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Economics of mandarin production in Nagpur district of Vidarbha region

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Abstract

This study was conducted during 2023-24 and focuses on the financial aspects of mandarin cultivation. Data were collected from 40 farmers across three tehsils namely Katol, Kalmeshwar, and Narkhed. The total cost of establishing a mandarin orchard over five years was Rs. 335120.07, with an annual establishment cost of Rs. 11968.57 over the orchard's productive lifespan of 28 years. The per-hectare cost of cultivation of mandarin orchards was examined Rs. 238322.49, with cost categories 'A₁' and 'A₂' amounting to Rs. 126954.73, representing 53.27 per cent of the total costs. Among these, manure accounted for the largest share at Rs. 35004.92 (14.69 per cent), followed by plant protection was Rs. 19540.20 (8.20 per cent). The highest benefit-cost ratio at cost 'C₃' was 1.87, indicating that mandarin cultivation is a profitable venture. However, major challenges faced by mandarin growers included significant fruit drop due to irregular and heavy rains, wind, hailstorms, and pest infestations, particularly from Phytophthora. Additionally, there was a general reluctance among farmers due to the high cost of inputs.

Keywords: Mandarin, establishment cost, benefit-cost ratio, profitable and phytophthora

Introduction

Mandarin (*Citrus reticulata* Blanco.) often known as mandarin or mandarine. Of all the citrus fruits grown in the world, mandarins are the most important crop since they are widely consumed as a tasty and healthy fruit. The tropical and subtropical regions of Asia and Oceania are thought to be the origin of mandarin oranges. Mandarins are the most widely grown citrus fruit worldwide, accounting for about two thirds of all citrus cultivation areas. The United States, Brazil, Central and South American nations, South Africa, Japan, China, India, and the Mediterranean region are among the top producers of mandarins. Mandarin, or *Citrus reticulata*, is the most extensively produced citrus fruit in India.

In India total area under Mandarin in 2023-24 is 446.31 thousand ha with production 6170.46 thousand MT (Ministry of Agriculture & Farmers' Welfare, Govt. of India, 2023-24-2nd Advance Estimates). In India Mandarin producing leading state includes Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Assam. In the year 2023-24 area under Mandarin cultivation in Maharashtra state is 135 thousand hectares with annual production 1335.29 thousand MT. (Ministry of Agriculture & Farmers' Welfare, Govt. of India, 2023-24-2nd Advance Estimates). In Maharashtra state, Mandarin production is emphasized in Nagpur and Amravati District. In 2022-23 area under cultivation Mandarin cultivation in Katol Tehsil was 4137.50 ha with production of 435.42 metric tonnes, Narkhed Tehsil had area 5551 ha with production of 555.15 metric tonnes and Kalmeshwar Tehsil had area of 3259 ha with production of 48885 metric tonnes. (Office of SAO, Nagpur).

The mandarins from Nagpur, best suited for the Vidarbha region, are highly esteemed. Study on economics of production and marketing of Nagpur Mandarin is important to understand its economic impact, optimize cultivation techniques, and explore market opportunities. It can boost local income, create jobs, and enhance regional development by leveraging the fruit's potential for both domestic and international markets.

Nagpur's mandarins are highly regarded; they are most suitable for the Vidarbha region. To understand the economic impact of Nagpur Mandarin, enhance cultivation methods, and

investigate market prospects, study of the economics of production is crucial. It can take advantage of the fruit's potential for both home and foreign markets to increase local income, create jobs, and improve regional development.

Objectives

1. To work out the establishment cost of mandarin
2. To study the cost and returns of mandarin
3. To study the constraints faced by mandarin growers

Methodology

The present investigation was carried out to study economics of production of mandarin in Nagpur district. The production of orange is mostly concentrated in Nagpur district of Maharashtra which is the reason for purposively selecting the district. Out of fourteen tehsils in Nagpur district three tehsils, were selected based on highest area under orange cultivation namely Katol, Kalmeshwar and Narkhed. From the selected three tehsils, nine villages were selected based on area under mandarin cultivation. From the selected villages a sample of 40 growers was selected to study the cost and returns of mandarin and a separate sample of 10 growers was selected to study the establishment cost of

mandarin orchard; hence a total 50 growers were selected for study during the year 2023-24.

The data were collected from mandarin growers by personal interview method with help of pre-tested interview schedule. To accomplish the objectives of the study the simple tabular analysis was used. Cost of production of mandarin was calculated as per the standard cost concept. For identification of constraints frequency distribution, percentile and simple ranking method was used.

Results and discussion

Per hectare input utilization of mandarin orchard

The efficient use of resources, decision-making procedures, and option selection can all be used to determine the degree of resource management. It also shows the degree of technology that the farmers have adopted. A farmer must spend in a variety of inputs, including machine labour, manure, fertilizers, seedlings, and human labour from humans. Thus, it is essential to understand the per-hectare expenditure pattern for these inputs. A detailed overview of the input use pattern per hectare for the chosen farmers is given in Table 1.

Table 1: Per hectare input utilization pattern of mandarin orchard (Cultivation)

| Sr. No. | Particulars | | Unit | Total units |
|---------|--------------------|--------|-----------|-------------|
| 1. | Hired human labour | Male | Days | 42.51 |
| | | Female | Days | 21.51 |
| 2. | Bullock labour | Hired | Pair Days | 3.11 |
| | | Owned | Pair Days | 2.37 |
| 3. | Machinery | Hired | Hrs. | 8.89 |
| | | Owned | Hrs. | 4.50 |
| 4. | Family labour | Male | Days | 15.45 |
| | | Female | Days | 11.21 |
| 5. | Manure | | Qtls. | 120.21 |
| 6. | Fertilizers | N | KG | 242.24 |
| | | P | KG | 162.55 |
| | | K | KG | 110.62 |
| 7. | Plant protection | | Rs. | 19540.20 |
| 8. | Growth regulators | | Rs. | 676.87 |
| 9. | Micronutrients | | Rs. | 4154.83 |
| 10. | Irrigation | | Rs. | 3851.84 |

In the mandarin orchards of Nagpur district, the utilization pattern per hectare showed a variety of resources allocated for cultivation. The amount of human labour, whether hired or from family members, was significant. Male hired labour contributed 42.51 days, while female hired labour contributed 21.51 days. Family labour added 15.45 days for males and 11.21 days for females. Bullock labour involved 3.11 days of hired pairs and 2.37 days of owned pairs being used. Machinery utilization included 8.89 hours of rented equipment and 4.50 hours of machinery owned by the individual. 120.21 quintals of manure were applied, with specific quantities used for fertilizers, i.e., 242.24 kg of nitrogen, 162.55 kg of phosphorus, and 110.62 kg of potassium. The investment in plant protection was substantial at Rs. 19540.20, alongside significant expenditures on micronutrients amounting to Rs. 4154.83, growth regulators costing Rs. 676.87, and irrigation charges being Rs. 3851.84.

This detailed input usage illustrated the substantial labour and resource commitment needed to maximize and maintain mandarin orchards, demonstrating a complete strategy to guarantee fruitful and sustainable farming practices.

Per hectare establishment cost of mandarin orchard

There are two main stages to any long-term horticulture crop, and mandarins are no exception: the establishment or development phase and the production phase. Mandarin orchards have a five-year gestation period after planting, during which the trees grow but produce no fruit. There are no returns on this first phase's substantial labour, input, and maintenance costs until the orchard begins to produce fruit. As a result, once the orchard enters the production phase, its establishment costs should be considered an investment capital that is necessary to guarantee its long-term productivity and profitability.

Table 2: Per hectare establishment cost of mandarin orchard (Rs. /ha)

| Particulars | I Year | II Year | III Year | IV Year | V Year | Total | Percent to total cost |
|--|-----------|----------|----------|----------|----------|-----------|-----------------------|
| Land Preparation | 7044.31 | - | - | - | - | 7044.31 | 2.10 |
| Marking of field | 2909.08 | - | - | - | - | 2909.08 | 0.87 |
| Digging of Pits | 4110.92 | - | - | - | - | 4110.92 | 1.23 |
| Gap filling expenditure | - | 3590.00 | - | - | - | 3590.00 | 1.07 |
| Fencing Cost | 23689.08 | - | - | - | - | 23689.08 | 7.07 |
| Value of planting material | 12582.19 | - | - | - | - | 12582.19 | 3.75 |
| Expenditure on Irrigation Structure | 8708.54 | - | - | - | - | 8708.54 | 2.60 |
| Receipt and upkeep of farm implements | 3599.77 | - | - | - | - | 3599.77 | 1.07 |
| Value of Human labour wages | 5420.21 | 8597.46 | 9814.31 | 10617.69 | 11708.92 | 46158.59 | 13.77 |
| Value of bullock labour wages | 353.92 | 373.08 | 388.46 | 385.08 | 373.08 | 1873.62 | 0.56 |
| Manure | 5782.32 | 7590.65 | 8489.12 | 11796.45 | 12550.97 | 46209.52 | 13.79 |
| Fertilizer | | | | | | | |
| N | 697.87 | 732.45 | 970.10 | 1128.86 | 1291.46 | 4820.74 | 1.44 |
| P | 537.85 | 623.31 | 828.06 | 981.28 | 1288.09 | 4258.60 | 1.27 |
| K | 636.46 | 720.29 | 982.24 | 1163.49 | 1357.34 | 4859.82 | 1.45 |
| Total | 1872.18 | 2076.05 | 2780.40 | 3273.63 | 3936.89 | 13939.15 | 4.16 |
| Micronutrient | - | 1695.62 | 2199.69 | 2835.38 | 3708.62 | 10439.31 | 3.12 |
| Replanting | - | 1152.31 | - | - | - | 1152.31 | 0.34 |
| Irrigation | 2766.77 | 3150.77 | 3419.69 | 3644.38 | 3716.77 | 16698.38 | 4.98 |
| Plant protection | 1476.92 | 1713.32 | 2364.20 | 2711.38 | 3226.77 | 11492.59 | 3.43 |
| Miscellaneous cost | 353.46 | 545.62 | 564.92 | 614.62 | 766.69 | 2845.31 | 0.85 |
| Repairing charges | 376.31 | 433.69 | 471.31 | 490.31 | 519.62 | 2291.23 | 0.68 |
| Incidental charges | 290.92 | 309.92 | 384.38 | 416.08 | 417.92 | 1819.23 | 0.54 |
| Working Capital | 81336.90 | 31228.47 | 30876.49 | 36785.01 | 40926.25 | 221153.12 | 65.99 |
| Interest on working capital @ 7%/Annum | 5693.58 | 2185.99 | 2161.35 | 2574.95 | 2864.84 | 15480.72 | 4.62 |
| Depreciation | 4776.92 | 3869.23 | 3976.92 | 4125.38 | 4135.85 | 20884.31 | 6.23 |
| Land revenue | 246.31 | 246.31 | 246.31 | 246.31 | 246.31 | 1231.54 | 0.37 |
| Cost A ₁ | 92053.72 | 37530.01 | 37261.08 | 43731.65 | 48674.70 | 258749.69 | 77.21 |
| Cost A ₂ | 92053.72 | 37530.01 | 37261.08 | 43731.65 | 48674.70 | 258749.69 | 77.21 |
| Interest on fixed capital @ 10%/Annum | 5869.23 | 6881.54 | 7089.23 | 6781.54 | 7125.31 | 33746.85 | 10.07 |
| Cost B ₁ | 97922.95 | 44411.55 | 44350.31 | 50513.19 | 55298.55 | 292496.54 | 87.28 |
| Cost B ₂ | 97922.95 | 44411.55 | 44350.31 | 50513.19 | 55298.55 | 292496.54 | 87.28 |
| Family Human Labour | 1878.92 | 2277.54 | 2675.92 | 2571.15 | 2754.54 | 12158.08 | 3.63 |
| Cost C ₁ | 99801.87 | 46689.08 | 47026.23 | 53084.34 | 58053.09 | 304654.61 | 90.91 |
| Cost C ₂ | 99801.87 | 46689.08 | 47026.23 | 53084.34 | 58053.09 | 304654.61 | 90.91 |
| 10% cost of Cost C ₂ | 9980.19 | 4668.91 | 4702.62 | 5803.43 | 5805.31 | 30465.46 | 9.09 |
| Cost C ₃ | 109782.06 | 51357.99 | 51728.85 | 58392.77 | 63858.39 | 335120.07 | 100.00 |
| Total Establishment Cost | | | | | | 335120.07 | |
| Per year establishment cost for bearing life of orchard (28 yrs) Rs. | | | | | | 11968.57 | |

The table 2. Shows that the total cost of establishing a mandarin orchard per hectare over five years amounted to Rs. 335120.07. The annual establishment cost for the orchard's productive lifespan, which is 28 years, was calculated to be Rs. 11968.57. The cost of input was highest during first year was Rs. 109782.06 whereas during second year cost of input was Rs. 51357.99, during third, fourth and fifth year the total cost of input were Rs. 51728.85, 58392.77 and 63858.39 respectively. The per hectare cost 'A₁' and 'A₂' was Rs. 258749.69 (77.21 per cent) out of these the highest contribution was of manure (13.79 per cent), proportion of share human labour wages (13.77 per cent) followed by fencing cost (7.07 per cent), irrigation (4.98 per cent), fertilizers (4.16 per cent), value of planting material (3.75 per cent), plant protection (3.43 per cent), micronutrients (3.12 per cent), expenditure on irrigation structure (2.60 per cent). The cost 'B₁' and 'B₂' was Rs. 292496.54 (87.28 per cent). The cost 'B₁' includes interest on fixed capital was Rs. 33746.85 (10.07 per cent). The cost 'C₁' and 'C₂' was Rs. 304654.61 (90.91 per cent). The cost 'C₁' includes family labour charges were Rs. 12158.08 (3.63 per cent), and cost 'C₃' (total establishment cost) was Rs. 335120.07.

Per hectare cost of cultivation of mandarin orchard

The physical inputs and output can be converted into monetary terms to determine the cost of cultivation per hectare. The success of any enterprise in agriculture can be judged based on economic benefits secured by the entrepreneur from the enterprise. In the present age of commercialization, the selected families gradually felt the impact of interplay of various economic forces. It has become necessary for them to look upon agriculture from the commercial point of view. This cannot be achieved unless the farms are conscious of aspect like costs of production, net profit gained or loss sustained by them and they tried to minimize the costs to maximize the returns. Per hectare cost of cultivation of mandarin production was calculated and presented in table 3.

Generally, mandarin trees start bearing for commercial fruiting from fifth year onwards. The growers must incur expenditure for the maintenance of orchard every year to obtain production. The expenditure is mainly incurred on labour for various operations, and inputs. The per hectare operations wise labour required for mandarin orchard, expenditure incurred on labour, other inputs used by the sample growers and expenditure incurred on inputs is discussed in the following part.

Table 3: Per hectare cost of cultivation of mandarin orchard (Rs. /ha)

| Particular | | Unit | Input | Cost per Input (Rs.) | Total cost (Rs.) | Percentage to total Cost C ₃ |
|---|--------------|-----------|--------|----------------------|------------------|---|
| Hired Human Labour | Male | Days | 42.51 | 340.41 | 14470.83 | 6.07 |
| | Female | Days | 21.51 | 230.14 | 4950.11 | 2.08 |
| | Total | | | | 19420.94 | 8.15 |
| Bullock Labour | Hired | Pair Days | 3.11 | 446.23 | 1386.38 | 0.58 |
| | Owned | Pair Days | 2.37 | 446.21 | 1058.66 | 0.44 |
| | Total | | | | 2445.03 | 1.03 |
| Machine labour | Hired | Hrs. | 8.89 | 923.21 | 8207.34 | 3.44 |
| | Owned | Hrs. | 4.50 | 923.16 | 4154.05 | 1.74 |
| | Total | | | | 12361.39 | 5.19 |
| Manure | | Qtls. | 120.21 | 291.21 | 35004.92 | 14.69 |
| Fertilizers | N | KG | 242.24 | 23.21 | 5622.39 | 2.36 |
| | P | KG | 162.55 | 32.14 | 5224.46 | 2.19 |
| | K | KG | 110.62 | 38.26 | 4232.15 | 1.78 |
| | Total | | | | 15079.01 | 6.33 |
| Micronutrients | | Rs. | | 4154.83 | 1.74 | |
| Growth regulator | | Rs. | | 676.87 | 0.28 | |
| Irrigation Charges | | Rs. | | 3851.84 | 1.62 | |
| Plant Protection | | Rs. | | 19540.20 | 8.20 | |
| Incidental Charges | | Rs. | | 579.98 | 0.24 | |
| Repairing Charges | | Rs. | | 2920.88 | 1.23 | |
| Working capital | | Rs. | | 116035.88 | 48.69 | |
| Interest on Working Capital @ 7% /annum | | Rs. | | 8122.51 | 3.41 | |
| Depreciation | | Rs. | | 2561.90 | 1.07 | |
| Establishment Cost | | Rs. | | 11968.57 | 5.02 | |
| Land Rev. Cess & other taxes | | Rs. | | 234.44 | 0.10 | |
| Cost A ₁ | | Rs. | | 126954.73 | 53.27 | |
| Rent paid for leased land | | Rs. | | - | - | |
| Cost A ₂ | | Rs. | | 126954.73 | 53.27 | |
| Interest on fixed capital @ 10%/annum | | | | 7824.78 | 3.28 | |
| Cost B ₁ | | Rs. | | 134779.51 | 56.55 | |
| Rental value of land | | Rs. | | 74038.10 | 31.07 | |
| Cost B ₂ | | Rs. | | 208817.61 | 87.62 | |
| Family Labour Charges | Male | Days | 15.45 | 340.41 | 5259.33 | 2.21 |
| | Female | Days | 11.21 | 230.14 | 2579.87 | 1.08 |
| | Total | | | | 7839.20 | 3.29 |
| Cost C ₁ | | | | 142618.71 | 59.84 | |
| Cost C ₂ | | | | 216656.81 | 90.91 | |
| 10% cost of Cost C ₂ | | | | 21665.68 | 9.09 | |
| Cost C ₃ | | | | 238322.49 | 100.00 | |
| Yield per hectare | | Ton | 15.89 | 28045.01 | 445635.21 | |
| Value of total produce | | Rs. | | | 445635.21 | |
| Per quintal cost of production | | Rs. | | | 2804.50 | |

The table 3. Revealed per hectare cost of cultivation of mandarin orchards. It is observed that, the per hectare cost 'A₁' and 'A₂' was Rs. 126954.73 (53.27 per cent) out of these the highest contribution of manure was Rs. 35004.92 (14.69 per cent) followed by plant protection was Rs. 19540.20 (8.20 per cent), hired human labour of Rs. 19420.94 (8.15 per cent). Proportion share of fertilizers of Rs. 15079.01 (6.33 per cent) i.e. Nitrogen (2.36 per cent), phosphorus (2.19 per cent) and potash (1.78 per cent), followed by machine labour was Rs. 12361.39 (5.19 per cent) micronutrient was Rs. 4154.83 (1.74 per cent), irrigation was Rs. 3851.84 (1.62 per cent), bullock labour costs Rs. 2445.03 (1.03 per cent), and growth regulator was Rs. 676.87 (0.28 per cent). The Cost of working capital was accounted to Rs. 11603588 (48.69 per cent).

The cost 'B₁' was Rs. 134779.51 (56.55 per cent) includes interest on fixed capital was Rs. 7824.78 (3.28 per cent) and the cost 'B₂' was Rs. 208817.61 (87.62 per cent) includes rental value of land was Rs. 74038.10 (31.07 per cent). The cost 'C₁' was Rs. 142618.71 (59.84 per cent) includes family labour charges was Rs. 7839.20 (3.29 per cent), cost 'C₂' was Rs. 216656.81 (90.91 per cent) and cost 'C₃' i.e., total cost of cultivation was found to be Rs. 238322.49.

Economics of mandarin cultivation

The per hectare profitability of mandarin orchard was worked out by deducting different costs viz. Cost 'A₁', Cost 'A₂', Cost 'B₁', Cost 'B₂', Cost 'C₁', Cost 'C₂', and Cost 'C₃' are presented in Table 4

Table 4: Economics of mandarin cultivation (Rs. /ha)

| Sr. No. | Particulars | Value |
|---------|------------------------|-----------|
| 1. | Main Produce (Ton/ha) | 15.89 |
| 2. | Value of Main Produce | 445635.21 |
| 3. | Gross Returns | 445635.21 |
| 4. | Cost of Cultivation at | |
| | Cost "A ₁ " | 126954.73 |
| | Cost "A ₂ " | 126954.73 |
| | Cost "B ₁ " | 134779.51 |
| | Cost "B ₂ " | 208817.61 |
| | Cost "C ₁ " | 142618.71 |
| | Cost "C ₂ " | 216656.81 |
| | Cost "C ₃ " | 238322.49 |
| 5. | Net Returns at | |
| | Cost "A ₁ " | 318680.48 |
| | Cost "A ₂ " | 318680.48 |
| | Cost "B ₁ " | 310855.70 |
| | Cost "B ₂ " | 236817.60 |
| | Cost "C ₁ " | 303016.50 |
| | Cost "C ₂ " | 228978.40 |
| | Cost "C ₃ " | 207312.72 |
| 6. | Benefit-Cost at | |
| | Cost "A ₁ " | 3.51 |
| | Cost "A ₂ " | 3.51 |
| | Cost "B ₁ " | 3.31 |
| | Cost "B ₂ " | 2.13 |
| | Cost "C ₁ " | 3.12 |
| | Cost "C ₂ " | 2.06 |
| | Cost "C ₃ " | 1.87 |

It is revealed from the table 4. that, the average gross returns worked out to Rs. 445635.21. The net returns obtain at various costs were Rs. at cost 'A₁' and cost 'A₂', Rs. 318680.48 at cost 'B₁', Rs. 310855.70 at cost 'B₂', Rs. 303016.50 at cost 'C₁', Rs. 228978.40 at cost 'C₂' and Rs. 207312.72 at cost 'C₃'. The highest benefit-cost ratio at cost 'C₃' was 1.87. This shows that mandarin is profitable crop enterprise.

Constraints faced by mandarin growers

All the selected mandarin growers were interviewed for the problems they are facing while producing mandarin. The information regarding the important problems faced by the farmers is presented in table 5.

Table 5: Constraints faced by mandarin growers

| Sr. No. | Particulars | No. of farmers | % to total | Rank |
|---------|--|----------------|------------|------|
| | | N=40 | | |
| 1. | Excessive fruit drop due to irregular and heavy rains, wind and hailstorm and infestation of insects and pest, particularly phytophthora | 38 | 95.00 | I |
| 2. | Growers less interested due to high initial investment during establishment of orchard | 31 | 77.50 | IV |
| 3. | Increased cost of inputs | 34 | 85.00 | II |
| 4. | Lack of technical guidance regarding production and practices | 32 | 80.00 | III |

It is observed from table 5, excessive fruit drop due to irregular and heavy rains, wind and hailstorm and infestation of insects and pest, particularly phytophthora was found to be the major constraint with 95.00 percent of growers followed by increased cost of inputs with 85.00 per cent of growers, lack of technical guidance regarding production and practices with 80.00 per cent of growers and growers less interested due to high initial investment during establishment of orchard with 77.50 per cent of growers.

Conclusion

1. Per hectare cost of establishment of mandarin orchard for five year was Rs. 335120.07 and cost of cultivation was Rs. 238322.49.
2. The Benefit-Cost ratio which is an indicator of economic efficiency in crop production, indicated that the mandarin

registered a good input-output ratio i.e. 1.87.

3. Major constraint faced by mandarin growers was excessive fruit drop due to irregular and heavy rains, wind and hailstorm and infestation of insects and pest, particularly phytophthora.

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