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ECONOMIC FEASIBILITY AND CONSTRAINTS ANALYSIS OF MANDARIN ORANGE CULTIVATION IN NAGPUR DISTRICT OF MAHARASHTRA (INDIA)

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ABSTRACT

The Economic feasibility and constraints analysis of mandarin orange cultivation has been studied in Nagpur district of Maharashtra for the period, 2021 -2023 by collecting data on various aspects of costs and returns. For study Benefit- Cost ratio (BCR), Net Present Value (NPV), Internal Rate of Return (IRR), Amortization cost, payback period (PBP), marketing efficiency and garret ranking technics has been used for statistical analysis. On the global scale India stands on ninth position in mandarin orange production. Mandarin orange is the most important commercial citrus species in India and contributes 41 percent of the total citrus production in the country. In the Vidarbha region of Maharashtra it is known for its special variety of mandarin orange grown in that area called Nagpur Mandarin orange and is the primary fruit crop in that area. The present study deals with, primary data collected from 75 farmers across three blocks in Nagpur district. The study revealed that the average cost of cultivation for establishing a mandarin orange plantation in Nagpur district was estimated Rs. 2,69,831.41 per hectare. Further analysis shown that amortization cost of Rs. 29,726.81 per hectare based on the total establishment cost, along with a maintenance cost of Rs. 64,796.75. In terms of yield, Nagpur had an average production of 9.27 tons per hectare with gross return of Rs. 1,85,459.59 and net return was Rs 120,662.84 per hectare. The discounted Net Present Value (NPV) per hectare in Nagpur was calculated Rs. 4,29,774.12. He estimated an Internal Rate of Return (IRR) of 12.98 percent. The Benefit-Cost Ratio (BC Ratio) was calculated 1.66 in Nagpur district, and the Payback Period (PBP) was estimated 6.36 years. The most important constraints in Mandarin orange cultivation are high initial investment as a prominent challenge followed by monopoly of traders and fruit drops, non-availability of quality planting materials and lack of skilled labours. Therefore, mandarin orange is more remunerative and yield can be sustainable if proper package of practices will be followed. The mode of pattern is same as conducted by Rama Rao, (2012).

Keywords : Mandarin orange, Cost and Revenue, Constraint's analysis, Nagpur, Maharashtra.

Introduction

Mandarin oranges, commonly known as mandarins belonging to the *Citrus reticulata* species. The Mandarin orange, is believed to have originated in the tropical and subtropical regions of Asia. Mandarin oranges have become widely cultivated and grown in

various countries around the world, including China, Brazil, USA, India, Spain, Mexico, and Argentina. In India, Mandarin oranges (*Citrus reticulata*) are widely cultivated and are known for their easy-to-peel nature and segment inside are easily separable. On a global scale, China leads in citrus production followed by Brazil. India ranks ninth in the world in mandarin

cultivation with average production of 10.5 million tonnes (2020-21) and share of approximately 3 percent of the total global production. Mandarin oranges are an exceptional fruit known for their outstanding nutritional value. Mandarins are rich in Vitamin C, in addition to vitamin 'C', they contain significant amounts of vitamins A, B and minerals such as calcium, phosphorus, iron, and alkaline salt. Mandarins have a high-water content, approximately 80 to 90 percent of the edible portion. These components play a vital role in maintaining a healthy diet as one orange fulfilling your daily needs.

Its make up a substantial 41% of the entire citrus production in the country, with sweet oranges and acid limes following closely behind. Maharashtra ranks second among the state in terms of the area dedicated to mandarin orange cultivation, contributing a significant 15.96% share to the nation's overall production. Specifically, Amravati and Nagpur are the key regions in Maharashtra responsible for the largest area and production. (Ref. Indiatat.com). Nagpur district alone accounted for 21,973.6 hectares area with production of 131841.6 metric tons of mandarin orange production in the year (2021-22)

To analyse the fact empirically the present study on Economic feasibility along with constraints analysis has been undertaken with following specific objectives:

- To work out costs and returns in production of mandarin orange.
- To identify the significant constraints in production of mandarin orange.

Materials and Methods

The study is based on primary data collected during the year 2022 -23 from 75 farm families. The multistage sampling technique was adopted for selecting the sampling units at various level. within Maharashtra, Nagpur district was selected purposively as it is one of the highest area of production under mandarin orange. All the mandarin orange growing tehsils from Nagpur district were listed and three tehsils viz- Pauni, Parshivni and Katol were selected as these tehsils have maximum area of mandarin crop. From each tahsil 25 respondents were selected randomly for the sampling. Thus the sample size was 75.famers for detailed study The mode of analysis of data followed was same as has been provided by Hangsing *et al.*, 2017; Kamble *et al.*, 2014; Kulkarni *et al.*, 2019 and Singh *et al.*, 2020; Singh *et al.*, 2022.

Analytical Tools

Following statistical tools were employed for the analysis of the data

Estimation of amortization cost

In the foundation stage, the establishment cost of the Mandarin Orange was distributed evenly over each year throughout the entire economic lifespan of the orchard. This cost is called the amortized cost.

$$\text{Annual amortization cost (A)} = \frac{P \times [(1+r) \times n] \times r}{[1+r]^{n-1}}$$

A= Annual amortization cost (Rs.)

P= Total establishment Cost of 5 years (Rs.)

r=Rate of interest/ Discount rate (10%)

n= Economic life of orchard in years (30 years)

Net Present Value (NPV): Net Present Value (NPV) or Net Present Worth (NPW) of the investment is the present worth of the cash flow stream of the project during its life span. The NPV can be given by following formula –

$$\text{NPV} = \frac{P_1}{(1+i)^{t1}} + \frac{P_2}{(1+i)^{t2}} + \dots + \frac{P_n}{(1+i)^{tn}} - C$$

where:

P₁ = Net cash flow in First Year

i = Discount rate

t= Time

C= Initial Investment

Benefit Cost Ratio Benefit cost ratio is the profitability indicator used to determine the viability of the cash flow generated in the investment.

$$\text{BCR} = \frac{\text{Discounted Cash Inflow}}{\text{Discounted Cash Outflows}}$$

Payback Period (PBP) The only undiscounted measure used is PBP. It indicates the total time required to cover the initial investment cost made in the plantation of orchard.

$$\text{PBP} = \frac{\text{Initial Investment on the Project}}{\text{Net Cash inflows per annum}}$$

Internal Rate of Return (IRR) Internal rate of return is the tool to estimate the financial feasibility of project. It measures the rate of return on the project.

IRR= lower discount rate

$$\times \frac{\text{+ Difference between two discount rates}}{\frac{\text{Present value of cash flow at lower discount rates}}{\text{Absolute difference between values of cashflowsstream at the two discount rates}}}$$

Garrett's ranking table Garrette ranking table was used to find out the major important constraints faced by the farmers and the intermediaries in the production

and marketing of Mandarin Orange in the study area. The mode of calculation followed was same as provided by (Bhandare *et al.*, 2014 & Deshmukh *et al.*, 2017),

$$\text{Per cent position} = \frac{(R_{ij} - 0.05)}{N_j} \times 100$$

Where,

R_{ij} = Rank given for i^{th} item by j^{th} individual

N_j = Number of items ranked by j^{th} individual

Result and Discussion

The estimated cost and return particulars of mandarin orange production pertaining to different

farm level collected from the 75 sample farmers of Nagpur district.

Cost and return structure in mandarin orange production

In case of plantation crop, estimation of costs included establishment cost and the maintenance cost of the orchard. Establishment cost includes various cost required during entire pre bearing period of 5 years and the maintenance cost includes all the costs incurred for the maintenance of orchard during bearing period.

Table 1 : Establishment cost of mandarin orange in Nagpur district during pre-bearing period (Rs/ha)

Sl. No.	Particulars	Small	Semi-medium	Medium	Overall
1	Irrigation structure	54,743.50 (20.56)	54,980.43 (20.49)	53,530.64 (19.49)	54,431.87 (20.17)
2	Sprayer	5,650.43 (2.12)	5,560.64 (2.07)	5,440.53 (1.98)	5,551.93 (2.06)
3	Fencing	7,400.00 (2.78)	8,200.00 (3.06)	9,100.00 (3.31)	8,235.28 (3.05)
4	Planting material	5,709.61 (2.14)	5,362.88 (1.20)	4,948.75 (1.80)	5,341.79 (1.98)
5	Seedling for gap filling	1,401.88 (0.46)	1,396.27 (0.52)	1,216.64 (0.51)	1,338.59 (0.50)
6	Manure	9,266.45 (3.48)	8,926.69 (3.33)	8,738.28 (3.18)	8,979.41 (3.33)
7	Fertilizers	11,325.70 (4.25)	10,910.40 (4.07)	10,680.10 (3.89)	10,974.84 (4.07)
8	PPC	4,099.50 (1.54)	3,789.34 (1.41)	4,550.47 (1.66)	4,147.42 (1.54)
9	Irrigation charges	2,925.07 (1.10)	2,785.00 (1.04)	2,540.00 (0.92)	2,750.74 (1.02)
10	Hired labour	14,550.00 (5.46)	14,709.50 (5.48)	18,210.00 (6.63)	15,823.17 (5.86)
11	Machine labour	22,197.00 (8.34)	15,363.00 (5.72)	15,141.00 (5.59)	17,571.66 (6.51)
12	Family labour	8,660.00 (3.25)	8,543.00 (3.18)	8,420.00 (3.07)	8,541.00 (3.16)
13	Miscellaneous	5,000.00 (1.88)	4,500.00 (1.68)	4,000.00 (1.46)	4,501.18 (1.67)
14	Subtotal	1,53,380.10	1,45,337.30	1,45,755.28	1,48,157.56
15	Interest on working capital @8%	12,270.41 (4.58)	11,626.98 (4.33)	11,660.42 (4.24)	11,855.59 (4.39)
	Fixed cost				
1	Land revenue	465.00 (0.17)	465.00 (0.17)	465.00 (0.17)	465.00 (0.17)
2	Rental value of land	62,500.00 (23.47)	62,500.00 (23.30)	62,500.00 (22.75)	62,500.00 (23.16)
3	Depreciation	27,853.10 (10.46)	36,609.95 (13.65)	40,627.25 (14.79)	35,038.13 (12.98)
4	Total fixed cost	90,818.10	99,574.95	1,03,592.25	97,995.10
5	Interest on fixed Capital @12%	10,898.17 (4.09)	11,948.99 (4.45)	12,431.07 (4.53)	11,762.26 (4.36)
	Total cost	2,67,366.78	2,68,488.23	2,73,439.01	2,69,831.41
	Amortization cost	29,455.28	29,578.83	30,124.25	29,726.81

The costs of establishment were incurred in the first 5 years of pre-bearing period of mandarin orange are given in Table-1. A perusal of tables reveals that, the total establishment cost per hectare of mandarin orange on overall farm level was found to be Rs. 2,69,831.41. Among the different input cost, machine labour cost was found to be highest, sharing about 6.51% followed by the hired labour cost 5.86%, of the

total costs. Some permanent structures in the farm includes irrigation structure Rs. 54,431.87 (20.17 %), followed by sprayer 2.06% and fencing 3.05% respectively. The fixed cost components include land rent which accounts maximum share 23.16%, followed by depreciation cost 12.98% and land revenue 0.17%. The amortization cost which was calculated on the total cost was Rs. 29,726.81 in the study area.

Table 2 : Maintenance cost of mandarin orange farm in Nagpur district during bearing period.

					(Rs/ha)
	Particulars	Small	Semi-Medium	Medium	Overall
Variable cost					
1	Manures	2,680.00 (4.18)	2,540.00 (3.94)	2,260.00 (3.43)	2,493.33 (3.85)
2	PPC	981.00 (1.53)	925.00 (1.44)	903.48 (1.37)	936.49 (1.45)
3	Hired labour	2,850.00 (4.44)	2,780.00 (4.31)	2,500.00 (3.80)	2,710.00 (4.18)
4	Machine labour	1,050.00 (1.64)	995.00 (1.54)	972.00 (1.48)	1,005.67 (1.55)
5	Family labour	2,540.00 (3.96)	2,490.00 (3.86)	2,350.00 (3.57)	2,460.00 (3.80)
6	Miscellaneous	550.00 (0.86)	540.00 (0.84)	500.00 (0.76)	530.00 (0.82)
7	Irrigation charges	564.00 (0.88)	518.00 (0.80)	498.00 (0.76)	526.67 (0.81)
8	Total working capital	11,215.00	10,788.00	9,983.48	10,662.16
9	Interest on working capital @ 8%	897.20 (1.40)	863.04 (1.34)	798.68 (1.21)	852.97 (1.32)
Fixed cost					
1	Rental value of land	14,500.00 (22.60)	14,500.00 (22.50)	14,500.00 (22.04)	14,500.00 (22.38)
2	Land revenue	98.30 (0.15)	98.30 (0.15)	98.30 (0.15)	98.30 (0.15)
3	Depreciation	5,570.61 (8.68)	6,121.99 (9.50)	7,625.45 (11.59)	6,439.35 (9.94)
4	Total fixed capital	20,168.91	20,720.29	22,223.75	21,037.65
5	Interest on fixed capital @12%	2,420.27 (3.77)	2,486.43 (3.86)	2,666.85 (4.05)	2,524.52 (3.90)
6	TVC+TFC	34,701.38	34,857.76	35,672.76	35,077.30
	Amortization cost	29,338.33 (45.91)	29,557.44 (45.90)	30,262.60 (45.78)	29,719.45 (45.87)
	Total cost	64,039.71	64,415.2	65,935.36	64,796.75

(Figures in parenthesis are in percentage)

It was revealed from the table -2. that the overall maintenance cost per hectares required for mandarin orchard was Rs 35077.72. The study also showed that among the variable cost involved in the maintenance cost, the shares of hired labour was maximum Rs. 2,710 (4.18%), followed by manures (3.85%). It was also revealed that among the fixed cost components,

the rental value of land Rs. 14,500 (22.38%) followed by the depreciation cost of Rs. 6,439.35 (9.94%). The amortization cost was calculated Rs 29726.81 accounting 45.87 per cent of total cost. The total maintenance cost was observed for mandarin orange orchard was Rs. 64,796.75. per hectares.

Table 3 : Measures of Yield and returns

Sl. No.	Particulars	Nagpur
1	Yield (tonne/ha)	9.27
2	Selling price (Rs. /tonne)	20,000
3	Gross return (Rs. /tonne)	1,85,459.59
4	Net return (Rs. /tonne)	1,20,662.84

A perusal of the table -3 revealed , that the average yield of mandarin orange was found 9.27 tonnes/ha and the average selling price in the market was Rs 20,000 per tonne. Thus, the farmer gets a net return of Rs. 1,20,662.84 per tonne of mandarin orange.

Table 4 : Financial feasibility of mandarin orange in Nagpur district .

Sl. No.	Particulars	Nagpur			
		Small	Semi-medium	Medium	Overall
1	NPV (Rs. /ha)	436310.45	4,27,429.90	4,25,582.01	429774.12
2	IRR (%)	13.25	13.12	12.57	12.98
3	BC Ratio	1.68	1.67	1.64	1.66
4	PBP (years)	6.58	6.61	6.73	6.64

The study observed that the Net present value for overall farmers was found Rs. 4,29,774.12 per ha. (Table 4). Among the group of farmers the Small farmers had the highest NPV value of Rs. 4,36,310.45 and lowest on Rs 4,25,582.02 on medium farmers. IRR was calculated overall farms was 12.98 per cent. The benefit -cost ratio of overall farmers was observed 1.66. It was also revealed that the payback period of overall farm level was computed and found to be 6.64 years. Medium farmers had observed that the highest payback period of 6.73 years (Table 4).

Table 5 : Production constraints of mandarin orange in Nagpur district.

Sl. No.	Constraints	Nagpur	
		Garrett Score	Rank
1	High initial investment	67.79	1
2	Non availability of quality planting materials	60.23	2
3	Monopoly of traders	58.65	3
4	Non availability of skilled labour during peak season	56.16	4
5	Fruit drop	55.18	5
6	Demand of high labour wages	48.12	6
7	High cost of inputs	44.30	7
8	Insect pest attack	37.91	8
9	Water scarcity	37.95	9
10	Wild animal, birds attack	32.68	10

A survey was carried out to gather opinions from mandarin orange growers and marketing intermediaries and ranked using Garrets ranking technique and results are given in Table 5. The mode of calculation followed was same as has been provided in Singh *et al.* (2022).

It was observed that the mandarin orange growers facing many problems. The result showed, that the high investment cost of mandarin orange is the severe problem faced by the farmers in the area. Non-availability of quality planting material and monopoly of traders, non-availability of skilled labour during peak season are another major problem faced by the farmers. The others least constraints were like fruit

drop, demand of high labour wages, high cost of input, and insect pest attack.

Summary and Conclusion

It may be summarized from the study that the cost for establishment of mandarin orange in Nagpur district was found Rs. 2,69,831.41 and the amortization cost calculated was Rs. 29,726.81. The maintenance cost during bearing period was calculated to be Rs. 64,796.75. The maintenance cost was calculated by adding amortization cost to the fixed cost and variable cost required in a year. The net return earned by the farmers was Rs 1,20 ,662.59. The discounted Net Present Value (NPV) per hectare was Rs. 4,29,774.12. The Internal Rate of Return was 12.98 per cent, and the

Benefit Cost Ratio was 1.66 and the Payback Period was 6.36 years in the study area. The major constraints faced by the farmers was high initial investment cost, followed by non-availability of quality planting materials on that time, monopoly of traders, non-availability of the labours during peak season etc.

Suggestions/ Policy Implication

- The study was suggested that farmers should be motivated for the establishment of more mandarin orchards, and the government should offer incentives and provide high-quality planting materials at the subsidized rate to the farmers.
- Efforts should be made to educate the farmers regarding the adopting improved practices of planting through extension experts or agencies.
- Efforts should be directed towards expansion and strengthening by the financial institution to meet the needs of farmers.

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Competing Interests

Authors have declared that no competing interests exist

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