</sub>	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-out	tput ratio			
а	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	

#### 5. Conclusion

The analysis of socio-economic status revealed that the average percentage of males in the study sample was 52.37 percent and female was 47.66 percent. In marginal household male was 51.87 percent and female was 48.13 percent. 50.75 percent male and 46.24 percent female were in small household. Medium house hold comprised of 51.34 percent male and 48.65 female. Marginal section of farmer share only 0.55 ha, small farmer was 1.78 and medium group share 3.22 ha the average land holding of all the farmers was 1.20 hectare.

Cropping pattern analysis concluded that in kharif season Paddy, Sugarcane, Maize and Til were the major crops grown. Paddy on average was grown on 0.55 hectare (27.70 percent) land in the study sample while Sugarcane, Maize and Til were grown on 0.50 hectare (26.83 percent), 0.11 (4.40 percent) and 0.04(1.80 percent) area, respectively.

The cropping intensity analysis showed that cropping intensity of marginal household was 241.34 percent. The average cropping intensity of small and medium households

were 208.78 percent and 191.12 percent, respectively. The average cropping intensity of study sample was 201.64 percent.

The input output ratio regarding costs C3, C2,C1,B2,B1, and A2/A1 were recorded 1:2.14,1:3.37, 1;2.57, 1:2.57, 1:3.08 and 1:3.22, respectively. On the basis of cost C3 input output ratio was highest on marginal farms (1:2.17) followed by small farms (1:2.00) and medium farms (1:1.93), respectively. I t may be concluded the cost of cultivation on different size group of farm increases with an increase in farm size. But net return per hectare was found of negative trend with farm size. It was because of less increase in yield against the increased input factors at increasing size of farm.

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