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Economic appraisal of mango production in Yamunanagar district of Haryana, India

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Abstract
The present study has been designed to investigate cost of production, and returns per hectare of mango fruit. A sample of 30 mango farmers was taken purposively from various villages in Radaur block of Yamunanagar district of Haryana. On the basis of the nature of data, various statistical and economic tools were used for estimation of cost and returns of mango production. The primary data for the agriculture year 2017-18 was collected by survey method by conducting personal interviews of the selected mango growers with the help of specially designed schedule. The average first year establishment costs per hectare for mango has been worked out to be ₹ 28034. The overall per hectare per year returns from mango orchards have been worked out to be ₹ 256856. The economic viability of the mango fruit, mainly net present value, internal rate of return, benefit-cost ratio and payback period have been computed as ₹ 693165.96, 29.14 per cent, 1:4.02 and 8 years, respectively.

Keywords: Mango, production, NPV, IRR, B:C ratio and payback period

Introduction

The Mango, *Mangifera indica L*, which belongs to the family of Anacardiaceae, is one of the most important tropical and subtropical fruits of the world and is popular both in fresh and processed forms. It is called as the king of fruits on account of its nutritive value, taste, attractive fragrance and health promoting qualities. In many languages it is called the mother of all tropical fruits and is the national fruit of India. Mango has been in cultivation in Indian subcontinent for well over 4,000 years and has been the most favourite fruit since ages. Historical facts revealed that mango was introduced to India archipelago from the main land. Some researchers are of the view that it had originated in the Indo–Burma region. Presently, besides India, it is being cultivated world over especially, in the South and South-East Asian countries, African countries, tropical Australia and the USA. In USA mango is grown mostly in Florida, Hawaii, etc. Mango is also grown in Venezuela, Mexico, Brazil, West Indies Island and Cambodia.

From nutritional point of view, is an outstanding source of vitamin "A" and good source of vitamin "C", apart from usual source of minerals and other vitamins. The mango is also considered to have many medicinal properties. The ripe fruit is fattening, beneficial in diuretic and laxative action in human beings. The smoke of the burning leaves is supported to cure hiccups and some throat troubles and the kernels is effective against diarrhoea and asthma. In many parts of India, the mango is the mainstay of people during the fruiting season. It is also processed into pickle, mango pulp, juice, and preserves, mango powder and chutneys of all sorts. Mango pickle is the most important pickle and along with its mango chutney constituents the most important item of export of preserved fruit product from India.

In India mango is cultivated in largest area *i.e*. 4946 thousand ha and the production is around 46.50 million tonnes, contributing 40.38 per cent of the total world production of mango. The main mango producing states in India are Uttar Pradesh (21.64%), Andhra Pradesh (21.35%), Karnataka (8.60%), Bihar (7.07%), Gujarat (6.85%) and Tamil Nadu (6.16%). China and Thailand stood at second and third position among mango producing countries in the world with 4664 and 3432 thousand tonnes respectively. The other major mango producing countries in the world during 2016 were Thailand (3432 thousand tonnes), Pakistan (1606 thousand tonnes), Mexico (2197 thousand tonnes) and Indonesia (2184 thousand tonnes) respectively (Indian Horticulture database 2016-17). Major mango producing districts in Haryana are Yamunanagar, Ambala, Panchkula, Kurukshtera and Karnal. No doubt, mango cultivation is a profitable enterprise but it require heavy initial investment in form of capital, labour and skilled management. With the rapid increase in the area under this crop, several problems of production and marketing has emerged which need to be careful investigation.

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Methodology
Multistage stratified sampling technique was adopted to select the ultimate unit of sample. Out of 22 districts of Haryana state Yamunanagar district was selected, on the basis of highest production which accounted about 60.87 per cent of total mango production in the state during 2017-18. A sample of 30 mango farmers was taken purposively from various villages in Radaur block Yamunanagar district of Haryana. Primary data pertaining to the year 2017-18 were collected from selected respondents by conducting personal interviews with help of specifically designed schedule. Suitable statistical tools were used for analysis of data and interpretation of results.

Amortization of fixed cost
The annual amortization of cost was computed from the investment made on establishment of mango fruit, assuming the rate of interest 12 per cent per annum and the expected life 30 years for mango. Thus, annual amortization was worked out by using the compounding cost formula and by adding it to maintenance cost for estimating the annual cost of cultivation of mango fruit of respective farmers.

$$I = B \frac{i}{1-(1+i)^{-n}}$$

Where, I = Annual cost (in Rs), B = Present fixed cost (in Rs), i = Interest rate (12 % per annum), and
n = Economic life of the mango orchard (30 years).

Economic viability
To examine the economic feasibility of orchard while studying the economics of fruits cultivation, four indicators were used viz., net present value (NPV), internal rate of return (IRR), cost benefit ratio and payback period. The detailed method used to find out these indicators are given below.

Net present value
Future net returns were discounted to their net present value by using the following formula:

$$N.P.V. = \frac{R_1}{(1+r)^1} + \frac{R_2}{(1+r)^2} + \ldots + \frac{R_{n-1}}{(1+r)^{n-1}} + \frac{R_n}{(1+r)^n}$$

Where, R_1, R_2 .... R_n are the net returns in the period 1, 2, ... n respectively, 'n' is the life span in years of the investment in the mango orchard, 'r' is the discount rate (prevailing interest rate) and N.P.V. is net present value of returns R_1, R_2, R_3 ....R_n.

Internal rate of return
In estimating the internal rate of return, the investment cost and incremental gross returns for each year in the life of mango orchard were calculated. The internal rate of return was calculated at the different rate of discount until it satisfies the relationship B – C = 0 where 'B' is the sum of discounted stream of positive value (returns) and 'C' is taken as the sum of discounted stream of negative values (costs).

$$IRR = \begin{pmatrix} \text{lower} \\ \text{discount} \\ \text{rate} \end{pmatrix} + \begin{pmatrix} \text{difference} \\ \text{between two} \\ \text{discount rates} \end{pmatrix} \times \frac{(\text{Present worth of the cash flow at lower discount rate})}{(\text{absolute difference between the Present worth of the cash flow at two discount rates})}$$

Benefit cost ratio
The benefit cost ratio is the ratio between the sum of discounted net benefits of returns (R) and the sum of discounted cost (K), i.e. B = R/K. If this ratio is greater than 1.00 then the investment in mango orchard is considered to be economically viable.

Payback period
It is the period within which the cost of the mango orchard is fully recovered from its own returns. In other words, it indicates the number of years by which the net returns (R) equal, to the cost of orchard (K). For this condition the following relationship must be satisfied.

$$\sum_{i=1}^{n} Ri = K$$

Where, i = 1, 2, 3 ……. 30 years, R = Return over a number of year, K = Cost of mango orchard.

Results and Discussion
Establishment cost of mango
The average total establishment cost of mango orchard in Yamunanagar district was estimated ₹ 28034 per hectare. The highest cost item of expenditure was incurred on preparation of land and layout which was worked out to be ₹ 5563 per hectare, constituting 19.84 per cent to total establishment cost, followed by digging and filling of pits which was ₹ 5443 per hectare, contributing 19.42 per cent of total establishment cost. Cost of permanent fencing (19.22 per cent), transportation of plants (8.80 per cent), cost of plants (7.49 per cent) and cost of irrigation (4.67) were also considered the other major component of the overall average establishment cost of the orchard. Cost of equipment accounted only 4.30 per cent of overall average establishments cost. In case of mango plantation ₹ 7650 per hectare subsidy is provided by government under National Horticulture Mission (NHM) scheme to increase the area under mango cultivation in the state (Table 1).

Table 1: Establishment cost of mango orchard in Yamunanagar district of Haryana

Sr. No.	Particulars	Value (₹/ hectare)	Percent
1.	Preparation of land and layout	5563	19.84
2.	Digging and filling of pits	5443	19.42
3.	Cost of irrigation	1308	4.67
4.	Cost of plant	2100	7.49
5.	Cost of replacement plant	825	2.94
6.	Manures and fertilizer	935	3.34
7.	Transportation of plant	2468	8.80
8.	Plantation cost	1033	3.68
9.	Intercultural operation	1133	4.04
10.	Permanent fencing	5388	19.22
11.	Cost of equipments	1205	4.30
12.	Miscellaneous	633	2.26
	Total cost	28034	100

Operational cost of mango orchard
Per hectare operational cost of mango production ranged between ₹ 21957 to 71928 from first year to tenth year. The operational cost goes on increasing up to tenth year of the establishment of an orchard and thereafter it becomes more or less stabilized. The average operational cost from first to tenth years were found to be ₹ 9527.50 on picking (20.75 %), ₹ 9391.30 on plant protection (20.45 %), ₹ 8113.30 on irrigation (17.67 %), ₹ 6264.50 on manure and fertilizers

(13.64 %), ₹ 5867.40 on watch and ward (12.78 %) and ₹ 4527.10 on intercultural and hoeing (9.86 %) in mango cultivation per hectare annually respectively. A similar result was observed by Dahiya (2002) [2] in their study (Table 2).

Cost and returns from mango orchard

The cost and returns from mango orchards depends upon the age of plants. Data presented in Table 3 shows the cost and returns per hectare of mango orchard at different ages i.e. from the year of establishment to tenth-year age of orchard. It was observed that there was no production of mango up to the age of four years since the bearing of fruits usually starts after attaining age of four years. The production of fruits increases with advancement of age. The per hectare production of fruits starts increasing gradually from nearly 117 quintals in fifth year to about 285 quintals in tenth year orchard age. However, after attaining the age of tenth year it remain almost static with advance in age of the plants. Hence, the gross returns per hectare from mango orchard increase up to tenth year age of the plants. The gross returns per hectare worked out to be ₹ 442605 in the tenth year that is full bearing stage. This rate of return is expected to be more or less same up to age of 30 years.

Even after taking the returns from intercropping in the orchard the orchardist has to bear a loss of ₹ 59202, ₹ 72188, ₹ 82373 and ₹ 95340 per hectare in first, second, third, and fourth year, respectively. During the fifth year the net returns become positive and worked out to be ₹ 9834 per hectare. The net returns increase up to tenth year i.e. ₹ 256856 per hectare and after that it becomes more or less stable up to the age of 30 years. The net returns from inter cropping ranges from ₹ 30853 to ₹ 13531 per hectare during the first year to fifth year of the mango orchard. Thus, the negative returns during early years of mango cultivation ₹ 90055, ₹ 98098, ₹ 103031, ₹ 113757 and ₹ 3697 per hectare for first, second, third, fourth and fifth year of the orchards, respectively. Total net return was negative ₹ 59202, ₹ 72188, ₹ 52373 and ₹ 95340 during first, second, third and fourth years of mango plantation, respectively owing to returns from intercropping. Gupta and George (1974) in their study on the profitability of santra in Nagpur district of Maharashtra observed that the benefit: cost ratio even at high discount rate as 12% varied from 1:1. 85 to 1:2.64 according to the size of the growers. Singh (1991) studied the economic feasibility of grape cultivation and observed that an investment of ₹ 1 in a grape orchard fetched a return of ₹ 1.18. Similar results were observed by Tomer *et al.* (1997) and Dahiya (2002) [2].

Economic viability of mango orchard

To examine the economic feasibility of mango orchard, four indicators were used viz., net present value (NPV), and internal rate of returns (IRR), benefit-cost ratio and payback period which are discussed as below:

Net present value (NPV) of mango orchard

The net present value computed has been shown in Tables 4. The figure given in these Tables show that net present values (NPVs) for one hectare mango orchard came to be ₹ 693165.96 for the entire life (30 years) of the mango orchard. The positive NPV of mango cultivation is a sign of profitable crop enterprise in the Yamunanagar district of the state.

Internal rate of return (IRR) of mango orchard

The data presented in Tables 5 indicates a very high internal rate of return of 29.14 per cent per annum. This indicates that investment on mango orchards is highly profitable and internal rate of return is more than the present market interest rate i.e. 12 per cent per annum.

Benefit-Cost ratio of mango orchard

At discount rate of 12 per cent, on an average the benefit cost ratio obtained was equal to 1:4.02. It indicates that at the prevailing rate of interest 12 per cent per annum as investment of ₹ 1.00 would fetch a return of ₹ 4.02. Since this ratio is greater than unity, it shows that the investment in mango orchard is considered to be economically viable.

Pay back period of mango orchard

As discussed in the Tables 3 the net cost incurred on mango orchard were ₹ 59202, 72188, 82373and 95340 per hectare during first, second, third and fourth year of plantation. These costs are lesser than the returns of ₹ 9834, 37922, 124661 and 167815 per hectare from fifth to eighth year of plantation, respectively. This shows that return would be more than the cost in the eighth year. Thus, the payback period of one hectare mango orchard is eighth year. Khushk and Smith (1999) [6] observed that the payback period of mango orchards started from 3 and 9 years with and without intercropping, respectively. Dahiya (2002) [2] observed that capital cost of grape and her orchard in Haryana was recoverable in a period of seven years. Hence, the mango growing is economically viable.

Table 2: Operational cost of mango orchard in Yamunanagar district of Haryana (₹/ha.)

| Sr. No. | Particulars | Years | | | | | | | | | | Total cost | Average cost per annum |
		1	2	3	4	5	6	7	8	9	10		
1.	Manure and fertilizers	4473	4613	4965	5417	5890	6420	7241	7653	7855	8118	62645	6264.50 (13.64)
2.	Plant protection	4913	5663	6613	7240	8921	10641	11254	12420	12945	13303	93913	9391.30 (20.45)
3.	Pruning and cutting	-	-	-	-	662	889	1145	1648	2463	2808	9615	961.50 (2.09)
4.	Intercultural and hoeing	2814	3310	3645	4135	4645	4865	5113	5370	5334	6040	45271	4527.10 (9.86)
5.	Irrigation cost	5412	5890	6413	6895	7661	8631	9120	9618	10413	11080	81133	8113.30 (17.67)
6.	Replacement and causality	52	65	80	88	113	138	188	238	288	358	1608	160.80 (0.35)
7.	Watch and ward	3880	4392	4740	4921	5463	6164	6644	7163	7410	7897	58674	5867.40 (12.78)

8.	Picking cost	-	-	-	-	9664	11645	13948	19965	19640	20413	95275	9527.50 (20.75)
9.	Miscellaneous	413	488	613	763	971	1213	1427	1500	1700	1911	10999	1099.90 (2.40)
	Total operational cost	21957	24421	27069	29459	43990	50606	56080	65575	68048	71928	459133	45913 (100)

Figures in parentheses are the percentage to the average cost per annum

Table 3: Cost and return from mango orchard in Yamunanagar district of Haryana (₹/ha.)

Sr. No.	Particulars	Years									
		1	2	3	4	5	6	7	8	9	10
1	Rental value of land	60862	66145	68112	76162	81218	88670	89920	96368	98870	100588
2	Amortized fixed cost	3480	3480	3480	3480	3480	3480	3480	3480	3480	3480
3	Operational cost	21957	24421	27069	29459	43990	50606	56080	65575	68048	71928
4	Expected depreciation on fixed cost investment @4%	1121	1121	1121	1121	1121	1121	1121	1121	1121	1121
5	Interest on operational cost @12% PA	2635	2931	3248	3535	5279	6073	6730	7869	8166	8631
6	Total cost (1 to 5)	90055	98098	103031	113757	135088	149950	157331	174413	179685	185749
7	Production (qtls)	-	-	-	-	117	152	202	237	255	285
8	Price (₹/qtls)	-	-	-	-	1123	1236	1396	1444	1503	1553
9	Gross returns#	-	-	-	-	131391	187872	281992	342228	383265	442605
10	Net returns	-90055	-98098	-103031	-113757	-3697	37922	124661	167815	203580	256856
11	Return from inter cropping	30853	25910	20658	18417	13531	-	-	-	-	-
	Total net returns	-59202	-72188	-82373	-95340	9834	37922	124661	167815	203580	256856

Gross return has been worked out by taking average price (₹ 1553 per quintal) received by farmers during peak marketing season of the current period in Yamunanagar market.

Table 4: Per hectare net present value of mango orchard in Yamunanagar district of Haryana (r=12%)

Year	Cost(₹)	Net Returns (₹)	Discount coefficient $1/(1+r)^n$	Present Value	
				Cost(₹)	Net Returns (₹)
1.	-59202	-	0.8929	-52859.11	-
2.	-72188	-	0.7972	-57547.74	-
3.	-82373	-	0.7118	-58631.22	-
4.	-95340	-	0.6355	-60590.57	-
5.	-	9834	0.5674	-	5579.98
6.	-	37922	0.5066	-	19212.42
7.	-	124661	0.4523	-	56390.32
8.	-	167815	0.4039	-	67777.52
9.	-	203580	0.3606	-	73412.95
10 and onward up to 30 years	-	256856	2.7269	-	700421.39
Total	-309103	800668	-	-229628.63	922794.59

Net Present Value (NPV) = 922794.59-229628.63= 693165.96

Table 5: Internal rate of return from one hectare of mango orchard in Yamunanagar district of Haryana (₹/ hectare)

Year	Net cash flow	Present Value Coefficient r= 29% $(1/(1+r)^n$	Corresponding present value (₹)	Present Value Coefficient r= 30% $(1/(1+r)^n$	Corresponding present value (₹)
1.	-59202	0.7752	-45893.18	0.7692	-45540.15
2.	-72188	0.6009	-43379.53	0.5917	-42714.72
3.	-82373	0.4658	-38371.95	0.4552	-37493.24
4.	-95340	0.3611	-34428.52	0.3501	-33381.34
5.	9834	0.2799	2752.80	0.2693	2648.54
6.	37922	0.2170	8229.09	0.2072	7856.52
7.	124661	0.1682	20970.21	0.1594	19866.77
8.	167815	0.1304	21883.27	0.1226	20572.31
9.	203580	0.1011	20579.15	0.0943	19197.50
10 and onward up to 30 years	256856	0.3469	89103.44	0.3131	80421.70
Total		-	1444.79	-	-8566.11

IRR = 29+1 (1444.79)/ (1444.79+8566.11) = 29+0.14 + 29.14 per cent

Conclusion
In the light of above discussion, it may be said that although the initial investment in mango orchard establishment is very high yet it is an economically viable enterprise. The per hectare establishment cost of mango orchard was estimated ₹ 28034. Whereas, operational cost of mango orchard the sample as a whole was ₹ 71928. Average per year net return for the sample as a whole was ₹ 256856 among the different age groups of mango orchard. The economic viability of the mango fruit, mainly net present value, internal rate of return, benefit-cost ratio and payback period have been computed as ₹ 693165.96, 29.14 per cent, 1:4.02 and 8 years, respectively. The orchards indicating that mango cultivation was a profitable enterprise. It has a vital potential in increasing the

income and gainful employment of family community. Mango growing is a step towards the diversification and commercialization of agriculture in the state.

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