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Cost, returns and resource use efficiency in cauliflower production in Maharashtra

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Abstract
The study viz. "Economics of production and marketing of Cauliflower in Ahmednagar district of Maharashtra" was conducted in six villages of Sangamner and Akole tehsil of Ahmednagar district. The objectives of the study were to estimate the resource use, costs returns and productivity of cauliflower. Besides this marketing practices and patterns of disposal, marketing cost and price spread were studied. The problems faced by the farmers in production and marketing of Cauliflower in Ahmednagar district were also examined. The study was based on the primary data of cauliflower growers for the year 2019-20, spread over the six randomly selected villages of two tehsils. From each selected village, 15 growers, 5 from each size group viz. small, medium and large were randomly selected. Thus the total sample consisted of 30 farmers each of small, medium and large size groups.

The results revealed that the average per hectare use of resources such as human labour, machine power, seedlings and manure was 247.72 man-days, 14.82 hours, 32187.47 nos. and 32187.47 tonnes respectively. The average use of fertilizers was 152.15 kg nitrogen 76.69 kg Phosphorus and 81.22 kg Potash per hectare at overall level.

Per hectare cost of cultivation of cauliflower was estimated to ₹ 293529.68. Among the items of total cost, the rental value of land, human labour, manure, PPC, etc. were the major items of cost in the total cost of cultivation of cauliflower. The cost 'A' and cost 'B' were ₹ 146886.04 and ₹ 272874.90 respectively. The average production of 419.21 quintal per hectare of produce was obtained from cauliflower. The per hectare gross returns obtained were ₹ 724776.48 at the overall level with B: C ratio was 2.48 and profit at cost 'C' ₹ 431246.80.

Regression coefficient of seedling, female labour, manure, potassium, plant protection cost were positive and significant showing their impact on cauliflower production. At overall level, there was a large variation amongst farmers. The coefficient of multiple determination (R^2) was 0.82. The MVP to MFC ratio was found to be highest in Potassium (47.58), followed by Plant protection charges (37.35), Phosphorus (23.44), Seedlings (17.90), Nitrogen (12.67), Female (2.58).

Keywords: cost, cauliflower, input use, returns

Introduction
Agriculture is India's most significant economic industry. Vegetables, being a great source of carbohydrates, proteins, vitamins, and minerals, serve an essential function in human nutrition in agriculture. In India, per capita vegetable consumption is 170g per person per day, compared to a guideline of 280g per person per day.

India's most important vegetable crop is cauliflower. *Brassica olerace* L. var. botrytis is the species of Cauliflower, which belongs to the Brassicaceae family's genus Brassica. The name "cauliflower" comes from the Italian phrase cavolfiore, which means "flower of cabbage". The name is derived from the Latin words caulis (cabbage) and fls (flower) (flower). Cauliflower is a kind of cole crop that originated in the Mediterranean region's northeast. It began on the island of Cyprus and spread to other parts of the world, including Syria, Turkey, Egypt, Italy, Spain, and Northwestern Europe. It was initially cultivated in the late 1600s in North America. It's a winter crop that thrives in a cold, wet environment. Early kinds, such as Early Kunwar, Early Synthetic, Pusa Katki, and Pant Gobhi - 2, may be able to withstand greater temperatures and longer days.

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Objectives
1. To study the resource use, costs and returns of Cauliflower.
2. To estimate resource use efficiency.

Methodology
The research used a two-stage purposive and random sampling strategy, with the sample tehsil as the primary unit of sampling and the village as the secondary unit of sampling. On the basis of area under cauliflower cultivation, three villages each from Akole and Sangamner tehsils were selected for study. On the basis of information collected from the village revenue office, a list of Cauliflower farmers was constructed for each of the selected villages, together with their operating area and area under Cauliflower cultivation. For each of the selected villages, the Cauliflower growers were arranged in descending order of their area under cauliflower crop, and five growers from each of the three predetermined size classes (i.e. area under Cauliflower cultivation), namely Group I (0.01 to 0.40ha), Group II (0.41 to 0.80ha), and Group III (0.81 ha and above) were chosen at random. As a result, the study's overall sample size was 90 cauliflower farmers, with 30 in each size group.

To fulfil the specific objectives of the study, based on the nature and extent of availability of data, analytical tools and techniques *viz.,* tabular analysis was adopted to compile the general characteristics of the sample farmers, Standard cost concepts Cost-A, Cost-B, Cost-C, Estimation of resource use productivity Cobb - Douglas type production function, Resource use efficiency.

Results and Discussion
Average Family Size and It's Composition
The family size and composition provide an indication of the available labour force as well as an indirect indication of the family's consumption requirements. Table 1 provides information on the size and makeup of the selected farm families producing cauliflower.
The data shows that the average family size was 5.03, with 47.92 per cent males and 38.07 per cent females.

Table 1: Average Family size and composition of Cauliflower farmers (Numbers)

Sr. No.	Particulars	Size Groups			
		Small	Medium	Large	Overall
1	Family size (Number)				
a	Male	2.3 (45.73)	2.43 (47.00)	2.5 (51.02)	2.41 (47.92)
b	Female	2.00 (39.76)	1.77 (34.24)	1.97 (40.20)	1.91 (38.07)
c	Children	0.73 (14.51)	0.97 (18.76)	0.43 (8.78)	0.71 (14.02)
	Sub Total	5.03 (100.00)	5.17 (100.00)	4.90 (100.00)	5.03 (100.00)
2	Members working on Farm	2.7 (53.68)	2.6 (50.29)	2.37 (48.37)	2.56 (50.78)
3	Age (Head of Family in years)	47.43	50.77	46.97	48.39

(Figures in the parentheses are percentage to the total)

Small groups had the largest percentage of members working on the farm, followed by medium and large groups, with 53.68, 50.29, and 48.37, respectively. The average age is 48.39 years. The small size group's average family size was determined to be 5.03, with 45.73 per cent men, 39.76 per cent females, and 14.51 per cent children. A total of 53.68 per cent of members worked on the farm. The average age in the small size group was 47.43years.
The average family size in the medium size group was 5.17, with 47.00 per cent men, 34.24 per cent females, and 18.76 per cent children. The percentage of members working on the farm was 50.29 per cent, and the average age was 50.77 years. The average family size in the large size group was 4.90, with 51.02 per cent males, 40.20 per cent females, and 8.78 per

cent children. The percentage of members working on the farm was 48.37 per cent and the average age was 46.97 per cent, respectively.

Educational Status of Cauliflower Growers
Education has a significant impact on farmers' managerial abilities and technical understanding. Table 2 contains information about education.
Overall, 22.49 per cent of family members had education up to the degree level, 35.83 per cent had education up to the higher secondary level, 17.11 per cent had education up to the secondary level, 18.83 per cent had education up to the primary level, and 4.28 per cent of family members were illiterate.

Table 2: Educational Status of Cauliflower Growers (Numbers)

Sr. No.	Particulars	Size Groups			
		Small	Medium	Large	Overall
1	Up to Primary	0.83 (16.87)	1.13 (22.03)	0.93 (17.58)	0.96 (18.83)
2	Up to Secondary	0.73 (14.84)	1.00 (19.49)	0.90 (17.01)	0.88 (17.11)
3	Up to Higher secondary	2.13 (43.29)	1.80 (35.09)	1.54 (29.11)	1.82 (35.83)
4	Up to Degree	1.00 (20.33)	1.10 (21.44)	1.36 (25.71)	1.15 (22.49)
5	Illiterate	0.34 (6.91)	0.14 (2.73)	0.17 (3.21)	0.22 (4.28)
	Total	5.03 (100.00)	5.17 (100.00)	4.90 (100.00)	5.03 (100.00)

(Figures in the parentheses are percentage to the total)

In the small size group, 20.33 per cent of family members had completed a degree, 43.29 per cent had completed a higher secondary education, 14.84 per cent had completed a secondary education, 16.87 per cent had completed a primary education, and 6.91 per cent of family members were illiterate. It occurred in a small group of people.
In the medium-sized group, 21.44 per cent of family members had received a degree, 35.09 per cent had received a higher

secondary education, 19.49 per cent had received a secondary education, 22.03 per cent had received a primary education, and 2.73 per cent were illiterate.
In the large size group, 25.71 per cent of family members had completed degree, 29.11 per cent had completed a higher secondary education, 17.01 per cent had completed a secondary education, 17.58 per cent had completed a primary education, and 3.21per cent of family members were illiterate.

Land Use Pattern of Cauliflower Farmers
In the small, medium, and large size groups of sample farmers, the average land holding was 2.60, 2.88, and 3.90 hectares, respectively, with an overall average holding of 3.12 hectares. At the general level, the net sown area was 3.01 hectares, accounting for 96.47 per cent of total holdings. The area under permanent fallow land was 3.53 per cent of the total land area. The gross cultivated area totaled 3.38 hectares, with a cropping intensity of 119.03per cent.

The net sown area in small size holdings was 2.53 hectares, accounting for 97.31 percent, the gross cropped area was 2.77 hectares, and cropping intensity was 109.49 percent.

In medium size holdings, the net sown area was 2.80 hectares, accounting for 97.23 percent, the gross cropped area was 3.34 hectares, and cropping intensity was 119.28percent.

The net sown area in large size holdings was 3.73 hectares, accounting for 95.58 percent of the total, the gross cropped area was 4.02 hectares, and cropping intensity was 107.77 percent.

Cropping Pattern of Cauliflower Growers
Cropping patterns are another important element that influences agricultural expenditures and profits. It's also an indicator of the financial well-being of a group of farm families.

Sugarcane was the most common crop, accounting for 39.85 per cent of total cultivated area. Cauliflower 15.26 per cent, fruit vegetables 7.14 per cent, pomegranate 8.09 per cent, wheat 6.21 per cent, groundnut 4.98 per cent, gram 4.91 per cent, summer groundnut 2.90 per cent, jowar 2.49 per cent, and fodder (sorghum) 1.27 per cent, respectively, followed Cauliflower 15.26 per cent, fruit vegetables 7.14 per cent, pomegranate 8.09 per cent, wheat 6.21 per cent, groundnut 4.98 per cent, gram 4.91 per cent. Cropping intensity was 119.03 per cent at the overall level. Cropping intensity varied with holding size, with 109.49per cent, 119.28 per cent, and 107.77 per cent in the small, medium, and large size groups, respectively.

Cropping intensity was higher in the medium size group than in the small and large size groups. The gross cropped area was 3.38hectares at the overall level. It measured 2.77,3.34and 4.02hectares. In three different sizes of groups: small, medium, and large.

Resource Use, Costs and Returns of Cauliflower
Physical inputs utilized per hectare in cauliflower production were estimated and given in Table 3. It can be seen from the table that total human labour was used 247.72man days per hectare, with 120.06male labour and 127.66female labour days. For small, medium, and large groups, the average per hectare labour usage was 320.76, 221.55, and 200.86man days, respectively. Overall, 32187.47 number of seedlings were utilised. The small size group (32345.53 nos.) consumed the most seedlings, followed by the large size group (32281.14 nos.) and the medium size group (31935.75 nos.).

Table 3: Per hectare physical inputs used in Cauliflower production

Sr. No.	Particulars	Size of group holding			Overall
		Small	Medium	Large	
1	Human labour (Man Days)	320.76	221.55	200.86	247.72
	Male	172.20	100.44	87.54	120.06
	Female	148.56	121.12	113.31	127.66
2	Machine labour (Hours)	17.70	10.34	16.41	14.82
3	Manures (Tonnes)	30.00	30.00	29.38	29.79
4	Fertilizers (Kg)				
	N	154.10	151.93	150.42	152.15
	P	78.47	76.34	75.26	76.69
	K	91.78	76.54	75.33	81.22
5	Seedlings Nos./ha	32345.53	31935.75	32281.14	32187.47
6	Irrigation costs (₹)	3473.27	2960.63	3541.97	3325.29
7	Plant protection (₹)	9633.71	9280.65	9174.00	9362.79

The total amount of manure used was 29.79 tonnes per hectare. Manure was used more frequently in medium-sized holdings than in small and large-sized holdings. Chemical fertiliser consumption per hectare, i.e. Nitogenous, Phosphorus, and Potash, was 152.15, 76.69, and 81.22 kg ha, respectively. Farmers in the small-sized group used more fertilisers than those in the small and large-sized groups. Overall, per hectare irrigation costs was ₹3325.29. Per hectare irrigation expenditure was higher in the large size group (₹3541.97) than the small (₹3473.27) and medium (₹2960.63) size groups. The entire cost of plant protection was ₹ 9362.79. Plant protection was used more in the small (₹9633.71) size holding group than in the middle (₹ 9280.65) and large (₹ 9174.00) size holding groups.

Cost of cultivation of Cauliflower
Using standard cost ideas, the cost of cauliflower farming per hectare was calculated. Table 4 shows data on several aspects of cauliflower farming costs in the Ahmednagar district for various size groupings of holdings.

It can be observed from the table that, at the overall level per hectare cost of cultivation of cauliflower i.e. Cost 'C' was ₹ 293529.68. Amongst the different items of cost, rental value of land was the major item of cost which accounted for ₹ 120635.86 (41.24%) followed by manure ₹ 44687.5 (14.65%), hired human labour ₹ 40895.25 (13.31%) where male ₹ 20375.06 (6.60%) and female ₹ 20520.19 (6.71%), seedlings ₹ 18507.65 (6.05%), family labour ₹ 20654.78 (4.99%), plant protection ₹ 9362.79 (3.07%), machinery ₹ 9341.89 (3.05%), fertilizer ₹ 7251.91 (2.38%), where male labour ₹ 15642.47 (4.99%), female ₹ 5012.32 (1.60%), interest on working capital ₹ 8153.68(2.67%), irrigation ₹ 3325.29 (1.09%), interest on fixed capital ₹ 5352.78 (1.80%), incidental charges ₹ 1373.27 (0.45%), Repairs ₹ 1149.05 (0.38%), land revenue ₹ 159.83 (0.18%) of the total cost of cultivation of cauliflower, Cost 'A' was ₹ 146886.04 (47.99%) and Cost 'B' was ₹ 272874.90 (93.05%). In case of cost 'B' and cost 'C' It was seen that, the cost was decreasing with increase in size group of holding. The per quintal cost of cauliflower cultivation was observed to be high for small size of holdings as compared to medium and large size group of holdings.

Table 4: Itemwise cost of production of Cauliflower (per ha)

Sr. No.	Particulars	Group			Overall
		Small	Medium	Large	
A.	Cost of Cultivation				
i)	Hired Labour				
	Male	26228.81(7.86)	17330.52(5.88)	17565.85(6.06)	20375.06(6.60)
	Female	21819.05(6.54)	20000(6.79)	19741.52(6.80)	20520.19(6.71)
	Total labour	48047.85(14.40)	37330.52(12.67)	37307.37(12.86)	40895.25(13.31)
ii)	Seedling	19407.32(5.82)	19161.45(6.50)	16954.18(5.84)	18507.65(6.05)
iii)	Machinery	10180.24(3.05)	8001.98(2.72)	9843.45(3.39)	9341.89(3.05)
iv)	Manure	45000(13.48)	45000(15.28)	44062.5(15.19)	44687.5(14.65)
v)	Fertilizer	7295.04(2.19)	7233.02(2.46)	7227.68(2.49)	7251.91(2.38)
vi)	Irrigation	3473.27(1.04)	2960.63(1.01)	3541.97(1.22)	3325.29(1.09)
vii)	PPC	9633.71(2.89)	9280.65(3.15)	9174(3.16)	9362.79(3.07)
viii)	Repairs	1153.61(0.35)	1150.96(0.39)	1142.59(0.39)	1149.05(0.38)
ix)	Incidental charges	1389.96(0.42)	1377.97 (0.47)	1351.89 (0.47)	1373.27 (0.45)
x)	Working Capital	145581(43.62)	131497.18(44.64)	130605.63(45.02)	135894.6(44.43)
xi)	Interest on working capital @6%	8734.86(2.62)	7889.83(2.68)	7836.34(2.70)	8153.68(2.67)
xii)	Depreciation	4829.35(1.45)	1936.35(0.66)	1267.57(0.44)	2677.76(0.85)
xiii)	Land revenue	159.67(0.05)	161(0.05)	158.82(0.44)	159.83(0.18)
	Cost A	159305.22(47.73)	141483.36(48.03)	139869.53(48.21)	146886.04(47.99)
xv)	Rental value of land	106035.24(34.54)	120989.50(42.67)	134882.83(46.49)	120635.86(41.24)
xvi)	Interest on F.C.	8298.27(2.70)	4026.58(1.42)	3733.5(1.29)	5352.78(1.80)
	Cost B	273638.39(89.14)	266500.45(94.00)	278485.86(95.99)	272874.90(93.05)
	Family labour				
i)	Male	25429.88(7.62)	12800.11(4.35)	8697.41(3.00)	15642.47(4.99)
ii)	Female	7892.46(2.36)	4223.21(1.43)	2921.28(1.01)	5012.32(1.60)
	Total	33322.34(9.98)	17023.32(5.78)	11618.69(4.01)	20654.78(6.59)
	Cost C	306960.73(100)	283523.77(100)	290104.55(100)	293529.68(100)
B.	Output				
	Main produce	396.69	429.15	431.8	419.21
	By produce	0.00	0.00	0.00	0.00
	Gross value	637169.44	726903.02	810256.98	724776.48
C.	Per Qtl. Cost of Production	773.81	660.67	671.85	702.11

The total cost of cultivation per hectare for the small, medium, and large size groups was ₹. 306960.73₹. 283523.77and ₹. 290104.55 respectively. There was a higher variance in the usage of different inputs across all size groups, resulting in a significant difference in the cost of cauliflower growing.

Costs, Returns, Gross Income and B:C Ratio of Cauliflower
Table 5 shows information on cauliflower cost per hectare, returns, gross income, and B: C ratio. According to the table, cauliflower growers obtained a gross income per hectare for small, medium, and large holdings, the values are ₹637169.44, ₹726903.02, and 810256.98, respectively. It was ₹724776.48 on an overall basis, with 419.21 quintals of cauliflower produced per hectare. Small, medium, and large holdings produced 396.69, 429.15, and 431.8 quintals per hectare, respectively. It shows that the large size group had the highest per hectare production of cauliflower.

The large size group (₹520152.43) had the highest per hectare profit at cost C, followed by the medium size group (₹443379.26) and the small size group (₹330208.71).
The benefit cost ratio at cost 'C' was highest in the large size holding group (2.79). Holdings with a medium size group (2.56) and a small size group (2.08) are next. The benefit cost ratio was 2.48 on a large scale.
The cultivation of cauliflower is economically feasible, since the benefit-cost ratio was more than unity at all cost levels and groups, proving the hypothesis that Cauliflower in Ahmednagar district is profitable.

Results of Cobb-Douglas Production Function
The table shows that the value of the co-efficient of multiple determination was estimated to be 82 per cent at the overall level. As a result, the value of the co-efficient of multiple determinations indicated that the nine variables collectively explained 82 per cent of the variation in cauliflower output.

Table 5: Costs, returns, gross income and B:C ratio (per ha)

Sr. No.	Particulars	Size Group			
		Small	Medium	Large	Overall
1	Gross returns	637169.44	726903.02	810256.98	724776.48
2	Costs (₹.)				
	i) Cost A	159305.22	141483.36	139869.53	146886.04
	ii) Cost B	273638.39	266500.45	278485.86	272874.90
	iii) Cost C	306960.73	283523.77	290104.55	293529.68
3	Profit (₹.) at				
	i) Cost A	477864.22	585419.66	670387.45	577890.45
	ii) Cost B	363531.05	460402.58	531771.12	451901.58
	iii) Cost C	330208.71	443379.26	520152.43	431246.80
4	Production	396.69	429.15	431.8	419.21
5	Benefit - Cost ratio	2.08	2.56	2.79	2.48

Table 6: Results of estimated Cobb-Douglas Production Function

Sr. No.	Variables	Regression coefficients
1	Constant (Intercept)	-2.2675 (0.9795)
2	Seedling (X1)	0.5446** (0.3093)
3	Male (X2)	-0.0440** (0.0213)
4	Female (X3)	0.0824*** (0.0239)
5	Manure (X4)	0.0408* (0.0252)
6	Nitrogen (X5)	0.0347NS (0.0429)
7	Phosphorus (X6)	0.0504NS (0.09)
8	Potassium (X7)	-0.001NS (0.001)
9	Irrigation Cost (X8)	0.0111NS (0.0930)
10	Plant Protection Cost (X9)	0.5037*** (0.1800)
	R^2	0.82

(Figures in parentheses indicate standard error)

The regression co-efficient of female(X_3), plant protection cost(X_9) were positive and highly significant at 1 per cent level of significance. The regression co-efficient of seedlings (X_1), potassium (X_7) were positive and significant at 5 per cent level of significance, this indicates that there is scope to increase the use of these resources to increase the production. Positive and significant coefficients indicated that, one per cent increase in the use of female, Plant protection, seedlings, potassium and Manure would increase the yield by 0.0824, 0.5037, 0.5446, 0.0571 and 0.0408 per cent respectively.

While manure (X_4) was positively significant at 10 per cent level of significance, the regression co-efficient of Male (X_2) was negative and significant at 5 per cent level of significance, however, Nitrogen (X_5), Phosphorus (X_6), and Irrigation Cost (X_8) were Non-significant.

Table 7: Resource Use Efficiency

Sr. No.	Resources	M.V.P.	F.C.(Px)	MVP/FC	Remarks
1	Seedling (X_1)	10.74	0.6	17.90	Under utilized
2	Male (X_2)	-369.64	300	-1.23	Excess utilized
3	Female (X_3)	515.97	200	2.58	Under utilized
4	Manure (X_4)	886.36	1500	0.59	Excess utilized
5	Nitrogen (X_5)	146.57	11.57	12.67	Under utilized
6	Phosphorus (X_6)	424.86	18.125	23.44	Under utilized
7	Potassium (X_7)	515.34	10.83	47.58	Under utilized
8	Irrigation Cost (X_8)	1.88	1	1.88	Under utilized
9	Plant Protection Cost (X_9)	37.35	1	37.35	Under utilized

Note: *Significant at 10% level
** Significant at 5% level
*** Significant at 1% level
NS- Non significant

The MVP/FC ratio was used to assess the efficiency of resource use on the sample farm.

The MVP/FC ratio for the variables, male (X_2) and manure (X_4) was less than unity, indicating that optimal resource use efficiency was not achieved, whereas, the MVP/FC ratio for the variables seedlings (X_1), female (X_3), N (X_5), P (X_6), K (X_7), irrigation cost (X_8), plant Protection Cost (X_9) was greater than unity, indicating that higher resource use efficiency was achieved. In the case of these factors, study indicated that increasing the usage of seedlings, female labour, nitrogen, phosphate, potassium, irrigation cost and plant protection costs could increase the profitability of cauliflower production.

Conclusion

Per ha cost of cultivation were 293529.68₹ /ha with B:C ratio 2.48 (highly profitable). The per hectare gross returns realized were ₹. 724776.48 at overall level. The value of coefficient of multiple determination i.e., $R^2 = 0.82$. Results revealed that Cauliflower cultivation in Ahmednagar district is highly profitable.

Policy Implication

As results of regression analysis indicted that the coefficient of Nitrogen and phosphorus were non -significant, emphasising the importance of disseminating detailed knowledge about the appropriate quantitative use of nitrogen (120Kg/ha) and phosphorus (60Kg/ha) fertilizers among Cauliflower producers through state agriculture department training programmes for getting higher yield.

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