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Cost benefit analysis of brinjal cultivation in Amravati district of Maharashtra

Snehal Athawale, Sunita Suryawanshi and Swati Gawande

Abstract
In India and other areas of the world, brinjal is one of the most widely cultivated vegetable crops. The present study was undertaken to determine the growth rate of area and production of brinjal in the Amravati district along with the estimation of cost and returns in brinjal production for the year 2020-2021 for the *kharif* season. The study is based on both primary and secondary data. Total 90 brinjal growers were interviewed from three tahsils; Amravati, Anjangon Surji and Achalpur tahsil of Amravati district. Both area and production of brinjal showcased the positive growth rate as 11.38 and 18.55 percent, respectively. The gross returns from brinjal was ₹ 2,37,372.55, ₹ 2,40,346.38 and ₹ 2,45,110.32 for small, medium and large group of brinjal growers, respectively. At overall level, the gross return was ₹ 2,39,800.69. Whereas per hectare total cost of cultivation of brinjal was the highest in the large group at cost "C_3" (₹ 1,65,224.40) followed by medium group (₹ 1,59,815.15) and small group (₹ 1,52,882.64). The highest benefit-cost ratio of brinjal at cost "C_3" was recorded 1.55 in small group followed by 1.50 in medium group and 1.48 in large group. At overall level benefit-cost ratio was 1.53. Results revealed that brinjal cultivation is profitable hence area under brinjal can be increased because of profitability.

Keywords: Brinjal, production, cost and return, cost benefit analysis

Introduction
Vegetables play a crucial role in the agricultural sector of regional as well as national economy. India holds the position of the second-largest global producer of vegetables, following China [1]. In India, generally vegetable crops are grown in an open field. India produces 185.88 million metric tonnes of vegetables by cultivating 10.10 million hectares of the area during 2018-19 [2]. Among vegetables, brinjal also known as eggplant is one of the major vegetables, stands as a prominent and substantial component in Indian cuisine. Brinjal was grown over an area of 7,46,095 hectares in India during the 2020-21 season, with a yield of 12,724.97 thousand metric tonnes and a productivity of 17.05 metric tonnes per hectare. In Maharashtra, area under brinjal in 2020-21 was 16,870 hectares, production 276.66 thousand metric tonnes and productivity was 16.40 metric tonnes per hectare. In the state of Maharashtra, specifically in Pune, Jalgaon, Nashik, Aurangabad, and Satara, supremacy is observed in brinjal production. Within the Vidarbha region of Maharashtra, out of 11 districts, percent share of Amravati district area under brinjal cultivation was 8.18 percent (485 ha) and in terms of production the percent share of Amravati district brinjal production was 10.39 percent (10.26 MT) [3].

Brinjal is known as a profitable crop among farmers. The demand for brinjal is growing every day making it dominant contributor to the overall earnings of producers[4]. However, despite its profitability, brinjal cultivation carries certain constraints due to its perishable nature. A slight unfavorable change in climatic conditions can lead to reduced enormous yields as well as crop is prone to many pest attacks, resulting in great losses for the growers. As the cost of cultivating brinjal is comparatively higher than that of other crops, amplifying the potential impact of any setbacks.

Brinjal cultivation seems to generate opportunity of employment and boosting the income of farmers of Amravati district. Although there are numerous issues related to the production of the brinjal crop. The crop is grown in open conditions in the Vidarbha region. Therefore, in the backdrop of situation it becomes worthwhile to conduct growth rate of area and production of brinjal in the district along with estimation of cost and returns in brinjal production as brinjal cultivation generates the significant income to support the livelihood of farmers. In light of the above discussion, a study has been conducted to examine cost and returns in brinjal production in Amravati district with specific objective in mind.

Objective
1. To estimate the growth rate of area and production in brinjal in the district.
2. To estimate the cost and returns in brinjal cultivation.

Methodology
Keeping in view of the objective of the study, the primary data was collected for the *kharif* season of 2020-21. The list of brinjal growers was obtained from the office of Panchayat Samiti (Talathi), Krishiseva Kendra and seed shops of the Amravati, Anjangon Surji and Achalpur tehsils of Amravati district as these areas have a higher concentration of brinjal cultivation. Three villages were selected randomly from each tahsil and ten farmers were selected for the study from each village, comprising in a total of ninety brinjal growers. The farmers were stratified into three groups *viz.*, Small: upto 2 ha; Medium: 2.01-4 ha; Large: 4.01 ha and above. Ultimately, 90 (47 small, 24 medium and 19 large) respondents were selected randomly for conducting detail study of present investigation.

Analytical techniques
Parametric trend models
To get an overall movement of the time-series data of brinjal grown in the study region, trend equations were fitted. Different models, like polynomial, exponential, linear, compound, *etc*. were examined. The polynomial trend model was found to be the best fit for the data. It can be expressed by the following equation-

$$Y_t = \beta_0 + \beta_1 x + \beta x^2$$

where *Y*t is the area and production of brinjal, $\beta 0$ the intercept term, β, $\beta 1$ are the regression coefficients and *t* is the time.

Compound annual growth rate
The area and production of brinjal in the study region were computed between 2013–14 to 2022–23 to be examined by estimating the compound annual growth rate using the formula below.

$$Y_t = ab^t$$

Where, *Yt* is the area and production of brinjal, a is the constant, b is the regression coefficient and t is the time variable.
After log transformation and estimation of the equation-

$$\ln Y_t = \ln a + t \ln b$$

The compound annual growth rate was estimated as

$$G = (\text{antilog}\,(\ln b) - 1) \text{ x } 100$$

Tabular Analysis
The cost of production of the selected vegetables were calculated as per the standard cost concept *viz*; Cost-A, Cost-B, Cost-C and tabulated for interpretation.

Cost Concepts
These includes cost A_1, A_2, B_1, B_2, C_1, C_2 and C_3

A) Cost 'A₁'
All actual expenses in cash and kind incurred in production by the producer. The items covered in cost A_1 are costs on:
1. Value of hired human labour (HL)
2. Value of bullock labour (BL)
3. Value of machine labour (ML)
4. Value of seed
5. Value of plant protection
6. Value of manures (owned and purchase)
7. Value of fertilizers
8. Irrigation charges
9. Depreciation on implements
10. Land revenue, cesses and other taxes
11. Interest on working capital @ 6 percent
12. Miscellaneous expenses (Artisans etc.)

B) Cost 'A₂'
Cost A_1+ Rent paid for leased-in land.

C) Cost 'B₁'
Cost A_1 + interest value of owned fixed capital assets @ 10 percent (excluding land).

D) Cost 'B₂'
Cost B_1 + Rental value of owned land @ 1/6th of gross value of produce by deducting the land revenue (net of land revenue) and rent paid for leased-in land.

E) Cost 'C₁'
Cost B_1 + imputed value of family labour.

F) Cost 'C₂'
Cost B_2 + Imputed value of family labour.

G) Cost 'C₃'
Cost C_2 + 10 percent of Cost C_2.

Gross and net returns
1. Gross returns
Gross return of the farmers under the present study was estimated from returns obtained from sale of main produce.

2. Net returns
Net returns were computed at different costs i.e. Cost A_1, Cost A_2, Cost B_1, Cost B_2, Cost C_1, Cost C_2 and Cost C_3 by deducting respective costs from the gross returns.

Benefit-cost ratio
It is a ratio between the value of gross output and the cost of cultivation at different cost concepts. The probability of crop production cannot be justified completely unless benefit cost ratio were worked out. This is the ratio which represents returns obtained per rupee of investment. It was worked out by dividing gross return by the total cost. It was calculated at cost A_1, cost A_2, cost B_1, cost B_2, cost C_1, cost C_2 and cost C_3.

Results and Discussion
Growth rate of brinjal in Amravati district
During the selected time period, a positive growth rate was observed in the area and production of brinjal as 11.38 and 18.55 percent, respectively, at 5 percent level of significance, in the Amravati district of Maharashtra. (Table 1). The increase in brinjal production was mainly due to an increase in yield as the expansion in the area under brinjal cultivation.

Table 1: Growth rate of area and production of brinjal in Amravati district

Particulars	CAGR
Area	11.38**
Production	18.55**

**Significant at 5% probability level,
Source: Authors' computation based on the data from Horticulture Area and Production Information System, Government of India (2013-14 to 2020-21).

To determine the trends in the production of brinjal in the Amravati district, parametric trend models were used. Figure 1 and Figure 2 s the trend in area and production for the past 10 years (from 2013-14 to 2022-23) for brinjal crop. In both cases, the polynomial trend model was applied as it was found to be the best-fitting parametric model. From the Figure 1 it is evident that there was a steady growth in the area under cultivation of brinjal over the past years. It is apparent from Figure 2 that production has increased over the past 10 years and showed positive growth (although there was a time when production was low during 2017-18), which has resulted in higher availability of brinjal crop for the growing population.

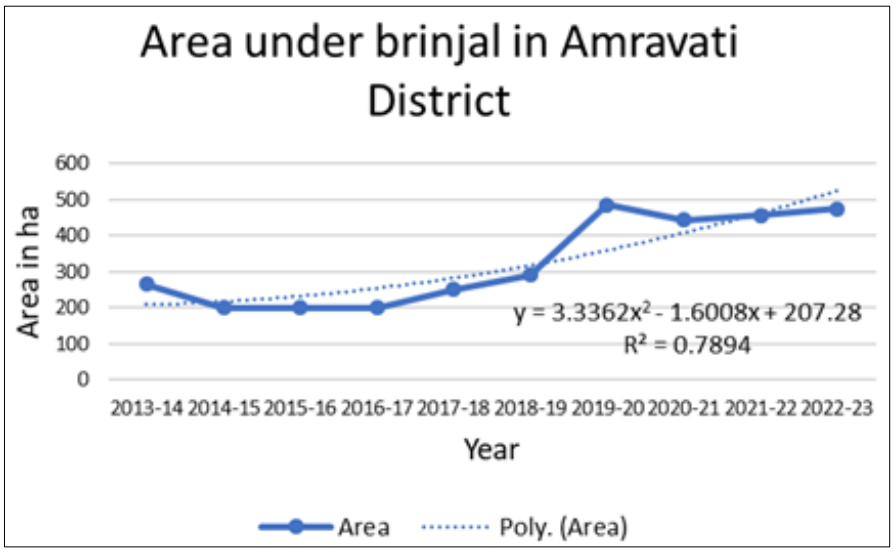

Fig 1: Area under brinjal in Amravati District

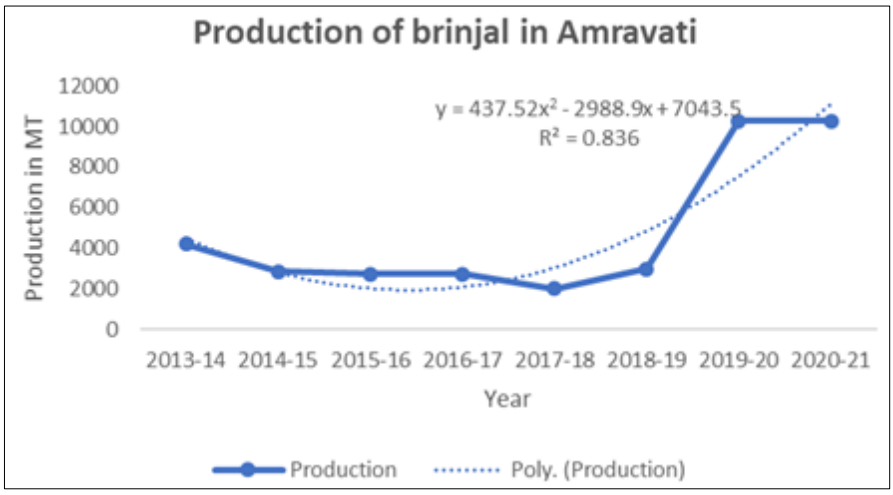

Fig 2: Production of brinjal in Amravati District

Per hectare cost of cultivation of brinjal

It is observed from the Table 2 that the per hectare cost of cultivation in small holding growers at cost "C_3" was ₹ 1,52,882.64. Among all the expenses incurred in cost "C_3" the percentage share of rental value of land was the highest (25.83%) followed by plant protection (15.10%) and hired human labour (14.43%). Per quintal cost of production was found ₹ 540.12.

It is revealed from the Table 2 that the per hectare cost of cultivation in medium size of holding growers at cost "C_3" was ₹ 1,59,815.15. Among all the expenses incurred in cost "C_3" the percentage share of rental value of land was the highest (25.05%) followed by hired human labour (15.50%). Per quintal cost of production was found ₹ 540.27.

It is observed that the per hectare cost of cultivation in large holdings growers at cost "C_3" was ₹ 1,65,224.40. Among all the expenses incurred in cost "C_3" the percentage share of rental value of land was the highest (24.71%) followed by hired human labour (16.03%) and plant protection (14.59%). Per quintal cost of production was found ₹ 554.46.

Per hectare cost of cultivation in overall brinjal growers at cost "C_3" was ₹ 1,56,982.98. Among all the expenses incurred in cost "C_3" the percentage share of rental value of land was the highest (25.44%) followed by hired human labour (15.20%) and plant protection (14.92%) Per quintal cost of production was found ₹ 542.06.

Table 2: Per hectare cost of cultivation of brinjal for small growers (₹/ha)

Sr. No.	Particulars	Unit		Small			Medium			Large			Overall		
				Input	Total Cost	% to Cost "C3"	Input	Total Cost	% to Cost "C3"	Input	Total Cost	% to Cost "C3"	Input	Total Cost	% to Cost "C3"
1	Hired Human Labour	Male	Days	34.95	7584.15	4.96	40.11	8634.48	5.40	42.60	8520.00	5.16	37.95	8201.78	5.22
		Female	Days	96.53	14479.50	9.47	107.55	16132.50	10.09	119.73	17959.50	10.87	104.37	15655.50	9.97
	Sub total			131.48	22063.65	14.43	147.66	24766.98	15.50	162.34	26479.50	16.03	142.31	23857.28	15.20
2	Bullock Labour		Pair days	8.41	5795.25	3.79	6.02	4251.15	2.66	3.77	2658.23	1.61	6.80	4725.98	3.01
3	Machine charges		Hours	6.96	2436.00	1.59	8.39	3356.00	2.10	10.35	4140.00	2.51	8.06	3042.19	1.94
4	Seed		Kg.	0.70	9391.82	6.14	0.72	9728.82	6.09	0.72	9884.08	5.98	0.71	9567.28	6.09
5	Manures		Quintals	82.42	16484.00	10.78	91.79	18358.00	11.49	89.06	17812.00	10.78	86.20	17240.00	10.98
6	Fertilizer	a) N	Kg.	104.12	1507.66	0.99	103.68	1501.29	0.94	98.11	1420.63	0.86	102.74	1487.68	0.95
		b) P	Kg.	54.83	1370.75	0.90	51.92	1298.00	0.81	50.54	1263.50	0.76	53.15	1328.75	0.85
		c) K	Kg.	43.37	737.29	0.48	41.44	704.48	9.29	40.04	680.68	0.41	42.15	716.55	0.46
	Sub-total		Kg.	202.32	3615.70		197.03	3503.77		188.69	3364.81		198.03	3532.98	
7	Irrigation (electric charges)		(₹)		2173.94	1.42		2334.03	1.46		2494.69	1.51		2284.34	1.46
8	Plant Protection		liters	3.55	23087.08	15.10	3.59	23620.87	14.78	3.42	24111.05	14.59	3.53	23424.39	14.92
9	Incidental charges		(₹)		482.04	0.32		619.72	0.39		926.81	0.56		612.65	0.39
10	Repairing Charges		(₹)		394.04	0.26		405.52	0.25		503.75	0.30		420.26	0.27
11	Working Capital (1 to 10)		(₹)		86331.41	56.47		90960.59	56.92		92879.26	56.21		88028.07	56.07
12	Interest on working Capital @ 6%				2588.90	1.69		2728.82	1.71		2786.38	1.69		2640.84	1.68
13	Depreciation		(₹)		837.06	0.55		1520.65	0.95		3590.32	2.17		1600.60	1.02
14	Land Revenue		(₹)		176.29	0.12		177.60	0.11		178.23	0.11		177.05	0.11
15	COST "A" (Items 11 to 14)		(₹)		89933.67	58.83		95387.66	59.69		99434.19	60.18		92446.56	58.89
16	Rental Value Leased in land		(₹)	-	0.00	0.00	-	0.00	0.00	-	0.00	0.00	-	0.00	0.00
17	COST "A2" (Items 15 to 16)		(₹)		89933.67	58.83		95387.66	59.69		99434.19	60.18		92446.56	58.89
18	Int. on Fix.Cap. @ 10%		(₹)		1875.53	1.23		2175.00	1.36		2276.32	1.38		2640.84	1.68
19	COST "B1" (Items 17 to 18)		(₹)		91809.20	60.05		97562.66	61.05		101710.51	61.56		95087.40	60.57
20	Rental Value of Land		(₹)		39486.86	25.83		40028.76	25.05		40821.94	24.71		39937.11	25.44
21	COST "B2" (Items 19 to 20)		(₹)		131296.06	85.88		137591.43	86.09		142532.45	86.27		135024.51	86.01
22	Family Human Labour	a) Male	Days	17.87	3873.67	2.53	17.87	3880.57	2.43	17.87	3857.05	2.33	17.87	3872.79	2.47
		b) Female	Days	25.43	3814.50	2.50	25.43	3814.50	2.39	25.43	3814.50	2.31	25.43	3814.50	2.43
	Sub total			43.30	7688.17	5.03	43.30	7695.07	4.81	43.30	7671.55	4.64	43.30	7687.29	4.90
23	Cost " C1 " (Items 19+22)		(₹)		99497.37	65.08					109382.06	66.20		102774.69	65.47
24	Cost " C2 " (Items 21+22)		(₹)		138984.22	90.91					150204.00	90.91		142711.80	90.91
25	10% Cost C2*		(₹)		13898.42	9.09					15020.40	9.09		14271.18	9.09
26	Cost " C3 " (Items 24+25)		(₹)		152882.64	100.00					165224.40	100.00		156982.98	100.00
27	Main Produce		Quintals	257.32	237371.99		268.91			270.90	245109.89		263.28	239799.73	
28	Per quintal cost of Prod.		(₹)		540.12						554.46			542.06	

Figures in parentheses indicates the percentage to cost C_3; Source: Based on authors calculations, filed survey- 2020-21.

Per hectare cost and returns from brinjal

The Table 3 indicates that per hectare production of brinjal for small, medium and large size group of growers was 257.32 quintals, 268.91 quintals and 270.90 quintals, respectively. At overall level, it was 263.28 quintals per hectare. The gross returns from brinjal was ₹ 2,37,372.55, ₹ 2,40,346.38 and ₹ 2,45,110.32 for small, medium and large group. At overall level, the gross return was ₹ 2,39,800.69. The cost of cultivation at "C_3" of these groups have been estimated to be ₹ 1,52,882.64, ₹ 1,59,815.15 and ₹ 1,65,224.40 respectively. The overall cost required for cultivation of brinjal at cost "C_3" was ₹1,56,982.98. Per hectare net returns at cost "C_3" received by small, medium and large size of brinjal growers was ₹ 84,489.35, ₹ 80,535.02 and ₹ 79,885.49 respectively. At an overall level, the net returns was ₹ 82,816.75. The benefit-cost ratio at cost "C_3" for small, medium and large group brinjal grower was 1.55, 1.50 and 1.48, respectively. At overall level benefit-cost ratio was 1.53. The benefit-cost ratio which is an indicator of economic efficiency in crop production for the crop and it indicated that the brinjal registered a good benefit-cost ratio 1.53 means hypothesis is acceptable.

The findings of present study are in line with the findings of Mondal *et al.* (2019) [5], who calculated that sample farmers have made an investment of ₹ 1,64,365.65 per hectare at cost "A". The net returns are estimated to be ₹ 2,18,500.97 per hectare at cost "A" Although, farmers belonging to the farm size class of 0.5 to 1.0 hectare have spent maximum total cost to get the maximum net returns per hectare with return-cost ratio of 1.12, but no definite relationship between farm size and net returns can be established from the study. Singh and Chauhan (2004) [6] concluded that brinjal cultivation is a profitable venture. Balappa and Hugar (2002) [7], who concluded that there exists a vast scope for increasing the profit from brinjal cultivation. However, the costs and labour fertilizers and pesticides lower the profit margin of farmers.

Table 3: Per hectare cost and returns from brinjal (₹/ha)

Sr. No.	Particulars	Small	Medium	Large	Overall
1	Main Produce (q/ha)	257.32	268.91	270.90	263.28
2	Rate per quintal	922.48	893.78	904.80	910.82
3	Gross Returns	237372.55	240346.38	245110.32	239800.69
4	**Cost of Cultivation at**				
	Cost "A1"	89933.67	95387.66	99434.19	92446.56
	Cost "A2"	89933.67	95387.66	99434.19	92446.56
	Cost "B1"	91809.20	97562.66	101710.51	95087.40
	Cost "B2"	131296.06	137531.43	142531.45	135024.51
	Cost "C1"	99497.37	105257.74	109382.06	10277.67
	Cost "C2"	138984.22	145286.50	150204.00	142711.80
	Cost "C3"	152882.64	159815.15	165224.40	156982.98
5	**Net returns at**				
	Cost "A1"	147438.32	144962.51	145675.70	147353.17
	Cost "A2"	147438.32	144962.51	145675.70	147353.17
	Cost "B1"	145562.79	142787.51	143399.38	144712.33
	Cost "B2"	106075.93	102818.74	102578.44	104775.22
	Cost "C1"	137874.62	135092.43	135727.83	229522.06
	Cost "C2"	98387.77	95063.67	94905.89	97087.93
	Cost "C3"	84489.35	80535.02	79885.49	82816.75
6	**Benefit-cost ratio at**				
	Cost "A1"	2.64	2.52	2.47	2.59
	Cost "A2"	2.64	2.52	2.47	2.59
	Cost "B1"	2.59	2.46	2.41	2.52
	Cost "B2"	1.81	1.75	1.72	1.78
	Cost "C1"	2.39	2.28	2.24	23.33
	Cost "C2"	1.71	1.65	1.63	1.68
	Cost "C3"	1.55	1.50	1.48	1.53

Source: Based on authors calculations, filed survey- 2020-21.

Summary and Conclusions

Brinjal crop is the important vegetable crop grown in Amravati district. Though the brinjal is cultivated on small area but it contributes sizable share in total earnings of the cultivator Keeping the above objectives in mind, the study was conducted to estimate the cost and returns of brinjal production in Amravati district of Maharashtra for the *kharif* season of 2020-21. Number of the selected brinjal growers was 90, out of which 47 farmers belongs to small holding, 24 farmers belongs to medium and 19 farmers to large size of holding with average size of holding 1.46 hectares, 2.92 hectares and 6.15 hectares respectively. The average size of holding of brinjal cultivator was 2.84 hectare. Per hectare cost of cultivation at cost "A_1" was highest in large size group i.e. 99,434.19 followed by medium size group of brinjal grower i.e. ₹ 95,387.66 and small size group of brinjal grower i.e. ₹ 89,933.67 respectively. The per hectare total cost of cultivation of brinjal i.e. cost "C_3" was highest in the large size group i.e. 1,65,224.40 per hectare followed by medium size group i.e. ₹ 1,59,815.15 and small size group i.e. ₹1,52,882.64 respectively. The benefit cost ratio of brinjal cultivation at cost "C_3" was highest in small size group i.e. 1.55, followed by medium size group (1.50) and large size group (1.48). The benefit-cost ratio which is an indicator of economic efficiency in crop production for the crop and it indicated that the brinjal registered a good benefit-cost ratio as at overall level benefit-cost ratio was 1.53. Results revealed that brinjal cultivation is profitable hence area under brinjal can be increased because of profitability.

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