Economics of production of moringa (*Moringa oleifera* Lam) in Tamil Nadu

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ABSTRACT

The study was carried out in Theni and Dindigul districts of Tamil Nadu during 2017-18 to estimate the costs and returns of moringa cultivation and economic feasibility of moringa orchards. Multistage purposive sampling was employed in the present study. A sample of 160 moringa growers was drawn from eight purposively selected villages of four highest moringa producing blocks of Theni and Dindigul districts. Required data were recorded on a well-structured pre-tested schedule through personal interaction with selected moringa growers. The study revealed that the establishment cost of moringa was Rs 7.72 and 6.88 lakh: the cost of plant protection occupied a major share to the tune of 30.44 and 25.62 per cent in Theni and Dindigul districts respectively. The average yield of moringa was 27,015 kg/ha in Theni and 22,063 kg/ha in Dindigul. The net present value (NPV) of moringa plantation was Rs 16.87 and 12.82 lakh, benefit-cost ratio (BCR) of moringa orchard was 1.72 and 1.63 and internal rate of return (IRR) was 27.66 and 25.00 per cent in Theni and Dindigul districts respectively indicating that moringa was a profitable venture. Among the constraints in production of moringa the major constraint was invasion of pests and diseases in Theni and lack of labour availability in Dindigul district. Indicators of economic analysis (B-C ratio and IRR) showed that investment on moringa plantation was a sound financial worthy one fetching substantial returns. Appropriate technological intervention was needed to combat the menace of pests and diseases in moringa plantation to fetch higher returns.

Keywords: Moringa; production; net present value; benefit-cost ratio; internal rate of return

INTRODUCTION

Indian subcontinent is endowed with suitable climate for different types of crops especially horticultural crops. Among the total production of horticultural crops in the country, fruits and vegetables account for nearly 90 per cent. India occupies second position in the production of fruits and vegetables in the world and is leading in several horticultural crops. Among all vegetables India is the largest producer of *Moringa oleifera* Lam (drumstick) that belongs to family Moringaceae. Moringa tree is a drought-tolerant, fast-growing, multi-purpose and one of the most useful trees due to its medicinal and nutritional properties in the world and therefore is described as 'miracle tree'. Moringa leaves are an exceptionally good source of vitamins A, B and C, minerals (in particular iron and calcium) and the sulphur-containing amino acids, methionine and cystine (Foidl et al 2001). Moringa leaves also act as a good source of natural antioxidant due to the presence of various types of antioxidant compounds such as ascorbic acid, flavonoids, phenolics and carotenoids (Anwar et al 2007).

Moringa is widely used as vegetable and grown commercially for its edible pods and leaves. It is an important food commodity which has had enormous attention as the 'natural nutrition of the tropics'. The leaves, fruits, flowers and immature pods of this tree are used as a highly nutritive vegetable in many countries particularly in India, Pakistan, Philippines, Hawaii and many parts of Africa. India is the prime producer of moringa with an annual production of 2.2 MT of tender fruits with the productivity of around 51 tonnes per ha. Tamil Nadu is one of the largest producers of Moringa with an annual production of 6.71 lakh tonnes of tender fruits from an area of 13,042 ha. Among the districts, Theni leads in both area and production. Here the area under moringa cultivation is 3,424 ha followed by Dindigul (2,645 ha), Karur (2,070

ha), Thoothukkudi (1,465 ha), Tiruppur (1,191 ha), Ariyalur (813 ha) and Madurai (536 ha) (Sekhar et al 2018).

Virtually every part of moringa tree is beneficial in some way for both rural and urban population in Theni and Dindigul districts of Tamil Nadu. For many farmers it is a source of livelihood. Even though the soil, climate and other phenotypic factors are favourable for moringa cultivation in these districts, the farmers are not harnessing the fullest yield potential and making suboptimal returns. Even though the moringa economy has promising features and the global demand for its products has been rising, the Moringa farmers in Theni and Dindigul districts of Tamil Nadu are not able to reap its fullest benefits. Hence it was felt to critically assess the economics of production of moringa in these districts.

METHODOLOGY

A multi-stage purposive sampling technique was employed in the present study at the block level and village level to collect all the necessary primary data. In the first phase of selection of districts in Tamil Nadu, Theni and Dindigul districts and in the second stage of sampling Andipatti and Mayiladumbarai blocks of Theni and Batlagundu and Thoppambatti blocks of Dindigul were purposively selected which had maximum area under moringa. In the next stage two revenue villages of each block were selected for study. In each village 20 moringa growers were randomly selected thus making a total sample size of 160. The data were collected using pre-tested interview schedule.

As moringa is maintained as a perennial crop, the total cost of cultivation was divided into establishment costs and maintenance costs.

Establishment costs: The establishment costs are the costs incurred in the zero-time period comprising costs of plant material, land preparation, manures and fertilizers and investment on planting the stems of moringa (Singh et al 2017).

Operational and maintenance costs: The costs mainly incurred for land preparation, manures and manuring, channel and basin formation, fertilizer application, pesticide use, irrigation and the human labour used for different operations to maintain the plantations are operational and maintenance costs.

Tabular analysis was used to analyse the fixed costs and operational costs.

Economic viability of moringa orchards: To assess worthiness of the investment in moringa, capital budgeting techniques were employed.

Net present value (NPV): Net present value indicates the present value of the net benefits which is computed by deducting the total discounted costs from the total discounted returns. The positive NPV indicates the worthiness of investment in moringa orchard. This is simply the net present worth of cash flow stream.

$$NPV = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+i)^t}$$

where B_t: Benefits realized in rupees per ha per annum, C_t: Costs incurred in rupees per ha per annum, n: Number of years of investment, i: Discount rate (here the 8% discount rate was used for the study and the discounted benefits and costs were estimated)

Benefit-cost ratio (BCR): Benefit-cost ratio was another indicator used in the present study to test the worthiness of investment. It is the ratio of sum of discounted net benefits to the sum of discounted capital costs. It is expressed as follows:

$$BCR = \frac{\sum_{t=1}^{n} \frac{B_t}{(1+i)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+i)^t}}$$

where B_t: Benefits realized in rupees per ha per annum (1-19 years), C_t: Costs incurred in rupees per ha per annum (0, 1-19 years), n: Number of years of investment considered (0, 1-19 years), i: Discount rate (8%)

Internal rate of return (IRR): To find out the measure of the earning capacity of the project the IRR was computed which is the discount rate at which the present value of net cash flows is just equal to zero. It is the return obtained for the investment of one rupee.

Garrett's ranking: The constraints in the production of moringa production were analysed using Garrett's ranking technique. The ranks assigned by the

respondents were converted into per cent position by using the formula as suggested by Kumar et al (2007).

$$\text{Percentage position} = \frac{100\,(R_{ij} - 0.05)}{N_j}$$

where R_{ij}= Rank given for i^{th} factor by j^{th} individual, N_j= Number of factors ranked by j^{th} individual

RESULTS and DISCUSSION

Moringa being a perennial crop can be maintained up to 20 years. During the first year of establishment of its orchard, the utmost care is given with proper irrigation and other inputs such as ferttilizers, manures and suitable pesticides for pest control and cultural operations like weeding, pruning and earthing up. From the second year onwards the operations such as pruning, earthing up, weeding, manuring and plant protection are carried out to maintain the orchard for increasing productivity. The costs incurred in establishing moringa plantation are given in Table 1.

The total establishment cost was Rs 7.72 lakh in Theni whereas it was Rs 6.88 lakh in Dindigul. Among all operations farm building and storehouse cost was maximum in both the districts which was Rs 3,00,000 (38.87%) and 2,80,000 (40.69%) in Theni in Dindigul districts respectively. Even though the establishment costs of moringa appear higher initially it is worth investing since the plantation lasts for 20 years. In the study area majority of the moringa orchards were

Table 1. Establishment costs of moringa in Theni and Dindigul districts

Component	Theni		Dindigul	
	Cost (Rs/ha)	Per cent to total	Cost (Rs/ha)	Per cent to total
Rental value of land	37,500	4.86	40,000	5.81
Farm building and store house	3,00,000	38.87	2,80,000	40.69
Farm equipments	2,50,000	32.39	2,00,000	29.06
Ploughing	9,000	1.17	5,250	0.76
Pitting	7,875	1.02	59,37.5	0.86
pit mixture	14,437	1.87	13,687	1.99
Planting material	7,875	1.02	5,937.5	0.86
Planting charges	1,575	0.20	1,425	0.21
Installation of pipelines	75,000	9.72	70,000	10.17
Other operational costs	68,629	8.89	65,879	9.57
Total	7,71,891	100.00	6,88,116	100.00

Source: Primary survey

Table 2. Annual operational cost of moringa plantation (5^{th} year) in Theni and Dindigul districts

Operation	Theni		Dindigul	
	Cost (Rs/ha)	Per cent to total	Cost (Rs/ha)	Per cent to total
Pruning	7,000.00	4.06	3,375.00	2.47
Earthing up	4,000.00	2.32	5,625.00	4.12
FYM	15,000.00	8.70	10,938.00	8.01
Fertilizer	10,321.00	5.99	9,289.00	6.80
Plant protection	52,500.00	30.44	35,000.00	25.62
Irrigation	30,000.00	17.40	25,500.00	18.67
Weeding	18,000.00	10.44	16,875.00	12.35
Harvesting	35,625.00	20.66	30,000.00	21.96
Total	1,72,446.00	100.00	1,36,602.00	100.00

Source: Primary survey

at their 5th year of establishment hence a snapshot of operational expenses of orchard during 5th year of establishment was gathered (Table 2).

The annual maintenance cost per hectare amounted to Rs 1,72,446.00 and 1,36,602.00 in in Theni and Dindigul districts respectively. The major share of maintenance costs was occupied by the plant protection charges that was Rs 52,500.00 (30.44%) in Theni and 35,000.00 (25.62%) in Dindigul. It was followed by harvesting cost which was Rs 35,625.00 (20.66%) in Theni and Rs 30,000.00 (21.96%) in Dindigul. Since moringa is invaded by many pests and diseases, effective and timely control of these is mandatory for good maintenance of the crop. As such the farmers were resorting to intensive pesticide application. The harvesting cost occupied a major share of 20.66 and 21.96 per cent of total operational costs in Theni and Dindigul districts respectively. Since moringa crop needs 4 to 6 harvestings in a month during peak season it demands a larger proportion of casual labour.

Table 3. Yield and returns from moringa plantation

Year	Yield (kg/ha) from moringa plantation	
	Theni	Dindigul
2	18,550	169,95
3	22,500	18,090
4	29,050	21,013
5	30,750	21,835
6	32,350	23,075
7	33,050	24,005
8	31,650	24,595
9	30,750	26,040
10	32,350	27,885
11	30,050	26,150
12	28,650	24,085
13	27,595	23,011
14	27,240	22,116
15	26,535	22,262
16	24,485	21,137
17	24,100	20,400
18	22,430	20,187
19	21,750	19,110
20	19,445	17,201
Average	27,015	22,063

Source: Primary survey

Table 3 shows that the yield of moringa was on upward trend up to 11 years; afterwards it exhibited a diminishing trend. The maximum yield was obtained within 5 to 10 years of age in both the districts. The average yield was 27,015 kg/ha per annum in Theni and 22,063 kg/ha per annum in Dindigul district.

Economic feasibility of moringa plantation in Theni an Dindigul districts

Since moringa is a perennial crop, while analyzing the costs and returns the time comparison principle had to be used for economic analysis. As such the costs and returns were needed to be discounted to arrive at the net present value (NPV). Table 4 gives such discounted costs and returns and the corresponding NPV and benefit-cost ratio (BCR). Economic viability can be assessed using internal rate of return (IRR), BCR and NPV. Tables 4, 5, 6, 7 and 8 clearly show that the NPV of plantation in Theni district was Rs 16,86,560.43 and Rs 12,82,396.02 in Dindigul. The BCR in Theni was 1.72 and 1.63 in Dindigul which was reasonably higher than one. IRR was 27.66 per cent in Theni and 25.00 per cent in Dindigul district which was magnificently higher than the opportunity cost of capital. The results of NPV, BCR and IRR indicate that investment in moringa plantation was sound worthy investment fetching reasonably higher returns.

Table 4. Economic feasibility analysis of two districts

Component	Theni	Dindigul
NPV @ 8%	16,86,560.43	12,82,396.02
B-C ratio	1.72	1.63
IRR	27.66	25.00

It is evident from the data given in Tables 7 and 8 that IRR was found to be 27.66 per cent for moringa farms in Theni and 25.00 per cent in Dindigul that indicates financial viability of investment in moringa cultivation. Considering the average bank rate (8%) it can be observed that the returns from the investment was higher. Since the power of earning capacity of the moringa plantation is greater than 25 per cent which is higher than the opportunity cost of capital, the investment in this project was worthy. In the present scenario when bank rates are diminishing, moringa plantation is an attractive investment opportunity.

Constraints in moringa production

The constraints faced by the famers in moringa cultivation were analysed using Garrett's ranking technique and the data thus obtained are presented in Table 9.

Table 5. Net present value of moringa farms in Theni district

Year	Cost (Rs)	Benefit (Rs)	Discount factor (8%)	Discounted benefit (Rs)	Discounted cost (Rs)
0	7,71,891	0	1.000	0.00	7,71,891.25
1	1,33,066	2,34,658	1.080	2,17,275.46	1,23,209.49
2	1,49,193	3,10,050	1.166	2,65,817.90	1,27,909.06
3	1,65,130	3,38,184	1.260	2,68,460.97	1,31,085.52
4	1,72,447	4,19,502	1.360	3,08,346.49	1,26,753.60
5	1,75,511	4,20,004	1.469	2,85,847.67	1,19,450.01
6	1,85,043	5,21,700	1.587	3,28,759.49	1,16,608.75
7	1,85,826	4,48,797	1.714	2,61,868.74	1,08,427.47
8	1,90,570	4,61,250	1.851	2,49,199.02	1,02,959.04
9	1,78,822	4,90,103	1.999	2,45,173.27	89,455.46
10	1,75,633	5,40,900	2.159	2,50,541.36	81,351.83
11	1,69,759	5,51,513	2.332	2,36,534.26	72,806.89
12	1,65,693	5,79,495	2.518	2,30,125.44	65,798.77
13	1,54,413	4,42,650	2.720	1,62,761.49	56,777.27
14	1,49,756	4,64,363	2.937	1,58,097.34	50,985.96
15	1,45,600	5,63,155	3.172	1,77,529.94	45,899.29
16	1,38,223	4,45,850	3.426	1,30,139.36	40,346.01
17	1,34,941	3,14,020	3.700	84,869.86	36,470.43
18	1,31,534	3,34,950	3.996	83,820.91	32,916.35
19	1,27,729	3,11,120	4.316	72,090.26	29,596.35
				40,17,259.23	23,30,698.79

NPV= 16,86,560.43, B-C ratio= 1.72 Source: Primary survey

Table 6. Net present value of moringa farms in Dindigul district

Year	Cost (Rs)	Benefit (Rs)	Discount factor (8%)	Discounted benefit (Rs)	Discounted cost (Rs)
0	6,88,116	0	1.00	0.00	6,88,116.25
1	1,22,254	2,14,987	1.08	1,99,061.81	1,13,197.92
2	1,28,411	2,49,280	1.17	2,13,717.59	1,10,091.68
3	1,30,380	2,95,233	1.26	2,34,365.20	1,03,499.85
4	1,36,602	3,20,538	1.36	2,35,604.85	1,00,406.69
5	1,47,197	3,63,662	1.47	2,47,502.25	1,00,179.72
6	1,47,604	4,44,093	1.59	2,79,853.61	93,015.60
7	1,55,011	2,99,567	1.71	1,74,794.53	90,447.58
8	1,67,918	3,90,600	1.85	2,11,029.03	90,721.11
9	1,56,011	4,22,458	2.00	2,11,334.05	78,044.47
10	1,43,293	3,66,100	2.16	1,69,575.14	66,372.59
11	1,42,886	4,63,636	2.33	1,98,845.64	61,281.46
12	1,41,354	4,83,221	2.52	1,91,893.51	56,133.64
13	1,39,072	3,59,385	2.72	1,32,145.12	51,136.44
14	1,36,290	3,89,576	2.94	1,32,635.54	46,401.33
15	1,35,915	4,01,594	3.17	1,26,599.02	42,845.98
16	1,33,758	3,77,400	3.43	1,10,159.46	39,042.54
17	1,33,197	3,63,366	3.70	98,206.55	35,998.98
18	1,32,136	2,94,294	4.00	73,646.79	33,066.97
19	1,30,822	3,09,609	4.32	71,740.14	30,313.01
				33,12,709.80	20,30,313.78

NPV= 12,82,396.02, B-C ratio= 1.63 Source: Primary survey

Table 7. Internal rate of return of moringa farms in Theni district

Year	Cost (Rs)	Benefit (Rs)	Net benefit (Rs)	Low discount factor (25%)	Discounted net benefit (L) (Rs)	High discount factor (35%)	Discounted net benefit (H) (Rs)
0	7,71,891	-	-7,71,891	1.00	-7,71,891.25	1.00	-7,71,891.25
1	1,33,066	2,34,658	1,01,591	1.25	81,273.00	1.35	75,252.78
2	1,49,193	3,10,050	1,60,857	1.56	1,02,948.40	1.82	88,261.66
3	1,65,130	3,38,184	1,73,054	1.95	88,603.39	2.46	70,336.23
4	1,72,447	4,19,502	2,47,055	2.44	1,01,193.78	3.32	74,380.45
5	1,75,511	4,20,004	2,44,493	3.05	80,115.38	4.48	54,525.18
6	1,85,043	5,21,700	3,36,657	3.81	88,252.50	6.05	55,614.04
7	1,85,826	4,48,797	2,62,971	4.77	55,149.09	8.17	32,178.97
8	1,90,570	4,61,250	2,70,680	5.96	45,412.57	11.03	24,535.00
9	1,78,822	4,90,103	3,11,281	7.45	41,779.38	14.89	20,900.09
10	1,75,633	5,40,900	3,65,268	9.31	39,220.30	20.11	18,166.59
11	1,69,759	5,51,513	3,81,753	11.64	32,792.34	27.14	14,064.07
12	1,65,693	5,79,495	4,13,803	14.55	28,436.29	36.64	11,292.44
13	1,54,413	4,42,650	2,88,237	18.19	15,846.01	49.47	5,826.54
14	1,49,756	4,64,363	3,14,607	22.74	13,836.56	66.78	4,710.81
15	1,45,600	5,63,155	4,17,555	28.42	14,691.40	90.16	4,631.34
16	1,38,223	4,45,850	3,07,627	35.53	8,658.93	121.71	2,527.46
17	1,34,941	3,14,020	1,79,079	44.41	4,032.49	164.31	1,089.86
18	1,31,534	3,34,950	2,03,416	55.51	3,664.41	221.82	917.02
19	1,27,729	3,11,120	1,83,391	69.39	2,642.94	299.46	612.40
					76,657.92		-2,12,068.32

IRR= 27.66 Source: Primary survey

Table 8. Internal rate of return of moringa farms in Dindigul district

Year	Cost (Rs)	Benefit (Rs)	Net benefit (Rs)	Low discount factor (25%)	Discounted net benefit (L) (Rs)	High discount factor (35%)	Discounted net benefit (H) (Rs)
0	6,88,116	-	-6,88,116	1.00	-6,88,116.25	1.00	-6,88,116.25
1	1,22,254	2,14,987	92,733	1.25	74,186.40	1.35	68,691.11
2	1,28,411	2,49,280	1,20,869	1.56	77,356.33	1.82	66,320.58
3	1,30,380	2,95,233	1,64,853	1.95	84,404.56	2.46	67,003.06
4	1,36,602	3,20,538	1,83,936	2.44	75,340.03	3.32	55,377.17
5	1,47,197	3,63,662	2,16,465	3.05	70,931.29	4.48	48,274.65
6	1,47,604	4,44,093	2,96,488	3.81	77,722.66	6.05	48,978.46
7	1,55,011	2,99,567	1,44,556	4.77	30,315.56	8.17	17,688.84
8	1,67,918	3,90,600	2,22,682	5.96	37,359.77	11.03	20,184.32
9	1,56,011	4,22,458	2,66,447	7.45	35761.84	14.89	17,889.83
10	1,43,293	3,66,100	2,22,807	9.31	23,923.67	20.11	11,081.29
11	1,42,886	4,63,636	3,20,750	11.64	27,552.22	27.14	11,816.67
12	1,41,354	4,83,221	3,41,866	14.55	23,492.88	36.64	9,329.35
13	1,39,072	3,59,385	2,20,313	18.19	12,111.84	49.47	4,453.50
14	1,36,290	3,89,576	2,53,287	22.74	11,139.66	66.78	3,792.62
15	1,35,915	4,01,594	2,65,679	28.42	9,347.74	90.16	2,946.80
16	1,33,758	3,77,400	2,43,643	35.53	6,857.93	121.71	2,001.76
17	1,33,197	3,63,366	2,30,169	44.41	5,182.95	164.31	1,400.79
18	1,32,136	2,94,294	1,62,158	55.51	2,921.17	221.82	731.02
19	1,30,822	3,09,609	1,78,787	69.39	2,576.59	299.46	597.03
					368.85		-2,29,557.41

IRR= 25.00 Source: Primary survey

Table 9. Constraints in production of moringa in two districts

Factor	Constraint in production	Theni		Dindigul	
		Garrette's score	Rank	Garrette's score	Rank
F1	Labour shortage	52.27	IV	69.12	I
F2	Pest incidence	69.03	I	58.11	II
F3	Incidence of heavy rainfall	45.33	V	48.82	IV
F4	Disease infestation	65.30	II	45.85	V
F5	Drainage	35.22	VI	51.10	III
F6	Lack of irrigation sources	55.20	III	43.07	VI
F7	Lack of credit support	30.62	VII	36.91	VII

In the case of Theni district the invasion of pests and diseases was identified as major constraint in Moringa production followed by lack of irrigation sources. Hence the farmers had to spend a lot to control the attack of pests and diseases in the crop. In Dindigul district labour shortage was identified as foremost problem followed by pest attack and loss of crop due to inappropriate drainage.

CONCLUSION

It was observed that owing to the indiscriminate use of pesticides, the cost of pesticide application was huge among moringa growers in both Theni and Dindigul districts of Tamil Nadu. This calls for policy promotion of integrated pest management (IPM) practices among the moringa farmers which might reduce not only the cost of production but also increase biodiversity.

The financial feasibility analysis revealed promising internal rate of return for the crop which was more than 25 per cent in both the districts. Hence the policy of liberal lending to growers would attract more farmers to opt for moringa cultivation besides enabling the existing growers to expand and strengthen the infrastructure.

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