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A Comparative Analysis in Cost and Returns of Sugarcane Production in Odisha, India

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A B S T R A C T

Sugarcane is a major cash crop of India, particularly in UP, Maharastra, Tamil Nadu, Karnataka, Andhra Pradesh, Bihar, Gujurat, and Foot hils of Uttarakhand. Sugarcane crop has a productivity of 70 tonnes/ha and an area of 4.2 mha. plays a pivotal role in the national economy. Sugarcane is considered as one of the best cash crops in Orissa. It is grown in all the 30 districts of Orissa. The selected district Dhenkanal occupied 10th position in area (1.19 thousand ha), 9th position in production (81.46 thousand MTs) and 14th position in yield (68510 kg/ha) in 2004-05. The establishment of a sugar factory in Dhenkanal district has increased the prospect of this crop in the surrounding area. The marginal and small farms managed to earn more net return that other two categories of sample farms in both the regions. The other measures of farm incomes, like family labour income farm business income farm investment income etc. exhibited inverse relationship with farm size in both the regions excepting few cases.

Introduction

Sugarcane is the main source of sugar in India and holds a prominent position as a cash crop. It contributes approximately 56 per cent of total sugar production in the world. Sugar is one of the oldest commodities in the world and traces its origin in 4th century AD in India and China. India is the largest consumer (18 million tones) and the second largest producer of sugar after Brazil. The Indian sugar Industry is one of the largest producers of white crystal sugar with massive enterprise of sugar factories located throughout the country with an annual turnover of Rs. 150 billion. The sugar factories located in various parts of the country work as nucleus for development of rural areas by mobilizing rural resources and generating employment, transport and communication facilities. Over 45 million farmers are dependants and a large mass of agricultural labour are involved in sugarcane cultivation, harvesting and ancillary activities. The industry employs over 0.5 million skilled and un-skilled workmen, mostly from the rural areas.

Sugarcane is considered as one of the best cash crops in Orissa. It is grown in all the 30 districts of Orissa. Among these districts, Cuttack (5.45 thousand ha), Koraput (5.24 thousand ha), Nayagarh (4.45 thousand ha), Nawarangpur (3.85 thousand ha), Ganjam (2.48 thousand ha) are leading districts in sugarcane cultivated areas in the year 2004-05. The production of sugarcane in 2004-05 was to the extent of 496.03 thousand MTs in Koraput followed by 325.03 thousand MTs in Cuttack, 276.27 thousand MTs in Nayagarh, 191.94 thousand MTs in Ganjam. The productivity varied from 94589 kg/ha in Korapur, 85800 kg/ha in Kalahandi, 83200 kg/ha in Gajapati and 82288 kg/ha in Kendrapara.

Materials and Methods

Sample design

The multi-stage stratified random sampling technique was adopted in the study. In the first stage two blocks namely Dhenkanal Sadar and Kankadahada were selected randomly, in the second stage, 16 villages were randomly selected at the rate of 8 villages per block. This constituted 5 per cent of the total number of villages of two selected blocks. In the final stage, list of sugarcane farmers was prepared separately for both types of sample villages and 10 farm households from each of the 16 sample villages were selected randomly.

Cost concept

The cost concepts generally used in farm management studies viz. cost A_1, cost A_2, cost B_1, cost B_2, cost C were considered in the present study.

Cost A_1 = Cost of hired human labour and attached labour + Cost of hired and owned bullock labour + Cost of hired and owned machine charges + Cost of pesticides, seeds, manures and fertilizers + Depreciation, repair and maintenance of implements and farm building + Irrigation charges + Land revenue, cesses and other taxes + Interest on working capital + Transportation charges

Cost A_2 = Cost A_1 + rent paid for leased in land

Cost B_1 = Cost A_2 + interest on value of owned capital assets excluding land

Cost B_2 = Cost B_1 + rental value of owned land and rent paid for leased Land

Cost C_1 = Cost B_1 + imputed value of family labour

Cost C_2 = Cost B_2 + imputed value of family labour

Farm business measures

Net income (NI) = Gross Income – Cost C

Family labour income (FLI) = Gross Income – Cost B_2

Farm Business Income (FBI) = Gross Income – Cost A_1

Owned Farm Business Income = Gross Income – Cost A_2

Farm Investment Income (FII) = Farm Business Income – Imputed value of family labour

Results and Discussion

An analysis of basic characteristics of the sample farms is considered to be of significance as it provides relevant background information against which the analysis is to be attempted. The detailed structures of the sample farms according to farm size groups have been discussed.

Size of holding

The distribution of holding according to different size groups is given in Table 1.

The average size of holding was estimated to be 2.44 ha for Dhenkanal Sadar (Region-I) and 1.89 ha in Kankadahada Block (Region-II) of the sample district. The operational size of holding of marginal, small, medium and large farmers are found to be 0.91, 1.56, 2.68 and 6.34 ha. as against 0.85, 1.51,2.73 and 6.21 ha, respectively.

Type of ownership of land

Information relating to the land ownership are given in Table 2.

It may be noted from the table that more than three-fourth of their total operational holdings accounted for owned land while the remaining were by way of leased in land on a share cropping basis. This clearly indicates that there is negligible extent of tenancy among the farmers in the area under study. On an average, the percentage of owned and leased in land worked out to 80.74 and 19.26 per cent in Dhenkanal Sadar as compared to 78.84 per cent and 21.16 per cent in Kankadahad Block. And between size groups, the proportion of leased in land increased with decrease in size of holding. This was mainly due to the fact that the marginal and small farmers were interested to make their units viable by making labour investments in their farms.

Size of family

Human labour engaged in farming is generally family members and in the peak season, hired labourers are engaged to assist the operational work. Table 3 shows the average size of family members in different size groups in the study area.

As can be seen from the table that the size of family per farm increased less than proportionately with the increase in the size of holding.

In region-I on an average, the family size worked out to 5.62, 7.81, 8.01 and 8.44 for marginal, small, medium and large farmers respectively. On the other hand in region-II, the average size of the family is worked out to 5.71, 6.92, 7.57 and 7.92 for the above respective farms. The average number of family members per farm is 7.47 and 6.75 for region-I and region-II respectively.

Family labour

Family labour constitutes the major proportion of total labour utilized in agricultural operations of the farm. Table 4 shows the variation in number of family labourers available for farm work in different size groups of farms.

Table 4 has revealed that more of family labour was available for agriculture work in the lower size group as compared to higher size group. In region-I the average number of family labour available for agricultural operations in different categories of farm sizes were 1.58, 2.35, 2.87 and 2.88 in the marginal, small, medium and large farms respectively. The magnitude in region-II was 1.82, 2.38, 2.91 and 2.99 respectively.

This shows that the number of dependents in agriculture was more in marginal and small size farms than medium and large size farms. This meant that a substantial proportion of earners in large farm categories were engaged in non-agricultural pursuits.

The marginal and small farms have no other alternatives but to depend upon agricultural occupation.

Bullock labour

Bullock labor provides drought power for undertaking various operations of farm. Table 5 shows the average number of bullocks and area operated by a pair of bullocks in different size groups.

The table indicates that there was a positive correlation between the farm size and the availability of bullocks per farm. But it was reversed when viewed on per hectare availability of bullock labourers among the sample farms. The average number of bullocks in marginal, small, medium and large size farms was worked out to 1.86, 2.22, 3.68 and 3.92 respectively in region-I. The corresponding figures in region-II are 1.52, 2.89, 3.01 and 3.28 in the respective farm categories.

As regards the average area commanded by a pair of bullocks it worked out to 0.81 for marginal, 0.86 for small, 1.16 for medium and 1.31 for the large farms with the average 1.0 ha in region-I. In region-II such magnitudes are 0.94, 1.00, 1.23 and 1.56 ha. for the respective farm categories with average 1.07 ha.

Costs and returns of sugarcane

The major emphasis of the present study is on examining the costs and returns and resource productivity on sugarcane farms. An attempt has, therefore, been made here to make a detailed analysis of costs and returns of sugarcane production in the area under study. It also analyses the marketing costs, margins price spread etc. of sugarcane.

Cost of production often becomes a policy issue when producers complain that the prices they receive for the product do not cover the cost of production which means the expenses incurred per unit of output exceeds the returns. The items of cost that go into the cost of production are both the fixed and variable costs. The data pertaining to cost of production of sugarcane are presented and discussed below.

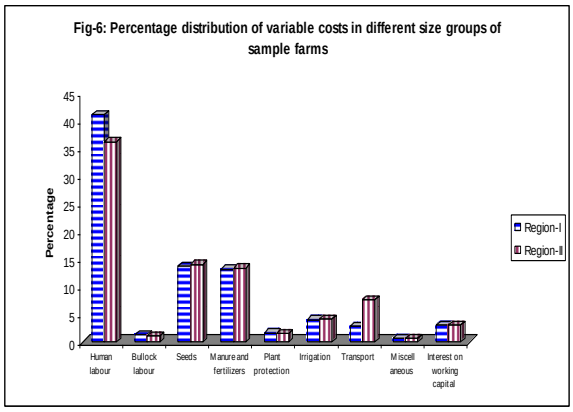
Cost of production

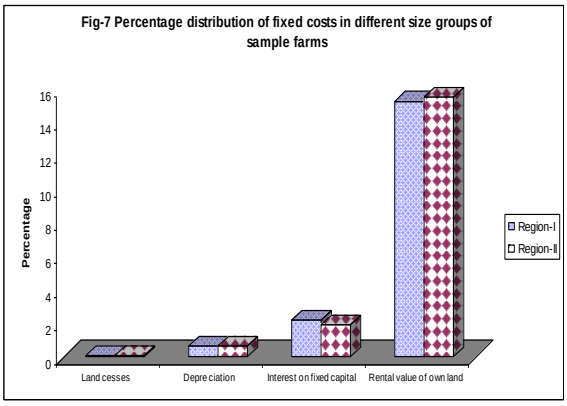
The break-up of total cost of production among different size group of farms is given in Table 6.

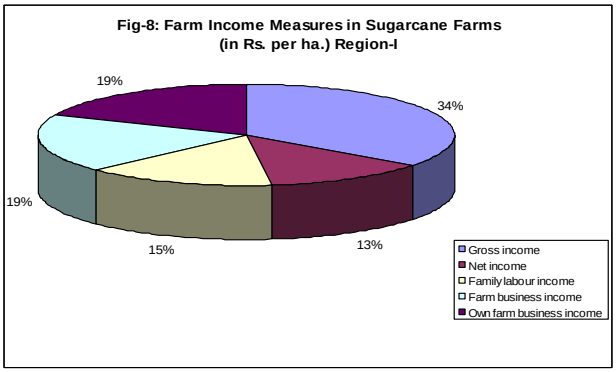
It is evident from the table that the cost of cultivation per hectare increased from Rs.50608.81 on marginal farms to Rs.51311.49 on large farms in region-I against Rs. 50124.31 in marginal farms to a decrease of Rs. 49799.22 in large farms in region-II. This meant that the large farms have incurred expenditure relatively more as compared to their counterparts in marginal farms with a variation in region-II. This also confirms our second hypothesis. The high level of such expenditure in case of large size farms was on account of heavy expenditure incurred on human labour and fertilizers.

It clearly reflects the intensive use of factor inputs on large size farms. In region-II, the cost of cultivation of sugarcane per hectare appears to be nearly same in marginal and small farms with lower application of inputs by the both farm categories.

An examination of the break-up of total cost of cultivation indicated that there exists positive relationship between variables cost and total cost of cultivation. However, the percent share of variable cost showed an inverse relationship with farm size. The proportion of this cost was 81.90 for marginal, 81.66 per cent in small 81.70 in medium and 81.39 per cent in large farms in region-I as compared to 81.56 per cent 81.44 per cent, 81.76 per cent and 81.88 per cent for the respective farms in region-II.







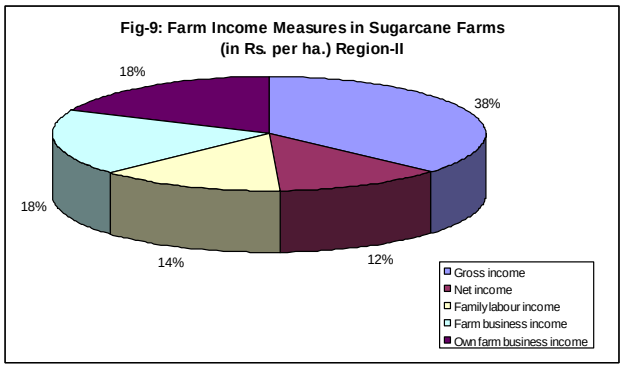


Table.1 Distribution of holding in different size groups of sample farms of blocks

Size groups	Dhenkanal Sadar (Region-I)		Kankadahada (Region-II)	
	Total No. of sample farms	Average size of operational holding (in ha.).	Total No. of sample farms	Average size of operational holding (in ha.).
I (below 1.00 ha)	18	0.91	26	0.85
II (1.01 to 2.00 ha)	28	1.56	29	1.51
III (2.01 to 4.00 ha.)	22	2.68	20	2.73
IV (4.00 and above)	12	6.34	5	6.21
Pooled	**80**	**2.44**	**80**	**1.89**

Table.2 Distribution of own and leased in land in different size groups of sample farms (in ha)

Size groups	Dhenkanal Sadar (Region-I)			Kankadahada(Region-II)		
	Average size of operational holding	**Own land**	**Leased in land**	**Average size of operational holding**	**Own land**	**Leased in land**
I	0.91 (100)	0.76 (83.53)	0.15 (16.48)	0.85 (100)	0.71 (83.53)	0.14 (16.47)
II	1.56 (100)	1.21 (77.56)	0.35 (22.44)	1.51 (100)	1.36 (90.00)	0.15 (9.93)
III	2.68 (100)	2.31 (86.31)	0.37 (13.69)	2.73 (100)	1.58 (57.88)	1.15 (42.12)
IV	6.34 (100)	5.92 (93.38)	0.42 (6.62)	6.21 (100)	5.97 (96.14)	0.24 (3.86)
Pooled	**2.44 (100)**	**1.97 (80.74)**	**0.47 (19.26)**	**1.89 (100)**	**1.49 (78.84)**	**0.40 (21.16)**

(Figures in parentheses are percentages)

Table.3 Distribution of average size of family

Size groups	Dhenkanal Sadar (Region-I)		Kankadahada(Region-II)	
	No. of family members per farm	No. of family members per hectare	No. of family members per farm	No. of family members per hectare
I	5.62	6.92	5.71	6.65
II	7.81	4.81	6.92	4.87
III	8.01	3.19	7.57	3.14
IV	8.44	3.05	7.92	3.01
Pooled	**7.47**	**4.58**	**6.75**	**4.90**

Table.4 Distribution of family labour in different size groups of sample farms

Block	Size groups	Total no. of earners/ farm	No. of agril. Earners/ farm	Percentage of agril. Earners to total earners	No. of earners per ha.	No. of earners in agril. Per ha.
Dhenkanal Sadar (Region-I)	I	1.92	1.58	82.13	2.21	1.98
	II	3.01	2.35	78.16	2.01	1.76
	III	3.73	2.87	76.98	1.62	1.43
	IV	3.87	2.88	74.52	1.41	1.29
	Pooled	**3.09**	**2.40**	**78.18**	**1.86**	**1.65**
Kankadahada (Region-II)	I	2.21	1.82	82.35	2.62	2.12
	II	3.12	2.38	76.28	2.33	1.96
	III	3.78	2.91	76.98	1.98	1.78
	IV	3.91	2.99	76.47	1.67	1.57
	Pooled	**3.04**	**2.37**	**78.44**	**2.30**	**1.94**

Table.5 Distribution of bullock labour in sample farms and average cultivated area peer pair of bullocks

Size groups	Dhenkanal Sadar (Region-I)			Kankadahada (Region-II)		
	No. of bullocks per farm	No. of bullocks per ha	Area per pair of bullocks (ha)	No. of bullocks per farm	No. of bullocks per ha.	Area per pair of bullocks (ha)
I	1.86	2.46	0.81	1.52	2.12	0.94
II	2.22	2.32	0.86	2.89	2.01	1.00
III	3.68	1.72	1.16	3.01	1.62	1.23
IV	3.92	1.53	1.31	3.28	1.28	1.56
Pooled	**2.80**	**2.07**	**1.00**	**2.50**	**1.90**	**1.07**

Table.6 Cost structure of sugarcane per hectare

Size groups		(A) Variable costs										(B) Fixed costs					
		Human labour	Bullock labour	Seeds	Manure and fertilizers	Plant protection	Irrigation	Transport	Miscell-aneous	Interest on working capital	Sub-total	Land cesses	Depre-ciation	Interest on fixed capital	Rental value of own land	Sub – total	Cost of produ-ction (A+ B)
Dhenkanal	I	20575.77	703.98	7028.09	6793.18	850.12	2015.31	1540.21	380.85	1560.20	**41447.71**	48.25	345.25	1099.02	7668.58	9161.10	**50608.81**
	II	20815.68	706.00	6985.13	6705.32	845.89	2035.47	1450.32	345.12	1538.21	**41427.14**	46.35	355.29	1125.25	7775.98	9302.87	**50730.01**
	III	21104.89	702.24	7005.82	6700.15	840.61	2105.72	1420.33	327.23	1550.87	**41757.86**	49.67	339.54	1138.25	7828.25	9355.71	**51113.57**
	IV	21015.88	699.68	6997.31	6696.37	835.28	2112.52	1460.28	325.67	1620.86	**41763.85**	47.66	349.25	1225.38	7925.35	9547.64	**51311.49**
	Pooled	**20871.26**	**703.56**	**7002.31**	**6722.32**	**843.80**	**2061.81**	**1463.79**	**345.32**	**1559.04**	41573.22	**47.89**	**347.79**	**1137.94**	**7788.59**	**9322.22**	50895.44
Kankadahad (Region-II)	I	18024.00	542.48	7015.38	6698.15	825.75	2025.27	3870.25	372.31	1510.11	**40883.70**	37.86	335.25	985.25	7882.25	9240.61	**50124.31**
	II	18000.00	555.30	6980.51	6680.21	801.57	2042.25	3790.15	342.67	1490.75	**40683.41**	38.25	332.28	976.25	7622.53	8969.31	**49652.72**
	III	18020.00	575.92	6996.05	6625.11	800.68	2105.27	3770.38	325.01	1520.89	**40739.31**	39.22	337.65	950.63	7758.21	9085.71	**49825.02**
	IV	17999.47	597.94	7009.27	6615.22	798.17	2100.97	3720.65	322.27	1610.83	**40774.79**	36.33	338.53	960.33	7689.24	9024.43	**49799.22**
	Pooled	**18012.77**	**558.95**	**6997.53**	**6668.20**	**808.99**	**2056.16**	**3806.90**	**346.61**	**1512.08**	40768.19	**38.25**	**334.98**	**971.78**	**7745.03**	**9090.03**	49858.22

Table.7 Percentage distribution of costs in different size groups of sample Sarms

Size Groups		(A) Variable costs										(B) Fixed costs					
		Human labour	Bullock labour	Seeds	Manure and fertilizers	Plant protection	Irrigation	Transport	Miscell aneous	Interest on working capital	Sub-total	Land cesses	Depre ciation	Interest on fixed capital	Rental value of own land	Sub – total	Cost of produ ction (A+ B)
Dhenkanal Sadar (Region-I)	I	40.66	1.39	13.89	13.42	1.68	3.98	3.04	0.75	3.08	81.90	0.10	0.68	2.17	15.15	18.10	100.00
	II	41.03	1.39	13.77	13.22	1.67	4.01	2.86	0.68	3.03	81.66	0.09	0.70	2.22	15.33	18.34	100.00
	III	41.29	1.37	13.71	13.11	1.64	4.12	2.78	0.64	3.03	81.70	0.10	0.66	2.23	15.32	18.30	100.00
	IV	40.96	1.36	13.64	13.05	1.63	4.12	2.85	0.63	3.16	81.39	0.09	0.68	2.39	15.45	18.61	100.00
	Pooled	**41.01**	**1.38**	**13.76**	**13.21**	**1.66**	**4.05**	**2.88**	**0.68**	**3.06**	**81.68**	**0.09**	**0.68**	**2.24**	**15.30**	**18.32**	**100.00**
Kankadahad (Region-II)	I	35.96	1.08	14.00	13.36	1.65	4.04	7.72	0.74	3.01	81.56	0.08	0.67	1.97	15.73	18.44	100.00
	II	36.25	1.12	14.06	13.45	1.61	4.11	7.63	0.69	3.00	81.94	0.08	0.67	1.97	15.35	18.06	100.00
	III	36.17	1.16	14.04	13.30	1.61	4.23	7.57	0.65	3.05	81.76	0.08	0.68	1.91	15.57	18.24	100.00
	IV	36.14	1.20	14.08	13.28	1.60	4.22	7.47	0.65	3.23	81.88	0.07	0.68	1.93	15.44	18.12	100.00
	pooled	**36.13**	**1.12**	**14.03**	**13.37**	**1.62**	**4.12**	**7.64**	**0.70**	**3.03**	**81.77**	**0.08**	**0.67**	**1.95**	**15.53**	**18.23**	**100.00**

Table.8 Unit cost of production and productivity in sugarcane

Blocks	Size of groups	Gross cost/ha (Rs.)	Yield of sugarcane/ ha. (Tonnes)	Cost of production of sugarcane/ Tonne (Rs.)	Cost of production/Qtl. (Rs)
Dhenkanal Sadar (Region-I)	I	50608.81	74.35	680.68	68.07
	II	50730.01	74.01	685.45	68.54
	III	51113.57	73.85	692.13	69.21
	IV	51311.49	72.95	703.38	70.34
	Pooled	**50895.44**	**73.88**	**688.90**	**68.89**
Kankadahada (Region-II)	I	50124.31	70.37	712.30	71.23
	II	49652.72	69.68	712.58	71.26
	III	49825.02	68.78	724.41	72.44
	IV	49799.22	68.12	731.05	73.11
	Pooled	**49858.22**	**69.58**	**716.60**	**71.66**

Table.9 Structure of production costs in sugarcane farms (in Rs.)

Blocks	Size groups	Cost A_1	Cost A_2	Cost B_1	Cost B_2	Cost C
Dhenkanal Sadar (Region-I)	I	37260.69	37260.69	38359.71	46028.29	50608.81
	II	37589.05	37589.05	38714.30	46490.28	50730.01
	III	38043.46	38043.46	39181.71	47009.96	51113.57
	IV	38595.55	38595.55	39820.93	47746.28	51311.49
	Pooled	**37791.11**	**37791.11**	**38929.05**	**46717.64**	**50895.44**
Kankadahada (Region-II)	I	37458.50	37458.50	38443.75	46326.00	50124.31
	II	37392.19	37392.19	38368.44	45990.97	49652.72
	III	37506.87	37506.87	38457.50	46215.71	49825.02
	IV	37562.20	37562.20	38522.53	46211.77	49799.22
	Pooled	**37453.04**	**37453.04**	**38424.81**	**46169.84**	**49858.22**

Table.10 farm income measures in sugarcane farms (in Rs. per ha.)

Blocks	Size groups	Gross income	Net income	Family labour income	Farm business income	Own farm business income
Dhenkanal Sadar (Region-I)	I	80298.00	29689.19	34269.71	43037.31	43037.31
	II	79930.80	29200.79	33440.52	42341.75	42341.75
	III	79758.00	28644.43	32748.04	41714.54	41714.54
	IV	78786.00	27474.51	31039.72	40190.45	40190.45
	Pooled	**79794.18**	**28898.74**	**33076.54**	**42003.07**	**42003.07**
Kankadahada (Region-II)	I	75999.60	25875.29	29673.60	38541.10	38541.10
	II	75254.40	25601.68	29263.43	37862.21	37862.21
	III	74282.40	24457.38	28066.69	36775.53	36775.53
	IV	73569.60	23770.38	27357.83	36007.40	36007.40
	Pooled	**75148.29**	**25290.07**	**28978.45**	**37695.25**	**37695.25**

Table.11 Regression co-efficient of inputs, return to scale and co-efficient of multiple determination for sugarcane farms

Items	Dhenkanal Sadar (Region-I)					Kankadahada (Region-II)				
	Marginal farms	Small farms	Medium farms	Large farms	Pooled	Marginal farms	Small farms	Medium farms	Large farms	Pooled
Area and other crops	1.087* (0.233)	2.126* (0.342)	1.366* (0.098)	1.706* (0.413)	0.897* (0.2016)	1.021* (0.129)	1.507* (0.137)	1.687* (0.046)	1.328* (0.303)	0.6344* (0.2136)
Bullock labour	0.313* (0.021)	0.216* (0.032)	0.283 (0.081)	1.086 (1.203)	0.769 (0.532)	0.177* (0.018)	0.244* (0.025)	1.084 (1.165)	1.188 (1.781)	0.811 (0.723)
Human labour	-2.063* (0.628)	2.176* (0.733)	0.061 (0.078)	1.434 (0.367)	0.321* (0.066)	-2.112* (0.607)	-2.698* (0.823)	1.849 (0.313)	2.014 (0.498)	0.401* (0.073)
Fertilizers & manure	0.631* (0.102)	0.724* (0.133)	0.716* (0.202)	0.838* (0.197)	0.677* (0.135)	0.534* (0.106)	0.618* (0.122)	0.609* (0.145)	0.718* (0.181)	0.603* (0.159)
Irrigation	0.428* (0.093)	0.449* (1.087)	0.533* (0.092)	0.468* (0.086)	0.379 (0.021)	0.421* (0.082)	0.434* (0.088)	0.399 (0.027)	0.452* (0.036)	0.316 (0.075)
Seeds	1.234 (1.196)	1.609 (1.012)	-2.036 (1.925)	-3.017 (1.811)	2.872 (1.578)	-2.306 (1.895)	-1.989 (1.733)	-3.122 (1.936)	-3.827 (1.364)	-2.938 (1.626)
$\sum b_i$	1.645	1.894	1.673	1.792	1.830	1.737	1.708	1.836	1.899	1.803
R_2	0.83	0.87	0.81	0.83	0.833	0.76	0.78	0.79	0.74	0.77
N	18	28	22	12	80	26	29	20	5	80

* Significant at 1 per cent level
Figures without any asterisk are not statistically different from zero.
Figures in parenthesis are standard errors.

18.10 per cent for marginal, 18.34 per cent for small, 18.30 per cent for medium and 18.61 per cent for larger farms in region-I as compared to 18.44 per cent, 18.06 per cent, 18.24 per cent and 18.12 per cent for the above categories of farms respectively in region-II. Thus variable costs accounted for 81.39 to 81.94 per cent of the total cost of sugarcane cultivation in the study area. In case of fixed cost, there was a direct relationship between size of farm and fixed costs. The total fixed costs constituted 16.40 per cent for small, 17.97 per cent for medium and 18.10 per cent for large farms.

The table further indicated that among the various cost concepts on different farm sizes, maximum expenditure was due to human labour followed by rental value on own land, seeds and fertilizers and manure used by farms. In region-I the share of human labour to total expenditure was 40.66, 41.03 and 41.29 and 40.96 per cent for marginal, small, medium and large farms respectively. In region-II such magnitude are 35.96, 36.25, 36.17 and 36.14 per cent for the respective farms.

This showed that sugarcane was a labour intensive crop. The next important component of total cost of cultivation in sugarcane crop was rental value on own land and seeds which were worked out to be on an average Rs.7668.58 and Rs.7028.09 for marginal, Rs. 7775.98 small, Rs.6985.13 for small Rs.7828.25 and Rs. 7005.82 for medium and Rs.7925.35 and Rs.6997.31 for large farms in region-I. Such figures in region-II are Rs. 7882.25 and Rs. 7015.38 for marginal Rs. 7622.53 and Rs.6980.51 for small, Rs. 7758.21 and Rs. 6996.05 for medium and Rs. 7689.24 and Rs. 7009.27 for large. Among the remaining items no such proportionate expenditure could be observed in any of the items reported under cost of sugarcane cultivation.

Among the fixed cost items, land cess, depreciation and interest on fixed capital combined together accounted for 92.95 to 3.16 per cent in different categories of sample farms in region-I as against 2.67 to 2.72 per cent in region-II.

Unit cost of production

The details of per hectare yield and cost of production of sugarcane per quintal are presented in Table 8.

It may be noted from the table that higher level of productivity was observed on large size farms followed by medium small and marginal size farms in both the regions. The average yield of sugarcane per hectare was worked out to 73.88 tonnes and 69.58 tonnes in regions-I and region-II respectively. The average yield per hectare has decreased marginally with increase in farm sizes. The marginal and small size farms are found to be efficient in utilizing resource which has contributed to higher level of productivity than other categories of farms. This is again conformity with our second hypothesis

The per quintal cost of production of sugarcane was of the highest order on large farms followed by medium, small and marginal farms in both regions. At the aggregate level the per quintal cost of production of sugarcane was Rs. 68.89 in region-I and Rs. 71.66 in region-II. The higher unit cost of production of sugarcane has been attributed due to higher cost of transport of cane to the factory.

The above findings clearly reflect the efficiency of different categories of sample farms. The results revealed that the economics on marginal and small farm was very much encouraging in contrast to the medium and small farms in the area under study. This might be due to the fact that when the farm

size was more, due to less efficient use of resources unit cost of production becomes more. This finding is in contradiction to the findings of other research workers who have found that sugarcane cultivation was more profitable on large farms as compared to small ones.

Cost concepts

The different cost concepts used in this study are A_1, A_2, B_1, B_2 and C based on these cost concepts the production cost of sugarcane was calculated and presented in Table 9.

An examination of various cost concepts in different size groups of farms revealed that cost A_1 was the highest on large farms followed by medium small and marginal farms in both the regions. On an average, it worked out to Rs.29198.61 for marginal, Rs. 29411.43 small, Rs.29826.00 for medium and Rs.30273.29 for large farms respectively. In region-I as against Rs. 29203.14, Rs. 29399.13, Rs. 29371.79 and Rs. 29498.10 for the respective farms in region-II. Cost A_2 is found lower in large size farms then other categories of farms due to absence of lease in land in both the regions. In the remaining categories of farms the difference in cost A_2 was due to the leased in land. Like cost A_1, cost B_1 was also highest on large farms followed by medium, small and marginal farms in both the regions. Similar trend is also found in case of Cost B_2. On an average, cost C estimated to be Rs.34922.57 in region-I as compared to Rs. 33994.94 in region-II. The variation in cost C is primarily due to the difference in transportation cost.

With regard to variation between cost B_1, B_2 and cost C, it was found to be marginally higher on large farms than that of medium, small and marginal farms. While the family labour utilization was more on the later category other cost components are higher in the farmer category. The variations in B_1, B_2 and C between the two regions appears to be fairly unequal.

Measures of farm income

The various measures of farm income i.e. net income, family labour income; farm business income and farm investment income were calculated and presented in Table 10.

It may be observed from the table that marginal size farms recorded the highest net income followed by small, medium, and large farms in both the regions. On an average, it worked out to Rs.29689.19, Rs.29200.79, Rs. 28644.43 and Rs. 27474.51 on marginal, small, medium and large farms respectively in region-I. In region-II such magnitudes are Rs. 25875.29, Rs. 25601.68, Rs. 24457.38 and Rs. 23770.38 for the respective farms.

Same trend was observed in the farm business income showed the same trend which varied from Rs.40190.45 on large farms to Rs.43037.31 on marginal farms with an overall average of Rs.42003.07 in region-I as compared to Rs. 37095.25 in region-II. This clearly shows that there was a positive relationship between per hectare farm business income and family size.

The family labour income realized by the marginal, small, medium and large farms on an average was Rs.34269.71, Rs.33440.52, Rs32748.04 and Rs.31039.72 respectively in region-I.In region-II such magnitude are Rs 29673.60, Rs 29263.43 Rs 28066.69 and Rs 27357.83 for the respective farms.

Production function analysis

With a view to examining the efficiency of various input factors employed in the production of sugarcane, production function analysis was carried out.

Cobb-Douglas function was selected for this study because of its relative advantages over other production functions. With this function, elasticities of production are computed directly. The sum of elasticities ($\sum b_i$) indicates the nature of return to scale. If the sum of elasticities is equal to one, greater than one and less than one, it indicates constant, increasing and decreasing returns to scale respectively.

Zero order correlation matrices for all the variables were worked out to study the problem of multicolinearity. It was found that the interaction between inputs was low enough to wad any impact on sugarcane output. The results of the cobb-Douglas production function are presented in Table 11.

The results revealed that the regression co-efficient associated with land area were found to be positive and significant in all size categories in both the regions. This was also reflected when all size groups were pooled together, indicating thereby that if area under this crop is increased the returns per hectare will also increase.

Regression co-efficient associated with bullock labour, fertilizers and irrigation on marginal, small and medium farms and human labour, fertilizer on large farms were positive and significant indicating thereby that these resources contributed significantly to the returns of this crop. However seeds did not enter as one of the significant variable in any of the farm size groups and regions.

The negative and significant co-efficient of human labour on marginal and small farms indicated that these farms are using this input in excess quantity. When the data for all farm size groups were pooled together, human labour, fertilizers and irrigation were found to have positive and significant relationship with returns from sugarcane.

The value of R_2 (Co-efficient of Multiple determination) was found to be 0.83, 0.87, 0.81, 0.83 and 8.33 in region-I for marginal, small, medium, large farms respectively as compared to 0.78, 0.76, 0.79 and 0.74 for the respective fars in region-II. It indicates that 83, 87, 81 and 83 percent of variation in gross return could be explained by all the explanatory variables included in the equation in region-I as compared to 78, 76, 79 and 74 percent in region-II.

The sum of elasticities was 1.645, 1.894, 1.673 and 1.792 for marginal, small, medium and large farms in region-I respectively indicating increasing return to scale. Increasing return to scale is also observed in region-II with magnitude 1.708, 1.737, 1.836 and 1.899 for the respective farm sizes. A comparison revealed that in region-I has advantage over region-II with higher magnitude of returns to scale.

The above analysis revealed that economic of sugarcane production in Dhenkanal district of Odisha has been fluctuating though it has potential as per the perception of sampled farmers. It emerged from the study that the marginal and small farms managed to earn more net return that other two categories of sample farms in both the regions. The other measures of farm incomes, like family labour income farm business income farm investment income etc. exhibited inverse relationship with farm size in both the regions excepting few cases.

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