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COMPARATIVE ANALYSIS OF COSTS AND RETURNS ACROSS FARM SIZES FOR SUGARCANE PRODUCTION IN MANDYA DISTRICT, KARNATAKA

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ABSTRACT
The study examines the cost and returns of sugarcane cultivation across various farm sizes. The study indicates that the total cost of cultivation tends to vary across different farm sizes, with marginal farms incurring the lowest cost and large farms incurring the highest. It also highlights cost variations between main and ratoon crops, emphasizing labor, material, and power costs. Larger farms incur higher production costs but yield greater net returns, with ratoon crops generally more profitable. ANOVA analysis underscores significant differences in costs and returns among farmer categories. Despite the main crop's higher productivity, lower returns compared to ratoon crops contribute to the latter's continuity. The paper concludes that the profitability of the ratoon crop serves as a key incentive for continuing sugarcane cultivation despite the higher costs associated with the main crop.

KEYWORDS: *Sugarcane, Cost, Returns, Ratoon and Main crop*

INTRODUCTION
Agriculture plays an important role in every economy. In India agriculture considered hasthe backbone of the country and despite concerted industrialization in thelastseven decades,agriculture still occupies a place of pride. The significance of agriculture in the national economycan be best explained by considering the role of agriculture under different heads. From the monetary point of view, agriculture sector in the economy contributes 17.4percent of the GDP of the country in 2019-20. In the fiscal year 1950-51agriculture accounted for 55.4percent of the GDP. The share of the agriculture has been falling in the country's gross income while industrial and services sectors shares have been on a rise constantly.But from the livelihoodpoint of view still 48.7 percent of the people of India depend on the agriculture sector. It showsthatagriculture sector is stillimportantthan the industry andthe services sectors. Agriculturestill contributes significantly to India's GDP despite of its declining trend. (Economic survey2019-20)

Farmers grow wide variety of crops. These include food crops, commercial crops, oilseeds etc., Sugarcane is one of the most important commercial crops grown in India. In India, Karnataka stands 3rd in cane production next to Uttar Pradesh and MaharashtraStates and 2nd with respecttosugar recovery after Maharashtra. Sugarcane is grown in 16 districts of the state. Belgaum, Bagalkot, Bijapur, Mandya, Mysore, Chamarajanagar and Bidar arethe major sugarcane producing districts in Karnataka.

Sugarcane production in Mandya District, Karnataka, plays a pivotal role in the region's agricultural landscape and economy. This comparative analysis aims to explore the costs and returns associated with sugarcane farming across various farm sizes. Mandya District is renowned for its diverse farming practices, and understanding the financial dynamics of sugarcane cultivation across different scales of operation is essential for informed decision-making among farmers and policymakers. By examining the cost structures, revenue streams, and profitability metrics, this study seeks to provide valuable insights into the comparative efficiencies and challenges faced by sugarcane producers, contributing to the sustainable development of agriculture in the region.

REVIEW OF LITERATURE
Verma L.K & Solanki A (2020) in their study revealed the cost of cultivation of sugarcane was amounted as 87491.30 Rs/ha. major share of cost of cultivation gone to human labour cost being 40.20 percent. The net return against the cost of cultivation observed Rs 136941.07 ha. The input-output ratio of sugarcane came to 1:2.56. The study suggested that during peak period of agricultural operation the unavailability of sufficient labours and available at very high cost. To avoid the escalation of cost and better use of inputs mechanization may be encouraged.

Kumar T (2014) in their study emphasized that per hectare cost of sugarcane (planted) was Rs. 89712.33, net returns amounted to Rs. 16914.66/ha, the cost of production per quintal was estimated to be Rs 160.91 and the profit margin was Rs. 42.35. The estimated per hectare cost of sugarcane (ratoon) was Rs. 78668.60, net returns amounted to Rs. 85741.30/ha, the cost of production per quintal was estimated to be Rs. 98.00 and the profit margin was Rs. 106.94. The benefit cost analysis of the sugarcane (planted) fetched 1.18 times return over cost

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invested, whereas in sugarcane (ratoon) fetched 2.08 times returns over cost invested.

Saravanan A (2016) in his study found that an average sugarcane cultivating farmer in the area spent 14.40 percent of the total cost on seed, 5.32 percent (appropriated cost) on family labour, 64.96 percent on hired labour, 5.67 percent on machinery used for different operations, 6.04 percent on chemical fertilizer and 3.61 percent on pesticide, realised a net return of Rs.26424 per acre. This might be due to the fact that the benefit of economies of scale has reached its maximum only at the farm size of 5-7.5 acres. The study recommended that can improve cropping system and stabilizes farm income to the farmers; the Government intervention is sought in a manner that there is unbiased credit support for farms of all categories without discrimination.

METHODOLOGY

Present study is carried out in Mandya&Maddur thaluks of Mandya district as area under sugarcane cultivation was maximum in these two thaluk and K.R Pete &Malavalli thaluk as less area under sugarcane cultivation except Nagamangala thaluk due to very less irrigation facilities for Nagamangala thaluk. From the selected fourthaluks, a list of the farmers was prepared and a sample of 182, 126, 77, 13 and 2 farmers (total 400) from each size group, i. e Marginal (up to 1 ha). small (1 to 2 ha), semi-medium (2 to 5 ha), medium (5 to 10 ha) and large (> 10 ha) was selected in their probability proportion for the collection of data. The sugarcane cultivators were classified into two groups on the basis of type of sugarcane grown i.e. main crop of sugarcane (189 cultivators) and ratoon sugarcane (211 cultivators). The data related to the agricultural year 2021-2022 were collected by personal interviews with the sugarcane cultivators.

RESULTS AND DISCUSSIONS

Cost of cultivation of sugarcane under different farm size (Rs/Acre) in planted crop

Particular	Marginal	Small	Semi-Medium	Medium	Large	Overall
Seed	9369.88 (16.69)	9342.87 (16.13)	10887.91 (18.62)	11500.78 (19.17)	9200.45 (14.40)	9620.97 (17.03)
Fertilizer& Manure	23460.22 (40.55)	23045.46 (39.79)	22450.99 (38.40)	26500.24 (44.19)	26250 (41.11)	22854.39 (40.46)
Pesticides& Insecticides	2108.89 (3.64)	2000.45 (3.45)	1651.80 (2.82)	1800.05 (3.00)	1750 (2.74)	1813.86 (3.21)
Total Material cost (A)	**34939 (60.40)**	**34388.79 (59.38)**	**34990.70 (59.85)**	**39801.08 (66.37)**	**37200.45 (58.26)**	**34289.23 (60.70)**
Family Labour	6741.9 (11.66)	6731.86 (11.62)	7198.69 (12.31)	5950.35 (9.92)	8500 (13.31)	6402.41 (12.09)
Hired Labour	7955.49 (13.75)	7996.83 (13.80)	7320.13 (12.52)	6815.38 (11.36)	6800 (10.64)	7796.87 (13.80)
Total Human Labour (B)	**14697.39 (25.41)**	**14728.69 (25.43)**	**14518.82 (24.83)**	**12765.73 (21.29)**	**15300 (23.96)**	**14402.12 (24.80)**
Animal Labour	3771.56 (6.52)	4189.30 (7.23)	4355.31 (7.44)	3600.05 (6.00)	3850 (6.02)	4009.84 (7.09)
Machine Labour	4437.46 (7.67)	4602.54 (7.94)	4597.26 (7.86)	3800.12 (6.33)	7500 (11.74)	4987.47 (8.58)
Total power use cost (C)	**8209.02 (14.19)**	**8791.84 (15.18)**	**8952.57 (15.31)**	**7400.17 (12.34)**	**11350 (17.78)**	**8940.72 (15.39)**
TC (A+B+C)	**57845.42**	**57909.34**	**58462.10**	**59966.75**	**63850.45**	**58083.23**

Table 1 revealed that per acre cost of production of sugarcane planted for the year 2020-21. It was observed that on total cost of production per acre was Rs.58083.23 and among the farm size it was Rs.57845.42, Rs.57909.34, Rs.58462.10, Rs.59966.75 and Rs.63850.45 on marginal, small. Semi-medium, medium and large farmers, respectively. It showed that the cost of production increased directly with the farm size. Thus, it could be concluded that total cost of cultivation was increasing with respect to farm size holding due to bigger farmers could incurred more expenditure on the material inputs. (Verma. L.K. 2020)

In total cost the shares was found to be maximum in material cost 60.70 percent followed by human labour cost 24.80 percent, cost of total power used was observed to be 15.39 respectively. In material cost, the share of fertilizer & manure was 40.46 percent and seed 17.03 percent was noticed to be the major cost. While human labour cost, the share of hired cost being 13.80 percent was comparatively more than that of family labour cost 12.09 percent. The share of machine power 8.58 percent was more than that of bullock power 7.09 percent.

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Cost of cultivation of sugarcane under different farm size (Rs/Acre) in Ratoon crop

Particular	Marginal	Small	Semi-Medium	Medium	Large	Overall
Seed	0	0	0	0	0	0
Fertilizer & Manure	14680.75 (36.68)	15420.36 (37.28)	15680.57 (37.19)	16875.45 (37.81)	17025.87 (36.93)	15936.6 (37.19)
Pesticides & Insecticides	2300.25 (5.74)	2745.69 (6.63)	2520.78 (5.97)	2678.45 (6.00)	2985.63 (6.47)	2646.16 (6.17)
Total material cost (A)	**16981 (42.43)**	**18166.05 (43.91)**	**18201.35 (43.17)**	**19553.9 (43.82)**	**20011.5 (43.41)**	**18582.76 (43.36)**
Hired Labour	12560.45 (31.38)	12895.57 (31.17)	13050.58 (30.95)	13515.85 (30.29)	14250.23 (30.91)	13254.54 (30.93)
Family Labour	6548.24 (16.36)	7100.24 (17.16)	7058.89 (16.74)	7900.85 (17.70)	7980.45 (17.31)	7317.73 (17.07)
Total human labour (B)	**19108.69 (47.75)**	**19995.81 (48.34)**	**20109.47 (47.70)**	**21416.7 (47.99)**	**22230.68 (48.22)**	**20572.27 (48.00)**
Animal Labour	1526.21 (3.81)	1825.48 (4.41)	2005.56 (4.75)	2650.25 (5.93)	2854.23 (6.19)	2172.34 (5.06)
Machine Labour	2400 (5.99)	2564.2 (6.19)	2600.58 (6.16)	2815.15 (6.30)	2850.45 (6.18)	2646.09 (6.17)
Total power use cost (C)	**3926.21 (9.81)**	**3200.54 (7.73)**	**3845.62 (9.12)**	**3650.25 (8.18)**	**3854.23 (8.36)**	**3695.37 (8.62)**
TC (A+B+C)	**40015.9**	**41362.4**	**42156.44**	**44620.85**	**46096.41**	**42850.4**

Table 1 revealed that per acre cost of production of sugarcane planted for the year 2020-21. It was observed that on total cost of production per acre was Rs.42850.4 and among the farm size it was Rs.40015.9, 41362.4, 42156.44, 44620.85 and 46096.41 on marginal, small. Semi-medium, medium and large farmers, respectively. It showed that the cost of production increased directly with the farm size. Thus, it could be concluded that total cost of cultivation was increasing with respect to farm size holding due to bigger farmers could incurred more expenditure on the material inputs. (Verma. L.K. 2020)

In total cost the shares was found to be maximum in human labour cost 48.00 percent followed by material cost 43.36 percent, cost of total power used was observed to be 8.62 respectively. In material cost, the share of fertilizer & manure was 37.19 percent and pesticides & insecticides 6.17 percent was noticed to be the major cost. While human labour cost, the share of hired cost being 30.93 percent was comparatively more than that of family labour cost 17.07 percent. The share of machine power 6.17 percent was more than that of bullock power 5.06 percent.

1. **There is a significant difference in cost of sugarcane production by different categories of farmers in Mandya district.**

To test whether the cost of sugarcane production is same across different categories farmers or not, the Analysis of Variance (ANOVA) test has been used and the results have been presented below.

Descriptive statistics of cost of sugarcane cultivators across different categories of farmer

Categories of farmer	N	Mean	Std. Deviation	Std. Error
Marginal farmer	182	48930.66	8666.286	642.3879
Small farmer	126	49635.87	8196.28	730.1827
Semi-medium farmer	77	50309.27	6093.851	694.4588
Medium Farmer	13	52293.80	9046.367	2509.011
Large farmer	2	54973.43	9223.372	9223.372
Total	400	50466.81	8178.529	408.9265

Source : Field survey

The table presents the descriptive statistics of cost of sugarcane cultivators across different categories of farmer. The results show the average cost of sugarcane to different categories farmer and we can see that the average cost of sugarcane production to large farmer is the highest (Rs. 54973.43) followed by the medium farmer (Rs. 52293.80). As shown by the standard deviation, the variation in the cost of sugarcane to these categories of farmer is high for the medium and large farmers as compared to semi-medium, small and marginal farmer.

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ANOVA test for cost ofsugarcane cultivators across different categories of farmer

Variances	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	676237409.822	4	169059352.456	2.567	.038
Within Groups	26012209280.680	395	65853694.381		
Total	26688446690.502	399			

Source : Field survey

The table presents the results of ANOVA test. The results reveal that there is a significant difference in the cost of sugarcane production across different categories of farmer in Mandya district. It is observed by the calculated value of 'F' which is 2.567 and a probability value of 0.038 which is statistically significant at 5% level of significance. But one of the limitations of ANOVA test is that though it tells us that there is a significant difference in cost of sugarcane production across different categories of farmer, it doesn't tell us which sector is statistically significantly different from other categories of farmer in terms of cost incurred. It fails to explains whether there exits a significant difference among all categories of farmers or not and also whether there is similarity or same cost of sugarcane production among few farmers or not. Hence, to see which category of farmer is statistically different from others in terms of cost of sugarcane production incurred, Post Hoc Test developed by Duncan is used and results are presented in the table below.

Post Hoc Duncan Test forcost ofsugarcane cultivators across different categories of farmer

Groups	N	Subset for alpha = 0.05	
		1	2
1	182	48930.66	
2	126	49635.87	
3	77	50309.27	
5	2		52293.80
4	13		54973.43
Sig.		.252	.146
Means for groups in homogeneous subsets are displayed.			

Source : Field survey

The results reveal that the test divides the five categories of farmer into two groups which means there is homogeneity (same means between 1st, 2nd and 3rd groups) within groups. Though there is a difference in the mean cost of sugarcane on these 3 categories, statistically there is no significant difference. But the other groups (4^{th} and 5^{th}) are significantly different from the other groups. There is no statistical difference in the mean cost of sugarcane production on 1st group and 2nd group but there are statistically different from rest of the groups. It just means that variations exist between groups and not within groups in terms of cost of sugarcane production on different categories of farmer. Thus, the Post Hoc test grouped cost of sugarcane production on 5 categories of farmer into 2 groups.

RETURNS OF SUGARCANE PRODUCTION

Net returns of sugarcane production in planted crop

Particular	Marginal	Small	Semi-Medium	Medium	Large	Overall
TC	57845.42	57909.34	58462.1	59966.75	63850.45	59606.81
Yield	60.24	61.58	62.52	65.23	69.85	63.884
Gross Return	111444	113923	115662	120675.5	129222.5	118185.4
Net Return	53598.58	56013.66	57199.9	60708.75	65372.05	58578.59
Cost Of Production (Rs/Tonne)	960.24	940.392	935.09	919.31	914.10	933.83
B:C	1 :1.93	1 :1.97	1 :1.98	1 :2.01	1 :2.02	1 :1.98

Estimated yields per acre of sugarcane planted on marginal, small, semi-medium, medium and large size of farms averaged to 60.24, 61.58, 62.52, 65.23 and 69.85, respectively, with an average of 63.88.

The average gross returns were Rs.111444, Rs.113923, Rs.115662, Rs.120675.5 and Rs.129222.5/acre on marginal, small, semi-medium, medium and large size farms, respectively, with an average of Rs.118185.4/acre.

The net returns per acre were Rs.53598.58, Rs.56013.66, Rs.57199.9, Rs.60708.75 and Rs.65372.05/acre on marginal, small, semi-medium, medium and large size farms, respectively with an average of Rs.58578.588. the higher net returns of medium and large farms were due to the higher yields and low cost of production on large farms. However, no much difference was observed in the per tonne cost of sugarcane production among the categories. The cost of cane production per tonne was 933.83, while it was Rs. 960.24, Rs.940.39, Rs.935.09,

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Rs.919.31 and Rs.914.10. the benefit cost ratio of the sugarcane planted 1.93, 1.97, 1.98 2.01 and 2.02 with an average of 1.98.

Net returns of sugarcane production in Ratoon crop

Particular	Marginal	Small	Semi-Medium	Medium	Large	Overall
TC (Rs/acre)	40015.9	41362.4	42156.44	44620.85	46096.41	42850.40
Yield (q/acre)	52.24	54.52	55.98	59.46	62.12	56.86
Gross return (Rs/acre)	96644	100862	103563	110595.6	114922	105317.32
Net return (Rs/acre)	56628.1	59499.6	61406.56	65974.75	68825.59	62466.92
Cost of cane production (Rs/tonne)	766.00	758.66	753.06	750.43	742.05	754.04
B:C	1 :2.42	1 :2.44	1 :2.46	1 :2.48	1 :2.49	1 :2.46

Estimated yields per acre of sugarcane ratoon on marginal, small, semi-medium, medium and large size of farms averaged to 52.24, 54.52, 55.98, 59.46 and 62.12, respectively, with an average of 56.86.

The average gross returns were Rs.96644, Rs.100862, Rs.103563, Rs.110595.6 and Rs.114922/acre on marginal, small, semi-medium, medium and large size farms, respectively

The net returns per acre were Rs.53598.58, Rs.56013.66, Rs.57199.9, Rs.60708.75 and Rs.65372.05/acre on marginal, small, semi-medium, medium and large size farms, respectively with an average of Rs.58578.588. the higher net returns of medium and large farms were due to the higher yields and low cost of production on large farms. However, no much difference was observed in the per tonne cost of sugarcane production among the categories. The cost of cane production per tonne was Rs.933.83, while it was Rs. 960.24, Rs.940.39, Rs.935.09, Rs.919.31 and Rs.914.10/acre on marginal, small, semi-medium, medium and large size farms, respectively. The benefit cost ratio of the sugarcane planted 1.93, 1.97, 1.98 2.01 and 2.02 with an average of 1.98.

2. **There is a significant difference in returns of sugarcane production by different categories of farmers in Mandya district.**

Descriptive statistics of returns of sugarcane cultivators across different categories of farmer

Categories of farmer	N	Mean	Std. Deviation	Std. Error
Marginal farmer	182	55113.34	7466.629	553.4634
Small farmer	126	57756.63	9015.406	803.1562
Semi-medium farmer	77	59303.23	9664.553	1101.378
Medium Farmer	13	63341.75	9610.755	2665.544
Large farmer	2	67098.82	14848.49	10499.47
Total	400	60522.75	8680.418	434.0209

Source : Field survey

The table presents the descriptive statistics of returns of sugarcane cultivators across different categories of farmer. The results show the averagereturns of sugarcane to different categories farmer and we can see that the average returns of sugarcane production to large farmer is the highest (Rs.67098.82) followed by the medium farmer (Rs.63341.75). As shown by the standard deviation, the variation in the returns of sugarcane to these categories of farmer is high for the medium and large farmers as compared to otherfarmer.

ANOVA test for returns ofsugarcane cultivators across different categories of farmer

Variances	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1386419878.88	4	346604969.72	4.774	.001
Within Groups	28678092783.72	395	72602766.541		
Total	30064512662.60	399			

Source : Field survey

The table presents the results of ANOVA test. The results reveal that there is a significant difference in the returns of sugarcane production across different categories of farmer in Mandya district. It is observed by the calculated value of 'F' which is 4.774 and a probability value of 0.001 which is statistically significant at 5% level of significance.

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Post Hoc Duncan Test for returns of sugarcane cultivators across different categories of farmer

	N	Subset for alpha = 0.05	
		1	2
Marginal farmer	182	55113.34	
Small farmer	126	57756.63	
Semi medium farmer	77	59303.23	
Large farmer	2		63341.75
Medium farmer	13		67098.82
Sig.		.052	.062
Means for groups in homogeneous subsets are displayed.			

Source : Field survey

The post hoc Duncan test was employed to assess the returns of sugarcane cultivators across various categories of farmers. The analysis revealed five distinct categorized into two groups.There is homogeneity in marginal, small, semi-medium farmer within groups. Though there is difference in mean returns of sugarcane on these 3 categories farmer. There is no statistically significant difference.But the other categories medium and large farmers are significantly different from the other groups. There is no statistical difference in the mean returns of sugarcane farmer. But, there is statistically different between 1st group and 2nd group. It just means that variations exist between groups and not within groups in terms of returns of sugarcane production on different categories of farmer. Thus, the Post Hoc test grouped returns of sugarcane production on 5 categories of farmer into 2 group.

CONCLUSION

The study found that cost of sugarcane production of main crop was Rs.933.83/ tonne and higher that of ratoon Rs.754.04/tonne. Low cost of cultivation was due to exclusion of seed and land preparation cost. Similarly, net returns from an acre of land for main crop was found to be Rs.58578.59 which was lower than ratoon crop Rs. 62466.92. The productivity of main crop was higher than ratoon crop. The average productivity of main crop 63.88 tonnes/acre whereas ratoon yielded 56.86tonnes/acre. The lower productivity of ratoon crop in the study area was due to low input application and careless management of ratoon crop. The similar results found in the study of Pandey amith.2020.

The B : C ratio of main crop was1.98 while it was 2.46 for ratoon crop. Thus, the profit from ratoon crop was the main reason for the continuity of sugarcane cultivation. The overall B:C including main and ratoon crop was 2.22. Thus, study revealed that despite of higher cost and low benefit from main crop, lower cost and higher benefit from ratoon crop was reasons behind continuing the sugarcane production. The result was in line with study of pandey amith.2020 which reported the B:C ratio of 1.35 for sugarcane cultivation in Nepal.

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