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Economic Appraisal of Mandarin Cultivation in Jhalawar District of Rajasthan

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Abstract: The study examined various aspects of mandarin such as growth in area, production and productivity and various tools to measure the economic viability of mandarin in Jhalawar district of Rajasthan area during 2008-09. A sample of sixty farmers was drawn from six selected villages. In Jhalawar district the compound growth rate of area, production and productivity of mandarin showed a significant and positive growth rate of 9.06, 19.96 and 9.98% per annum, respectively, during 1998-99 to 2007-08. The economic feasibility of mandarin orchard was tested by four different methods viz., payback period, net present worth, internal rate of return and gross benefit cost ratio. The establishment cost was estimated as Rs. 26,535. On the basis of this establishment cost, the pay back period of the investment was worked out to 7 years. The net present worth was estimated to Rs. 5,73,951.26 in the study area. The total discounted cost and benefit were observed as Rs. 5,75,969.42 and Rs. 11,49,920.67, respectively. The IRR was calculated as 34.90%. This indicated high profitability of mandarin cultivation. The gross benefit cost ratio was calculated as 2.00, which was more than unity. Finally, by all the techniques of investment decision such as NPW (Rs. 5,73,951.26), IRR (34.90 %), GBCR (2.00:1) and PBP (7 years), it was found that the mandarin cultivation in Jhalawar district was profitable and economically viable.

Key words: Mandarin, Jhalawar, orchards, economic analysis.

Mandarin (*Citrus reticulata Blanco*), is most common among citrus fruits grown in India and occupy about 50% area. Citrus fruits have only 13.00% of total production of all fruit crops in India, with third rank after banana and mango. Major fruits produced in India were banana (38.00%), mango (21.00%) and citrus (13.00%) in 2009-10 (Anonymous, National Horticulture Board, 2010). Mandarin fruits facilitate the running of the processing industry with a higher margin of profit. Its importance lies in providing employment to a large number of persons in our country. Mandarin which is locally known as "Nagpur-Santra" has good reputation and it is the best of its kind grown in India. In Rajasthan highest production of mandarin was in Jhalawar district i.e. 166055 metric tonnes from 8277 hectares of area with a productivity of 20062 kg ha^{-1} during 2008-09. Jhalawar district produces one of the best quality of mandarin comparable at the national level. Jhalawar is popularizing as Chhota Nagpur because of production of best quality mandarin. Thus, looking to the importance of mandarin in citrus fruits in general and Jhalawar district in particular, the present study was carried out in Jhalawar district to study the growth in area, production and productivity of mandarin and to test the economic feasibility of investment made on mandarin cultivation in the district.

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Materials and Methods

The study was limited to Jhalawar district, which was selected on the basis of highest area under mandarin in Rajasthan. Mandarin orchards were mainly concentrated in three tehsils i.e. Jhalrapatan, Pirawa and Pachpahar. Out of these, two tehsils viz., Jhalrapatan and Pirawa were purposively selected on the basis of highest area under mandarin cultivation. Six villages namely Junakhera, Barodiya, Maanpura, Guradiya, Gadiya and Saamiya having highest area under mandarin were finally selected for investigation.

A complete enumeration of all mandarin growers in each selected village along with their area under mandarin was done. In order to have comparative analysis, all mandarin growers were categorized into three groups on the basis of age of orchard. viz., Group I: 1-5 years, Group II: 6-12 years and Group III:

above 12 years. Under each group 20 growers were selected randomly. The study pertains to the year 2008-09. A simple tabular analysis and simple functional forms were used to arrive at stated objectives.

Growth rates of area, production and productivity of mandarin

To examine the changes in area, production and productivity of mandarin over the years, compound growth rates were worked out. For this purpose, data on area, production and productivity of mandarin from 1998-99 to 2007-08 were collected and analyzed.

The compound growth rate of area, production and productivity of mandarin was worked out to know the pattern of growth in these variables. These were computed by fitting exponential function to the figures of area, production and productivity for the period 1998-99 to 2007-08. The following form of exponential function was used:

Exponential trend equation:

$Y = ab^t u_t$

where,

Y = Area/production/productivity of mandarin,

t = time in years,

u_t = error term,

b = growth rate over a time period, and b = (r+1)

where,

r = Compound growth rate

Thus,

$Y = a(r+1)^t u_t$

On making log transformation of this equation:

$\text{Log } Y = \log a + \log(r+1)\ t + \log u_t$

Compound growth rate 'r' = (Antilog of b-1) x 100

Economic feasibility of investment

The costs and returns of mandarin were distributed over a number of years. Hence, discounting technique was used to compare the streams of costs and returns over the years. To test the economic feasibility of any long term investment, the economic parameters viz:, Pay Back Period (PBP), Net Present Worth (NPW), Internal Rate of Return (IRR) and Gross Benefit Cost Ratio (GBCR) were worked out by conventional methods (Gittinger, 1982).

Pay back period (PBP): It means the length of time required to recover the initial outlay. In this study investment does not give a uniform annual return. Therefore, the payback period was computed with the help of annual returns. The annual returns or cash inflows were cumulated and the time by which cash inflows equal to the investment was the payback period of the mandarin cultivation.

Net present worth (NPW): It is the present value of all cash associated with the investment including the outlay.

$$\text{NPW} = \sum_{i=1}^{n} \frac{Bn - Cn}{(1+r)^n}$$

where,

Bn = Benefit in n^{th} year

Cn = Cost in n^{th} year

r = Rate of interest or discount rate

n = Number of years

It was computed by deducting the total discounted cost stream from the discounted benefit stream.

Internal rate of return (IRR): It is the rate of discounting which makes the net present value of the investment zero. It gives the earning power of investment.

$$\text{IRR} = \sum_{i=1}^{n} \frac{Bn - Cn}{(1+r)^n} = 0$$

where,

Bn = Benefit in n^{th} year

Cn = Cost in n^{th} year

r = Rate of interest or discount rate

n = Number of years

Gross benefit cost ratio (GBCR): It measures the returns or benefits per unit cost of investment. It is the ratio of the discounted value of all cash inflows to the discounted value of all cash outflows.

Table 1. Age wise distribution of mandarin orchard

Age group	No. of farm family	No. of orchards	No. of mandarin plants	Average number of plants ha^{-1}
1-5 years	20	20	4715	339
6-12 years	20	20	6845	352
Above 12 years	20	20	6660	350
Total	60	60	18220	347

$$GBCR = \frac{\sum_{i=1}^{n} \frac{B_n}{(1+r)^n}}{\sum_{i=1}^{n} \frac{C_n}{(1+r)^n}}$$

Net BCR = GBCR – 1

where,

B_n = Benefit in n^{th} year

C_n = Cost in n^{th} year

r = Interest rate or discount rate

n = Number of years

The assumptions underlying the study were as follows:

i. The life period of mandarin orchard was considered to be 22 years (as per standard practice)

ii. The yields were stabilized after 15 years of planting (as per standard practice)

iii. The mandarin starts yielding benefits from the sixth years of investment

iv. The costs and returns were discounted at the rate of 12%, the prevailing bank rate.

Results and Discussion

Age wise distribution of mandarin orchard

The age wise distribution of mandarin orchards of the study area is given in Table 1. The results of the study showed that number of farm families were equal to the number of orchards. Thus each of the farm family had an individual mandarin orchard.

It was observed that the total number of mandarin plants and average number of plants for each age group were 4715 and 339, 6845 and 352 and 6660 and 350 for 1-5 years, 6-12 years and above 12 years, respectively. The overall total number of plants per hectare for all the sample growers was 347 in the study area.

Growth rates of area, production and productivity of mandarin

Compound growth rates of area, production and productivity of mandarin were worked out (Table 2) for Jhalawar district to assess the direction of change in these aspects over time.

Compound growth rate represents a uniform rate of change from one year to another. In Jhalawar district the compound growth rate of area, production and productivity of mandarin showed a significant and positive growth rate of 9.06, 19.96 and 9.98% per annum, respectively. Similar results were also obtained in Maharashtra for fruits by Rahane *et al.* (2000)

Economic feasibility of mandarin cultivation

The commercial production of mandarin starts after 5th year. The cost incurred for the first five years is the establishment cost and maintenance cost. The per hectare cost of establishment of mandarin orchard was worked out to Rs. 26,535. It included the cost incurred on preparation of land and lay out, digging and filling of pits, cost of saplings, plantation cost, manures, fertilizers, etc.

The per hectare total cost (fixed cost plus variable cost) of mandarin production is shown in Table 3. Total cost of cultivation of mandarin was Rs. 54,475.61 ha^{-1} per year. Out of the total cost, the fixed cost was estimated as Rs. 31,376.00 (57.60%) ha^{-1} and the variable cost amounting to Rs. 23,099.61 (42.40%), which covered 18.47% material cost and 23.93% labor cost. These results were also supported by Dahiya *et.al.*, (2002).

Table 2. Compound growth rate of area, production and productivity of mandarin (1998-99 to 2007-08)

Particulars	Area	Production	Productivity
Compound	9.06	19.96	9.98
Growth rate (per cent/year)	(0.006)	(0.018)	(0.022)

Figures in parentheses are the standard errors of coefficients.

Table 3. Structure of total cost per hectare for mandarin (2008-09)

Particulars	Per hectare cost (Rs.)	Per cent to the total
Fixed cost		
Land revenue	45.25	0.08
Rental value of own land	16194.42	29.73
Depreciation	8407.88	15.44
Interest on fixed investment	6728.45	12.35
Total fixed cost	31376.00	57.60
Variable cost:		
Labor cost	13037.08	23.93
Material cost	10062.53	18.47
Total variable cost	23099.61	42.40
Total cost:	54475.61	100.00

It was observed that the fixed cost, which accounted for 57.60% of the total cost, of which rental value of own land and depreciation accounted for 29.73% and 15.44%, respectively.

The economic viability of mandarin cultivation in Jhalawar district, was tested by five different methods viz., pay back period, net present worth, internal rate of return, gross benefit cost ratio and sensitivity analysis. The details of different indicators are described as under.

Net present worth

The net present worth was estimated as Rs. 5,73,951.26 in the study area (Table 4). It indicated that the nature of the investment was on the right direction. This could have been possible because of high productivity of the mandarin in Jhalawar district.

Internal rate of return

The returns of project is defined as the discount rate at which the net present worth is equal to zero. The decision rule says that accept the project, if the IRR is higher than or equal to minimum desired IRR other wise reject the project. The IRR was calculated as 34.90% as shown in Table 5. This indicated the high profitability of mandarin cultivation. These results were in line with results of Rahane *et al.* (2002).

Table 4. Discounted benefit cost ratio and net present value of mandarin orchard (in Rupees)

Year	Cost	Benefit (gross return)	Net benefit (net return)	Discounted factor (12%)	Discounted cost	Discounted benefit	NPW
1	64080.29	0.00	-64080.29	0.8929	57214.54	0.00	-57214.54
2	63310.29	0.00	-63310.29	0.7972	50470.58	0.00	-50470.58
3	67396.29	0.00	-67396.29	0.7118	47971.35	0.00	-47971.35
4	71125.29	0.00	-71125.29	0.6355	45201.41	0.00	-45201.41
5	63521.14	0.00	-63521.14	0.5674	36043.60	0.00	-36043.60
6	74382.29	121651.20	47268.91	0.5066	37684.38	61632.28	23947.90
7	81194.94	143772.00	62577.06	0.4523	36728.47	65035.15	28306.68
8	76414.29	165184.00	88769.71	0.4039	30862.45	66715.05	35852.60
9	76140.29	213120.00	136979.71	0.3606	27456.95	76853.21	49396.26
10	83890.29	244640.00	160749.71	0.3220	27010.43	78767.53	51757.10
11	86645.29	273912.00	187266.71	0.2875	24908.45	78743.15	53834.70
12	87368.89	318800.00	231431.11	0.2567	22425.42	81828.02	59402.60
13	97455.29	354144.00	256688.71	0.2292	22334.24	81160.66	58826.43
14	94810.12	422120.00	327309.88	0.2046	19400.03	86374.12	66974.09
15	98387.22	592014.00	493626.78	0.1827	17974.98	108158.74	90183.77
16	92615.29	526641.52	434026.23	0.1631	15107.56	85906.64	70799.08
17	96856.29	477874.00	381017.71	0.1456	14106.57	69599.64	55493.07
18	89784.29	447032.00	357247.71	0.1300	11675.51	58131.86	46456.35
19	87763.29	418522.96	330759.67	0.1161	10189.91	48593.35	38403.44
20	86269.29	394366.64	308097.35	0.1037	8943.26	40882.71	31939.46
21	72589.74	366696.00	294106.26	0.0926	6718.88	33941.24	27222.36
22	67041.29	333936.00	266894.71	0.0826	5540.46	27597.31	22056.85
					575969.42	1149920.68	573951.26

Table 5. Pay back period (PBP), Net present worth (NPW), Internal rate of return (IRR) and Gross benefit cost ratio (GBCR) of mandarin cultivation

Indicators	Value
Net present worth (Rs.)	573951.26
Internal rate of return (%)	34.90
Gross benefit cost ratio	2.00
Payback period (Years)	7

Gross benefit cost ratio

It measures the returns or benefits per unit cost of investment. On the basis of available data it was calculated as 2.00 as shown in Table 5. This indicated that by investing Rs. 1.00 as a cost, farmers obtained Rs. 2.00 as benefit. The net benefit cost ratio worked out to 1.00 i.e. 2.00 minus one. Thus, the mandarin cultivation was profitable in the study area. These results were also in line with the results of Singh and Singh (2006).

Pay back period

As the name suggested it is defined as the time period within which the initial investment of project recovered in the form of yearly benefits. In the study area, the per hectare establishment cost was estimated as Rs. 26,534.59. On the basis of this establishment cost, the pay back period of the investment was worked out to 6 years and seven months as shown in the Table 5. The pay back period of mandarin was found to be high in study area because the productive age of mandarin orchard was only 22 years and production of mandarin was found to be lower in initial years.

Finally, by all techniques of investment decision indicators such as NPW (Rs. 73,951.26), IRR (34.90%), GBCR (2.00:1) and PBP (7 years), it was found that the mandarin cultivation in Jhalawar district was profitable and economically viable.

Sensitivity analysis

The estimated values of various parameters used to test the economic viability of mandarin orchard along with the sensitivity analysis of investment under varying situations are presented in Table 6.

It is evident from the results that under normal cost and returns situation, the net present worth (NPW) was positive (Rs. 5,73,951.26) at 12% discount rate, which indicated the financial soundness of the investment on mandarin orchard. The benefit cost ratio (BCR) was higher than unity (2.00), indicating the worthiness of the investment. The internal rate of return (IRR) was found higher than the normal bank interest rate (34.90) and pay back period (PBP) refers to the time required for the net benefits to equal the capital cost of the project. The pay back period for mandarin orchard was found to be around seven years.

Moreover, the Table 6 also exposed the fact that how the value of feasibility on changing the cost and returns for 10% rate of change revealed that under all the four varying situations of costs and returns, values of NPW, BCR, IRR and PBP satisfied the acceptance rules of investments. These indicated the level of stability and certainty of economic viability of investment on the mandarin orchard.

Thus, at varying situations of costs and returns as a part of sensitivity analysis, the cultivation of mandarin was a profitable proposition.

Conclusions

Mandarin cultivation involves heavy capital investment in the initial stage. The area, production and productivity of mandarin in Jhalawar district showed a positive and significant compound growth rate to the tune of 9.06, 19.96 and 9.98% per annum respectively. The establishment cost was Rs. 26,535.00 ha^{-1} and total cost of cultivation

Table 6. Sensitivity analysis of economic viability of mandarin cultivation

Combinations	NPW (Rs.)	BCR	IRR (%)	PBP (year)
With actual costs and returns	573951.26	2.00	34.90	7
With varying costs and returns situation				
(i) 10% increase in cost with original returns	516354.31	1.81	32.41	7
(ii) 10% decrease in returns with original cost	458959.18	1.80	32.11	7
(iii) 10% increase in cost and 10% decrease in returns	401362.20	1.63	29.67	7
(iv) 10% increase in returns and 10% decrease in cost	746540.30	2.44	38.64	6

(Discount rate=12%)

for mandarin was Rs. 54,475.61 year^{-1}. The gross benefit cost ratio and internal rate of return was found to be 2.00 and 34.90%, respectively. The mandarin cultivation seems to be quite profitable and economically viable.

Looking to the positive growth in production of mandarin in Jhalawar district, the government should provide and scientific storage better marketing and facilities to the farmers of the region by opening more number of regulated markets.

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