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ECONOMIC ANALYSIS AND GROWTH TRENDS OF MANGO CULTIVATION IN BILASPUR DISTRICT, CHHATTISGARH

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ABSTRACT
The study examined the economics of mango cultivation and growth trends in Bilaspur district of Chhattisgarh. Three major mango-growing blocks—Masturi, Belha, and Takhatpur—were selected, and primary data were collected from 150 farmers across 15 villages. Secondary data on area, production, and productivity for the period 2007–08 to 2016–17 were analyzed using CACP cost concepts, Compound Growth Rate (CGR), and statistical tools. The results revealed an average mango yield of 100.01 quintals per hectare and a production cost of ₹780.55 per quintal. Large farms achieved higher gross returns due to better productivity and production efficiency, whereas small farms incurred higher production costs because of lower yields. The input–output ratio of 1:2.60 confirmed that mango cultivation is a profitable enterprise. Growth analysis showed significant increases in area (5.75%) and production (5.52%), while productivity declined slightly (-0.24%). The study concludes that sustainable growth in mango cultivation requires improved orchard management, adoption of improved varieties, balanced input use, post-harvest management, nearby processing facilities, farmer training, and stronger government support.

KEYWORDS: Cost of cultivation; Productivity; Compound Growth Rate (CGR); Farm profitability.

INTRODUCTION

The horticulture sector is a crucial component of Indian agriculture, contributing nearly 33 percent to the Gross Value Added (GVA) of the agricultural sector. Its continuous growth reflects sustained government support aimed at improving productivity, efficiency, rural employment, farmers' income, and nutritional security. India is the second-largest producer of fruits and vegetables in the world, accounting for about 90 percent of total horticultural production, owing to its favorable agro-climatic conditions, low production costs, and abundant labor availability. Among horticultural crops, mango (*Mangifera indica*), popularly known as the "King of Fruits" and the national fruit of India, occupies a prominent position due to its economic, nutritional, cultural, and commercial importance. India has the largest area under mango cultivation in the world, covering approximately 2.2 million hectares and producing about 23–25 million tonnes annually.

In Chhattisgarh, mango is one of the major fruit crops, cultivated over 5.5–6.0 thousands hectares with an annual production of about 4.5-5.0 lakh tonnes. Bilaspur district is an important mango-growing region of the state, having around 4,000–6,000 hectares under cultivation and producing 30.00-50.00 thousands tonnes annually. The district's favorable climatic conditions and increasing commercial interest have encouraged the expansion of mango orchards.

However, productivity remains variable due to factors such as climatic fluctuations, pest incidence, irrigation constraints, and differences in orchard management practices. Previous studies Savariya et al. (2020) and Verma (2019) have highlighted significant post-harvest losses, inadequate processing awareness, poor transportation facilities, and lack of scientific storage infrastructure as major constraints affecting farmers' returns. Therefore, an economic analysis of mango cultivation, along with an assessment of growth trends in area, production, and productivity in Bilaspur district, is essential for understanding the performance, profitability, and future prospects of mango cultivation in the region.

MATERIALS AND METHODS

A. Selection of farmers:- Bilaspur district have highest area under mango crop contributing in 16.26 percent in the Chhattisgarh state. So, Bilaspur district was selected for the study. The Bilaspur district has four blocks in which three blocks were selected namely Masturi, Belha, and Takhatpur for the present study on the basis of area of mango crop. Five villages were selected from each block. So, fifteen villages were selected from Masturi, Belha and Takhtpur each. In all, fifteen villages were selected for the study. Ten farmers were selected from each village. In all 150 farmers were interviewed for the study.

B. Data Collection- The present study was based on primary and secondary. The primary data collected from respondents with the help of interview schedule. The secondary time-series data pertaining to the area, production, and productivity of mango in Bilaspur district, Chhattisgarh, for the period from 2007–08 to 2016–17. The required data were collected from various publications and reports of the National Horticulture Board (NHB), the Agricultural and Processed Food Products Export Development Authority (APEDA), and the Directorate of Horticulture, Government of Chhattisgarh. The collected data were systematically analyzed to estimate the compound growth rates of area, production, and productivity of mango during the study period. The analysis helped assess the growth performance and trends in mango cultivation in the study area, providing valuable insights into the development of the mango sector in Bilaspur district.

C. ANALYTICAL TOOLS

1. Cost of Cultivation

The cost of cultivation of the mango farmers was worked out by using various cost concepts viz. Cost A1, Cost A2, Cost B1, Cost B2, and Cost C1, Cost C2, Cost C3 as defined below:

CostA_1: Consist of following items of costs:-

1. Value of hired human labour (permanent&casual)
2. Value of hired and owned bullock labour
3. Value of hired and owned machinery
4. Value of seed (both farm-produced and purchased)
5. Value of manure(produced on farm and purchased)and fertilizers
6. Value of insecticides and fungicides.
7. Irrigation charges
8. Landrevenue and other taxes
9. Depreciation
10. Interest on the working capital.
11. Miscellaneousexpenses(wages of artisans, and repairs to small farm implements)"

Cost A_2 =CostA_1+rent paid for leased-inland.

CostB_1=CostA_1+interest on value of owned capital assets (excluding land)

CostB_2=Cost B_1+ rental value of owned land +rent paid for leased in land

CostC_1=CostB_1+imputed value of family labour.

CostC_2=Cost B_2+imputed value of family labour.

CostC_3=Cost C_2+10 percent of cost C_2as managerial cost

- **Interest on working capital:**

It was calculated @ 4%per annum for half of the crop period.

- **Interest on fixed capital:**

It was calculated @ 10%per annum for the crop period.

- **Rental value of owned land:**

It was calculated based on the prevailing rates in the"sampling villages.

- **Depreciation:**It represents the value by which a farm resource decreased in value as a result of cause other than a change in general price of the item. Straight-line method was used for calculating the depreciation:"

$$\text{Depreciation} = \frac{\text{Purchase value of the asset-Junk value}}{\text{No. of useful years of life (expected life)}}$$

- **"Input:output ratio:**

It is ratio between input and output and computed by dividing value of total output by value of total input.

Input output ratio=O/I

Where,
I=Total input and
O =Total output

2. **Compound Growth Rate (CGR):**

The method used for estimating the growth rate has been described below:

Measurement of Compound Growth Rate (CGR):
The specific functional form was used to estimatethe growth rate i.e.

$$Y_t = ab_tU_t$$

Where:
- (Y_t) = Area, production, or productivity in year (t)
- (a) = Intercept (constant term)
- (b) = Growth coefficient
- (t) = Time period (year)
- (U_t) = Random error term

Taking logarithms on both sides:

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

The Compound Growth Rate (CGR) was calculated as:

$$CGR = (b-1) X 100$$

or

$$CGR (\%)\} = (Antilog (\ln b)-1) X 100$$

RESULT AND DISCUSSION

1. Cost of cultivation of mango

The cost of cultivation of mango is presented in table 1 and figures 1 & 2. The study revealed that the cost of mango cultivation increased with the size of the farm. The average cost of cultivation was estimated at ₹78,029.69 per hectare**,** with large farms incurring the highest cost (₹80,050.39/ha)**,** followed by medium farms (₹77,559.75/ha) and small farms (₹75,291.44/ha)**.**

Singh, S. P. and Nandi, A. K. (2020) find out the investments in mango orchard are highly profitable (net present value (NPV) was 600237.34/ha.), economically feasible (Benefit-cost ratio was 1.76) and financially viable (IRR is also worked out as 19.80 percent) during over the year of the mango orchard in Lucknow District of Uttar Pradesh. Chanchal and Jain, B.C. (2021a) estimated that the initial investment cost was Rs. 27571/ ha. during first year, total maintenance cost (second, third and fourth year) was Rs. 22781/ ha. The annual total cost of production was Rs.26610.20/ ha. In the Kanker district of Chhattisgarh. Vinutha, B.S. *et al.* (2022a) observed that the per acre establishment cost of mango orchard during five years was Rs. 1,46,122. Datarkar, S.B. et al. (2014) estimated that the per hectare establishment cost of mango orchard during five year for overall age groups of orchard was Rs.41,796.08. Among the different items of expenditure share of human labour was higher followed by bullock labour. Per hectare establishment cost for bearing life of the orchard i.e. 20 years was Rs.2,089.80. S.S., Bhosale et al. (2016) observed that the cost of establishment of mango orchard per hectare for five years was Rs. 1, 74,970. Initial establishment costs such as planting material, gap filling and fencing account for 9.76 per cent of total establishment cost. The average initial establishment cost was Rs. 17100/ha.

The higher cultivation cost on large farms was mainly due to greater investment in modern agricultural inputs such as fertilizers, plant protection chemicals, and hired labour. Better access to institutional credit and stronger economic conditions enabled large farmers to adopt improved cultivation practices, resulting in higher expenditure compared to small and medium farmers. Overall, the findings indicate a positive relationship between farm size and the cost of mango cultivation. Large mango cultivators can significantly reduce production costs by improving input-use efficiency, adopting modern resource-conserving technologies, reducing labor dependence through mechanization, and utilizing institutional support. These measures can help maintain profitability while ensuring sustainable orchard management. The two most activities focus on 1. Train laborers and improve farm management practices to enhance labor productivity and reduce operational inefficiencies. 2. Access government schemes and subsidies for irrigation systems, machinery, and orchard management to offset cultivation expenses for reduction of cost of cultivation by large farmers.

2. Yield, value of output and cost of production per quintal-

The yield, value of output per hectare and cost of production per quintal" of mango orchard "on the sample farms have been worked out in table 2 and figure 2. The study showed that the average yield of mango orchards was 100.01 quintals per hectare on the sample farms. The average cost of production was estimated at ₹780.55 per quintal**,** with costs being highest on small farms (₹799.86/quintal), followed by large farms (₹783.04/quintal), and lowest on medium farms (₹763.53/quintal). The higher cost of production on smaller farms was mainly due to their relatively lower yields compared to larger farms. The average gross income from mango cultivation was ₹202,399.73 per hectare**,** ranging from ₹189,779.25 on small farms to ₹205,433.36 on medium farms and ₹207,435.91 on large farms**.**

Chanchal and B.C. Jain (2021b) observed that the yield was 25 quintal of mango per ha. in overall farms size. The gross income received from mango was observed to be Rs. 87500 per hectare. The net profit at total cost was Rs. 62163.24 per hectare. Input-output ratio was 3.45 and benefit-cost ratio of mango was 2.45 rupees. The per quintal production cost of mango was Rs 1013.47 in Kanker district of Chhattisgarh state.

Vinutha, B.S. et al. (2022b) estimated that the per acre cost of cultivation of mango orchard during bearing period for the sample as a whole was Rs.58,257 out of which share of variable cost (61.45%) was higher as compared to fixed cost(38.55%). Total human labour requirement was 38.86 mandays and that of bullock labour was 6.56 machine hours. At overall level, annual average yield was 4.45 t/ac and 90 kg/tree. Average gross and net returns were Rs. 94,217 and Rs. 35,961 respectively. The returns per rupee of total cost was 1.62 indicating mango cultivation was profitable to the growers in the Eastern Dry Zone of Karnataka. Among the material cost, maximum cost was incurred on FYM (13.08 %) followed by seedlings (6.50 %), irrigation (5.64 %) in the non-bearing period. The study was noted that the in first year, among the material cost, maximum cost was spent on the purchase of seedlings, followed by FYM and irrigation. Total fixed cost accounted for 28.03 per cent of the total establishment cost. S.S., Bhosale *et al.* (2016) observed that the per hectare costs and gross income of Kesar mango were Rs. 81,831.00 and Rs.1,31,200.00 respectvely. The study was revealed that human labour cost, cost on plant protection and manures and fertilizers accounts for 58.82 per cent of the total cost. Of this, cost on manures ranks high with a percentage of 23.83. Human labour cost ranks next with a percentage of 13.56. Plant protection and fertilizers cost form 9.79 and 7.97 per cent, respectively of the total cost. The yield in physical terms was 4.10 metric tonnes/ha. The prevailing rate in the market during the period under study was ranging between Rs. 3200.00 per quintal.

The higher gross income achieved by large farms was primarily attributed to their greater productivity and higher yields. Overall, the results indicate that larger mango farms benefit from better production efficiency, resulting in lower production costs per unit and higher gross returns. Small mango growers can substantially increase yields by adopting scientific orchard management practices, improving nutrient and water use efficiency, maintaining healthy trees through proper pruning and pest management, and using quality planting material, regionally suitable mango varieties. Replace old and unproductive trees with improved cultivars where feasible. These measures can enhance productivity, reduce production costs per unit, and improve overall farm profitability. Gain knowledge on scientific mango cultivation, orchard management, and new technologies.

Table 1: Cost of cultivation of mango cultivation on different size groups of farms (Rs./ha.)

S.No.	Cost	Farm size			
		Small	**Medium**	**Large**	**Overall**
(A)	**Variable cost**				
1.	Human labour				
(a)	Family labour	11067.21 (14.69)	10123.39 (13.05)	9873.46 (12.33)	10252.89 (13.13)
(b)	Hired labour	21261.67 (28.23)	22616 (29.15)	22942.27 (28.65)	22416.89 (28.72)
	Total human labour	**32328.88 (42.93)**	**32739.69 (42.21)**	**32815.73 (40.99)**	**32669.78 (41.86)**
2.	Bullock labour	1561.11 (2.07)	1664.97 (2.14)	1736.82 (2.16)	1668.71 (2.13)
3.	Machine labour	4382.78 (5.82)	4567.47 (5.88)	4838.17 (6.04)	4633.80 (5.93)
4.	Manure & fertilizer cost	12679.63 (16.89)	12881.23 (16.60)	13231.78 (16.52)	12976.07 (16.62)
5.	Plant protection chemicals	5332.22 (7.08)	5738.32 (7.39)	6224.71 (7.77)	5839.18 (7.48)
6.	Irrigation charges	3298.98 (4.38)	3577.63 (4.61)	3931.87 (4.91)	3655.31 (4.68)
7.	Interest on working capital	3132.63 (4.16)	3461.58 (4.46)	3821.69 (4.77)	3529.28 (4.52)
	Total variable cost	**62716.23 (83.29)**	**64630.71 (83.33)**	**66600.77 (83.19)**	**64972.76 (83.26)**
(B)	**Fixed cost**				
1.	Depreciation	558.22 (0.74)	621.82 (0.80)	732.64 (0.91)	651.93 (0.83)
2.	Land revenue	12.00	12.00	12.00	12.00
3.	Rental value of owned land	9321.32 (12.38)	9532.89 (12.29)	9814.47 (12.26)	9597.08 (12.29)
4.	Interest fixed capital	2683.67 (3.56)	2762.33 (3.56)	2891.11 (3.16)	2796.15 (3.58)

5.	**Total fixed cost**	**12575.21 (16.70)**	**12929.04 (16.66)**	**13450.22 (16.80)**	**13057.18 (16.73)**
	Total cost = (A+B)	**75291.44 (100.00)**	**77559.75 (100.00)**	**80050.99 (100.00)**	**78029.94 (100.00)**

3. Measures of farm profit"

The values of net income, family labour income and farm business the per hectare the sample farms of different size groups have been worked out in the table 2. The study revealed that the average net family labour income and farm business income from mango cultivation were ₹124,369.81 per hectare and ₹136,763.04 per hectare, respectively, across all farm-size groups.

The input output ratio was found to be 1:2.60, indicating that every rupee invested in mango cultivation generated a return of ₹2.60. This demonstrates that mango cultivation is a profitable enterprise and provides substantial returns to farmers. Overall, the results suggest that mango cultivation is economically viable and contributes significantly to farm income and livelihood improvement.

The Benefit–Cost ratio of small mango orchards can be increased by enhancing yield, improving fruit quality, obtaining better market prices, and minimizing cultivation costs through efficient use of inputs and modern orchard management practices. These measures will improve profitability and ensure higher economic returns from mango cultivation. Use proper harvesting, grading, packaging, and storage practices to minimize damage and wastage. Use Avail subsidies for drip irrigation, farm machinery, and horticultural development programs to reduce production costs.

Participate in training programs to learn modern technologies and best management practices for mango cultivation.

Table 2: Cost and return of mango orchard on the sample farm for different groups of farm (Rs./ha.)

S.No.	**Particulars**		**Farm size**		
		Small	**Medium**	**Large**	**Overall**
1.	Input cost	75291.44	77559.75	80050.39	78029.69
2.	Output cost	189779.25	205433.36	207435.91	202399.73
3.	Net income	114487.81	127873.61	127385.52	124370.08
4.	Family labour income	112509.91	127873.61	127384.92	124369.81
5.	Farm business income	126492.08	140168.83	140091.05	136763.04
6.	Farm investment income	126492.08	140168.83	140091.01	136763.31
7.	Benefit cost ratio	1:2.52	1:2.64	1:2.59	1:2.60

4. Cost and returns on the basis of cost concept"

The cost and returns on the basis of cost concept in the production of" mango orchard "have been presented in the table 3. The analysis of costs and returns revealed that the average per hectare **costs** of mango cultivation at the overall level were ₹65,636.69 (Cost A1/A2)**,** ₹68,432.84 (Cost B1)**,** ₹78,029.92 (Cost B2)**,** ₹78,685.73 (Cost C1)**,** ₹88,282.81 (Cost C2)**,** and ₹97,111.09 (Cost C3)**.** Correspondingly, the average income over these costs was estimated at ₹136,763.04**,** ₹136,763.04**,** ₹133,966.89**,** ₹124,369.81**,** ₹123,714.00**,** ₹114,116.92**,** and ₹105,288.64 per hectare**,** respectively. Despite the increase in cultivation costs across different cost concepts, mango cultivation remained profitable at all levels.

Datarkar, S.B. *et al.* (2014) estimated that the Per hectare cost of cultivation (Cost "C") of mango orchard for the sample as a whole was Rs.63,964.85 per hectare. Average per year gross income for the sample as a whole was Rs.1,48,956.00/ha. The output-input ratio found to be 1:2.57.

The study further indicated that income over various cost measures increased with farm size, mainly due to higher output and better resource-use efficiency on larger farms. Overall, larger mango farms realized greater profitability as higher production more than compensated for the increase in cultivation costs. Farm business income can be increased by raising gross returns and reducing paid-out costs (Cost A1/A2)**.**

Small mango growers can adopt the following strategies: improving yield and fruit quality, reducing cultivation costs through efficient resource use, minimizing post-harvest losses, and adopting better marketing strategies. These measures will enhance profitability and strengthen the economic viability of small mango orchards.

Table 3: Per hectare yield value of output and cost of production per quintal of mango orchard. (Rs./ha.)

S.No.	Cost/category	Small	Medium	Large	Overall
A.	**Break-up cost**				
1.	Cost A_1 (all actual expenses)	63286.45	65264.53	67345.41	65636.69
2.	Cost A_2=Cost A_1+Rent paid for leased in land	63286.45	65264.53	67345.41	65636.69
3.	Cost B_1=Cost A_1+Interest on value of owned fixed capital	67948.02	68026.86	70236.52	68432.84
4.	Cost B_2=Cost B_1+Rental value of owned land and rent paid for leased inland	77269.34	77559.75	80050.99	78029.92
5.	Cost C_1=Cost B_1+Imputed value of family labour	79015.23	78150.25	80109.98	78685.73
6.	Cost C_2=Cost B_2+Imputed value of family labour	88336.55	87683.14	89924.45	88282.81
7.	Cost C_3=Cost B_2+10% of cost C_2 on account of managerial function performed by farmer	97170.20	96451.45	98916.89	97111.09
B.	**Income over different cost**				
	I.O.D.C. A_1	126492.08	140168.83	140090.05	136763.04
	I.O.D.C A_2	126492.08	140168.83	140090.05	136763.04
	I.O.D.C. B_1	121831.23	137406.05	137199.39	133966.89
	I.O.D.C. B_2	112509.91	127873.61	127384.92	124369.81
	I.O.D.C. C_1	110764.02	127275.11	127325.93	123714.00
	I.O.D.C. C_2	101442.07	117750.22	117511.46	114116.92
	I.O.D.C. C_3	92609.05	108981.91	108519.02	105288.64
C.	**Gross income**	**189779.25**	**205433.36**	**207435.91**	**202399.73**
D.	**Input output ratio**	**1:2.52**	**1:2.62**	**1:2.59**	**1:2.58**

5. Trend Analysis of Area, Production, and Productivity of Mango in Bilaspur District and Chhattisgarh State

The trend in area, production and productivity of mango was estimated by computing linear equation for the period of 2007-08 to 2016-17 and which is presented in table 4 figures 3 and 4.

The study revealed a substantial expansion in mango cultivation in Bilaspur district during the period 2007–08 to 2016–17**.** The area under mango cultivation increased from 3,872 hectares to 6,157 hectares**,** while production rose from 12,791 metric tonnes to 20,438 metric tonnes, indicating significant growth in the mango sector. Productivity fluctuated between 3.30 and 4.42 tonnes per hectare during the study period, with improvements attributed to the adoption of improved mango varieties and better availability of agricultural inputs.

Mango productivity in Bilaspur district can be increased through the adoption of improved varieties, balanced nutrient management, efficient irrigation systems, scientific canopy management, effective pest and disease control, and rejuvenation of old orchards. Strengthening farmer training, extension services, and access to modern technologies will further enhance yield levels and ensure sustainable growth in mango production in the district.

Table 4: Area, production and productivity of mango in Bilaspur district and Chhattisgarh state

S.No.	Years	Bilaspur district			Chhattisgarh state		
		Area (in ha.)	Production (mt)	Productivity (t/ha.)	Area (in ha.)	Production (mt)	Productivity (t/ha.)
1	2007-08	3872	12791.23	3.30	36339.00	121900.95	3.35
2	2008-09	3975	12998.25	3.27	37288	121931.76	3.27
3	2009-10	4054.5	13037.24	3.21	51537	191671.79	3.61
4	2010-11	5182.50	22906.65	4.42	49765	236969.90	4.76
5	2011-12	5384.94	18971.29	3.52	56714.50	271467.41	7.78
6	2012-13	5547	19256	3.47	60146	291827	4.85
7	2013-14	5729	19264	3.36	64350	327914	5.09

8	2014-15	5841	19647	3.36	67119	386667	5.76
9	2015-16	6016	20236	3.36	71515	420609	5.88
10	2016-17	6157	20438	3.31	74375	434783	5.84

The growth in production of mango in Chhattisgarh state was found in 16.13 per cent which was 5 per cent level of significant, area and productivity was 8.30 and 7.01 per cent respectively was found to be negative and non-significant (table 5)

The compound growth rate analysis showed that the area and production of mango increased significantly at annual rates of 5.75 per cent and 5.52 per cent**,** respectively, both significant at the 1 per cent level. However, the growth rate of productivity was negative (-0.24 per cent) and statistically non-significant**,** suggesting that the increase in production was mainly driven by the expansion of cultivated area rather than improvements in yield. Sagar *et al.* (2019) estimated that the positive increases growth of area of mango found to be in Raipur (29.15 percent) and Kawardha (36.07 percent) districts and rest of districts Durg, Kanker, Raigarh, Jashpur districts have non-significant. In case of production of mango found to be significant positive were Durg (23.79 percent), Raigarh (30.26 percent) and Jashpur (37.74 percent) and also significant negative growth were Jagdalpur (-61.64 percent), Kawardha (-52.36 percent), Kanker (-28.633 percent) districts. The productivity of mango the partial compound growth rate in Raipur (29.22 percent), Dantewada (-22.14 percent), Janjgir (-16.70 percent), Raigarh (28.024 percent) districts were found statistically significant during 2009-10 to 2013-14.

Murthy and Babu (2018) studies on area, production and productivity trends of Mango crop (Mangifera indica Linn) in Andhra Pradesh state, India for the period 1992-93 to 2016-17 based on linear and non-linear statistical models. The results reveal that there is decreasing trend on area and production and gradually increasing trend on productivity of Mango crop in Andhra Pradesh state in above study period. The study was noticed that the drastically decreasing trend on area and productivity of mango crop from 2011-12 in Andhra Pradesh state. Varalakshmi, A. at el. (2023) observed that the area, production and productivity of mango crop have an upward trend in Karnataka state. The study was noticed that the Mango crop has been increased since 2000 by replacing other horticulture and cereal crops area and their production in Karnataka over the study period. Balaganesh and Makarabbi (2023) identified that the area and production of mango was doubled in the India (during 1991-92 to 2021- 22). The study was found to be the declining trend, negative growth rate and high instability in major mango producing states like Uttar Pradesh, Andhra Pradesh (including Telangana), Karnataka, Bihar, Gujarat, Tamil Nadu, Odisha, West Bengal, Kerala and Maharashtra are also taken into consideration. The increasing trend was noticed in production and productivity the cases, but area decreased in last few years.

Guatam et al. (2024) analysis that the on the basis of study period. Study period was separate into four sub-times *i.e.* Period 1st from 1994 to 2003, Period 2nd from 2004 to 2013, Period 3rd from 2014 to 2023 and Period 4th from 2014 to 2023 for better understanding. The results depicted that area, production and yield of mango had a positive growth rate during all the study periods. Among the study periods, period 3rd had the highest and significant growth for area with 2.76% per annum of growth rate followed by period 2nd and period 1st. It is clear that mango production was the most instable, with a CVt of 12.52%, followed by yield (8.68%) and the cultivated area (4.53%). Decomposition analysis indicates that, during period 2nd, period 3rd and period 4th, the area impact was the most significant element driving the change in mango production in Uttar Pradesh state.

Overall, the findings indicate that while mango cultivation expanded considerably in Bilaspur district, greater emphasis on productivity-enhancing technologies and orchard management practices is needed to achieve sustainable growth in mango production. Although mango area and production have expanded significantly in Bilaspur district, productivity remains unstable due to limitations in orchard management, input use, and technology adoption. Sustainable increases in mango productivity can be achieved through orchard rejuvenation, improved varieties, balanced nutrient and water management, effective pest control, scientific canopy management, and strengthened extension support. These interventions will help increase yield per hectare and ensure long-term growth in mango production.

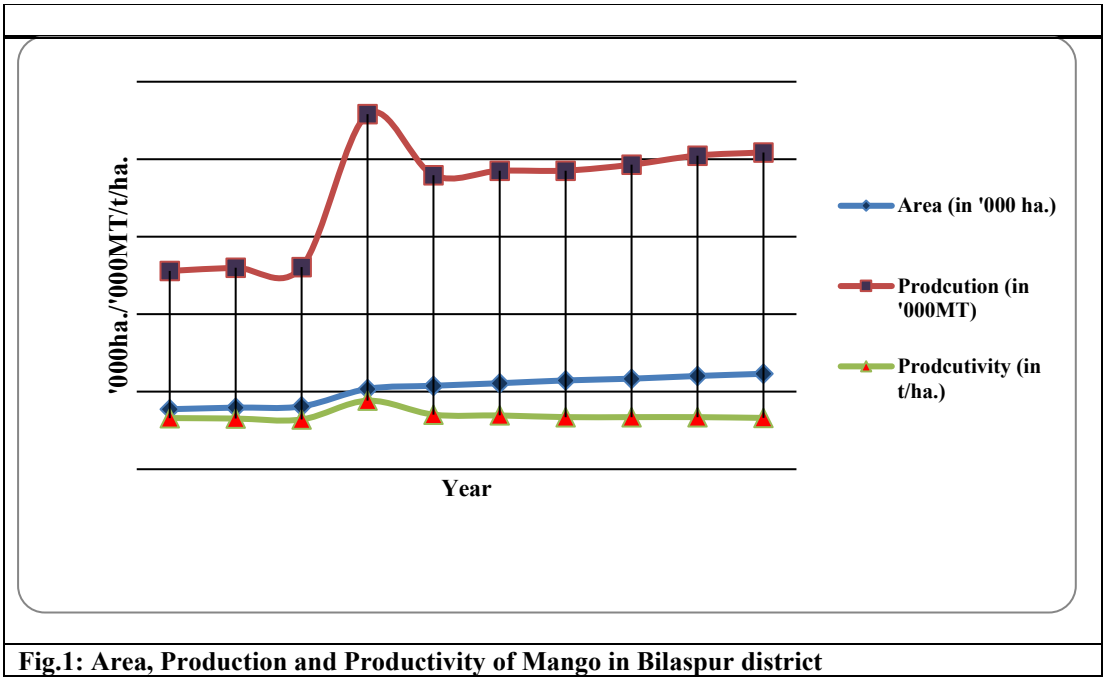

Fig.1: Area, Production and Productivity of Mango in Bilaspur district

Table 5: Compound growth rate of area, production and productivity of" mango in Bilaspur district and Chhattisgarh state

S.No.	Particular	Compound growth rate (2007-08 to 2016-17)	
		Bilaspur district	Chhattisgarh state
A	Area	5.75*	8.30*
B	Production	5.52*	16.13**
C	Productivity	-0.24	7.01*

Note: *significant in 1% level of probability, **significant in 5% level of probability"

CONCLUSION

Mango cultivation plays a significant role in the horticultural economy of Chhattisgarh, particularly in Bilaspur district, which has favorable climatic conditions and a substantial area under mango production. The study assessed the economics of mango cultivation and analyzed growth trends in area, production, and productivity. The average mango yield on sample farms was 100.01 quintals per hectare. The average cost of production was estimated at ₹780.55 per quintal, with the highest cost on small farms (₹799.86/quintal), followed by large farms (₹783.04/quintal), and the lowest on medium farms (₹763.53/quintal). Lower yields on small farms contributed to their higher production costs. Average gross income was ₹202,399.73 per hectare, ranging from ₹189,779.25 on small farms to ₹207,435.91 on large farms. Large farms achieved higher returns due to better productivity and production efficiency. The average net family labour income and farm business income were ₹124,369.81 and ₹136,763.04 per hectare, respectively. The input–output ratio of 1:2.60 indicates that every rupee invested generated a return of ₹2.60, confirming that mango cultivation is a profitable and economically viable enterprise that contributes substantially to farmers' incomes and livelihoods. Growth analysis revealed that mango area and production increased significantly at annual rates of 5.75% and5.52%, respectively. However, productivity recorded a marginal negative growth rate (-0.24%) and remainedstatistically non-significant, indicating that production growth was mainly driven by expansion of cultivated arearather than yield improvement.

Verma (2019) reported that the 60 per cent of the farmers expressed lack of processing awareness and only 27 per cent farmer expressed lack transportation facility. Non-availability of scientific storage facility was one of the major factors contributing to lower returns from Mango.

Overall, mango cultivation in Bilaspur district has expanded considerably and offers attractive economic returns. However, sustainable growth requires greater emphasis on productivity enhancement through scientific orchard management, orchard rejuvenation, adoption of improved and region-specific varieties, balanced nutrient and water management, effective pest control, canopy management, proper harvesting and post-harvest practices, stronger extension support and establishment of processing unit nearby production area. Adoption of modern technologies, farmer training, and utilization of government subsidies can further improve profitability, reduce production costs, and ensure long-term growth in mango production.

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