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An economic analysis of production of sugarcane under different method of irrigation in Durg division of Chhattisgarh

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Abstract

The study on economic analysis of sugarcane cultivation was fulfilled with the specific objective to estimate cost and return in sugarcane cultivation was conducted in Durg division (Kabirdham and Balod district) of Chhattisgarh during the year 2015-16. It was conducted in 2 blocks from Kabirdham namely Kawardha & Bodla and from Balod district, 2 blocks namely Balod itself and Gunderdehi blocks were undertaken on the basis of maximum area brought under cultivation of sugarcane of Chhattisgarh state. 200 farmers were selected randomly from four blocks out of which, marginal (12), small (49), medium (68) and large (71). The findings of the study envisaged that among the different irrigation methods, drip method was the highest percentage at large farm in sugarcane cultivation and found to be 78.70 percent area, which was start decreasing as farm size decreases. Drip method was not popular among marginal and small farmers. The sampled households were sugarcane growers and percentage area under sugarcane was ranging from 26.08 percent at large farms to 31.25 percent at marginal farms. The cropping intensity was also high, which varied from 105 percent at large farms to 267 percent at marginal farms. The inputs/material use in fresh sown sugarcane and ratoon crop was not as per the recommendation and initial inputs use, labour and power use were found to be less than fresh sown sugarcane. The cost of cultivation of crop under flood ratoon was 93728 Rs/ha, sprinkler 97973 Rs/ha and drip 93568 Rs/ha whereas, it was found to be flood fresh sown sugarcane was 126188 Rs/ha, in sprinkler 133957 Rs/ha and in drip 136043 Rs/ha, respectively. This gives us variable cost incurred in ratoon crop was less than fresh sown sugarcane. The benefit cost ratio in ratoon crop of sugarcane was comparatively higher in all three methods of irrigation than that of fresh sown sugarcane; it indicates that ratoon crop has involvement of low cost of production and high net return but not have long term benefit to increase the productivity of sugarcane.

Keywords: Sugarcane, productivity, cost of cultivation, net return, benefit cost ratio

Introduction

Sugarcane is an important commercial crop of the world and the cultivation of sugarcane, in India dates back to Pre-Vedic period (2000 B.C.). India is one of the principal centers of the origin of the sugarcane. Sugarcane is grown in diversified climatic condition i.e. tropical and sub-tropical. India is the only country in which sugarcane is grown in both types of the climate, Sugarcane (*Saccharum* spp. hybrid complex) is an important commercial crop in India and plays a pivotal role in agricultural and industrial economy of our country. Sugarcane is one of the most important commercial crop of the world. Approximately 100 countries produce sugar. Brazil, Cuba, Mexico and Thailand are the major sugarcane producing countries and they producers 78% sugar from cane. Nearly, 69% of the world's sugar is consumed in the country of region.

Sugarcane is cultivated in 20.10 million hectares area of the world with a production of 1318.10 million tonnes and an average productivity of 65.5 t ha⁻¹. The productivity of sugarcane varies from country to country. Brazil has the highest area (5.34 million hectares) while Australia has the highest productivity of 85.10 t ha⁻¹.

India is second largest sugarcane growing countries of the world in both area and production after Brazil. The area of sugarcane was 5.31 million hectares in 2014-15 (ISMA, 2015) with average yield was 69.10 t ha⁻¹, which was at par with world's average productivity of 65.50 t ha⁻¹ and the production of sugarcane during the same year was 366.80 million tonnes. In Indian, the sugar industry is the largest industry next to the textile industry in playing a vital role in the socio-economic transformation of the country (Wagh 2015).

The production of sugar was drastically increased to around 24.30 million tonnes during the same year. The recovery rate of sugar is 10.17 percent from one tone of sugarcane.

Sugarcane is cultivated on about 4.35 million hectares area of India and accounted for 2.24% of the gross cropped area. The crop is predominantly cultivated in Uttar Pradesh, Maharashtra, Karanataka, Tamil Nadu, Andhra Pradesh, Gujarat, Punjab, Haryana, Uttaranchal and Bihar. Uttar Pradesh and Maharashtra together alone accounted for nearly 60% of the total sugarcane area (Government of India 2002). Which contribute of about 81.63% of total sugarcane area in India (Narayan Moorthy, 2005). Sugarcane has been cultivated mainly under surface method of irrigation, but the water use efficiency is very low (35 -40%) due to substantial Evaporation and distribution losses (Sivanappa, 1994, Rosegrant & Menizen-Dick, 1996). The scarcity of irrigation water and decline availability irrigation potential, by considering water scarcity and avoiding water losses in surface method of irrigation, a new method of irrigation was introduced to increase the water use efficiency in Indian agriculture is drip method of irrigation.

Some of the districts of Chhattisgarh are also cultivated sugarcane predominantly and catching the area in Kabirdham (Kawardha), Ambikapur and Balod districts. About two-thirds of the total sugarcane produced in India is used for making gur and khandsari and one third of its goes to sugar factories. The total area of sugarcane cultivation in the Chhattisgarh state was around 3.49 thousand hectares in 2001-02 which increased to 30.12 thousand hectares in 2015-16. However, the total production of sugarcane in the state is 8.98 thousand tonnes in 2000-01 that increased to 46.90 thousand tonnes in 2015-16. In view of this sugarcane is being promoted at farmers' fields in Durg division (Kabirdham and Balod districts) of Chhattisgarh to meet out the requirement of sugar mill. Sugarcane is heavy feeder of nutrients and requires frequent irrigation to get more productivity. The crop sown with proper spacing and stand for longer period of time. Therefore, a project aim is to understand the private and social costs on subsidy provided for fertilizers and drip irrigation system in sugarcane cultivation and their impact on resource use efficiency. Hence, a research work will examine the following specific objectives

Objective

To find out the cost and return of sugarcane under different method of irrigation in Durg division of Chhattisgarh.

Materials and Methods

Present study deals with the cost and return of sugarcane in Durg division of Chhattisgarh. Durg division having 5 districts Among them 2 districts i.e., Kabirdham and Balod was selected purposively, it is because of 2 sugar factory was started at Kabirdham and 1 sugar factory was started at Balod district. From the selected districts of Durg division 4 blocks were undertaken on the basis of maximum area under cultivation of sugarcane. 200 sugarcane growers were selected randomly 20 villages and were categorized into marginal (12), small (49), medium (68) and large (71) farmers based on their holding size. The primary data from the farmers was collected through personal interview method with the help of well prepared pretested schedule and questionnaire for the year 2017.

Cost of cultivation

The study find out the cost of production of sugarcane as per the definition given by Commission on Agricultural Costs and Prices (CACP) that are as follows;

Cost A_1 = Value of purchased material inputs (seed, insecticides and pesticides, manure, fertilizer), hired human labour, animal labour (hired and owned), hired farm machinery, depreciation on farm implements and farm buildings, irrigation charges, land revenue cases and other taxes, and interest on working capital.

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

Cost B_1 = Cost A_1 + interest on value of owned capital assets (excluding land).

Cost B_2 = Cost B_1 + rental value of owned land (net of land revenue) and rent paid for leased-in land.

Cost C_1 = Cost B_1 + Imputed value of family labour.

Cost C_2 = Cost B_2 + Imputed value of family labour.

Cost C_3 = Cost C_2 + 10% of Cost C_2 on account of managerial functions performed by farmer

Income over different cost

Income over cost A_1 = Output – Cost A_1

Income over cost A_2 = Output – Cost A_2

Income over cost B_1 = Output – Cost B_1

Income over cost B_2 = Output – Cost B_2

Income over cost C_1 = Output – Cost C_1

Income over cost C_2 = Output – Cost C_2

Income over cost C_3 = Output – Cost C_3

Results and Discussion

Cost of cultivation of sugarcane by method of irrigation

The cost of cultivation is a principal factor in order to pursue price policy support in terms of minimum support price declared by the government to benefit the farmers. The cost incurred on different inputs while sugarcane cultivation was varies in fresh sugarcane and ratoon sugarcane crop table 01 and table 02.

The cost of cultivation of fresh sown sugarcane the inputs/material used, human labour, power used and interest incurred shows large difference between them but the percent cost among same input, labour & power used under three different irrigation method does not varies much. In the study, highest cost incurred in human labour i.e flood (42.83%), sprinkler (44.84%) and drip (48.62%) and material used i.e; flood (27.36%), sprinkler (27.73%) and drip (25.44%), irrigation methods, respectively.

The data revealed that the total fixed cost shares smaller amount i.e; flood (21.88%), sprinkler (20.61) and drip (20.29%) irrigation method to the total cost of cultivation where as the cost incurred in total variable cost were highest in flood (78.71%) sprinkler (79.39%) and drip (79.71%) irrigated method, respectively. Thus, the cost incurred in variable cost is higher but total cost of cultivation can be reduced by managing the resources or inputs/material, which is the cause of increased variable cost. Since, variable cost changes with level of production therefore; optimum level of inputs should be used.

The cost of cultivation for ratoon crop is lesser than fresh sown sugarcane crop. The human labour cost incurred 50 percent of total cost of sugarcane cultivation. The result reveals that the total fixed cost was higher in ratoon crop (29.45%), sprinkler (28.18%) & drip (29.50%) in flood irrigation than the fresh sown sugarcane crop. The variable cost was in flood (70.55%), sprinkler (71.82%) and drip (70.50%) irrigation method, which is lower than the fresh

sown sugarcane crop. Since, variable cost changes with the levels of production, more the production higher the cost and *vice versa*, which interpretate that the production of fresh

sown sugarcane is higher thus variable cost is higher where as in ratoon crop production is lower therefore the total variable cost is less than the fresh sown sugarcane crop.

Table 1: Cost of cultivation of sugarcane fresh sown by method of irrigation (₹./ha.)

S.N.	Particulars	Flood	%	Sprinkler	%	Drip	%
A.	Material cost						
i	Setts	19435.94	15.40	19595.72	14.63	13783.51	10.13
ii	Fertilizer	9454.83	7.49	11217.30	8.37	13795.35	10.14
iii	Plant Protection	3440.08	2.73	3816.67	2.85	3947.32	2.90
iv	Irrigation charge	2197.16	1.74	2519.34	1.88	3087.25	2.27
	Total Material cost	34528.01	27.36	37149.03	27.73	34613.44	25.44
B	Human labour cost						
i	Family labour	7783.13	6.17	4897.78	3.66	5642.58	4.15
ii	Hired Labour	46261.12	36.66	55170.18	41.18	60774.35	44.67
	Total Human Labour	54044.26	42.83	60067.96	44.84	66416.93	48.82
C	Power use cost						
i	Bullock Labour	0.00	0.00	0.00	0.00	0.00	0.00
ii	Machine power	8285.63	6.57	7278.46	5.43	5677.80	4.17
	Total power cost	8285.63	6.57	7278.46	5.43	5677.80	4.17
D	Interest on working capital	1726.40	1.37	1857.45	1.39	1730.67	1.27
	Total variable cost	98584.31	78.12	106352.90	79.39	108438.83	79.71
i	Land revenue	29.64	0.02	29.64	0.02	29.64	0.02
ii	Rental value of land	24700.00	19.57	24700.00	18.44	24700.00	18.16
iii	Interest on fixed capital	2874.46	2.28	2874.46	2.15	2874.46	2.11
	Total fixed cost	27604.10	21.88	27604.10	20.61	27604.10	20.29
	Total Cost of cultivation	126188.41	100	133957.00	100	136042.94	100

Table 2: Cost of cultivation of sugarcane ratoon sown by method of irrigation (₹./ha.)

S.N.	Particulars	Flood	%	Sprinkler	%	Drip	%
A.	Material cost						
i	Setts	0.00	0.00	0.00	0.00	0.00	0.00
ii	Fertilizer	8402.68	8.96	9304.12	9.50	8122.19	8.68
iii	Plant Protection	3231.31	3.45	3094.26	3.16	2535.87	2.71
iv	Irrigation charge	1627.79	1.74	1681.37	1.72	1721.89	1.84
	Total Material cost	13261.78	14.15	14079.75	14.37	12379.94	13.23
B	Human labour cost						
i	Family labour	4125.45	4.40	4023.16	4.11	2066.57	2.21
ii	Hired Labour	43265.07	46.16	45845.55	46.79	45217.47	48.33
	Total Human Labour	47390.52	50.56	49868.71	50.90	47284.03	50.53
C	Power use cost						
i	Bullock Labour	4808.27	5.13	5716.29	5.83	5681.00	6.07
ii	Machine power	0.00	0.00	0.00	0.00	0.00	0.00
	Total power cost	4808.27	5.13	5716.29	5.83	5681.00	6.07
D	Interest on working capital	663.09	0.71	703.99	0.72	619.00	0.66
	Total variable cost	66123.65	70.55	70368.74	71.82	65963.98	70.50
i	Land revenue	29.64	0.03	29.64	0.03	29.64	0.03
ii	Rental value of land	24700.00	26.35	24700.00	25.21	24700.00	26.40
iii	Interest on fixed capital	2874.46	3.07	2874.46	2.93	2874.46	3.07
	Total fixed cost	27604.10	29.45	27604.10	28.18	27604.10	29.50
	Total Cost of Cultivation	93727.75	100.00	97972.84	100.00	93568.08	100.00

Economics of sugarcane cultivation

Benefit cost ratio determine the amount of monetary gain realized by the farmers versus the amount it cost to grow sugarcane crop in the field. It was found that the amount used in inputs/material, labour and power used in fresh sown sugarcane and ratoon method under different irrigation method were varies. Therefore, the cost of production under flood irrigation was 164.24 ₹/ha, sprinkler 152.00 ₹/ha and drip 128.84 ₹./ha which is higher than the ratoon crop i.e. flood 138.66 ₹./ha, sprinkler 126.16 ₹./ha and 97.76 ₹./ha. It was observed that cost of cultivation directly proportional to the output production level therefore, the fresh sown sugarcane has higher yield & more cost of cultivation i.e. flood 768.30 q/ha, sprinkler 881.330 q/ha and drip 1055.93 q/ha where as in ratoon the cost of cultivation is lower than

the fresh sown sugarcane therefore the yield recorded as in flood 675.96 q/ha, sprinkler 776.58 q/ha and drip 957.13 q/ha. The gross return of fresh sown sugarcane was higher than the gross return of ratoon sugarcane crop but the net return of ratoon sugarcane crop is higher than the fresh sown sugarcane. Since, net return gets by deducting all fees, expense and taxes therefore the ratoon sugarcane has higher net return because expenses and taxes i.e. cost incurred for cultivation and production is much less than the fresh sown sugarcane. Hence, monetary gain is more in ratoon crop because amount it cost to grow is less. In the study, benefit cost ratio of ratoon crop is higher 1.02 in flood, 1.22 in sprinkler and 1.86 in drip whereas in the fresh sown sugarcane benefit cost ratio is 0.70 in flood, 0.84 in sprinkler and 1.17 in drip table 03 & table 04.

This show that benefit cost ratio of ratoon sugarcane crop is higher for short period than fresh sugarcane. The ratoon crop gives high return immediately after harvesting therefore significant important method of growing of sugarcane but not have potential to increase the productivity of the crop for long period.

Table 3: Economics of sugarcane cultivation under fresh sown method

S.N.	Particulars	Flood	Sprinkler	Drip
1.	Yield (q/ha)	768.30	881.30	1055.93
2.	Cost of Cultivation (₹/ha)	126188.41	133957.00	136042.94
3.	Gross return (₹/ha)	215124.49	246764.49	295659.00
4.	Net Return (₹/ha)	88936.08	112807.49	159616.06
5.	Cost of production (₹/Qt)	164.24	152.00	128.84
6.	B:C Ratio	0.70	0.84	1.17

Table 3.10 Economics of sugarcane cultivation under ratoon sown method

S.N.	Particulars	Flood	Sprinkler	Drip
1.	Yield (q/ha)	675.96	776.58	957.13
2.	Cost of Cultivation (₹/ha)	93727.75	97972.84	93568.00
3.	Gross return (₹/ha)	189267.87	217442.33	267995.00
4.	Net Return (₹/ha)	95540.11	119469.49	174426.92
5.	Cost of production (₹/Qt)	138.66	126.16	97.76
6.	B:C Ratio	1.02	1.22	1.86

Break-up of total cost and income obtained over different cost of sugarcane

The cost of cultivation also determined by the breaking-up of the total cost which standard method by CACP. The break-up of the total cost and income obtained over different cost of fresh sown sugarcane under different irrigation method is given in table 05 & 06. Now while calculating cost of cultivation by CACP method question arise out of 7 costs which cost is appropriate to calculate profitability (return over cost of cultivation). In the present study, A₁ and A₂ cost under different method of irrigation method is same i.e., A₁=A₂ for flood irrigation method (90830.81) A₁=A₂ for sprinkler irrigation method (10484.76 ₹./ha) A₁=A₂ for drip (102825.90 ₹./ha) and return over cost A₁ and A₂ is also equal this is because in the study farmer does not had lease-in or lease out land. The analysed data reveals that the cost A₁, A₂ is not a appropriate cost to determine return over the cost because in these cost does not cover interest on value of owned capital assets and rent for land which would form substantial share in modern agriculture today. The cost B₁ and B₂ covers the interest on value of owned capital assets and rent for land but the return over the cost B₂ was decreased from the cost incurred in the cost B₂ i.e. flood cost incurred in B₂ 118405.27 but the return over the cost B₂ is 96719.21 ₹./ha Similarly sprinkler cost B₂ = 129059.22 ₹./ha gets return over 117705.27 ₹./ha and in drip cost B₂ = 130400.36 ₹ gets return over 165258.64 ₹./ha this shows that the rental value of owned land is very high which decrease the profitability. Moreover the cost B₁ and B₂ does not include the cost for performing managerial operation therefore actual profitability can not be worked out. The cost C₂ and C₃ cost concept can be used to find the profitability cost C₂ cover actual expenses in cash and kind incurred in production by owner, rent paid for leased-in land, input value of family labour and the interest on value of owned capital assets (excluding land). The C₃ cost include all the component of cost C₂ and adds 10 percent of the cost C₂ on account of managerial functions performed by the farmers.

There C₂ and C₃ cost provided actual return over cost in the present analysed data shows that the fresh sown sugarcane under different methods of irrigation the return over the cost C₂ and C₃ get decrease table 3.11. But, under drip irrigation method the return over the cost incurred A₁, A₂ and cost B₁, B₂ shows significant increased in return over cost A₁, A₂ and B₁, B₂. Whereas cost C₂ show small increase in the return over cost and return over cost C₃ again get decrease due to improper management of resource in the irrigation system. Which support that the initial cost of cultivation of fresh sown is much high where as in ratoon sown crop under different irrigation the cost incurred cost C₂ and Cost C₃ is less than the fresh sown sugarcane table 3.12. Despite of less cost incurred in ratoon sugarcane the return over cost C₂ under flood method is less and the return over cost C₃ get decrease. Similarly under sprinkler irrigation method the return over cost was not very significant and at last not the least the drip irrigation method which is the best irrigation method for sugarcane crop shows highly significant increased in the profitability over the cost incurred i.e. the return over cost of A₁, A₂, B₁, B₂, C₁, C₂ and C₃ all shows high profitability than any other method of irrigation under fresh sown sugarcane method. Therefore, in the present study reveals that drip irrigation in ratoon is most demarcating method by analysis profitability over other method used in sugarcane crop.

Table 5: Break-up of total cost and income obtained over different cost of sugarcane Fresh sown by method of irrigation (₹/ha.)

S.N.	Particulars	Flood	Sprinkler	Drip
A Break-up of cost				
1.	Cost A ₁	90830.81	101484.76	102825.90
2.	Cost A ₂	90830.81	101484.76	102825.90
3.	Cost B ₁	93705.27	104359.22	105700.36
4.	Cost B ₂	118405.27	129059.22	130400.36
5.	Cost C ₁	101488.41	109257.00	111342.94
6.	Cost C ₂	126188.41	133957.00	136042.94
7.	Cost C ₃	138807.25	147352.70	149647.23
B Return obtained over different cost				
1.	Return over Cost A ₁	124293.67	145279.73	192833.10
2.	Return over Cost A ₂	124293.67	145279.73	192833.10
3.	Return over Cost B ₁	121419.21	142405.27	189958.64
4.	Return over Cost B ₂	96719.21	117705.27	165258.64
5.	Return over Cost C ₁	113636.08	137507.49	184316.06
6.	Return over Cost C ₂	88936.08	112807.49	159616.06
7.	Return over Cost C ₃	76317.24	99411.79	146011.77

Table 6: Break-up of total cost and income obtained over different cost of sugarcane ratoon sown by method of irrigation (₹/ha.)

S.N.	Particulars	Flood	Sprinkler	Drip
A Break-up of cost				
1.	Cost A ₁	62027.84	66375.22	63927.05
2.	Cost A ₂	62027.84	66375.22	63927.05
3.	Cost B ₁	64902.30	69249.68	66801.51
4.	Cost B ₂	89602.30	93949.68	91501.51
5.	Cost C ₁	69027.75	73272.84	68868.08
6.	Cost C ₂	93727.75	97972.84	93568.08
7.	Cost C ₃	103100.53	107770.13	102924.89
B Return obtained over different cost				
1.	Return over Cost A ₁	127240.02	151067.11	204067.95
2.	Return over Cost A ₂	127240.02	151067.11	204067.95
3.	Return over Cost B ₁	124365.56	148192.65	201193.49
4.	Return over Cost B ₂	99665.56	123492.65	176493.49
5.	Return over Cost C ₁	120240.11	144169.49	199126.92
6.	Return over Cost C ₂	95540.11	119469.49	174426.92
7.	Return over Cost C ₃	86167.34	109672.21	165070.11

Conclusion and Suggestions

The major findings are found as on the inputs/material use in fresh sown sugarcane and in ratoon crop in sampled farms was not as per the recommended dose and in ratoon crop the initial input, labour and power use were less than the fresh sugarcane. The number of irrigation was higher in ratoon crop than the fresh sown sugarcane under different irrigation methods. It also envisaged that initial input was less in ratoon crop therefore, the cost of cultivation of ratoon was less than fresh sown sugarcane. The total cost of cultivation of sugarcane under flood ratoon crop was 93728 ₹/ha, sprinkler 97973 ₹/ha, and drip 93568 ₹/ha where as cost of cultivation under flood irrigation method of fresh sown sugarcane was 126188 ₹/ha, in sprinkler 133957 ₹/ha and in drip 136043 ₹/ha. It also found that variable cost incurred in ratoon sugarcane was less than the fresh sugarcane. This depicts that variable cost changes with level of production therefore; optimum level of inputs should be used. The benefit cost ratio of ratoon crop was higher and found to be 1.02 in flood, 1.22 in sprinkler and 1.86 in drip irrigation method where as in the fresh sown sugarcane benefit cost ratio was 0.70 in flood, 0.84 in sprinkler and 1.17 in drip irrigation method. The benefit cost ratio of ratoon crop was high due to low cost of production higher net return but not have long term benefit to increase the productivity of sugarcane.

Based on outcomes, the following suggestions are hereby recommended for the welfare of sugarcane growers of the state. The ratoon crop of sugarcane is sensational between farmers as they prefer to take ratoon crop since it does not requires setts for sowing and low fertilizer applied which make farmers to believe that input cost will decrease as compared to fresh sown sugarcane. But, ratoon crop does not able to enhance the farm productivity of sugarcane in long terms. Therefore, it is recommended that farmers should not prefer more than 2 to 3 years ratoon in sugarcane cultivation. Analytical results show that drip method of irrigation in fresh sown sugarcane is profitable over cost incurred of A₁, A₂, B₁, B₂ and C₃ shows high profit. Drip method of irrigation in ratoon crop is most demarcating method by profitability analysis over other method. Therefore, it should be promoted to get high return with high rate of resource efficiency and efficient use of irrigation water.

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