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Economic Evaluation of Nagpur Mandarin Cultivation in Vidarbha Region of Maharashtra

L.S. Gangwar and Shyam Singh*

Citrus occupies a place of importance in the horticultural wealth and economy of the country. Demand for citrus fruit and their products has increased and it is likely to go up further because of increased nutritional awareness. Nagpur mandarins (oranges), besides being the most refreshing, delicious, health promoting fruit, have been known all over the country for their excellent quality. This paper deals with the economics of production of and the constraints in the cultivation of Nagpur mandarins in the Vidarbha region of Maharashtra. The main objectives of this paper are (i) to study the costs and returns from Nagpur mandarins, (ii) to determine the profitability of Nagpur mandarins through different investment appraisal methods, (iii) to suggest a better method for economic appraisal of the orchards and (iv) to work out the economic productive life of mandarin orchards in the study area.

DATABASE AND METHODOLOGY

The data for this study were collected from four tahsils (Katol, Kalmeshwar, Narkhed and Saoner) of Nagpur district, which accounted for more than 65 per cent of the total area under mandarins. To select the sample size, five villages from each tahsil were randomly selected. A list of farmers from each selected village was obtained and arranged in ascending order in proportion to land holding allocated to the mandarin orchards. A sample of 103 mandarin growers was selected and the required information was collected through personal interview with the help of a questionnaire. The data were collected on various aspects of establishment of orchards, maintenance cost, constraints faced in the cultivation and economic returns from orchards, relating to the year 1996-97. The age of mandarin orchards ranged from below one year to 26 years. The costs and returns for different age groups of orchards were compiled from the survey data itself. The mandarin orchards were devided into five groups, namely, below 5 years (non-bearing period), 6-10 years (increasing yield), 11-15 years and 16-20 years (constant yield) and above 21 years (decreasing yield) for the purpose, of analysis.

Several techniques are available for evaluating the economic viability of investment in orchards (Gittinger, 1974). For studying the economic viability of mandarin orchards, the project evaluation techniques are used. Besides, the present value summation method commonly used, namely, net present value, benefit-cost ratio, payback period, and internal rate of return, the annual amortization method (Nelson *et al.*, 1973; Subrahmanyam and Mohandas, 1982) which has been used for working out the repayment capacity is also used for the purpose of making a comparison of these two methods. The amortized establishment cost could be used as a guideline for taking decision for replanting of mandarin orchards.

* Scientist (Agricultural Economics), Indian Institute of Sugarcane Research, Lucknow-226 002 and Director National Research Centre for Citrus, Shankarnagar, Nagpur-440 010, respectively.
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RESULTS AND DISCUSSION

1. *Costs and Returns for Nagpur Mandarin Oranges*

The agewise costs and returns from Nagpur mandarin orchards (Appendix) were calculated on the basis of annual cash inflow and cash outflows. The establishment cost includes expenditure on land preparation, cost of planting material, labour wages for pit digging, etc. The maintenance cost includes investment on manure and fertiliser, labour wages, expenditure on plant protection chemicals, irrigation, bamboo stalking, harvesting and transportation cost. These data were used for computing the measures of investment worth and economic productive life of orchards. Maintenance costs of orchards were obtained by using the quantity of inputs used per plant at an average plant density of 324 plants per hectare (ha). The inputs were valued at 1996-97 prices. The returns from Nagpur mandarin orchards start from the sixth year and continue beyond 26 years, unlike Coorg mandarins which give economic returns beyond 40 years as an inter-crop with coffee plantation (Subrahmanyam and Mohandas, 1982). The total establishment cost of orchard was Rs. 35,452. The amortization cost, over 26 years at the rate of 12 per cent, was Rs. 4,490. The maintenance cost from the sixth year onwards varied from Rs. 12,667 to Rs. 22,403 per ha. The maintenance cost was rather high as compared to the cost worked out by George (1974) and Gupta and George (1974) at 1973-74 prices. The average gross returns per ha amounted to Rs. 30,864 per year. The measures of investment worth of Nagpur mandarin are presented in Table 1. Since the net present value (NPV) and benefit-cost (B-C) ratio are functions of the discount rate, these measures were obtained at 12 per cent and 18 per cent discount rate. These are the rates of interest charged by the various financial institutions providing loans for the development of mandarin orchards.

TABLE 1. MEASURES OF INVESTMENT WORTH PER HECTARE OF NAGPUR MANDARINS (ORANGES)

Sr. No.	Measures of investment worth	Size of the orchards (ha) (n = 26)			
		Up to 1.00	1.00-2.00	Above 2.00	Overall
(1)	(2)	(3)	(4)	(5)	(6)
1.	Payback period (years)	8	8	8	8
2.	Net present value (Rs.)				
	(a) Discount rate = 12%	46,564	45,865	40,718	44,379
	(b) Discount rate = 18%	18,885	18,804	14,552	17,414
3.	Internal rate of return (%)	28.73	28.83	25.78	27.74
4.	Benefit-cost ratio				
	(a) Discount rate = 12%	1.454	1.442	1.380	1.425
	(b) Discount rate = 18%	1.290	1.286	1.213	1.262
5.	Annual return (uniform) (Rs.)	6,277	5,807	5,157	5,621

The NPV at 12 per cent discount rate varies from Rs. 40,718 to Rs. 46,564 per ha depending upon the size of mandarin orchards. The B-C ratio for overall group was 1.425. The internal rate of return (IRR) was the lowest (25.78) for large orchards (above 2 ha). The payback period was less than 8 years for all categories of Nagpur mandarin orchards. The uniform annual returns, which help in determining the replacement period of orchard, can be computed by dividing the NPV by present value of an annuity of Re.1 over the expected life of orchard. At a discount rate of 12 per cent, the present value of Re. 1 received at the

end of each period for 26 years is Rs. 7.896. Thus the uniform annual returns at 12 per cent discount rate from Nagpur Mandarin orchards of sizes below 1 ha, 1-2 ha, above 2 ha and for overall group are Rs. 6,277, Rs. 5,807, Rs. 5,157 and Rs. 5,621 respectively. This means that so long as the net returns are greater than Rs. 6,277 per ha from mandarin orchards below 1 ha, they should not be replanted. The old mandarin orchards of above 2 ha size should not be replaced by new plantation until the net returns from old plantation do not fall below Rs. 5,157 per ha. The results of this study suggested that the Nagpur mandarin orchards of size below 1 ha will be replanted after 22 years of age. From the above analysis, it was concluded that the economic productive life of Nagpur mandarin orchards was up to 22 years in the study area.

The average per hecatre cost, gross and net returns from mandarin orchards are presented in Table 2. The table shows that the net returns over maintenance cost and over total cost were Rs.15,723 and Rs.11,233 respectively. The returns to maintenance cost ratio worked out to be 2.04 for Nagpur mandarin orchards. In the absence of opportunity cost of land and other scarce resources used in other competing crops, viz., cotton, soyabean, vegetables, etc., not much could be said about the comparative economics of Nagpur mandarin cultivation. It may be concluded that as long as the net returns from alternative crops do not fetch more NPV, IRR and B-C ratio as obtained from mandarin orchards, its cultivation is profitable. The study reveals that mandarin cultivation in Vidarbha region of Maharashtra is a profitable business from the producer's point of view.

TABLE 2. AVERAGE COSTS AND RETURNS FROM NAGPUR MANDARINS (ORANGES)

Sr. No. (1)	Particulars (2)	Amount (Rs. per ha) (3)
1.	Establishment cost amortized over 26 years @ 12 per cent interest per year	4,490
2.	Average maintenance cost	15,141
3.	Total cost per year	19,631
4.	Average gross income per year	30,864
5.	Net income per year	11,233

2. *Economic Evaluation*

The economic productive life as well as profitability of Nagpur mandarins was calculated with the help of different investment appraisal methods and project evaluation techniques. The B-C ratio, NPV and minimum income required for taking decision of replantation of orchards based on the present value summation method and annual amortization method along with IRR and payback period are presented in Table 3. The discounted and amortization values of returns are calculated at 12 per cent because the financial institutions advance short-term loans to the mandarin growers at this rate of interest. From the table it could be observed that the payback period is 8 years. The NPV was Rs. 44,379, the benefit-cost ratio 1.425 and IRR 27.74 under the present value summation method. Under amortization method also, the NPV and B-C ratio were more or less the same. This confirms that Nagpur mandarin orange production is profitable upto 22 years after its plantation.

TABLE 3. COMPARISON OF TWO METHODS OF MEASURES OF INVESTMENT WORTH PER HECTARE OF NAGPUR MANDARINS (ORANGES)

Sr. No. (1)	Measures of investment worth (2)	Present value (3)	Amortization method (4)
1.	Benefit-cost ratio	1.425	1.572
2.	Net present value (Rs.)	44,379	44,983
3.	Minimum net income required before replantation of orchard (Rs.)	>5,621	>4,490
4.	Internal rate of return (per cent)	27.74	-
5.	Payback period	8	-

3. *Comparison of Two Appraisal Methods*

The comparison of the results obtained from the two appraisal methods revealed that the amortization method seems to slightly over-estimate B-C ratio and present (capital) value of the mandarin orchards, however the differences are not large. There was wide difference in income calculated under present value method and amortization method (i.e., Rs. 1,131 per ha) over maintenance cost for making decision to replace old orchards by new plantations. The amortization method estimated an income of Rs. 4,490 over maintenance cost of mandarin trees for retaining the plantation, as this amount over fixed cost (amortization) would be enough to meet the amortization cost. However, the present value method (Rs. 5,621) looked more realistic as Nagpur mandarins are grown as pure crop and it has to compete with other cash crops in the area. In view of the fact that the Nagpur mandarin orchards have long productive life like other plantation crops and that it is difficult to collect information on costs and returns for all the years as required in the present value summation method, the amortization method is more useful and convenient. However, the establishment cost during pre-bearing period has to be collected and analysed for both the methods.

CONCLUSIONS

This study indicates that investment in Nagpur mandarin orchards is a profitable business from the producer's point of view and essential for strengthening the citrus industry in domestic as well as in international markets. Excluding the rental value of land (opportunity cost), investment in mandarin orchards has a payback period of 8 years. Nagpur mandarin cultivation in the Vidarbha region of Maharashtra is a profitable enterprise with an IRR varying from 25.78 to 28.83 per cent depending upon the size of the orchards. The NPV and B-C ratio at a discount rate of 12 per cent varied from Rs. 40,718 to Rs. 46,564 per ha and from 1.380 to 1.454 respectively, depending on the size of the orchards. The IRR for overall group is 27.74. The economic productive life of Nagpur mandarin orchards is approximately 22 years. The mandarin orchards need to be replanted when the annual (net) return over maintenance cost falls below Rs. 6,277, Rs. 5,807, Rs. 5,157 and Rs. 5,621 for the orchards of the size below 1 ha, 1-2 ha, above 2 ha and for overall size-group respectively. The optimum size of Nagpur mandarin orchards is upto 1 ha. There is negative correlation between the size of orchards and net returns. The main reason for low productivity from big orchards was that these orchards belonged to absentee landlords and were poorly managed by the labourers employed by the landlords. The comparison of results obtained from the

present value method and amortization methods shows that the mandarin trees are worth retaining as long as they give an income of Rs. 4,490 over maintenance cost. Regarding the method of economic appraisal of investment in Nagpur Mandarin orchards, the annual amortization method seems to be preferable to the present value summation method because of its simplicity, equal efficiency and close to real situation results.

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APPENDIX

(A) COST AND RETURNS OF NAGPUR MANDARINS (ORANGES) - AGEWISE

(Rs/ha)

Age	Size of orchard (in hectares)							
	Below 1.00 (ha)		1.00 - 2.00		Above 2.00		Overall	
	Cost	Returns	Cost	Returns	Cost	Returns	Cost	Returns
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	7,519	0	7,679	0	8,357	0	7,852	0
2	5,362	0	5,471	0	5,971	0	5,601	0
3	6,874	0	7,119	0	7,409	0	7,134	0
4	6,995	0	7,309	0	7,648	0	7,317	0
5	7,318	0	7,497	0	7,829	0	7,548	0
6	19,772	36,307	18,209	39,642	20,604	34,403	19,528	36,784
7	20,069	37,904	21,638	33,867	18,123	37,604	19,943	36,458
8	18,007	30,473	20,917	37,416	21,477	29,846	20,134	32,578
9	21,072	39,638	17,457	40,342	22,403	39,488	20,311	39,823
10	18,079	40,174	15,872	34,861	17,643	41,267	17,198	38,767
11	18,593	31,674	19,112	36,609	18,623	32,693	18,776	33,659
12	19,146	42,481	20,402	34,816	19,559	30,873	19,702	36,057
13	18,584	40,376	19,392	42,602	20,294	42,604	19,423	41,861
14	19,307	41,857	20,221	34,681	18,506	44,3[illegible]1	19,345	40,283
15	17,371	44,671	18,216	42,607	18,497	43,632	18,028	43,637
16	18,247	30,717	19,470	40,309	20,614	39,634	19,444	36,887
17	16,382	32,681	15,699	30,877	14,782	36,773	15,621	33,444
18	17,667	31,547	16,826	29,619	15,378	31,609	16,624	30,925
19	15,907	24,907	16,669	29,657	17,881	29,691	16,819	28,085
20	14,386	28,416	14,860	28,333	15,339	24,307	14,862	27,019
21	13,043	22,475	13,893	21,607	14,074	20,647	13,670	21,576
22	13,288	20,661	14,093	19,994	13,473	18,481	13,618	19,712
23	13,366	19,359	14,304	16,838	13,907	17,674	13,859	17,957
24	14,031	18,603	13,897	14,813	14,214	17,018	14,047	16,811
25	12,667	16,407	12,687	17,037	14,093	18,513	13,149	17,319
26	13,601	18,367	14,304	19,481	14,457	17,685	14,121	18,511

Note: Inter-cropping during establishment (pre-bearing) period of mandarin orchards is a common practice. The expenditure includes only maintenance of trees after deducting returns from inter-crops. Soybean, cotton, gram, jowar, vegetables are the important inter-crops grown in the orchards.

(Contd.)

APPENDIX (*Concld.*)

(B) PRICE OF NAGPUR MANDARINS

Sr. No. (1)	Year (2)	Price realised by farmers* (3)	Wholesale price (New Delhi) (4)	Price realised by farmers** (Rs./kg of fruits) (5)
1	1991-92	-	8.98	2.95
2	1992-93	-	11.04	3.62
3	1993-94	-	11.78	3.86
4	1994-95	-	10.38	3.40
5	1995-96	-	10.35	3.39
6	1996-97	4.30	13.11	4.30

* Obtained from the primary data (survey).
** Obtained from interpolation.

Note: Prices realised by the growers were compiled according to the *bahars* (*ambia* and *mrig*) and the market channels through which mandarin fruits were sold. The prices vary marginally in different *bahar* or market channels followed by farmers to dispose off their produce. The average price was calculated and used in converting yield figures to value terms. The average price realised during 1996-97 sseason was Rs.4.30 per kilogram of mandarin fruits. The information on price realised (1991-92 to 1996-97) was worked out through interpolation from the wholesale price of mandarins in Delhi market compiled from National Horticulture Board. The wholesale price indicates the consumer's price in Delhi market. The gaps among prices explain the marketing margins to the middlemen involved in mandarin marketing system.

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