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Production and marketing of annual moringa in Dindigul district of Tamil Nadu, India

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Abstract
The study was conducted in Dindigul district of Tamil Nadu, India with the following objectives of measuring the growth rate of area, production and productivity of annual moringa, estimating the cost and returns of annual moringa production, evaluating the post-harvest losses of annual moringa, studying the resource use efficiency and technical efficiency of annual moringa and to workout the price spread. The analytical tools used in the study included Compound growth rate, Cobb – Douglas production function, Data envelopment analysis and Garrett's ranking technique. Growth rate of area and production showed positive growth rate of 6.24 per cent and 5.45 per cent respectively. Productivity showed negative growth rate of -0.73 per cent. The cost of cultivation of annual moringa production worked out to Rs.86509.09/ha and net income was Rs.2, 23,491/ha. The variables of labour, FYM and fertilizers were significant at 5 per cent level and plant protection chemicals showed high significant at one per cent level. Technical efficiency under constant returns to scale ranged from 58.00 per cent to 100.00 per cent with the mean technical efficiency of 87 per cent. Channel – III was the best marketing channel which showed high marketing efficiency and producer share of 83.54 per cent and hence this channel should be practised by the farmers of the region.

Keywords: Cost and returns, resource use efficiency, technical efficiency, marketing channel, marketing efficiency and price spread

1. Introduction
India is the largest producer of moringa, with an annual production of 1.10 to 1.30 million tonnes of fruits. Among Indian states, Andhra Pradesh leads in both area and production (156.65 km²) followed by Karnataka (102.8 km²) and Tamil Nadu (74.08 km²), a pioneering state having varied genotypes from diversified geographical areas and introductions from Sri Lanka. India is the most advanced supplier of Moringa, but African and American countries are developing their production. There has also been extensive research on Moringa cultivation in India. Moringa has the potential not only as a health food supplement but also as a nutritional supplement in the fight against malnutrition. Moringa Market is estimated more than US$ 4 billion, which expected to cross US$ 7 billion by 2020 @ 9 per cent growth per annum.80 per cent of the production of moringa leaves- fetching crores of foreign exchange for the country. Growing at a rate of 26-30 per cent annually, the export of moringa leaves is a big business in Tamil Nadu, Andhra Pradesh, Karnataka and Odisha. India exported moringa leaves worth Rs 14.6 crore in 2015, compared to Rs 11.61 crore in 2014.The latest trend in the moringa market was the use of organic leaves and usage of solar driers.
Tamil Nadu is the second largest producer in India which occupies an area of 13042 ha. In Tamil Nadu, Moringa is being cultivated as sole crop in homesteads, around cattle sheds, on farm boundaries, and as isolated plants in fences and as groups of trees on village waste lands. In the early 1990s, in Southern Tamil Nadu, people have started growing perennial Moringa types in Moolanur block of Dharapuram taluk, Moringa is established as an intercrop on field in a large scale and their allies were cropped with vegetables and Sorghum formed a Moringa based intercropping system. Based on the significance of Moringa in the human diet, this study might be more viable with the specific objectives of assessing the production and marketing practices of Moringa prevalent in the Western and Southern Districts of Tamil Nadu. Tamil Nadu is one of the largest producers of Moringa with an annual production of 6.71lakh tonnes of tender fruits from an area of 13042ha. Among the Districts, Theni leads in both area and production (3424ha) followed by Dindigul (2645ha), Karur (2070ha), Thoothukkudi (1465ha), Tiruppur (1191ha), Ariyalur (813ha) and Madurai (536ha). The study was undertaken with the following objectives

- To measure the growth rate of area, production and productivity.
- To estimate the cost and returns of annual moringa production.
- To evaluate post-harvest losses of annual moringa.
- To study the resource use efficiency and technical efficiency of annual moringa.
- To identify the marketing channels andto workout the price spread and marketing efficiency of annual moringa marketing.
- To identify the constraints in production and marketing and suggest measures for its improvement.

2. Methodology

Dindigul district was purposively selected for the present study in the first stage. In the second stage, Thoppampatti Block was purposively selected for its highest area and production of annual Moringa. The list of major annual moringa growing villages of this Block was collected. Then highest five annual moringa growing villages were selected randomly from the list of villages in this Block. These villages are namely Saravanapaatti, Keeranur, Puliyampatti, Devathur and Aalavalasu. From each selected village, eight annual moringa growers were selected at random and thus total sample size was 40. The intermediaries involved in marketing of annual moringa were also selected at the rate of ten for each channel and thus making the total sample size of 30.

2.1 Tools of analysis

2.1.1 Compound growth rate

In this present study, compound growth rate was used to measure the growth rate of area, production and productivity of annual moringa.

Exponential Model can be written as, $Y = b_0 t^{b1}$

$\ln(Y) = \ln(b_0) + \ln(b_1)\, t$

Where,

Y = area, production and Productivity of Moringa

t = time variable.

b_0 and b_i = coefficients to be estimated and ln is natural log.

CAGR= (Antilog of b -1) x 100

2.1.2 Cobb – Douglas production function

To measure the Resource use efficiency, Cobb-Douglas (CD) production function was used in this study.

It can be written as,

$Y = a x_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6}$

Where,

- Y is the yield of Moringa (t/ha)
- X_1 is the Seed (g/ha)
- X_2 is the Machine hours (hrs/ha)
- X_3 is the human Labour (man days/ha)
- X_4 is the FYM (Kg/ha)
- X_5 is the Fertilizers (Kg/ha)
- X_6 is the Plant protection chemicals (lit/ha)

2.1.3 Data envelopment analysis

In present study, Data Envelopment Analysis model was used to estimate the technical, scale efficiencies. The DEA method is the frontier method that does not require specification of a functional or distributional form and can accommodate scale issues. The DEA was applied by using both classic model CRS (Constant Returns to Scale) and VRS (Variable Returns to Scale) with input orientation, in which one seeks input minimization to obtain a particular product level.

2.1.4 Price spread

In marketing of annual moringa, the difference between price paid by the consumer and the price received by the producer for an equivalent quantity of moringa was defined as “price spread”.

2.1.5 Marketing efficiency

2.1.5.1 Shepherd’s Formula

The ratio of total value of goods marketed to the marketing cost could be used as a measure of marketing efficiency. The higher this ratio, higher would be the efficiency and vice versa. This can be expressed in the following form:

$ME = [(V/I)-1]$

where,

ME	=	Index of marketing efficiency
V	=	Value of goods sold
I	=	Total marketing cost

Value of goods refers to the price for final product paid by consumer. Total marketing cost included the costs incurred by various agencies in the marketing system.

2.1.5.2 Acharya and Agarwal’s formula:

Acharya and Agarwal formulated this method to compare the relative efficiency of different markets by using the following formula.

$$E = \frac{O}{I}$$

Where, E = marketing efficiency which can be expressed in percentage terms by multiplying with 100

O = value added to outputs in marketing system and

I = inputs used in marketing process

2.1.6 Garrett’s ranking technique

The respondents were asked to rank the problems in moringa production and marketing. In the Garrett’s ranking technique these ranks were converted into percent position by using the formula

$$\text{Per cent position} = \frac{100\,(R_{ij}-0.5)}{N_j}$$

where,

R_{ij} = Ranking given to the i^{th} attribute by the j^{th} individual

N_j = Number of attributes ranked by the j^{th} individual.

By referring to the Garrett’s table, the per cent positions estimated were converted into scores. Thus for each factor the scores of the various respondents were added and the mean values were estimated. The mean values thus obtained for each of the attributes were arranged in descending order. The attributes with the highest mean value was considered as the most important one and the others followed in that order.

3. Results and Discussion

3.1 Estimation of Growth Rate

The estimation of growth rate of area, production and productivity of annual moringa is presented in Table-1. It

could be seen from the table that the area and production of annual moringa in the study area showed the increasing trend with positive growth rates of 6.24 per cent and 5.45 per cent. Productivity of annual moringa showed the decreasing trend with negative growth rate of -0.73 per cent.

Table 1: Estimation of growth rate in area, production and productivity of annual moringa

Year	Area(ha)	Production(t)	Productivity(kg)
2005	1508	75400	50.00
2006	1504	68150	45.19
2007	1652	82600	50.00
2008	1792	89621	50.01
2009	1954	97687	49.90
2010	2130	106479	49.90
2011	2321	116062	50.00
2012	2530	126507	50.00
2013	2045	84938	41.53
CGR(%)	6.24	5.45	-0.73

3.2 Cost of cultivation in Annual moringa cultivation

3.2.1 Fixed cost

The fixed cost incurred by the sample farmers in annual moringa cultivation was worked out and presented in Table-2. The total fixed cost incurred by the sample farmers per ha was Rs. 5001.23/ha. Rental value for land accounted for a major share in fixed cost which accounted for 51.39 per cent. On the other hand, depreciation, interest on fixed capital and land revenue accounted for a lesser proportion with 37.92 per cent, 9.50 per cent and 1.19 per cent respectively to total fixed cost. Hence it could be concluded from the table that the rental value of land occupied the highest proportion to the total fixed cost.

Table 2: Fixed cost of production of Annual moringa

S. No.	Particulars	Amount (Rs/ha.)	Percentage to total fixed cost
1.	Rental value of land	25225572532570 2750	51.39
2.	Land revenue	60.00	1.19
3.	Depreciation	1896	37.92
4.	Interest on fixed capital	475.23	9.50
	Total fixed cost	5001.23	100.00

3.2.2 Variable Cost

Variable cost included the cost for preparatory cultivation, seed and sowing, manure and fertilizers, inter cultivation, plant protection, irrigation, harvesting and cleaning and Interest on working capital. The variable cost incurred by the sample farmers in annual moringa cultivation was worked out and presented in Table3. The total variable cost of the sample respondents was Rs. 81507.86 per hectare. Of the total variable cost, cost of labour accounted for highest proportion with 42.40 per cent to the total variable cost. This was followed by manures and plant protection chemicals with a proportion of 26.46 per cent and 9.68 per cent to the total variable cost respectively.

Table 3: Operation wise variable cost of annual moringa cultivation **(Rs/ha)**

S. No.	Particulars	Amount (Rs/ha.)	Percentage to total
1.	Land preparation	1120	1.37
2.	Seed cost	1136.43	1.39
3.	Manures	21560	26.46
4.	Fertilizers	6507.5	7.98
5.	Plant protection chemicals	7888	9.68
6.	Labour cost	34562.95	42.40
7.	Interest on working capital@12%	8732.98	10.72
8.	Total variable cost	81507.86	100.00

3.2.3 Costs and returns in Annual moringa cultivation

The costs and returns for the sample farms in the annual moringa cultivation were worked out and presented in Table4.The total cost of cultivation of annual moringa was Rs.86509.09 per ha. The share of variable cost was highest in total cost of cultivation with a proportion of 94.22 per cent while fixed cost accounted for a proportion of 5.78 per cent to total cost. Gross income from annual moringa cultivation was Rs. 310000 per ha and net income was Rs. 2,23,491 per ha. The output-input ratio worked out to 3.58. Similar output-input ratio of 2.52 was obtained by Rajendran and Prahadeeswaran (2014) during their study on Annual Moringa in Theni district of Tamil Nadu, India.

Table 4: Cost and returns in annual moringa cultivation

S. No	Particulars	Amount (Rs)
1.	Fixed cost	5 5001.23 (5.78)
2.	Variable cost	81507.86 (94.22)
3.	Total cost of cultivation	86509.09 (100.00)
4.	Gross income	3,10,000
5.	Net income	2,23,491

3.3 Post-harvest Losses in Annual moringa cultivation

The post-harvest losses of annual moringa cultivation by the sample farmers were worked out and furnished in Table 5. The total post-harvest losses included losses at farm level, at

wholesaler level and at retailers' level. The total post-harvest losses in Annual moringa cultivation were 5.60 Kg./Q. Among the components of post-harvest loss, farm level post-harvest loss occupied a highest proportion with 72.32 per cent. In this farm level loss, handling injuries was highest with 40.18 per cent. Wholesaler level loss was the next highest loss after farm level loss with 18.57 per cent to the total post-harvest loss of annual moringa. Retailer level recorded the least loss with a proportion of 8.93 per cent

Table 5: Post-harvest Losses in Annual moringa cultivation

S. No	Stages	Loss(Kg/qtl)	Loss in %
1.	**Farm Level**		
	Handling injuries	2.25	40.18
	Packing, loading/unloading	0.75	13.39
	Transportation	1.05	18.75
	Total	4.05	72.32
2.	**Wholesaler Level**		
	Storage	0.26	4.64
	Transport	0.78	13.93
	Total	1.04	18.57
3.	**Retailer**		
	Transport	0.35	6.25
	Handling	0.15	2.68
	Total	0.50	8.93
	Total Loss	5.60	100.00

3.4 Resource use Efficiency of Annual moringa farms

The Resource use Efficiency of Annual moringa farms is presented in Table 6. Cobb-Douglas production function was employed to study the relationship between the annual moringa production and the inputs used in the annual moringa production. It could be seen from the table that the coefficients of labour, FYM and fertilizers were positive and significant at five per cent level with the coefficient values of 0.27, 0.21 and 0.07respectively. This indicated that an increase in the usage of labour, FYM and fertilizers by one per cent from the existing mean level, the yield of annual moringa will be increased by 0.27, 0.21 and 0.07 per cent respectively. The plant protection chemical was significant at one per cent level with a coefficient value of 0.23.

Table 6: Resource use Efficiency of Annual moringa farms

S. No.	Variables	Regression coefficient
1	Regression Constant	5.91^{**}
2	Seed (kg/ha)	0.09^{NS}
3	Machine hours/ha	0.04^{NS}
4	Human Labour(man days/ha)	0.27*
5	FYM (t/ha)	0.21*
6	fertilizers	0.07*
7	Plant protection chemicals (Lit/ha)	0.23**

$R^2 = 0.87$ ** Significance at 1 percent level; NS- Non-significant

3.4.1 Estimation of Economic efficiency of Annual moringa farms

To evaluate the economic efficiency of resource use, marginal value productivity (MVPs) for the significant explanatory variables were worked out and compared with the unit cost of the respective resource (MIC) and the results are presented in Table 7. The MVP/MIC ratio for human labour, FYM and fertilisers was more than one which indicated that the above resources are at sub optimum level and there exists a possibility for enhancing the yield of annual moringa by increasing the respective inputs from the existing level. The reduction in plant protection chemicals from the existing mean level was required since MVP is less than MIC and currently it is over-utilized.

Table 7: Estimation of Economic Efficiency of Annual moringa farms

S. No.	Variables	Regression coefficient	MVP	MIC	MVP/MIC
1.	Human Labour (man days/ha)	0.27	2146.15	320	6.70
2.	FYM (t/ha)	0.21	3019.48	950	3.17
3.	Fertilizers	0.07	561.25	35	16.03
4.	Plant protection chemicals (Lit/ha)	0.23	3086.58	3500	0.88

3.5 Technical efficiency in Annual moringa farms

The technical Efficiency of Annual moringa production is presented in Table 8. The results revealed that the level of technical efficiency for sample farm ranged from 58.00 to 100.00 with mean efficiency of 87.00 per cent in constant return to scale. The mean level of technical efficiency indicated that 13.00 per cent of moringa farmers are falling short of the maximum possible level of technology. The technical efficiency calculated by using variable return to scale indicated that the efficiency ranged from 83.00 to 100.00 with mean efficiency of 98.00 per cent. With this measure, the proportion of farmers falling short of the maximum possible level of technology fell to 2.00 per cent. Scale efficiency ranged from 65.00 to 100.00 with mean efficiency of 89.00 per cent.

Table 8: Technical Efficiency of Annual moringa production

S. No.	Particulars	CRSTE	VRTSTE	SE
1	Mean	0.87	0.98	0.89
2	Standard deviation	0.12	0.045	0.10
3	Minimum	0.58	0.83	0.65
4	Maximum	1	1	1

3.5.1 Frequency distribution of annual moringa farms

The frequency distribution of annual moringa farms is presented in Table 9. The technical efficiency measures indicated that most farmers belonged to the most and medium efficient category (>95 per cent) each with a proportion of 37.50 per cent to total followed by least efficient category (80-95 per cent) with a proportion of 25.00 per cent annual moringa farmers. Under variable returns to scale, most efficient category was with a highest proportion of 77.50 per cent followed by medium efficient category with a proportion of 22.25 per cent. The scale efficiency measures indicated the same distribution pattern as under variable returns to scale with farmers belonging to the most efficient category with a highest proportion of 65.00 per cent followed by farmers belonging to medium efficient category with a proportion of 40.25 per cent and lastly the least efficient farmers with a proportion of 17.50 per cent.

Table 9: Frequency Distribution of Annual moringa Farms Based on Technical Efficiency

Technical efficiency classes (per cent)	CRSTE	VRTSTE	Scale efficiency
<80	10 (25.00)	0	7 (17.50)
80-95	15 (37.50)	9 (22.50)	17 (40.25)
>95	15 (37.50)	31 (77.50)	26 (65.00)
Total	40 (100.00)	40 (100.00)	40 (100.00)

3.6 Consumer preference of annual moringa

The Consumer preference of annual moringa is presented in Table 10. To study the consumer preference, 40 consumers were selected in the study area. PKM-1, PKM-2 and KKM-1 are the three major popular varieties cultivated and consumed by the people in the study area. Among the three varieties PKM- 1 was the most preferred variety by the sample respondents which constitute 45.00 per cent to the total respondents. PKM-2 was the second most preferred variety by the sample respondents which constitute 37.50 per cent to the total respondents and followed by KKM-1 which was preferred by 17.50 per cent of the respondents.

Table 10: Consumer preference of annual moringa

S. No.	Varieties	Preference by Sample respondents	Percentage
1.	PKM-1	18	45.00
2.	PKM-2	15	37.50
3.	KKM-1	07	17.50
		40	100.00

3.7 Marketing channel

In Dindigul district, annual moringa was marketed through three marketing channels. The following three marketing channels were identified in the study area.

Channel I

Producer - commission agent- wholesaler –retailer- consumer

Channel II

Producer-wholesaler-retailer-consumer

Channel III

Producer-retailer-consumer

Table 11: Farmers preference for different marketing channels

S. No.	Marketing channel	No of farmers preferred 40(100.00)
1.	I	19 (47.50)
2.	II	12 (30.00)
3.	III	9 (22.50)

Farmers preference for different marketing channels are presented in Table 11. From the table, among the three channels, channel –I (47.50%) was the most preferred channel-I (Producer - commission agent- wholesaler –retailer-consumer) by the sample farmers in the study area followed by channel-II and channel –III.

3.8 Price spread

The price spread analysis of channel-I is presented in Table 12. From the table, it could be seen that the farmers had received net price of Rs. 16.11 per kg. which constituted 68.59 per cent to the total consumer price. The marketing cost incurred by producer was Rs.2.95 per kg which constituted 12.55 per cent to the total consumer price. His marketing margin was Rs.4.42 which constituted 18.80 per cent to the total consumer price. Thus, the farmers share in consumer rupee was 68.59 per cent and price spread was 31.41 per cent.

Table 12: Channel 1- Producer - commission agent- wholesaler –retailer- consumer

Producer		Price/kg
	price received	17.125
	Packing	0.015
	Loading	0.0675
	Transport	0.53
	Wastage	0.245
	Commission	0.1
	Others	0.0525
	Marketing cost	1.01
	net price	16.115
Commission agent		
Wholesaler	purchase price	17.125
	Packing	0.0275
	Loading	0.065
	Transport	0.5125
	Wastage	0.3625
	Others	0.175
	Marketing cost	1.1425
	Marketing margin	2.9825
	price received	21.25
Retailer	purchase price	21.25
	Packing	0.0175
	Transport	0.287
	Wastage	0.35
	Others	0.15
	Marketing cost	0.8045
	Marketing margin	1.4455
	price received	23.5
Consumer	price paid	23.5
	Price spread (%)	31.41
	Farmer’s share (%)	68.59

The price spread analysis of channel-II is presented in Table 13. From the table, it could be seen that the farmers had received net price of Rs. 17.45 per kg which constituted 73.49 per cent to the total consumer price. The marketing cost incurred by producer was Rs.3.09 per kg which constituted 13.01 per cent to the total consumer price. His marketing margin was Rs.3.2 which constituted 13.47 per cent to the total consumer price. Thus, the farmers share in consumer rupee was 73.49 per cent and price spread was 26.51 per cent.

Table 13: Channel II- Producer-wholesaler-retailer-consumer

		Price per kg
Producer	price received	18.13
	Packing	0.25
	Loading	0.07
	Transport	0.16
	Wastage	0.38
	Others	0.02
	Marketing cost	0.67
	net price	17.45
wholesaler	purchase price	18.13
	Packing	0.25
	Loading	0.015
	Transport	0.63
	Wastage	0.41
	Others	0.23
	Marketing cost	1.54
	Marketing margin	1.84
	price received	21.5
Retailer	purchase price	21.5
	Packing	0.02
	Transport	0.25
	Wastage	0.28
	Others	0.33
	Marketing cost	0.88
	Marketing margin	1.36
	price received	23.75
Consumer	price paid	23.75
	Price spread (%)	26.51
	Farmer's share (%)	73.49

The price spread analysis of channel-II is presented in Table 14. It could be seen from the table that the farmers had received net price of Rs. 18.38 per kg which constituted 83.54 per cent to the total consumer price. The marketing cost incurred by producer was Rs.2.59 per kg which constituted 11.77 per cent to the total consumer price. His marketing margin was Rs.2.51 which constituted 11.40 per cent to the total consumer price. Thus, the farmers share in consumer rupee was 83.54 per cent and price spread was 16.46 per cent. On comparision of three marketing channels, channel III was the best channel as it had the highest farmers share of 83.54 per cent due to absence of intermediaries of commission agent and wholesaler as compared to channel II with 73.49 per cent farmers share and channel I with 68.58 per cent farmers share.

Table 14: Channel III-producer –retailer-consumer

		Price per kg
Producer	price received	19.86
	Packing	0.04
	Loading	0.063
	Transport	0.83
	Wastage	0.39
	Others	0.156
	Marketing cost	1.479
	net price	18.38
Retailor		
	purchase price	19.86
	Packing	0.063
	Transport	0.63
	Wastage	0.33
	Others	0.104
	Marketing cost	1.127
	Marketing margin	2.513
	price received	23.5
Consumer	purchase price	22
	price spread (%)	16.46
	farmer's share (%)	83.54

3.9 Marketing efficiency

Marketing is said to be efficient if the total marketing margins are higher per unit of marketing cost. The marketing efficiency of different marketing channels for annual moringa was estimated by Shepherd and Acharya and Agarwal method and the results are presented in Table 15. Both the efficiency measures with highest values of 6.04 in Shepherd method and 3.59 in Acharya and Agarwal method showed that marketing channel III was the efficient channel.

Table 15: Marketing efficiency of Annual moringa cultivation

S. No	Marketing channels	Acharya and Agarwal method	Shepherd's method
1.	I	2.19	4.46
2.	II	2.78	4.63
3.	III	3.59	6.04

3.10 Constraints faced by sample farmers

3.10.1 Production constraints faced by sample farmers

The farmers in the study area faced several problems in the production of annual moringa. The five constraints identified by the sample farmers were ranked using Garrett's ranking technique and the results are presented in Table 16. The farmers expressed that the non-availability of labour was the most important problem as most of the labour in the area were more willing to work under Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGA). The second major constraint in the moringa production was the prevailing drought. High wage rate which was Rs.500 for men and Rs.300 for women was the third major constrint. The wage acceleration was also due to operation of MNREGA scheme and construction activities in the study area. Price fluctuations and lack of market information was the fourth and fifth constraints faced by sample farmers.

3.10.2 Problems faced by intermediaries

The problems faced by the intermediaries were ranked using Garrett's' ranking technique and the results are presented in Table 17. The intermediaries expressed that high transport cost was the most important problem followed by price fluctuations, financial constraints, lack of storage facility and high wastage

Table 16: Problems faced in Annual moringa cultivation by sample farmers

S. No	Constraints	Mean score	Rank
1.	Non-availability of labour	503	I
2.	Drought	421	II
3.	High wage rate	409	III
4.	Price fluctuations	376	IV
5.	Lack of market information	291	V

Table 17: Problems faced by intermediaries

S. No	Constraints	Mean score	Rank
1.	High transport cost	339	I
2.	Price fluctuations	299	II
3.	Financial constraints	288	III
4.	Lack of storage facility	286	IV
5.	High wastage	274	V

4. Conclusion

Growth rate of area and production showed positive growth rate of 6.24 per cent and 5.45 per cent respectively. Productivity showed negative growth rate of -0.73 per cent. The cost of cultivation of annual moringa production worked out to Rs.86509.09/ha, net income was Rs.2,23,491/ha and output- input ratio of 1:3.58. 72.32 per cent of post-harvest loss was encountered at farmer's level due to handling injuries. The variables of labour, FYM and fertilizers were significant at 5 per cent level and plant protection chemicals showed high significant at one per cent level. Technical efficiency under constant returns to scale ranged from 58.00 per cent to 100.00 per cent with the mean technical efficiency of 87 per cent. Rest 13 per cent of yield could be improved by adopting frontier technologies. Channel – III was the best marketing channel which showed high marketing efficiency and producer share of 83.54 per cent. Labour shortage was the most important constraint in moringa farming faced by the sample farmers. High transport cost was the main problem for the intermediaries in marketing of moringa.

5. Policy Implications

By analysing growth rate, there is a need to increase productivity and hence efforts should be taken to increase the productivity of moringa by providing frontier technologies in Dindigul district by the Horticulture department. The productivity of moringa was 20 t/ha. in the sample farms which was significantly low as compared to the yield potential of 30–50 tonnes/ha. (PKM-1). Hence there is a need to increase awareness among the farmers to reap higher yield by the Horticulture department.

Moringa crop was also found to be more profitable one with output-input ratio of 1:3.5.Hence more farmers can adopt annual moringa to get more farm income.

Sample farmers having mean technical efficiency of 87 per cent and remaining 13 per cent could be attained by farmers with the conduct of input training by Agriculture Department conducting awareness programmes.

47.5 per cent of sample farmers adopted by marketing channel –I. But marketing channel -III was found to be best among 3 channels. Hence farmers should adopt marketing channel-III to get remunerative price.

Post-harvest losses could be minimized by careful handling. Labour shortage in moringa production could be overcome by mechanization.

6. References

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