

ECONOMIC VIABILITY REPORT ON
DRUMSTICK CULTIVATION &
CREATION OF
VALUE ADDED PRODUCTS



Vivekananda Kendra - NARDEP



Green Rameshwaram

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Moringa/Drumstick Cultivation

Introduction

Moringa or drumstick tree (*Moringa oleifera*) is a tree from which the pods and leaves are used in every household across the country. Moringa is well-known for its multi-purpose attributes, ease of growing and wide adaptability. Many people believe that Moringa is a miracle tree and it is backed by scientific studies. Its pods, leaves and flowers are full of nutrients and consumed by humans and animals. The leaves are eaten in vegetable curries and the pods are cooked on a day to day basis. The leaves can also be dried, powdered and sold commercially. Similarly, the dried moringa seeds can be sold for high value. The medicinal values of moringa are numerous. It is a better protein than soy and more impressive than olive oil. Professor M S Swaminathan's Research Foundation, MSSRF, has done a considerable research on the sustainable agriculture and rural development has also researched on moringa.

In Tamil Nadu, Moringa is currently cultivated in Dindigul, Thoothukudi, Theni, Tiruppur and Karur districts. Major markets are available in Dindigul, Koyambedu Market, Oddanchathiram, Manmari and Coimbatore. It is also being sent to other states such as Andhra Pradesh, Kerala, Maharashtra, West Bengal, Orissa and Rajasthan. Typically two types of moringa are cultivated namely, Annual Moringa and tree Moringa. Each annual moringa tree yields 35 kg of drumstick in a season. 200 tree moringa plants can be planted in 1 acre of land and with a net profit of Rs. 85000 per year. Thus cultivating moringa in an acre of land will yield good returns and it can be adopted as a sustainable livelihood by the people in Rameswaram. Rameswaram's Olakkuda moringa is famous in Tamil Nadu and this document serves to promote its awareness through mass cultivation.

Package of practices

Varieties

The Tamil Nadu Agricultural University has released three varieties of moringa for cultivation namely PKM 1, PKM 2, KKM 1, Rohit 1 and Coimbatore 2. PKM 1 can yield products in 8-9 months. Production occurs twice a year with 200-350 pods per plant for about 4 to 5 years. PKM 2 plants yield 300-400 pods. It is a good product but needs more water. Rohit 1 yields from 4-6 months and can produce for about 10 years. Each plant can give 40-135 pods of about 3-10 kgs. Coimbatore 2 plants can yield 250-375 pods for about 3-4 years. These are the various yields each variety can produce and currently, PKM 1 and PKM 2 are of high demand and they can be used for cultivations.

Agro-Climatic Conditions

Moringa trees mainly grow in semi-arid, tropical and subtropical areas. It can grow on a wide range of soil conditions. However, the ideal soil in which it grows is loamy, sandy or sandy-loamy type. The desired soil pH level is between pH 5-9. It also requires a rainfall ranging between 250mm and 3000mm. If the rainfall is less 800mm, irrigation facilities have arranged for leaf production.

Land Preparation & Planting

The ideal time for planting is between July and October. High density cultivation requires planting but low density cultivation does not. For low density cultivation, pits of size 35-45 cm deep and 25-35 cm wide can be dug, planted and refilled with soil. Digging pits loosens the soil and helps to retain the moisture in root zone enabling the seedling to grow faster. For high density farming, dig pits of size 45 cm³ with a spacing of 2.25 m either way. However, this is not strictly followed and a spacing of 3 m either way is given to ensure sufficient sunlight and airflow. Plant the trees in East-West direction to ensure sufficient sunlight and airflow. Apply 15 kg of compost or FYM/pit after mixing with top soil.

Spacing

According to Tamil Nadu Agricultural University, Coimbatore, to increase the yield of PKM 1, plant in high density at 1.5x1.0 m spacing with two plants per hill and plant population of 13,333 per hectare along with the application of fertilizer dose of 135:23:45 g of NPK/pit through drip. In NPK, Potassium is applied basally as soil production. Nitrogen and Phosphorus can be applied in the form of urea and muriate of potash through drip.

To increase the yield of PKM 2, follow the same procedure as that of PKM 1 with the closest spacing of 1.2x1.2 m.

Planting Material

Drumstick can be grown either by seedlings or cutting. One necessity for growing through seedlings is that, it requires irrigation facility. According to the Horticulture department of TNAU, the price of moringa seedling raised in polybags is Rs. 5 / plant. The price of moringa bean is Rs. 8 /plant and the annual moringa TFL seeds cost Rs. 1500 /kg. For mass cultivation, it is better to buy the seedlings raised in the polybags as they are already grown for the initial weeks and easily maintained after planting.

Irrigation

Irrigation should be done before sowing the seeds and then on the 3rd day after planting. It should be followed by irrigation at 10-15 days interval according to

the soil type. One advantage of irrigation facility is that, it can facilitate the growth of moringa trees any time during the year.

Manure & Fertiliser

This crop does not require more manure and fertilizers if only the pods are desired. But for commercial cultivation, fertilizers are necessary because leaves are important for making powder and the pests attack the leaves first. Once attacked, the whole tree has to be burned to stop the infection to the other trees. The three major nutrients viz., Nitrogen, Phosphorus and Potassium should be applied to the crop.

- A fertilizer dose of 45:15:30 g of NPK/pit can be applied 3 months after sowing. Then apply 45 g of N/pit after months when the crop is in bearing.

Plant protection

Moringa pod fly, bud worm, leaf caterpillar, leaf webber and hairy caterpillar are the major pests attacking moringa trees. To control the moringa pod fly, the soil is applied with Thiamethoxam 25 WG @ 200 g a.i. / hectare on 150, 180 and 210 days planting. Also place fermented tomato fruit trap @ 25/hectare. Need based foliar spray of Spinosad 45 SC @ 56 g a.i. / hectare followed by Profenophos 50 EC @ 250 g a.i. / hectare. To control budworm, leaf caterpillar and leaf webber, dust Carbaryl 10 D @ 25 kg/hectare or spray Carbaryl 50 WP @ 2 g/l. To control hairy caterpillar, use flame torch when the caterpillars settle on the tree trunk.

Inter Cultural Operations

As moringa is grown in every household, both men and women are familiar on handling the tree. As men have their primary livelihood as fishing, women can handle the moringa tree farming. Also weeding must be done regularly to avoid competition for nutrients, especially nitrogen. If not weeded properly, trees produce less leaves and the leaves at the base begin to turn yellow. In 2015,

Backward and Forward Linkages

Planting material is available with the nurseries or state horticulture farms and other inputs like manure & fertilisers, pesticides etc., are available in the local markets. The total moringa market is estimated more than US \$ 4 billion, which is expected to cross US \$ 7 billion by 2020 @ 9 per cent per annum. Also there is a huge encouragement from the government. Recently, The Horticulture College and Research Institute, Periyakulam in Theni district, has received Rs 1.5 crore grant from the state government to popularise the cultivation of drumstick (moringa oleifera) trees, especially for its leaves among farmers in the region. Thus the activity can be taken up by the women SHGs in villages and succeed provided a little training on harvesting the leaves.

Harvesting the Leaves and Drying

Leaf Harvesting

Moringa leaves can be harvested 3-4 months after sowing. Good harvest take place every 30 to 45 days.

- Carry out the harvest in the coolest parts of the day; early morning or late evening. Make sure the leaves are not wet with dew, particularly in the morning, in order to avoid mould growth during transport.
- Cut all branches with leaves 50 cm from the ground.
- Take them off the site. The branches must be well ventilated during transport: for short distances, baskets or perforated plastic containers can be used. Do not place anything on top of the leaves.
- Remove the leaves from the branches away from the site.
- Use the remaining green branches as animal fodder. They make a good protein supplement.

Drying the Leaves

The leaves must be dried quickly and away from sunlight and dust to avoid mould growth and degradation of the vitamins by ultraviolet light (UV). Two main drying methods can be used:

- A drying shelter can be constructed from simple materials. An empty hut can also be used. There must be mats on the floor or on racks, where the leaves will be spread out in thin layers to help them dry properly.
- The leaves can be dried on a string

Harvesting Moringa Seeds

The pods and the seeds are the second product to be harvested. One adult moringa tree produces around 200 to 250 pods, which equals 1 kg of pods. The pods can be harvested green or dry.

- Green pods can be harvested 7 months after planting.
- Dry pods can be harvested about 6 weeks later. They are ready to be harvested when they become brown and dry, and open up easily.
- The seeds are extracted, placed in bags and stored in a dry place.

Value Added Products

Dried Leaf Powder

Rich in vitamins, minerals and protein, moringa leaves processed into powder improve the diet of children and nursing mothers, and can be used as a treatment for diabetes and digestive and respiratory problems.

To obtain moringa leaf powder:

- Wash and dry the leaves away from the sun on the day of the harvest.
- Two days later, separate the folioles from the petioles, then dry the folioles for 3-4 days. Collect and clean the dried leaves.
- Grind them in a mortar or a grain mill. The result is a fine green powder.
- Sift the powder, place in hermetically sealed boxes or plastic bags, and store them in the shade in a container to avoid contamination.

Moringa Flower Powder

Moringa flower powder is produced in the same way as the leaf powder, after drying the flowers in a drier away from sunlight. It is used as medication or as a nutritional supplement.

Powder from Stems and petioles

Separated from their folioles, the stems and petioles are dried in the sun for about 15 days, then ground in a mill to obtain the powder. This is stored in bags and can be used as a food product for animals and humans.

Powder from roots, trunk, bark and bark skin

- Cut the trunk and the roots into pieces.
- Wash them in water, strip the bark/skin, and then cut them into smaller pieces.
- Group the pieces into four batches of the same type (roots, trunk, root skin, tree bark).
- Dry them separately in four baskets for about 10 days. Then grind them separately in a mill to obtain four different powders that can be used to treat certain medical problems, including swelling of the legs (water retention), dental pain and scabies.

Moringa seed powder

Leave the pods to dry on the tree and collect them when they have dried. Then remove the seeds from the pods and grind them into a fine powder using a mortar and pestle.

Moringa seed powder is used to treat and purify water. The quantity of crushed seeds needed to treat water will depend on the amount of suspended matters it contains:

For 1 litre of water: add 50 g of moringa seeds or moringa seed powder. Leave for 30 minutes, stirring occasionally, then filter.

For 20 litres of water (the contents of a large pail): first prepare a solution of two teaspoons of moringa seed powder in 250 ml of clear or boiled water, mix

thoroughly, and then filter. Add this preparation to 20 litres of water, stir for 10 to 15 minutes, then leave it to settle. When stirring, the moringa seed powder bonds together (or coagulates) the fine particles and bacteria to form larger particles that then sink to and settle on the bottom of the pail. After 1 hour the water will be clear.

This process removes 90-99% of the bacteria attached to the solid particles. However, some harmful micro-organisms may still be present in the water, especially if it is extremely polluted. To obtain drinking water, more powerful purification is recommended by boiling it and passing it through a filter containing sand.

Moringa leaf tea

Preparation of tea bags:

- Dry the moringa leaves and stems.
- Crush the leaves gently in a mortar.
- Mix the powder obtained with the stems that have previously been cut into small pieces. Pack the mixture into tea bags.

Consume after infusion in hot water. Moringa tea is often used as a cold remedy.

Preparing an infusion of leaves:

- For 1 litre of water, use 5 g of dried moringa leaves.
- Bring the water to the boil. Add the leaves and allow them to infuse for 30 minutes, then filter.
- The infused leaves can be reused to season a soup or side dish.

Moringa seed oil

- Crush the moringa seeds and boil them in water.
- Remove the foam that rises to the surface with a perforated skimming ladle.
- Recover the floating oil with a ladle.

The oil can also be extracted by using a manually operated hydraulic press or with a solvent (e.g. hexane).

One litre of oil is obtained from 4 kg of moringa seeds. The oil is used in the manufacturing of cosmetics.

Branding of Olakkuda Moringa

Parameter	Olakkuda moringa	Other moringa
Appearance	More fleshy; seeds do not protrude much like other varieties	Less fleshy; protruding seeds can be seen clearly
Flexibility (moringa is bent to 30 degree)	Does not deform	Breaks and deforms

Size of the ends (indicates	The taper at the ends is short	The taper at the ends is long
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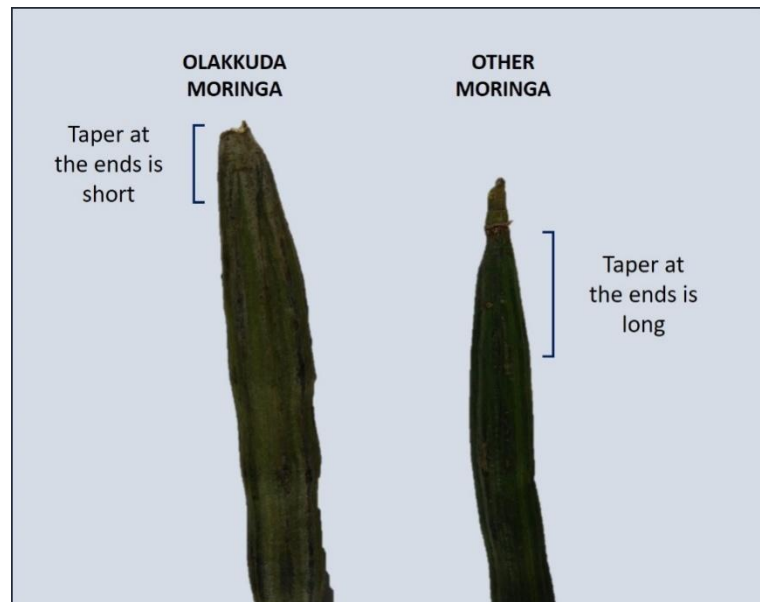


Figure 1. Comparison of the taper at the ends of moringa

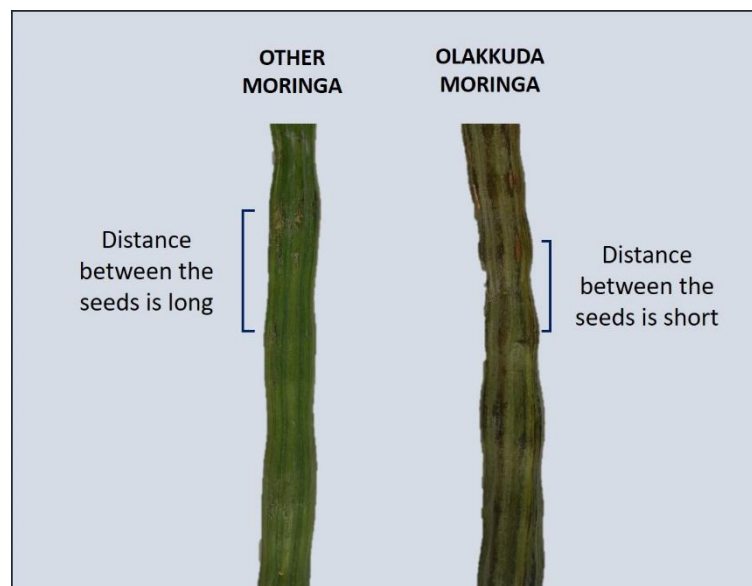


Figure 2. Comparison of flesh using the distance between the seeds

Empirical Analysis for creating value added products

The focus of this study was to check the feasibility of producing two value added products namely - Moringa powder and Moringa oil. For this purpose

in-depth study of two villages was conducted regarding the cultivation, consumption and selling practices of Moringa. Focus Group Discussions (FGDs) were conducted in the villages of Mangaadu and Sambai for understanding the supply chain of Moringa.

From the empirical analysis, we can conclude that, without any investment there is a potential to earn from the moringa trees after daily household consumption. If the same is done on a large scale as a commercial cultivation, there is a huge potential for make



Figure 3. Focuss Group Discussion at Mangaadu village in the presence of Sister V Saraswathy



Figure 4. Focuss Group Discussion at Sambai village

However we found that the yields of the two villages were different and their consumption and selling patterns were different. The major insights gained in both the villages are as follows:

- a. The nutritional value of Moringa and its products are not known.
- b. Every year there are two seasons where Moringa pods are produced.
- c. At the end of each season, all leaves get dried up and fall waste
- d. Trees can be categorized as medium sized (1-2 yrs) and large sized (>2 yrs)
- e. The moringa grown at “Mangaadu” has a brand appeal and thus it is rarely sold by the producers. They use it maximum for self consumption and give it to their relatives due to its unique taste.
- f. There is no scientific method being followed in growing Moringa trees.
- g. Every year due to pest attack the trees were rendered useless once
- h. There is also some amount of pods which are unplucked and go waste

Based on the insights obtained, a strategy was devised for the production of value added products.

Preparation of Moringa powder

Samples of moringa leaves and pods were collected from the villages of Mangaadu and Sambai and experiments were carried out for the production of Moringa powder. Two stem samples containing leaves of weight 75 gms were dried for four days tied to a rope in a shady room, in the absence of sunlight. The stems should be removed from the leaves and also infected leaves if present should be removed. The leaves were then dried for a few hours to remove the remaining moisture content. The dried leaves were then ground well to powder form in mixer and weighed to measure the yield (from stems containing leaves to powder). The steps are described below in pictorial form:

Drying of Moringa Leaves



Figure 5. Sample 1: Wt 75 grams



Figure 6. Sample 2: Wt 75 grams



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ge

Figure 7. Day 1



Figure 11. Separation of dried leaves and stems samples

Figure 8. Day 2



Figure 12. Grinding

Figure 9. Day 3



Figure 13. Moringa Powder

Figure 10. Day 4

The yield calculated empirically was found to be 20%. Based on the yield calculation the potential for production of Moringa powder for Mangaadu village is shown below:

Moringa Powder estimation			
Large Tree		Medium sized tree	
Number of stems from sub branches	8	Number of stems from sub branches	8
Number of sub branch per branch	6	Number of sub branch per branch	4
Number of branches	10	Number of branches	6
Total number of stems per tree	480	Total number of stems per tree	192
Weight per stem in grams	20	Weight per stem in grams	12.5
Total weight	9600	Total weight	2400
Assuming 60% is removed before the end of season	5760	Assuming 60% is removed before the end of season	1440
Yield percentage for converting into powder	0.2	Yield percentage for converting into powder	0.2
Net weight of moringa powder from a household	1152	Net weight of moringa powder from a household	288
Cost per kg of moringa powder	120	Cost per kg of moringa powder	120
Total benefit per household per season	138.24	Total benefit per household per season	34.56
Total benefit per year considering 2 seasons (A)	276.48	Total benefit per year considering 2 seasons (A)	69.12

Large Tree		Medium sized tree	
Number of pods per year	440	Number of pods per year	250
Number of pods used for self-consumption	270	Number of pods used for self-consumption	180
Number of pods remaining	170	Number of pods remaining	70
Number of pods sold in the market	140	Number of pods sold in the market	60
Number of pods not plucked	30	Number of pods not plucked	10
Revenue gained from sold pods in market @ 0.90 per pod	126	Revenue gained from sold pods in market @ 0.90 per pod	54
Scope of using dried pods for moringa oil		Scope of using dried pods for moringa oil	
Assuming 70% of pods can be plucked	21	Assuming 70% of pods can be plucked	7
Weight of seeds per pod in grams	5	Weight of seeds per pod in grams	5
Total weight of seeds that can be extracted	105	Total weight of seeds that can be extracted	35
Cost of seeds in the market	2000	Cost of seeds in the market	2000
Revenue that can be gained (B)	210	Revenue that can be gained (B)	70
Selling of pods through intermediaries		Selling of pods through intermediaries	
Number of pods produced in a season	112	Number of pods produced in a season	112
Number of pods produced in off season or during low supply	28	Number of pods produced in off season or during low supply	12
Revenue earned during season @ Rs. 0.9/pod	100.8	Revenue earned during season @ Rs. 0.9/pod	100.8
Revenue earned during off season @ Rs. 10/pod	280	Revenue earned during off season @ Rs. 10/pod	120
Direct Selling (C)		Direct Selling (C)	
Revenue earned during season @ Rs. 3/pod	336	Revenue earned during season @ Rs. 3/pod	336
Revenue earned during off season @ Rs. 12/pod	336	Revenue earned during off season @ Rs. 12/pod	144
Total revenue gained through direct selling	672	Total revenue gained through direct selling	480
	291.2		259.2
Net revenue potential from a large tree per year for a household (A+B+C)	777.68	Net revenue potential from a large tree per year for a household (A+B+C)	619.12

Results of Value Addition

The pods and the seeds are the second product to be harvested. One adult moringa tree produces around 200 to 250 pods, which equals 1 kg of pods. The pods can be harvested green or dry.

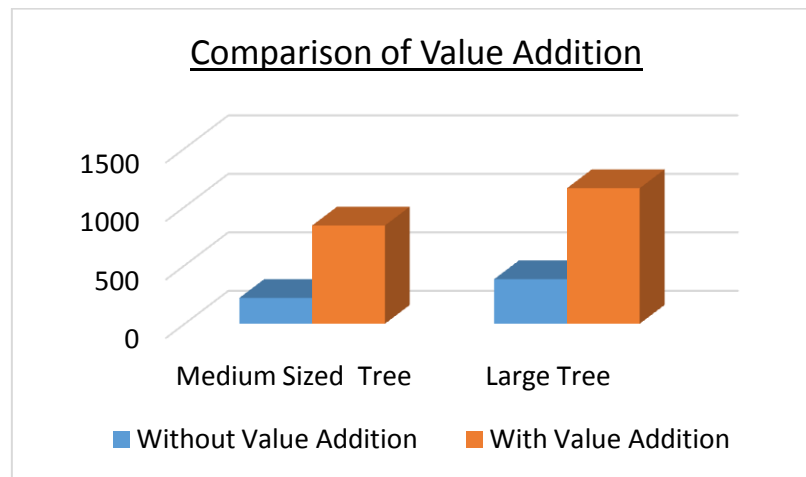


Figure 14. Impact of Value Addition

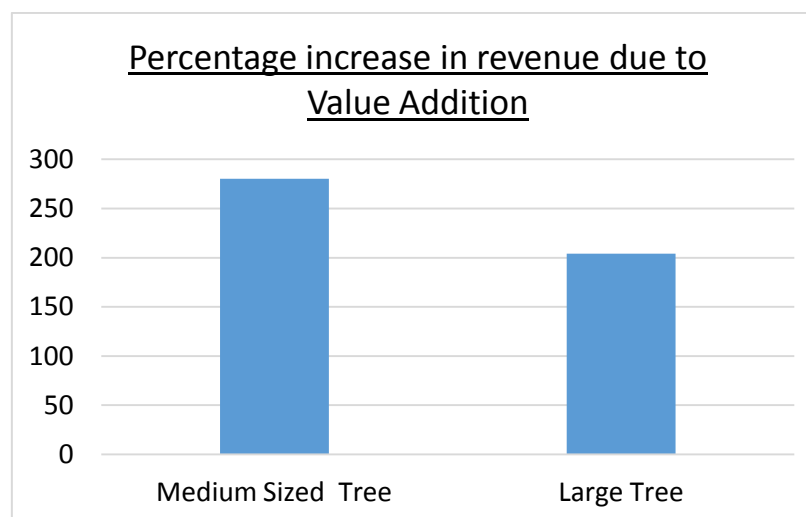


Figure 15. Percentage increase in revenue due to Value Addition

Conclusion

As per our study, when the scale of production of the value added products are increased, the revenue also increase proportionally. After a particular scale is achieved, we feel that this villages can become strategic suppliers for traders selling moringa powder and oil.