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EVALUATION OF NET PRESENT VALUE AND INTERNAL RATE OF RETURN UNDER MANGO ORCHARD IN REWA DISTRICT, MADHYA PRADESH, INDIA

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ABSTRACT

The present study was conducted in Rewa district of Madhya Pradesh to evaluate the economic viability of mango orchards using investment appraisal techniques such as Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PBP). Primary data were collected from 30 mango growers categorized based on orchard age. The results revealed that mango orchards incur high establishment costs during the initial non-bearing period (1–6 years), followed by substantial returns from the seventh year onwards. The estimated NPV was found to be Rs. 2,90,955.44 per hectare at a 12 percent discount rate, indicating strong economic feasibility. The IRR was calculated at 16.54 percent, confirming profitability. The payback period was approximately 8.8 years. However, major constraints such as high initial investment, price fluctuations, and lack of market infrastructure were identified. The study concludes that mango orchard investment is financially viable and can significantly enhance farmers' income if supported by improved market access and policy interventions.

Keywords : Mango, NPV, IRR, Payback Period, Economic Viability.

Introduction

Mango (*Mangifera indica* L.) is one of the most important fruit crops in India, contributing significantly to agricultural income and employment. India accounts for a major share of global mango production (NHB, 2023). Mango cultivation plays a crucial role in enhancing farmers' income and livelihood security (Singh *et al.*, 2022). In Madhya Pradesh, particularly in Rewa district, mango cultivation has gained importance due to favorable climatic conditions (Sharma & Patel, 2021). Mango orchards require high initial investment and have a long gestation period, making economic evaluation essential (Meena *et al.*, 2022). Investment appraisal tools such as Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period are widely used to assess long-term profitability (Gittinger, 1982; Pandey, 2020).

Previous studies have confirmed the economic viability of mango cultivation. Kumar and Singh (2021) reported positive NPV and benefit-cost ratios, while Reddy *et al.* (2020) highlighted stable long-term returns. However, profitability is affected by price

fluctuations, input costs, and market infrastructure (Khan & Singh, 2022). Mango growers also face several constraints such as high establishment cost, pest incidence, lack of storage, and poor marketing facilities (Patel *et al.*, 2023; Verma *et al.*, 2021). Therefore, this study aims to evaluate financial feasibility and identify key constraints in mango cultivation in Rewa district.

Materials and Methods

Sampling Procedures

The Rewa district was purposively selected due to its importance in mango production in the Rewa division. Rewa district comprises eight blocks, namely Rewa, Raipur, Gurh, Mauganj, Naigarhi, Sirmaur, Teonthar, and Jawa. Among its eight blocks, Rewa block was selected based on the highest area under mango orchards. A list of mangoes growing villages from Rewa block were prepared then ten villages were selected randomly. Mango orchard growers were categorized into three groups based on orchard age: young (1–6 years), middle-aged (7–20 years), and old (21–40 years). From each group, ten farmers were

selected using simple random sampling. Thus, a total of 30 mango orchard growers constituted the sample for the study.

Collection of data

The study required primary data, which was collected through pre tested interview schedule. Data was collected regarding information on cost and returns and investment from mango grower farmers.

Net Present Worth:

The net present worth (NPW) shows the value of all the money flow into the project, adjusted for the time value of money. It is also known as net present value (NPV). NPW is calculated using a specific formula.

$$NPW = \sum_{n=1}^t \frac{B_n}{(1+r)^n} - \sum_{n=1}^t \frac{C_n}{(1+r)^n}$$

Where,

NPW stands for Net Present Worth in period 't'

B_n represents the benefits from mango cultivation each year.

C_n is the cost of mango cultivation each year.

r is the discount rate.

n equals 1, 2, 3, ..., up to 40, which covers the entire life of the mango

Payback period (PBP)

The payback period was calculated by dividing initial investment of the project by annual net cash return.

$$\text{Payback period of the project in years} = \frac{\text{Initial Investment of the project (Rs./ha)}}{\text{Annual net cash revenue (Rs./ha)}}$$

Internal rate of return (IRR)

It is the rate of discounting which makes the present value of the investment zero. It gives the earning power of investment.

$$\sum_{n=1}^t \frac{B_n}{(1+r)^n} - \sum_{n=1}^t \frac{C_n}{(1+r)^n} = 0$$

Where,

B_n = Year wise profit from mango orchard

C_n = Year wise cost incurred mango orchard

t = total life period of orchard (40)

Constraints faced by Mango growers

Garrett's ranking method was used to evaluate the constraints mango faced by the mango growing farmers. The farmers were asked to rank the factors that limit their ability to produce and market mangoes. These rankings will then be converted into scores using this formula:

$$\text{Percent position} = \frac{100(R_{ij} - 0.50)}{N_j}$$

Where, R_{ij} = ranking assigned to the ith factor (i=1, 2, 3... n) by the jth farmer (j=1, 2, 3... n)

N_j = number of variables evaluated by the jth farmer

Result and Discussion

Net present value (NPV) of mango orchard

The results of the net present value analysis of mango orchards at a discount rate of 12 per cent are represented in the table 1. It was observed from the analysis of data that during the establishment period (1 to 6 years), the mango orchard incurred only costs with no returns, resulting in negative present values of costs. The total discounted cost during this non-bearing period was Rs. 246069.99 per hectare. From 7 year onwards, the orchard started generating income. The discounted present value of net returns during years 7 to 20 was Rs. 413 327.24/ha, followed by Rs. 98,792.19/ha during years 21 to 30, and Rs. 24905.99/ha during years 31 to 40. The total discounted present value of returns over the productive life of the orchard was Rs. 537025.43ha. The net present value (NPV) of the mango orchard was found to be positive (Rs. 290,955.44/ha) indicated that mango cultivation is economically viable and financially profitable at a 12 per cent discount rate. A positive net present value inferred that the present value of benefits greater than the present value of costs indicated that investment in mango orchards is economically viable. These findings are in line with earlier studies, where positive NPVs in perennial fruit crops indicate long-term profitability and sustainability (Kumar & Singh, 2021; Meena *et al.*, 2022). Similar results were also reported by Reddy *et al.* (2020), who found that mango orchards generate substantial returns after the gestation period, making them a viable long-term investment.

The payback period was approximately observed to be 8.8 years representing that the initial investment in mango orchard establishment is recovered within about nine years of operation. This is consistent with findings reported by Sharma and Patel (2021), who highlighted that orchard crops typically recover initial investment within 8–10 years under normal management conditions. The benefit–cost (B:C) ratio was greater than one, further confirming the economic feasibility and profitability of mango orchard cultivation. Overall, the results reveal that establishment of mango orchard is a profitable long-term investment for farmers and can contribute significantly to farm income over the productive life of the orchard.

Internal rate of return (IRR) of Mango orchard

The internal rate of return (IRR) analysis was carried out to evaluate the financial feasibility of investment in the mango orchard and the result is presented in the 2. The net cash flows gained from one hectare of mango orchard was discounted at two trial discount rates, *i.e.*, 25 per cent and 28 per cent, to analyzed the IRR. During the initial establishment period (1 to 6 years) the mango orchard incurred negative net cash flows due to high establishment and maintenance costs and absence of returns. From year 7 year onwards, the orchard started generating positive net returns, which continued throughout the productive life of the orchard (up to 40 years). The total discounted present value of net cash flows at 25 per cent discount rate was found negative Rs. 56,062.79/ha while at 28 per cent discount rate it was Rs. 75944.44/ha. Using interpolation between these two discount rates, the internal rate of return was estimated to be 16.54 per cent. The IRR value of 16.54 per cent

indicates that the mango orchard investment yields a return higher than the assumed opportunity cost of capital (12 per cent), implying that mango orchard cultivation is financially viable and economically profitable. A positive internal rate of return (IRR) is greater than the discount rate indicated that investment in mango orchard is profitable for farmers and investors. These results are supported by previous studies, where IRR values above the discount rate confirm the economic feasibility of fruit crop investments (Gittinger, 1982; Pandey, 2020). Similar findings were reported by Khan and Singh (2022), who observed that mango cultivation provides attractive returns despite market uncertainties. Overall, the internal rate of return analysis reveals that mango establishment of orchard is a profitable for the long-term investment in the study area and can significantly enhance farm income over the productive life of the orchard.

Table 1: Per hectare net present value of mango orchard ($r=12\%$)

Year	Cost Rs./ha	Net Return Rs./ha	DF $(1+r)^n$ $n=40$ year $r=12\%$	Discounted Net Cost Rs./ha	Discounted Net Return Rs./ha
1	-108091.65	-	0.8929	-96510.40	-
2	-48647.27	-	0.7972	-38781.30	-
3	-47884.08	-	0.7118	-34082.94	-
4	-45391.07	-	0.6355	-28846.84	-
5	-44125.58	-	0.5674	-25038.04	-
6	-45023.80	-	0.5066	-22810.46	-
7 to 20		123086.00	3.3580	-	413327.24
21 to 30		168662.10	0.5857	-	98792.19
31 to 40		132062.29	0.1886	-	24905.99
Total	-339163.44	423810.39	-	-246069.99	537025.43
NPW (NPV) Rs./ha				290955.44	
B: C ratio at 12 % Discount factor				2.18	
Payback period (In year)				8.8	

Table 2: Internal rate of return from Mango orchard (Rs./ hectare)

Year	Net cash flow Rs./ha	Lower discount rate $r=25\%$ $(1/(1+r)^n)$	Corresponding present value at lower discount rate Rs./ha	Upper discount rate 28% $(1/(1+r)^n)$	Corresponding present value at higher discount rate Rs./ha
1	-108091.65	0.8000	-86473.32	0.7813	-84446.60
2	-48647.27	0.6400	-31134.25	0.6104	-29691.94
3	-47884.08	0.5120	-24516.65	0.4768	-22832.91
4	-45391.07	0.4096	-18592.18	0.3725	-16909.49
5	-44125.58	0.3277	-14459.07	0.2910	-12842.23
6	-45023.80	0.2621	-11802.72	0.2274	-10237.23
7 to 20	123086.00	1.0025	123388.68	0.7864	96797.92
21 to 30	168662.10	0.0412	6942.99	0.0235	3955.69
31 to 40	132062.29	0.0044	583.72	0.0020	262.35
Total			-56062.79		-75944.44
Internal Rate of Return (IRR)				16.54 %	

Production constraints faced by Mango growers in the study area

The Garrett ranking technique was used to analyze the production constraints faced by mango growers in the study area and the results are revealed in the table 3. The data analysis of the production constraints revealed that initial heavy investment for orchard establishment was the most severe constraint with the highest mean Garrett score (78.79). (Patel *et al.*, 2023) followed by irregular bearing of mango trees (77.86), adverse climatic conditions (76.29), cost insecticide chemical (75.93), shortage of talented labour (74.14,) drop of fruits during flowering and fruiting stage (72.21), severe occurrence insect and pest (73.36), lack of irrigation facilities (70.86), high cost of enrichers and manures (67.64), non-availability of quality planting material (63.29), absence of procedural knowledge about orchard management (59.14), damage caused by wild animals (58.36), high cost of farm machinery (56.29), lack of training and extension services, (55.57) and soil fertility problems (53.36).

Marketing Constraints faced by Mango growers in the study area

The Garret ranking method was also applied to analyzed the marketing constraints faced by mango growers in the study area and the result is shown in the table 4. The analysis of the marketing constraints revealed that the price fluctuation in the market was the most serious marketing constraint with the highest Garrett score (83) (Khan and Singh ,2022), followed by irregular bearing of mango trees (77.86), adverse climatic conditions (76.29), high cost of plant protection chemicals (75.93), shortage of skilled labour (74.14), fruit dropping during flowering and fruiting stage (72.21), severe incidence of pests and diseases(73.36), lack of irrigation facilities (70.86), high cost of fertilizers and manures (67.64), non-availability of quality planting material (63.29), lack of technical knowledge about orchard management (59.14), damage caused by wild animals (58.36), high cost of farm machinery (56.29), lack of training and extension services (55.57), and soil fertility problems (55.36).

Table 3: Production constraints faced by Mango growers

S. No.	Production constraints	Mean Garrett Score	Rank
1	Initial heavy investment for orchard establishment	78.79	I
2	Irregular bearing of mango trees	77.86	II
3	Adverse climatic conditions	76.29	III

4	High cost of insecticide	75.93	IV
5	Shortage of capable technical	74.14	V
6	Dropping of fruits during flowering and fruiting period	72.21	VI
7	Severe occurrence of pests and diseases	73.36	VII
8	Lack of irrigation facilities	70.86	VIII
9	High cost of nourishments and manures	67.64	IX
10	Non-availability of quality planting material	63.29	X
11	Lack of procedural knowledge about orchard management	59.14	XI
12	Damage caused by wild animals	58.36	XII
13	High cost of farm machinery	56.29	XIII
14	Lack of training and postponement amenities	55.57	XIV
15	Soil fertility problems	53.36	XV

Table 4: Marketing constraints faced by Mango growers

S. No.	Marketing constraints	Mean Garrett Score	Rank
1	Price fluctuation in the market	75.64	I
2	Lack of regulated market facilities	74.14	II
3	High transportation cost	73.86	III
4	Lack of storage facilities	72.00	IV
5	Exploitation by middlemen	70.29	V
6	Lack of grading and standardization	69.29	VI
7	High cost of packaging materials	68.93	VII
8	Delay in payment by traders	67.79	VIII
9	Poor market information	66.29	IX
10	Lack of processing facilities	64.50	X
11	Lack of cold storage facilities	62.79	XI
12	High commission charges in markets	61.79	XII
13	Poor road and transport infrastructure	60.14	XIII
14	Limited access to distant markets	59.07	XIV
15	Lack of cooperative marketing system	56.79	XV

Conclusion

It is concluded from the study that mango cultivation is a economically viable and profitable under long-term investment. Although the orchard incurred costs during the initial non-bearing period (1–6 years), it gives returns from the seventh year onwards, leading to a positive NPV of Rs. 2,90,955.44 per hectare at a 12 percent discount rate. The estimated IRR of 16.54 percent, which is higher than the prevailing opportunity cost of capital, further confirms the economic feasibility of mango orchard investment. The payback period of approximately 8.8 years indicates that the initial investment can be recovered within a reasonable time frame.

Suggestions and policy implications

- For adopting mango cultivation, government should provide subsidies on fencing, inputs and also provided credits support to mango growing farmers during establishment phase.
- Established cold storage and processing unit to reducing post-harvest. losses and stabilize prices.
- For enhancing technical knowledge and decision-making capacity government should provide training on scientific orchard management and marketing strategy.
- Encouraging farmer producer organizations (FPOs) and cooperative marketing can reduce the role of intermediaries and improve farmers' bargaining power in the market.

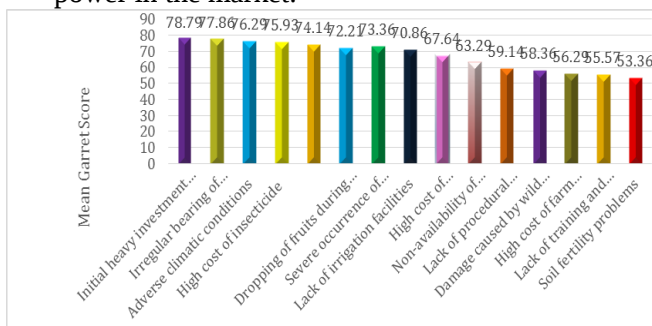


Fig. 1: Production constraints faced by Mango growers

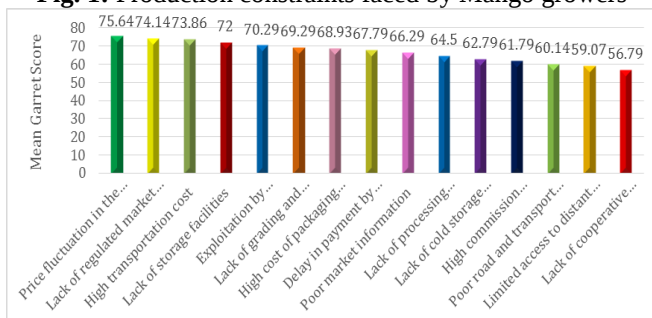


Fig. 2: Marketing constraints faced by Mango growers

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