



Opportunities for development of the Moringa sector in Bangladesh

Desk-based review of the Moringa value chains in developing countries and end-markets in Europe

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Moringa trees in Bangladesh and in other developing countries have great potential in terms of nutrition security and income generation, but often seem to be underutilized. The European market does offer opportunities for those suppliers that are willing to, and capable of, meeting EU regulations. However, entering the EU market for some developing countries like Bangladesh seems to be far-fetched at the time of writing. Firstly, awareness around the nutritional value and market potential of Moringa products needs to be raised so farmers and households begin to maximise the returns of Moringa trees. Secondly, a detailed cost and benefit analysis around a Moringa production company should be conducted. Thirdly, upcoming suppliers need to get acquainted with the regulations and standards required when targeting the export market. This also means that suppliers should establish, and nurture, trading relationships with EU importers or even intermediaries since the volume supplied is likely to be limited according to European terms.

Moringa bomen in Bangladesh en andere ontwikkelingslanden hebben een groot potentieel op het gebied van voedselzekerheid en het genereren van inkomsten, maar lijken vaak te worden onderbenut. De Europese markt biedt wel mogelijkheden voor die leveranciers die bereid en in staat zijn om aan de EU-regelgeving te voldoen. Echter, het betreden van de EU-markt lijkt voor sommige ontwikkelingslanden zoals Bangladesh, op het moment van schrijven, nog te vergezocht. Ten eerste, het bewustzijn rond de voedingswaarde en het marktpotentieel van Moringa producten dient te worden verhoogd, zodat boeren en huishoudens beginnen om het rendement van de Moringa bomen maximaliseren. Ten tweede moet een gedetailleerde kosten- en batenanalyse rond een Moringa productiebedrijf worden uitgevoerd. Ten derde moeten aanstaande leveranciers bekend worden met de regels en normen die van toepassing zijn, wanneer gericht wordt op de exportmarkt. Dit betekent ook dat leveranciers handelsbetrekkingen moeten aangaan, en onderhouden, met de EU-importeurs of zelfs met tussenpersonen, aangezien het geleverde volume naar waarschijnlijk te beperkt is volgens de Europese maatstaven.

Keywords: Moringa, Bangladesh, value chains, end-markets.

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Contents

Acknowledgements	5
List of abbreviations and acronyms	6
Summary	7
1 The Moringa tree	9
1.1 Introduction	9
1.2 Cultivation of Moringa	10
1.2.1 Cultivation requirements	10
1.2.2 Cultivation practices	10
1.3 Multipurpose uses of Moringa	11
1.3.1 Human consumption	11
1.3.2 Nutritious value of Moringa	11
1.3.3 Industrial uses	12
1.3.4 Medical use	13
2 Moringa value chain cases in developing countries	15
2.1 Leaf-based Moringa value chains	15
2.1.1 THE CASE OF NIGERIA	15
2.1.2 THE CASE OF MOZAMBIQUE	17
2.2 Drumsticks value chain	18
2.2.1 THE CASE OF INDIA	18
2.3 Project-based Moringa value chains	20
2.3.1 THE CASE OF NIGER	20
2.4 International Moringa value chains: the case of Moringa oil	22
2.5 Conclusions	23
3 The EU market for Moringa products	24
3.1 Market segments and EU regulations for food supplements and herbal medicines	24
3.1.1 The EU Market for Moringa Leaf Powder	26
3.1.2 The EU market for Moringa oil	27
4 The market for Moringa products in the Netherlands	28
4.1 Introduction	28
4.2 Superfoods	28
4.3 Market outlets for Moringa products in the Netherlands	28
4.4 Import of Moringa products into the Netherlands	30
5 Current status of the Moringa sub-sector in Bangladesh	32
5.1 Moringa in the context of Bangladesh	32
5.2 Moringa sub-sector: quick-scan	32
5.2.1 Farm survey	32
5.2.2 Secondary data	34
5.2.3 Key informants	36
5.3 Current Value Chain	37
5.4 Preliminary conclusions on the Moringa sub-sector	38

6	Recommendations	39
	Annex 1: Workshop report	40
	Annex 2: List of participants	43
	References	44

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List of abbreviations and acronyms

BDT	Bangladeshi Taka
CBI	Centre for the Promotion of Imports from Developing Countries
CDI	Centre for Development Innovation, Wageningen UR
EU	European Union
FAO	Food and Agriculture Organization of the United nations
GACP	Good Agriculture and Collection Practices
GMP	Good Manufacturing Practices
HACCP	Hazard Analysis and Critical Control Points
MMF	Netherlands enterprise agency
MRL	Maximum Residues Level
USAID	United States Agency for International Development
VC	Value Chain
Wageningen UR	Wageningen University & Research centre

Summary

The present report explores the uses of Moringa worldwide, gives an account of the Moringa value chains existing in different countries, describes the dynamics seen in the EU market -paying special attention to the Dutch market- and outlines the current status of the sub-sector in Bangladesh. To meet the objectives of this study, authors conducted an extensive desk-based research whereby relevant secondary data (publications, both academic as well as grey literature), national and international government databases and private sector information were gathered and assessed thoroughly. In addition, researchers also conducted a short fact-finding mission to Bangladesh to describe the current status of the Moringa sub-sector in country. The mission finished with a debriefing and stakeholder workshop in Dhaka, Bangladesh and in which the next steps for the growth of the Moringa sub-sector were outlined.

The nutritional value of Moringa pods, fresh leaves and leaf powder are well documented. But more interesting is to look at the many uses of the Moringa tree worldwide. Moringa can be used for human, industrial and medical purposes. Of the more than 30 uses listed in this document, Moringa leaf powder and pod production for human consumption appear to be the most relevant uses in developing countries.

A lesser known aspect of Moringa trees is what activities, and conducted by whom, take place along the so-called value chain. In other words, the journey from the farm to the end-market, whatever that might consist of, remains unknown for the most part. Only a few authors have attempted to describe isolated aspects of the value chains other than production practices; how Moringa leaf powder is manufactured, what end-markets there are for Moringa in a given country or how profitable a leaf-based Moringa farm can be. However, these aspects are hardly found interlinked and put into a value chain framework. This report bridges this information gap by gathering findings from a number of sources and piecing them together. In this way, we provide the following examples:

1. Leaf-based Moringa value chains. Leaf production is the single most common use of Moringa in developing countries since it requires only limited labour and low investments to reap decent profits (provided the market for that final product). Two cases (Nigeria and Mozambique) will illustrate what these underdeveloped value chains look like;
2. Drumsticks value chain. Overall, African countries have little taste for drumsticks in any form and the reason is the lack of awareness of pods' properties. In Asia, on the other hand, the consumption of Drumsticks surpasses that of leaf powder. We describe a standard value chain of Drumstick in India where the consumption of pods reaches significant levels;
3. Project-based Moringa value chain. Development organizations have food nutrition security high on their agendas. In this section, we provide an example by which food nutrition security is achieved by strengthening the value chain of Moringa in the region;
4. International Moringa value chains: the case of Moringa oil for the cosmetic sector. Of the many uses of Moringa, oil production delivers arguably the highest returns on investment. We provide an example of a standard Moringa oil value chain destined for the international market.

In Europe, Moringa products belong mostly in the cosmetics market segment and in the cross-segment 'food supplements', which is considered a combination of food and herbal medicines sub-segments. Moringa leaf powder used in the herbal medicine or food supplement segment is the single most important use of Moringa in the European market. At a distance, we find Moringa used as a natural ingredient for the cosmetics industry mostly in form of oil. The report also gives an account of the legislative and non-legislative requirements that producers in developing countries of Moringa as a natural ingredient for either market segment needs to comply with.

Meanwhile, in Bangladesh, Moringa trees are part of the landscape and are numerous in Khulna and Jessore regions. However abundant, the trees are almost uniquely used for pod production. Any other use does not constitute an important activity among farmers in the country.

All in all, Moringa trees in Bangladesh and in other developing countries have great potential in terms of nutrition security and income generation, but often seem to be underutilized. The European market does offer opportunities for those suppliers that are willing to, and capable of, meeting EU regulations. However, entering the EU market for some developing countries like Bangladesh seems to be far-fetched at the time of writing. Firstly, awareness around the nutritional value and market potential of Moringa products needs to be raised so farmers and households begin to maximise the returns of Moringa trees. Secondly, a detailed cost and benefit analysis around a Moringa production company should be conducted. Thirdly, upcoming suppliers need to get acquainted with the regulations and standards required when targeting the export market. This also means that suppliers should establish, and nurture, trading relationships with EU importers or even intermediaries since the volume supplied is likely to be limited according to European terms.

The good news is that, despite the barriers and challenges described throughout this report, the Moringa sub-sector in Bangladesh has the potential to grow substantially over time.

1 The Moringa tree

1.1 Introduction

Moringa is a multipurpose vegetable tree with a variety of potential uses, of which the nutritional and medicinal properties are initially considered the most interesting. In total there are 13 species in the genus Moringa, belonging to the family Moringaceae, of which *Moringa oleifera*, commonly referred to as the 'drumstick tree' (describing the shape of its pods) or 'horseradish tree' (the roots can be used as a substitute for horseradish), is the most commonly cultivated species. *Moringa oleifera* is native to the sub-Himalayan tracts of north-west India, Pakistan, Bangladesh and Afghanistan (Foidl et al., 2001). This multipurpose tree is characterized by high biomass yield and tolerance to unfavourable environmental conditions (Foidl et al., 2001).

The second most cultivated species of Moringa, *Moringa stenopetala*, often referred to as the African Moringa tree, is a multipurpose tree native to Ethiopia, northern Kenya and eastern Somalia (Jahn, 1991). Both species have many characteristics in common. However the *Moringa oleifera* is smaller tree which can be grown in higher densities, has a faster growth and development rate, yielding leaves, fruits and seeds quickly, and therefore is more suitable for commercial production purposes. In this report, 'Moringa' refers to *Moringa oleifera*.



Figure 1 *Moringa Oleifera*: Pods, flowers, seeds and leaves (source: flickr.com)

1.2 Cultivation of Moringa

1.2.1 Cultivation requirements

Moringa tolerates a wide range of environmental conditions. It grows best between 25 to 35°C, but will tolerate up to 48°C in the shade and can survive a light frost (Palada and Change, 2003). It is a drought-tolerant tree that grows well in areas receiving annual rainfall amounts that range from 250 to 1500 mm, prefers a well-drained sandy loam or loam soil, also tolerates clay, but will not survive under prolonged flooding and poor drainage (Palada and Change, 2003). Soil pH should range between 5.0 - 9.0. Altitudes below 600m are best for Moringa, but this adaptable tree can grow in altitudes up to 1200m in the tropics.

1.2.2 Cultivation practices

The germination rate of Moringa seeds is high (Saint Sauveur and Broin, 2010). Furthermore, Moringa seeds have no dormancy period, so they can be planted as soon as they are mature. Seeds may be sown in seedbeds (for transplanting) or directly in the main field. Moringa seeds germinate 5 to 12 days after seeding (Saint Sauveur and Broin, 2010).

For intensive (commercial) leaf production the spacing of the plants should be 15 x 15 cm or 20 x 10 cm, with conveniently spaced alleys to facilitate plantation management and harvests (Saint Sauveur and Broin, 2010). This intensive system requires careful crop management. For semi-intensive leaf production plants are spaced 50 cm to 1 m apart. This is more appropriate for small-scale farmers and gives good results with less maintenance. For fruit or seed production the spacing must be at least 2.5 x 2.5 meter in order to achieve good yields (Saint Sauveur and Broin, 2010).

For intensive production the land should be prepared by means of ploughing and harrowing to a maximum depth of 30 cm (Saint Sauveur and Broin, 2010). In case of semi-intensive production, it is better to dig planting pits (30 - 50 cm deep, 20 - 40 cm wide), which ensures good root system penetration and retains soil moisture, without causing too much land erosion (Saint Sauveur and Broin, 2010; Fugli and Sreeja, 2011). Compost or manure can be mixed with the fresh topsoil around the pit and used to fill the pit.

Moringa trees will at least flower and fruit annually. During its first year, a Moringa tree will grow up to five meters in height and produce flowers and fruits; when left alone, the tree can eventually reach 12 meters in height with a trunk 30 cm wide (Fugli and Sreeja, 2011). If the trees are left to grow naturally, yields will be low.

Pinching the terminal bud on the central stem is necessary when the tree attains a height of 50 cm to 1 m (Saint Sauveur and Broin, 2010). This will trigger the growth of lateral branches which need to be pinched too. Regular pinching will encourage the tree to become bushy and produce many leaflets and pods within easy reach and helps the tree develop a strong production frame for maximizing the yield (Fugli and Sreeja, 2011).

Maintenance pruning is also required. This can be done at each harvest (i.e. if the leaves are removed). In fruit and seed producing farms, pruning helps induce more fruits, as well as larger fruits (Saint Sauveur and Broin, 2010).

Moringa trees do not need much water and can germinate and grow without irrigation if sown during the rainy season. The roots will develop in about twenty days and allows young plants to endure drought (Saint Sauveur and Broin, 2010; Fugli and Sreeja, 2011). It is however advisable to irrigate regularly to ensure optimal growth and continuous yield, especially in arid conditions.

Moringa trees will generally grow well without adding very much fertilizer, but in order to achieve good yields the soil needs to provide enough nitrogen and minerals to the plant. Before seeding / planting, manure or compost can be mixed with the soil used to fill the planting pits. Afterwards it is important to apply manure or compost at least once a year, for instance before the rainy season, when the trees are about to start an intense growth period (Saint Sauveur and Broin, 2010).

Weeding must be done regularly to avoid competition for nutrients, especially for nitrogen. Weeding must be more frequent when the plant is young and the trees are small. Mulching can be applied

(covering the soil with e.g. crop or weed residues) in order to reduce the loss of soil moisture, minimize irrigation needs and also reducing weed growth.

Moringa is fairly resistant to pests and diseases since its relatively fast vegetative growth allows it to regenerate quickly from any disturbance. The most common pests and diseases are grasshoppers, crickets, caterpillars, termites and fungal disease. Preventive measures and timely detection of pests and diseases are important in the pest and disease management strategy.

When harvesting pods for human consumption, harvest when the pods are still young (about 1 cm in diameter) and snap easily. In seed producing farms (for planting or oil extraction), pods should be harvested when they reach maturity, i.e. when they turn brown and dry. Harvest the pods before they split open and seeds fall to the ground. Seeds should be extracted from the pods, bagged, and stored in a dry shady place. Harvesting of the leaves can be done by cutting shoots and leaves or by only removing the leaves, picking them directly off the tree. In this case it is advisable to apply pruning after the harvest of the leaves in order to ensure again a vigorous growth.

1.3 Multipurpose uses of Moringa

The Moringa plant is known worldwide for its nutritional and medicinal benefits and industrial uses. It is one of the most useful tropical trees. Almost every part of the Moringa plant has nutritional value.

1.3.1 Human consumption

The pods of the Moringa can be cooked as a vegetable and can be used in soups, stews or curries. The very young pods are very tasty, fibreless, and can be cooked and eaten like green beans. The root can be used as substitute for horseradish and can also be dried and ground for use as a seasoning. The leaves can be eaten as greens, boiled, fried, in soups and stews or for seasoning. The seeds can be extracted and eaten boiled or fried like peas when they are still green, can be roasted and eaten like a peanut, and can be ground to a powder for use as a seasoning. Even the buds and the flowers of Moringa can be eaten and can be added and processed in various dishes. Flowers can also be used to make tea. The resin from the trunk of the tree is useful for thickening sauces.

1.3.2 Nutritious value of Moringa

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 acts 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). Dried leaf powder can be added to any kind of meal as a nutritional supplement. Although Moringa pods are lower in nutritional value, they are still a very good source for adding nutrients to the daily diet.

Especially in cultures where the staple diet consist mainly of a starchy dish (e.g. rice, wheat, corn, cassava, millet), side dishes are very important for nutrients like proteins, vitamins and minerals. Moringa can easily be added to such side dishes and can in this way easily provide the necessary nutrients and contribute to nutrition security.

In the table below (Table 1.1) an overview is given of the nutritional value of Moringa pods, leaves and leaf powder. Nutrient content will vary with preparation method, leaf and pod age, and harvest season.

Table 1.1

Nutritional value analysis of Moringa oleifera pods, fresh leaves and dried leaf powder per 100 grams of edible portion (source: Fuglie, 2001)

Component	Unit	Pods	Leaves	Leaf Powder
Moisture	%	86.9	75.0	7.5
Calories	-	26	92	205
Protein	g	2.5	6.7	27.1
Fat	g	0.1	1.7	2.3
Carbohydrate	g	3.7	13.4	38.2
Fibre	g	4.8	0.9	19.2
Minerals	g	2.0	2.3	-
Ca	mg	30	440	2,003
Mg	mg	24	24	368
P	mg	110	70	204
K	mg	259	259	1,324
Cu	mg	3.1	1.1	0.57
Fe	mg	5.3	7.0	28.2
S	mg	137	137	870
Oxalic acid	mg	10	101	1600
Vitamin A – B Carotene	mg	0.11	6.8	16.3
Vitamin B – choline	mg	423	423	-
Vitamin B1 – thiamine	mg	0.05	0.21	2.64
Vitamin B2 – riboflavin	mg	0.07	0.05	20.5
Vitamin B3 – nicotinic acid	mg	0.2	0.8	8.2
Vitamin C – ascorbic acid	mg	120	220	17.3
Vitamin E – tocopherol acetate	mg	-	-	113
Arginine	mg	90	402	1325
Histidine	mg	27.5	141	613
Lysine	mg	37.5	288	1325
Tryptophan	mg	20	127	425
Phenylalanine	mg	108	429	1388
Methionine	mg	35	134	350
Threonine	mg	98	328	1188
Leucine	mg	163	623	1950
Isoleucine	mg	110	422	825
Valine	mg	135	476	1063

1.3.3 Industrial uses

1.3.3.1 Oil

The oil content of de-hulled Moringa seeds is about 42% (Foidl et al., 2001). The clear, sweet and odourless oil is of excellent quality for cooking, can be used as a lubricant for fine machinery (e.g. watches). The oil has little tendency to deteriorate and is known for its capacity to absorb and retain volatile substances and is therefore valuable for the perfume industry. It is also used as a component of many other cosmetic products, such as soaps, body lotions, facemasks, shower gels and shampoos. It has a particular high level of oleic acid (about 70%, comparable to olive oil), contains about 13% saturated and 82% unsaturated fatty acids, and a free fatty acid content varying between 0.5 – 3% (Foidl et al., 2001).

1.3.3.2 Water purification

Press cake obtained as a by-product of the oil extraction process contains a very high level of protein. Some of these proteins are active cationic polyelectrolytes, which neutralize the colloids in muddy or dirty water since the majority of these colloids have a negative electrical charge. This protein can therefore be used as a non-toxic natural polypeptide for sedimenting mineral particles and organics in the purification of drinking water, for cleaning vegetable oil, or for sedimenting fibers in the juice and beer industries (Foidl et al., 2001). It works as a primary coagulant as natural bridges are continuously formed between the colloid particles.

The properties of the natural polypeptides produced from the seeds can also be used for water purification in the form of powder (grounded dry seeds). Up to 99 % of colloids can be removed and only one seed is required per litre for slightly contaminated water, two seeds for very dirty water (Foidl et al., 2001). The powder can be mixed with water, agitated for approximately five minutes and

after about an hour it is filtered through a piece of woven fabric to obtain pure water. Purifying water using Moringa seeds can be carried out in homesteads and does not require mechanical grinding machines.

1.3.3.3 Biofuel

Biodiesel derived from Moringa oil is an acceptable substitute for petrodiesel when compared to biodiesel fuels derived from other vegetable oils. A survey conducted on 75 indigenous (India) plant-derived non-traditional oils concluded that *M. oleifera* oil, among others, has good potential for biodiesel production (Azam et al., 2005). Because Moringa oil has a high content of oleic acid (>70%), with saturated fatty acids comprising most of the remaining fatty acid profile, the methyl esters (biodiesel) obtained from this oil exhibit a high cetane number of approximately 67, one of the highest found for a biodiesel fuel (Rashid et al., 2008). It also has better oxidative stability than biodiesel made with most other feedstocks. Perhaps one of the main advantages of Moringa as an oil-producing tree is that it can be planted in marginal lands where it will not compete with cultivation of food crops (FAO, 2011).

Moringa can also be processed into biogas. Moringa plants should to be milled together with water, after which the fibre needs to be separated by filtration. The liquid fraction produced can be added to a biogas reactor. Foidl et al. (2001) reports that 580 litres of gas per 1 kg of volatile solids can be produced with an average methane content of 81%.

1.3.4 Medical use

A number of medicinal properties can be ascribed to the various parts of the Moringa tree. Almost all the parts of this plant: root, leaf, bark, gum, leaf, flowers, seed and fruit (pods) have been used for various ailments in the indigenous medicine of South Asia (Anwar et al., 2007). In table 2.1 an overview is given of some common medicinal uses of the different parts of Moringa.

Table 2.1

Medicinal uses of different parts of Moringa oleifera (source: Anwar et al., 2007)

Plant part	Medicinal Uses
Root	Antilithic, rubefacient, vesicant, carminative, antifertility, anti-inflammatory, stimulant in paralytic afflictions; act as a cardiac/circulatory tonic, used as a laxative, abortifacient, treating rheumatism, inflammations, articular pains, lower back or kidney pain and constipation.
Leaf	Purgative, applied as poultice to sores, rubbed on the temples for headaches, used for piles, fevers, sore throat, bronchitis, eye and ear infections, scurvy and catarrh; leaf juice is believed to control glucose levels, applied to reduce glandular swelling.
Stem bark	Rubefacient, vesicant and used to cure eye diseases and for the treatment of delirious patients, prevent enlargement of the spleen and formation of tuberculous glands of the neck, to destroy tumors and to heal ulcers. The juice from the root bark is put into ears to relieve earaches and also placed in a tooth cavity as a pain killer, and has anti-tubercular activity.
Gum	Used for dental caries, and is astringent and rubefacient; Gum, mixed with sesame oil, is used to relieve headaches, fevers, intestinal complaints, dysentery, asthma and sometimes used as an abortifacient, and to treat syphilis and rheumatism
Flower	High medicinal value as a stimulant, aphrodisiac, abortifacient, cholagogue; used to cure inflammations, muscle diseases, hysteria, tumors, and enlargement of the spleen; lower the serum cholesterol, phospholipid, triglyceride, VLDL, LDL cholesterol to phospholipid ratio and atherogenic index; decrease lipid profile of liver, heart and aorta in hypercholesterolaemic rabbits and increased the excretion of faecal cholesterol
Seed	Seed extract exerts its protective effect by decreasing liver lipid peroxides, antihypertensive compounds thiocarbamate and isothiocyanate glycosids have been isolated from the acetate phase of the ethanolic extract of Moringa pods.

1.3.4.1 Agricultural uses

Because of the nutritional characteristics of the Moringa tree, it is an excellent source of fresh forage material for livestock feed. The leaves are rich in protein, carotene, iron and ascorbic acid and the pod is rich in the amino acid lysine (Foidl et al., 2001). Feeding animals Moringa has been linked to increased milk production, increased nutrient uptake, and faster weight gain than with other feeds (Reyes-Sánchez et al, 2006; Foidl et al., 2001). Another important advantageous characteristic of Moringa for livestock forage is its high productivity of fresh material per unit area compared with other forage crops (Foidl et al., 2001). The press cake obtained as a by-product of the oil extraction process contains a very high level of protein and can therefore also be used as (additional) livestock feed (Foidl et al., 2001).

Moringa leaves can be used as a foliar spray (leaf extract) to increase plant growth and as a green manure to improve soil fertility. Moringa leaves contain reasonable levels of cytokinins, which are naturally occurring plant growth hormones. Cytokinins stimulate cytokinesis (cell division) in the shoots and roots of plants. Moringa leaves can be easily processed for their concentration of cytokinins to replace chemical fertilizers. Plants sprayed with Moringa leaf extract foliar spray have been shown to turn out firmer and more resistant to pests and disease. They have also been shown to produce more and larger fruit, consequently having a higher yield at harvest time. Increases in yields have been reported for various crops, including onions, bell pepper, soya, sorghum, coffee, chili, and melon (Makkar and Becker, 1996; Fuglie, 2001). The press cake obtained as a by-product of the oil extraction process can also be used as a fertilizer, due to its high content of nitrogen.

Moringa has also been reported to have the potential to be used as bio-pesticide (Fahey, 2005).

1.3.4.2 Various other uses

Apart from the above discussed uses for Moringa, there are also some various other uses reported:

- Domestic cleaning agent (crushed leaves);
- Blue dye (wood);
- Gum (from tree trunks);
- Honey (flower nectar);
- Pulp for paper (wood);
- Rope (bark);
- Tannin for tanning hides into leather (bark and gum).

2 Moringa value chain cases in developing countries

While *Moringa Oleifera* finds home in almost every corner of the world, the concept of Moringa value chains remain absent. Much is already known on the characteristics, benefits and the many uses of Moringa (see chapter 1). However, how does the product flow from the farm to final consumers? Is the 'value' of the final product capturing consumer needs? These and other questions regarding the value chain remain unanswered.

Only a handful of authors have attempted to explain what happens from harvest until consumption and describe the actors involved in the process.

The following section intends to bridge that information gap by piecing together, and putting in the context of value chains, the relevant documents and insights collected. In this way, we provide the following examples:

1. Leaf-based Moringa value chains. Leaf production is the single most common use of Moringa in developing countries since it requires only limited labour and low investments to reap decent profits (provided the market for that final product). One case from Nigeria and another one from Mozambique will illustrate what these underdeveloped value chains look like;
2. Drumsticks value chain. Overall, African countries have little taste for drumsticks in any form and the reason is the lack of awareness of pods' properties. In Asia, on the other hand, the consumption of Drumsticks surpasses that of leaf powder. We describe a standard value chain of Drumstick in India where the consumption of pods reach significant levels;
3. Project-based Moringa value chain. Development organizations have food nutrition security high on their agendas. In this section, we provide an example by which food nutrition security is achieved by strengthening the value chain of Moringa in the region;
4. International Moringa value chains: the case of Moringa oil for the cosmetic sector. Of all the many uses of Moringa, oil production delivers arguably the highest returns on investment. We provide an example of a standard Moringa oil value chain destined to the international market.

Each and every value chain described in the next section should be considered merely as informative. Any further step to create vibrant local Moringa value chains in Bangladesh require careful analysis of the local situation and identification of opportunities to move forward.

2.1 Leaf-based Moringa value chains

2.1.1 THE CASE OF NIGERIA¹

2.1.1.1 Brief description of the Moringa sub-sector in Nigeria

Called by different names in the local languages (Kadashi, 2008), the production and consumption of Moringa in Nigeria dates back decades. In Northern provinces, Moringa trees can be found in home gardens and hedges around houses. Not only is Moringa known at farm level, but also the Federal Government, through the Raw Materials Development Council, has been actively encouraging Moringa consumption across Nigeria.

Despite the promotional efforts, the production and usage of Moringa are limited to being an ingredient of a sauce (cooked leaves or powder), vegetable salad (uncooked leaves) and live fence. In

¹ The following research papers have been used to compose the current value chain: : Animashaun et al., 2013; Animashaun, 2013; Musa et al., 2015; Animashaun et al., 2014; Omotesho et al., 2013; Ojiako et al., 2013.

a few cases, Moringa producers have decided to set up small-scale schemes for commercial leaf production.

Although the sub-sector has a long way to go, many Nigerian researchers believe Moringa has tremendous potential in the medium-long term. For that reason, research conducted in Nigeria has investigated the economic feasibility of leaf-based Moringa plantations. If successful, these small-scale enterprises would then be followed by rampant medium-scale production of the plant for various uses (e.g. biogas, oil).

2.1.1.2 Value chain of Moringa leaf powder

Leaf production is the single most important use of Moringa in Nigeria. Any other use, such as oil, biogas or water purification lags a considerable distance behind. The informal, rather-short value chain of Moringa leaf powder comprises of few actors with a handful of end-products. Figure 2 captures the most important features in the value chain, which are described in greater detail below.

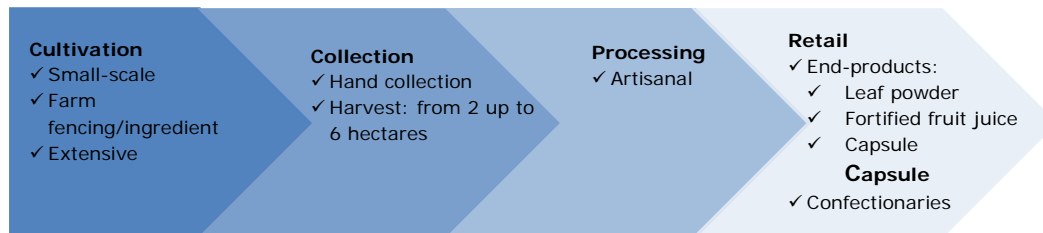


Figure 2 Moringa leaf powder value chain in Nigeria

2.1.1.3 Cultivation of Moringa leaves

Almost 50 percent of food produced in Nigeria comes from households headed by women. Percentage soars to 70-80 percent for Moringa production, which takes place mainly in the Northern Region. Trees remain relevant at household level only for small-scale landholdings. Indeed, 90 percent of Moringa farmers have a farm size of 0.2 – 1 hectares and of this percentage, about half of the farmers are in the 0.1-0.3 ha bracket.

Farmers' yields vary depending on the spacing and crop technique (intensive, extensive, agroforestry). Reportedly, farmers in Kebbi state use trees mainly for agroforestry and farm fencing, up to 6 times per year. In Kwara State, semi-intensive systems have been reported whereby 4,444 plants per ha, planted over a spacing of 1.5m by 1.5m.

2.1.1.4 Collection of Moringa leaves

Smallholder families collect Moringa leaves for either home consumption or further processing. When leaves are used for further processing farmers harvest from 2 up to 7 times depending on the cultivation technique, spacing, crop growth or season.

2.1.1.5 Processing of Moringa leaves

According to some authors, processing fresh leaves into leaf powder produces between 12.5% to 15% of leaf powder per unit of fresh leaves. Authors also suggest that some farmers themselves and their families dry and pound fresh Moringa leaves in a mortar. However, most farmers sell fresh or dried leaves to a third-party for further processing. Manual grinding techniques are labour intensive, slow and often produces an inconsistent powder. Alternatively, small-scale semi-automatic grinders (20-40 kg/h) can provide a fine Moringa powder of high market value. The investments would oscillate between 300 US\$ up to 2,000 US\$.

Estimated price for 1 kg of dried leaf is 180 NGN (Nigerian Naira), or €0.81. In terms of efficiency, the study conducted by Animashaun and Toye (2012) revealed that Moringa plantation at a planting density of 4,444 plants/ha (1.5 x 1.5 m spacing) yielded 110kg/ha per annum of processed Moringa dried leaf. This is equivalent to 24.75g of dried leaf per plant.

2.1.1.6 Commercialization of Moringa leaves (powder)

It remains unclear how the end-product reaches the market in Nigeria. Nevertheless, researchers point at four end-products for Moringa leaves. These are:

- Moringa leaf powder in Teabags;
- Moringa fortified fruit juice/honey;
- Moringa in capsule/tablets;
- Moringa fortified confectionaries.

Seemingly, these four end-products are the top choices for consumers in Nigeria. Ultimately, the decision on whether to choose one product or another depends on the technology available, scale of production and consumers' preference in that specific area. Moringa leaves, either in fresh, dried or powder form, are sold in most towns of the 21 states in the North of Nigeria and in the federal capital.

Box 1: Profitability of leaf-based farms

According to study feasibility, farms with plant density of 4,444 plants per ha for production of dried leaves see an average total cost of production per hectare of NGN 75, 350, or €340,33, the average total revenue was N187, 500, or €846,88 and the net income was N112, 150, or €506,55.

2.1.2 THE CASE OF MOZAMBIQUE²

2.1.2.1 Introduction

In Mozambique, the most common Moringa product is leaf powder. Despite the popularity of the product, the population seems to misunderstand product attributes and dosage. How much to consume? Should it be combined with other products? How does it help you? According to sources, scanty information about the product is believed to be affecting large-scale production and distribution of the end-product in the country.

Consumers purchase Moringa powder mostly in informal outlets such as small shops or local agricultural markets. On the production side, farmers often harvest Moringa leaves from their own garden or neighbourhood.

Value chain of Moringa Leaf Powder in Mozambique

The Moringa leaf powder value chain is considered as being short, fragile and dominated by few actors. Figure 3 illustrates the current value chain. Explanation by step in the chain follows.

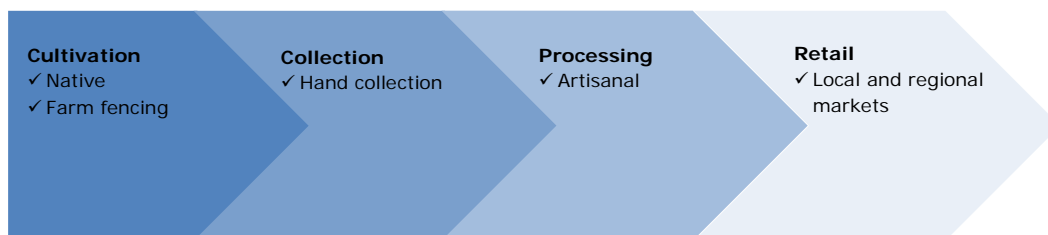


Figure 3 Value chain Moringa Leaf Powder in Mozambique

2.1.2.2 Cultivation of Moringa leaves

Moringa trees form part of the landscape in Mozambique. They become more numerous in the provinces of Inhanbame, Sofala, Gaza and Cabo Delgado. Most farmers use wild trees as a means of farm fencing, and only a fraction of farmers has small-scale production schemes in place. No medium or large-scale production companies are established in Mozambique yet. Reportedly, farmers undertake no crop management practices. Whenever household needs arise, farmers harvest the leaves needed and spend neither time nor the financial resources in pruning, fertilizing or irrigating Moringa trees.

² The following research paper has been used to compose the current value chain: GIZ, 2013.

2.1.2.3 Collection

Harvest of fresh leaves takes place mostly on an ad hoc basis and is carried out by family members. In most farms, Moringa trees are scattered across the fields together with other crops such as maize, sesame, and soya.

2.1.2.4 Processing of Moringa leaves

To a large extent, fresh leaves are consumed at the homestead. Only a small fraction of the leaves harvested will be processed into leaf powder. It is usually women who harvest and dry Moringa leaves in the open for two to four days, depending on the humidity of the climate. Note the reader that drying in the open will reduce the quality of the powder. Once dried, women pound the dried leaves in a wooden mortar. The few small-scale production companies dedicated to Moringa leaf production can either sell the dried leaves for further processing or process powder themselves. The powder is packaged in small paper or plastic bags and sold in the local market and mostly contain between 100 to 200 grams.

2.1.2.5 Retail

Processors sell leaf powder either directly to the end consumers in the local market or to bigger retailers. The price of 100 grams of Moringa Leaf Powder varies greatly between Mozambican Meticaís (MZN) 50 in Beira (€1,05) and around MZN 100 in Maputo (€2,1).

2.2 Drumsticks value chain

2.2.1 THE CASE OF INDIA³

The fast-growing, and drought-resistant, Moringa trees are native to the foothills of Himachal Pradesh, Sikkim and part of northern Uttar Pradesh, North-Western India. India is the largest producer of Moringa with an annual production of 1.1–1.3 million tonnes of tender fruits from an area of 38,000 ha. Among the main states of Moringa cultivation, Andhra Pradesh leads in both area and production (15,600 ha) followed by Karnataka (10,200 ha) and Tamil Nadu (7,400 ha). In other states, it occupies an area of 4,600 ha.

The cultivation of Moringa varies between growing areas. In the North and Eastern parts, farmers would harvest leaves in December–January and would collect pods in April–June. In the southern states, harvest of leaves and fruits take place throughout the year, with peaks of production in July–September and March–April.

Apart from edible pods, Indians also appreciate other Moringa sub-products such as seed oil, leaves for animal fodder, medicines or coagulants for water purification. Even flower buds and young flowers are prepared as a leafy vegetable or as a condiment in Orissa and Northern parts of India.

³ The following research papers have been used to compose the current value chain: Pandey, A. et al., 2010; Rajendran, T. et al., 2014. Prakash Mishra et al, 2012.

2.2.1.1 Value chain of immature and edible pods (drumsticks) in India

Young pods are commonly consumed as a vegetable and for culinary preparations. Consumers also cook medium and mature pods into different dishes and various condiments. Figure 4 depicts the value chain for edible pods in the state of Tamil Nadu, one of the largest Moringa producing states in India.

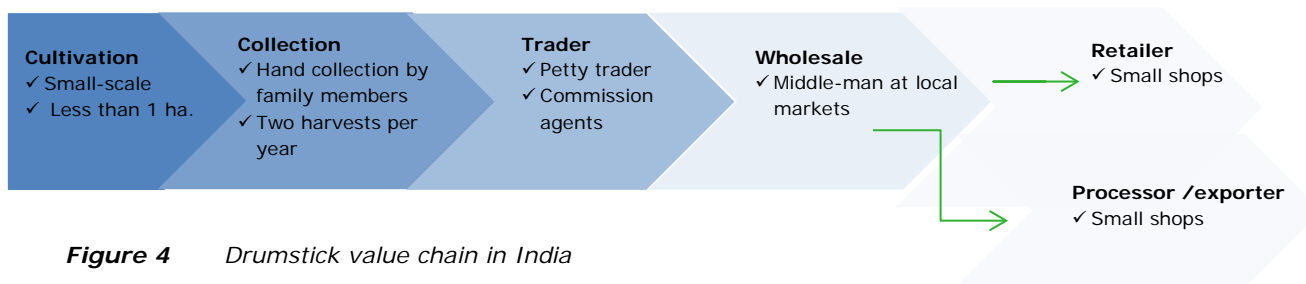


Figure 4 Drumstick value chain in India

It is worth to mention that in some parts of (Southern) India the dried leaves, root and seeds are used as condiments in traditional cooking. However, the popularity of these uses is far from that of Drumsticks in India.

2.2.1.2 Cultivation

Traditional perennial trees have made way to improved annual Moringa varieties, especially PKM-1 and PKM-2, which are suitable for commercial production. Moringa is propagated either by stem cuttings (limb cutting) or by seed. In Tamil Nadu, farmers report to be planting at 2.5 x 2.5 m spacing between rows, giving a plant population of 1600 plants/ha. Farmers do not generally apply fertilizers or water. Perennial types raised by cuttings yield 80-90 fruit per tree during the first two years and 500-600 fruit/tree/year in the fourth and fifth year. Annual Moringa trees yield between 250/400 fruits per tree and year from the first year.

Although fruit fly *Gitona distigmata* affect to some degree young pods, farmers carry out integrated pest management measures to prevent or reduce pest diseases. For annual trees, and in the period just after harvest, farmers cut down the trees to a height of one metre above ground level (ratooning).

2.2.1.3 Collection

When harvesting pods for human consumption, farmers collect them while they are still young and immature, are less than ½ inch in diameter and easy to snap. Farmers also harvest pods for other uses. When producing seed for planting or for oil extraction, farmers harvest dried and brown pods and store them in well-ventilated sacks in dry, shady places. For either use, family members take on harvest practices themselves.

2.2.1.4 Trader

A common sight in Moringa growing areas is the proliferation of petty traders who trade Moringa pods to wholesalers or small retailers in the nearest markets. It is unclear how many petty traders there are or how much they trade but one thing is certain- they greatly outnumber wage workers as well as licensed traders.

2.2.1.5 Wholesaler

Petty traders sell their produce to middle man (wholesaler) at markets such as Andipatti, Themmarasanayakkanur and Koyempedu. Drumsticks also have a large demand in metro cities like Hyderabad, Mumbai, Pune, Nashik or Surat.

2.2.1.6 Processor/export

The domestic sector represents the largest market for drumsticks. On the other hand, if we look at the potential for export, over the last two years Hong Kong has imported fresh Indian drumsticks for a total value of almost 100,000 USD (zauba.com) and remains on an upward trend. To meet the demand for the export market, processors/exporters pack 20-22 inch drumsticks on 10 kg carton boxes.

2.2.1.7 Retailers

Shop owners scattered across India often offer Moringa pods for consumption throughout the year, given the importance of Moringa pods in the local diet. Shop owners have different options to get their supply throughout the year; agreements with traders on a commission basis, direct agreement with farmers or supply through wholesalers, just to name a few mechanisms.

2.3 Project-based Moringa value chains

Unlike the first three case studies, the next case describes a typical Moringa-based development project that intends to address under-nutrition in large areas.

2.3.1 THE CASE OF NIGER

Rated the world's poorest country, Niger suffers from perennial hunger. More than 60 percent of the population survives on less than US \$1 a day. Nearly 80 percent of its 12 million people live in rural areas and 84 percent of men and 97 percent of women are involved in subsistence agriculture of some form.

In 2008, with this precarious situation regarding food production and nutrition, USAID's Office of Foreign Disaster Assistance issued a request for proposals in 2008 to address the food security and economic development needs in Niger. In this context, NCBA CLUSA International submitted a proposal entitled "Bolstering Food Security, Spurring Economic Growth and Improving Nutrition in Niger for the Moringa Tree Value Chain" in response to this request. The project received final approval for funding in February 2009.

2.3.1.1 CLUSA Moringa Project: characteristics

The reasons for choosing Moringa as a crop to address food security and economic development in Niger were:

1. Moringa attributes as a food crop. Moringa is a perennial tree that grows quickly, has many edible and nutritious parts and can be planted at any time of the year. Also, different parts of the tree can be processed and marketed yielding reasonable revenues;
2. Importance of Moringa in Niger. Leaves of the tree were largely being consumed and even marketed in some parts of the country;
3. A new variety of Moringa in the market. The variety, known as PKM14, was developed by ICRISAT (the International Crops Research Institute for the Semi-Arid Tropics) appears to be twice as productive and sweeter taste. Unfortunately, a limited release of seeds hampered a larger adoption of the variety in Niger.

In short, the project intended to i) increase food security, ii) economic growth, and iii) improve nutrition. Additionally, the project would also address the need for improved access to agricultural inputs and microcredit; training in horticulture, nutrition, business skills, and cooperative development.

Looking at the results achieved by the projects, we can group them by step in a generic value chain.

⁴ The Variety PKM 1 was developed in India for its large pods and high pod yield. It also produces large quantities of leaves tastier than those of other varieties. The potential yield oscillates between 60-62 tonnes of pods/ha (220 pods/tree/year). The availability of the variety PKM 1 in Bangladesh is unknown.

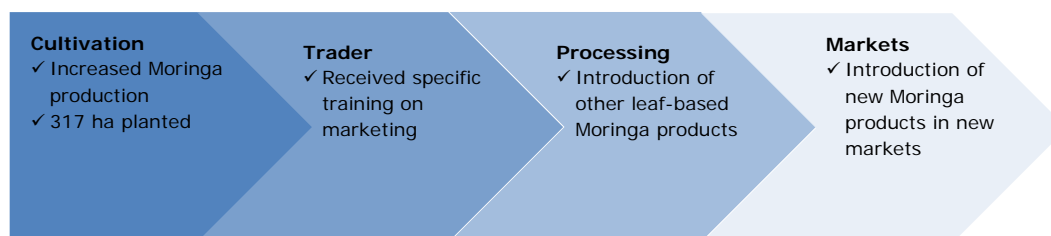


Figure 5 Value chain Moringa project

2.3.1.2 Cultivation

Many elements contributed to the development of Moringa in Niger:

- More than 6,500 farmers took part directly in project activities and 10,000 farmers received training on Moringa cultivation and the role of Moringa on malnourishment alleviation;
- 60 percent of the farmers were women;
- 119 producer groups were formed since project inception. Project also worked with 1773 already established groups;
- More than 10,000 farmers had access, free of charge, to Moringa seeds, loans, training and other inputs.

2.3.1.3 Traders

Staff and collaborating organizations within the project taught traders how to market Moringa products aiming either local markets in one village, multiple villages or large markets in larger urban areas. Overall, 600 traders (90% of them women) joined the marketing trainings. As it turned out, traders played an important role in buying and selling Moringa leaves and thus project pursued direct training to this instrumental stakeholder.

2.3.1.4 Processing

Traditionally, consumers prefer to buy fresh Moringa leaves. They should be consumed within a day after harvest. However, the lack of efficient logistic systems makes fresh Moringa leaves in the market scarce. To address this problem, population of Moringa turned to dried Moringa leaves for longer ‘shelf-life’. Much of the production in this form came from Northern Nigeria and even remains very important today. To strengthen the consumption of locally produced Moringa, the project introduced ‘a new value addition process: pre-cooking of Moringa leaves. Once pre-cooked, leaves are easily prepared and consumed by urban consumer. Also, pre-cooked leaves are more nutritional than dried leaves and can be stored for up to six months without spoiling.

Project also introduced Leaf Moringa powder production, at a small-scale. It can be mixed with rice or millet and is especially nutritious for pregnant and nursing women, infants and young children. It is important to note that, although stakeholders in Niger realize the potential of Moringa for other uses such as seed oils or seed pods, the market back then was not developed enough. Consumers only consumed leaf-based Moringa products.

2.3.1.5 Markets

The project intended, on the one hand, to increase the sales of fresh Moringa leaves by increasing productivity at farm level and, on the other hand, to introduce new processed Moringa products in markets given the popularity of Moringa among consumers. For both activities, traders received valuable training on how to “read” the market and on best business practices.

2.4 International Moringa value chains: the case of Moringa oil

Moringa oil is extracted from seeds which are harvested from pods and yield around 35–40% of non-drying Moringa oil. The healing properties of Moringa Oil are nothing new, however. Seemingly, Moringa Oil has been used in skin preparations since the ancient Egyptian times.

Today, Moringa oil seems to provide a large list of properties, of which we can mention a few (based on beeglorious.com):

- Reduces signs (the visibility) of aging;
- Firms skin and promotes elasticity;
- Younger and fresher looking;
- Skin radiance;
- Oil control (from an appearance perspective);
- Pores look smaller;
- Cleans acne-prone skin.

The benefits of using Moringa oil are largely described in dozen of websites on internet. A different thing, however, is finding available information on the cultivation of Moringa only for oil purposes and how it is marketed. As for the processing of oil, entrepreneurs or companies seem to go through the following protocol:

- **Firstly**, it is important to shell the seeds. Only after seeds have been shelled, oil press machine pours the shelled seeds on the receiving funnel only to start dripping oil from the outlet within minutes. Averagely, 1 kg of seeds (with coats) gives 120 ml of the cold pressed oil;
- **Secondly**, leave the oil to settle for a few days allowing for sedimentation. After that, decantation takes place by which oil leaves sediment in the old container;
- **Lastly**, the clean container filled with the yellow oil is then bottled and packaged to fit market purposes.

When extracting oil, the temperature has to be controlled carefully to preserve the valuable antioxidants and nutrients with their anti-aging properties. For this reason, cold pressing method is preferred as opposed to heat press machines. Small-scale machines are available on the website Alibaba at prices that range from 200 US\$ up to 5,000 US\$ or above depending on the capacity and sophistication needed.

To give a measure on the size of the (international)market for Moringa oil, we provide the export figures of the most important country when it comes to Moringa trade (in any of its forms), India. The following information has been compiled for the period Jan. 2013 – July 2015. As stated in the webpage zauba.com, India exported Moringa oil worth US\$ 1,039,276, about 65,000 litres, of which United States contributed US\$ 476,944. The next on the list were Thailand and Germany which imported Moringa oil worth US\$ 110,611 and US\$ 105,788, respectively.

Netherlands imported from India Moringa oil for value of 33,000 US\$ over the same period.

2.5 Conclusions

From chapter 2, we can draw the following conclusions:

- Moringa is widely cultivated across Asian and Africa although farmers have little knowledge on its properties and how to grow it to its full potential;
- The uses of Moringa differ greatly country-by-country. In this way, India seems to have taken more steps in the transformation of Moringa into marketable products. Moringa oil, extract for water purification, leaf powder for both domestic and international markets, production of animal feed and above all Drumsticks for domestic consumption (and only a fraction destined to export market) are the most common uses of Moringa in the country. On the contrary, in the majority of African countries Moringa is almost restricted to leaf powder consumption. Nigeria appears to have developed more advanced Moringa leaf-powder value chains although there is still a question on the profitability of the endeavour. Other African countries are becoming aware of the potential of Moringa for both food nutrition and income generation purposes;
- Limited investments are needed when producing leaf-powder. And this use is deemed as the most suitable to yield benefits in the short term since Moringa's properties are still unknown in many developing countries;
- Thanks to its apparent nutritive properties, many development partners and governments promote Moringa production, consumption and sale in the context of fast track projects where food nutrition security is targeted. Leaf-powder production requires low technology and can contribute decisively to food nutrition security;
- Leaf-powder and oil Moringa value chains hold a reasonable (international) market potential. The most important importing country is the United States;
- The processing of Moringa can be carried out using small-scale technologies. Whether it be leaf-powder or oil production, small-scale machinery seems to be available on the market;
- The production and even transformation of Moringa into higher-value products appear to be feasible. However, identifying the opportunities that the market provides and meeting the demands of final consumers seem to be a recurring problem when setting up a Moringa business/project.

3 The EU market for Moringa products

In Europe, Moringa products belong mostly in the cosmetics market segment and in the cross-segment 'food supplements', which is considered a combination of food and herbal medicines sub-segments.

3.1 Market segments and EU regulations for food supplements and herbal medicines

The following figure depicts how the EU market is segmented for health products.

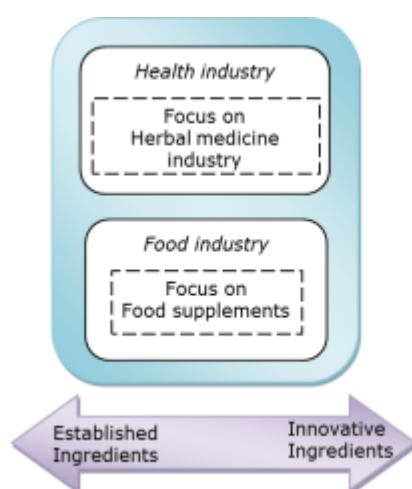


Figure 6 Market segments of herbal products in Europe. Source: BTC, 2014.

To reduce the costs associated with new ingredients, the herbal medicine industry focuses on well-established, and traditionally-used, ingredients. Each ingredient has a solid market that focuses on quantity and competitive prices. When Moringa aims at this herbal medicinal segment, producers need to comply with the Directive 2004/24/EC. This includes the legislative requirements on Good Agriculture and Collection Practices (GACP) if Moringa is traded as raw material (e.g. powder), and Good Manufacturing Practices (GMP) if Moringa is otherwise considered as a further-processed ingredient.

In contrast, dietary industries (e.g. food supplements) offer more opportunities for more innovative and less established wild-collected species, like Moringa. These products are regulated as food and not as pharmaceuticals and therefore face lower regulatory requirements.

If Moringa is to be used in food supplements, producer needs to comply with EU food supplement legislation and the EU General Food Law. The EU General Food Law covers the following aspects related to food safety:

- Maximum Residue Levels (MRLs): maximum levels of pesticides, a major concern for EU buyers;
- Contaminants in food: criteria and maximum levels of contaminants (e.g. mycotoxins, heavy metals);
- Microbiological contamination of food: criteria and maximum levels for foodborne micro-organisms, their toxins and metabolites;
- Hygiene of food (HACCP): legally binding for food processors (including ingredients) and recommended for farmers (primary production);
- Extraction solvents for food: EU rules for marketing and applying extraction solvents when producing foodstuffs and ingredients;
- Irradiation of food: is only permitted in specific cases for spices and herbs, including supplements;

- Traceability: trace food that is used for consumption through the value chain, based on the “one step back-one step forward” principle.

Whether Moringa is classified as a herbal medicine or as a food supplement when entering in Europe remains blurred. The Centre for Promotion of Imports from Developing Countries(CBI), in its document “Channel and segments: Natural Ingredients for Health Products in Europe” attempts to provide the main differences between markets.

	Herbal medicinal products industry Ingredients such as Rauwolfia alkaloids from <i>Rauwolfia serpentina</i> (Asia), and <i>Rauwolfia vomitoria</i> (West Africa)	Food supplement industry Ingredients such as <i>Ginkgo biloba</i> (Ginkgo) and <i>Cynara scolymus</i> (Artichoke)
Market size and dynamics	Small established market with limited growth, due to limited indications	Medium-sized market with high growth, due to new indications (e.g. stress and anxiety)
Competitiveness and margins	Regular supply difficulties Competitive market Medium margins Difficult for new producers to enter the market	Highly competitive market Low margins (in case of established species) Comparatively easy for new players to enter the market
Market players and volume requirements	Small but growing volumes and players, less visible players	Substantial and strongly increasing volumes and players, visible players
Raw material	Raw materials are to a large extent wild-collected.	Raw materials for established species are mainly cultivated and often well
	Traceability not always available.	documented as they are also used in public health industries. Growing importance of organic certification and in some markets fair trade certification.
Sourcing	Traders are main market channel	Traders, processors and manufacturers are the main market channels
Value chain	High level of vertical integration in the chain.	High level of vertical integration in the chain.
Trade	Trade relations offer room for collaboration.	For established species, trade relations are focused on maximizing supply security and reducing supply costs. For innovative ingredients, there is need for collaboration.
Quality	Increasing level of standardisation.	Increasing level of standardisation.

Figure 7 Main differences between herbal medicine and food supplement products in Europe.

Source: CBI, 2015.

In short, the food supplement market is characterized with higher growth but lower margins than the herbal medicine segment. Also, the food supplement sector appears to be more accessible to new players from developing countries.

EU regulations for natural ingredients for cosmetics in Europe

Moringa Oil, when used in the cosmetics industry, needs to comply with the EU Cosmetics Regulation (EC 1223/2009) that specifies the requirements concerning the physico-chemical, microbiological & toxicological profile or product information. Exotic vegetable oils, including Moringa Oil, that are not chemically modified are exempted from the EU’s regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) (SFA, 2015). For exotic vegetable oils, which are imported into the EU for the first time, the importer is required to present a proven record of use in the country of origin, which serves as an informal verification of its safety for use as a cosmetic product.

Box 2 summarizes the legislative requirements & non-legislative requirements for importing Moringa both for the herbal medicine/food supplement sector and cosmetics.

Box 2: Legislative requirements & non-legislative requirements for importing Moringa

Legislative requirements are the minimum requirements set by the EU, which must be met by exporters of health and cosmetic products marketed in the EU. Products that fail to meet these requirements are denied market access.

Non-legislative requirements include a variety of private certifications and standards that often go beyond the minimum legislative requirements, address certain market demands or niche markets, and differentiate products from those of competitors.

There are different requirements based on whether producing ingredients for the herbal medicine, food supplement or cosmetics market and whether the product is already established on the market or not.

The Centre for the Promotion of Imports from developing countries (CBI), part of the Netherlands Enterprise Agency and commissioned by the Ministry of Foreign Affairs of the Netherlands, provides on their website detailed and stepwise information on the legislative and non-legislative requirements that natural ingredients for health products and cosmetics should comply with to be allowed on the European market:

<http://www.cbi.eu/market-information/natural-ingredients-health-products/buyer-requirements>

<http://www.cbi.eu/market-information/natural-ingredients-cosmetics/buyer-requirements>

Trends and developments

Although the benefits of consuming Moringa are rapidly gaining attention among consumers worldwide, its market size remains unclear. Several authors estimate the market size of Moringa to be over US\$4 billion a year. Note to the reader that this figure should be treated with caution since it lacks official recognition.

In chapter 1, we reviewed the most important uses of Moringa worldwide. Looking at their commercial value, two uses stand out: Moringa leaf powder and Moringa oil as an ingredient for cosmetic products. The reasons for these marked market preference lie in the product's natural properties. Increasingly, consumers in developed countries seek for natural products that either contain dietary supplemental ingredients or can be used in cosmetics.

This increased demand for healthier lifestyles comes hand in hand with the development of new herbal medicinal products and food supplements in Europe that are not being used at a large scale yet. Some 1,200-1,300 native species are commonly used in food supplements in the EU and around 130 are cultivated within EU territory. The remainder is cultivated and sourced from tropical and subtropical countries due to climatic reasons. Therefore, the steep growth of food supplements in Europe offers good market opportunities for developing countries looking to supply natural ingredients (CBI, 2015).

According to predictions from Euromonitor International, the food supplement market in Western and Eastern Europe will reach €9 billion by 2018. This represents a growth of 28% for the period 2013-2018. Italy, Germany, France, the UK and Russia are the main markets for food supplements. A common trend seen in all those markets is the demand for natural ingredients that are produced in a natural, sustainable and ethical way. The most popular categories in food supplements in 2013 included digestive health, general wellbeing, bone health, sexual health, immunity and heart health. In most European markets, Moringa is now available on health food websites and in many health stores.

3.1.1 The EU Market for Moringa Leaf Powder

Dietary supplements are concentrated sources of vitamins, minerals, herbals and botanicals, amino acids, enzymes, and many other products with a nutritional or physiological effect (European Commission). Food supplements come in a variety of forms, such as pills, powders, energy bars or liquids in measured doses.

India supplies around 80% of the market needs for Moringa leaf powder worldwide. Its strong market position has to do with the country's long tradition of including Moringa in people's diets. Today, Moringa leaf powder is produced in large plantations at a comparatively low price.

According to Zauba.com, India exported Moringa leaf powder worth USD 4,746,132, equivalent to 836,806 kg. for the period June 2013 up to July 2015. Of the total amount, United States is the largest single buyer of Moringa leaf powder accounting for USD 3,303,870 followed by Germany and United Kingdom which imported Moringa leaf powder worth USD 364,170 and USD 162,365, respectively. Netherlands imported Moringa leaf powder worth 12,594 US\$ over the same period. It is worth mentioning that the category 'Moringa leaf powder' includes product such as dried leaves, organic, fine powder, extract and powder mixed with other herbs.

There is important requirement when producing Moringa leaf powder. Leaves need to be processed immediately to avoid quality deterioration. This makes Europe a predominantly buying market. On the other hand, developing countries with suitable growing conditions for Moringa cultivation are in position of capturing global market share.

However, India and increasingly China present tough competition since they have low production costs and can produce significant volumes. As of late, various African companies intend to differentiate themselves from those big actors in Asia by targeting niche markets where the 'story' of being collected in the wild or grown by smallholders have a market value. Third-party certification can provide the recognition needed.

Aspects such the quantity, quality and use of the product have an influence on the final market price to EU importers. If we use the trade occurred in India as benchmark (source: ZAUBA.com), we see that prices range from US\$ 4 to 16 per kg. At retail markets (in the Netherlands), prices climb up to US\$ 35 - 55 per kg.

3.1.2 The EU market for Moringa oil

As it occurs with the food supplement sector, the conventional cosmetic market is experiencing a shift towards natural ingredients. A growing consumer demand on natural cosmetic products is causing the industry to start offering exotic vegetable oils. Between 2010 and 2014, European countries imported vegetable oils for a value of € 989 million. By countries, France, Netherlands and Germany top the list of most important importers by tonnes. On the supplier side, India and interestingly Netherlands, Germany and Denmark play an important role in the supply of vegetable oil to Europe. In 2014, developing countries represented a 37% share of the total volume of vegetable oil imported by EU countries. Nevertheless, much of the demand for Moringa oil internationally comes from US companies which are used to refine or process the oil further to comply with (own) specifications (CBI, 2015).

Unlike the EU market for Moringa leaf powder, the position of India as an oil producer leaves room for new producers to access the EU and International market. This is mainly due to the wide use of young Moringa pods for household consumption in the country.

If we look at the trade in India as benchmark (source: ZAUBA.com), we see that export prices range from US\$ 18 to 90 per litre of oil. At retail markets (in Netherlands), prices rise up to US\$ 180 - 220 per litre.

4 The market for Moringa products in the Netherlands

4.1 Introduction

In the Netherlands, following the general trend seen in Europe, Moringa is mainly marketed as a superfood or dietary supplement in a variety of forms (e.g. powder, capsules, tablets). More conventional type of products that can be found on the Dutch market are Moringa tea and cosmetic products like shower gels and body oils. Moringa is mainly a product that is marketed online, and it can be considered as a niche market, especially in the form of superfood. A few health shops and cosmetic chains do have Moringa based products in their product range, but to a very limited extent (see table 4.1).

4.2 Superfoods

Super foods are foods which are said to contain a high content of nutrients or bioactive substances, such as vitamins, minerals and antioxidants, and to which all kinds of positive characteristics are attributed. However, there is controversy around superfoods. According to the Dutch Food Centre (www.voedingscentrum.nl), the leading authority providing consumers science-based and independent information about a healthy, safe and more sustainable food choices, the term superfoods is somewhat misleading as no single food can supply all the essential nutrients that the body needs. So far it has not been scientifically proven that superfoods have a better effect than other products. Furthermore, the term superfoods is not defined by law and may be used by anyone. Because there is no official definition of a superfood, the term may be given to any kind of food that may vary in composition.

The superfood movement in the Netherlands became active around 2013 after copying the trend coming from the United States of America and in line with the emerging consumer trends against consumption of sugary foods, alcohol, and fatty foods, towards a more healthy lifestyle. The movement is growing in popularity ever since and new superfoods are 'discovered' at a rapid pace. Apart from Moringa, other examples of superfoods are goji berries, cacao beans, chia seeds, hemp seeds, bee pollen, wheat grass, coconut oil, seaweed and algae extracts.

Superfoods are mainly added by consumers to their daily diet for their alleged contribution to good health. The growing trend of superfoods is sometimes explained by fears of consumers that their food is not healthy enough and at the same time worries about increasing reports on Western lifestyle diseases. With superfoods, people try to allay these fears and therefore superfoods can also be marketed as feel-good-foods.

4.3 Market outlets for Moringa products in the Netherlands

Moringa products in the Netherlands can be found in food supplement and health shops either in physical locations or online. Also some cosmetic shops occasionally have Moringa based products in their product assortment.

The table below shows a selection of retail and online shops as well as identified wholesalers distributing Moringa products in the Netherlands. Especially the online shop overview is just a selection and is not complete, as there can be found many bigger and smaller online shops offering moringa products. The number of international online shops is even much bigger. Some of these

shops even have a Dutch website, especially focusing on potential Dutch buyers. Online shops can be either superfood or food supplement shops, or shops specialized in Moringa products only.

Table 4.1

Selection of retail shops, online shops and wholesalers in the Netherlands selling and trading Moringa products

Shop	Website	Moringa product	Brand / Supplier
Retail Health Shops			
De Tuinen	www.detuinen.nl	Moringa Oleifera Capsules	Mattisson HealthStyle
		Moringa Oleifera Tea	Jacob Hooy
G&W gezondheidswinkel	www.gezondheidswinkel.nl	Moringa Powder	Jacob Hooy
		Body Oil Moringa / Aloe Vera	Jacob Hooy
Unlimited Health	www.unlimitedhealth.nl	Moringa Oleifera Tea	Jacob Hooy
		Moringa Powder	Original Superfoods
Retail cosmetic shops			
The Body Shop	www.thebodyshop.nl	Vineyard Peach Body Mist	The Body Shop
		Moringa Body Butter	The Body Shop
		Moringa Shower Gel	The Body Shop
Online Health Shops			
Superfood Centre	www.superfoodcentre.nl	Moringa Leaf Powder Organic	SuperfoodZ
		Vitamineral Green Capsules	HealthForce Nutritionals
Superfood markt	www.superfoodmarkt.nl	Super Greens Organic	Pur Ya!
		Vitamineral Green Capsules	HealthForce Nutritionals
Raw Super Food / Z Company	www.raw-superfood.com	Moringa Leaf Powder Capsules	Mattison HealthStyle
		Moringa Leaf Powder	Mattison HealthStyle
		Moringa Leaf Powder Organic	SuperfoodZ
		Moringa Oleifera Capsules	Natusor
De notenshop	www.denotenshop.nl	Vitamineral Green Capsules	HealthForce Nutritionals
		Moringa Leaf Powder	Mattison HealthStyle
Body en fitshop	www.bodyenfitshop.nl	Moringa Leaf Powder Organic	SuperfoodZ
		Moringa Leaf Powder	Mattison HealthStyle
Puur & Fit	www.puurenfit.nl	Moringa Oleifera Capsules	Swanson
		Moringa Powder	Puur & Fit
Superfoods online	www.superfoodsonline.nl	Moringa Oleifera Tea	Jacob Hooy
		Moringa Blend Organic	Dynamic Health
		Moringa Capsules	Dynamic Health
Ecomarkt	www.ecomarkt.nl	Moringa Powder Organic	Purason
		Moringa Oleifera Tea	Jacob Hooy
Superfood.nl	www.superfood.nl	Moringa Powder	n.a.
FormaFit	www.formafitness.nl	Moringa Pure	FormaFit
Online Moringa Shops			
Moringa's Finest	www.moringasfinest.nl	Moringa Leaf Powder	Moringa's Finest
		Moringa Tablets	Moringa's Finest
		Moringa Capsules	Moringa's Finest
		Moringa Oil	Moringa's Finest
		Moringa Tree	-
		Moringa Seeds	-
		Moringa Fresh	-
Wholesalers			
Jacob Hooy	www.jacob-hooy.nl	Moringa Oil	Jacob Hooy
		Moringa Oleifera Tea	Jacob Hooy
		Moringa powder	Jacob Hooy
Mattison HealthStyle	www.mattisson.nl	Moringa Oleifera Capsules	Mattison HealthStyle
		Moringa leaf powder	Mattison HealthStyle
Superfoods And More	www.sam-wholesale.com	Moringa Leaf Powder Organic	Original Superfoods
NutriBoost	www.nutriboost.nl	Moringa Powder Organic	n.a.
Nutramin	www.nutramin.nl	Moringa Capsules	Nutramin
Hanoju	www.hanoju.nl	Moringa Leaf Powder	Hanoju
		Moringa Powder Organic	Hanoju
		Moringa Tea	n.a.
		Moringa Tablets	Hanoju
		Moringa Leaf Tablets	Hanoju
		Moringa Animal Feed	n.a.

As the figure shows, natural ingredients can be wild-sourced or otherwise produced and harvested on farms or plantations. Later on, local traders collect and move the produce upward the chain. Seemingly, there is a tendency to cut out the 'middlemen' or local traders as they often have a limited value-addition function. In some instances, the natural ingredient may go through the hands of domestic processors who will in turn add value to the product. Reportedly, the growing emergence of capable processors that meet EU requirements in developing countries is limiting the export of ingredients without value addition and this trend can be seen in different developing countries (CBI, 2015).

The next step is to export the product via local exporters or directly to EU trader or processors. These actors will then supply the final product to food supplement or herbal medicinal product manufacturers.

Often, suppliers from developing countries are small and experience difficulties in complying with additional buyer demands. Nevertheless, many European buyers nowadays require only limited quantities of a natural ingredient. This evidences the availability of a reliable market for smaller suppliers from developing countries.

Moringa used in cosmetic products

Exotic vegetable oils are often marketed through specialised (large or small) importers who often source their products directly from developing countries. Intermediaries are still a very important actor for the many small-scale suppliers in developing countries to make the bridge between production and the European market.

Often, some cosmetic manufacturers may consider to source ingredients directly from companies in developing countries. This 'close' buying relationship allows to achieve quality requirements, consistent supply and is also likely to fit into the manufacturer's Corporate Social Responsibility (CSR) strategy.

5 Current status of the Moringa sub-sector in Bangladesh

5.1 Moringa in the context of Bangladesh

Malnutrition and food insecurity are major challenges in Bangladesh. According to the World Food Programme Household Food Security and Nutrition Assessment, a quarter of the population is food insecure and 41% of all younger than five year olds suffer from chronic undernutrition. Given its high nutritional values, Moringa could play a role in reducing food insecurity and malnutrition in Bangladesh.

Furthermore, from a market perspective the Moringa sub-sector is not yet exploited to its full potential when considering the many different multipurpose uses of Moringa (see section 1.3). Strengthening the value chains for several Moringa uses could create new market opportunities for (smallholder) farmers and improve their livelihoods.

The Moringa sub-sector in Bangladesh is hardly documented and data availability is limited. Therefore, the current review of the sector is neither exhaustive, nor conclusive. It does however offer a first insight into the current status of the Moringa sector and market in Bangladesh.

5.2 Moringa sub-sector: quick-scan

Although time and resources were limited and this assignment has a more desk-based character, a quick scan in the field was conducted by Niels van Den Berge in order to reveal some more information about the current status of the Moringa sub-sector in in Bangladesh. Three sources of information were used:

- Short farm survey among seven Moringa farmers in Southern Bangladesh;
- Secondary data collected from the Bangladesh Bureau of Statistics and Moringa Pvt. Limited, the only commercial Moringa farm identified;
- Interviews with key informants in the field of agribusiness and agricultural development.

5.2.1 Farm survey

Seven Moringa farmers were randomly selected of which five grow their Moringa trees in the Blue Gold Programme Area, the Barguna district (see Figure 8). The other two farmers were located in the Barisal and Jhalokati districts. Because of the limited number of farmers surveyed and their estimations on questions about numbers and figures, the quantitative data presented hereafter should therefore not be taken as representative for the whole of the sector but only to get a first impression about the Moringa sub-sector in Bangladesh.

Of the 7 surveyed farmers, 3 can be characterized as homestead farmers, while the other 4 can be characterized as small farmers. Five out of the 7 surveyed farmers initially planted the trees for own consumption and not with commercial intentions. Only 2 farmers explicitly mention they planted the Moringa trees for commercial use.

The pods are used by all 7 farmers, the leaves by 6 and the flowers only by 2 farmers. Of the total amount of pods produced by the 7 famers about one third (31%) are being used for own consumption. The remainder of the produced pods (69%) are used for sales. As with regard to the leaves and flowers, in case the farmers use them, half of it is used for own consumption and the other half is for sales.

When the farmers were asked why they do not use other parts of the tree, all farmers responded that they did not know that other parts of the trees could also be consumed or used.

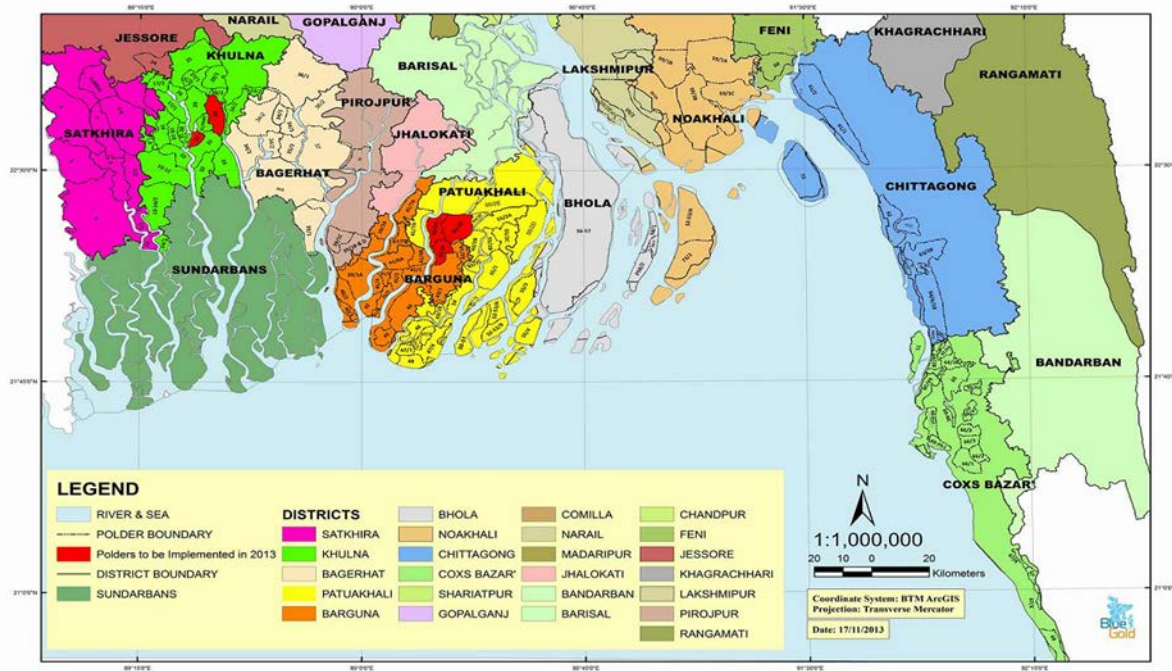


Figure 8 Districts in Bangladesh

Table 5.1

Characteristics of interviewed Moringa farmers

Farmer	Type	District	Parts using	Pods (kg / yr)		Leaves (kg /yr)		Flowers (kg /yr)	
				Own use	Sales	Own use	Sales	Own use	Sales
1. Habibur	Homestead	Barguna	Pods	10	25	0	0	0	0
2. Shah	small farmer	Jhalokati	Pods, leaves	25	50	1	2	0	0
3. Jaman	small farmer	Barguna	Pods, leaves	10	45	1	2	0	0
4. Sanu	small farmer	Barguna	Pods, leaves	10	22	1	0	0	0
5. Arif Hossen	Homestead	Barguna	Pods, leaves	15	15	1	0	0	0
6. Mithun Das	small farmer	Barisal	Pods, leaves, flowers	25	35	2	1	1	1
7. Arif Hossen	Homestead	Barguna	Pods, leaves, flowers	25	70	1	2	1	1
SUM				120	262	7	7	2	2
Percentage				31%	69%	50%	50%	50%	50%

All surveyed farmers sell their Moringa produce to local traders, who sell the products on the local, rural markets. Almost all (6 out of 7) also sell Moringa products to their neighbours (or other community members). Only one of the surveyed farmers sells Moringa products to a middleman, who does not sell the products on the local market.

The majority of surveyed farmers (6 out of 7) considers to grow Moringa on a commercial scale. The following reasons were mentioned:

- Relatively low cultivation costs;
- Relatively high price;
- Moringa is a cash crop;
- Parts of the tree can be used as a biofuel;
- Moringa can be used as a shading tree;
- Moringa is a nutritive, multipurpose tree.

Two farmers mentioned that 'developing a proper marketing system' would help to increase the price and would make it more attractive to grow Moringa on a commercial scale. One of the surveyed farmers does not consider to grow Moringa on a commercial scale, because of 'low demand' for the Moringa products.

All surveyed farmers learnt about the benefits of Moringa from other farmers, 6 farmers also learnt about it from their parents, 1 from the government and 1 from an NGO.

5.2.2 Secondary data

Bangladesh Bureau of Statistics

The uses and potential of Moringa in Bangladesh have hardly been studied and secondary data are only limitedly available. Those secondary data that are available have been gathered and analyzed, to give an insight in the Moringa sub-sector in Bangladesh.

Data gathered from the Bangladesh Bureau of Statistics (Ref: Bangladesh Bureau of Statistics – Estimation of Horse Radish Tree 'Sajina' – 2013-2014) shows that Moringa oleifera is mainly cultivated in gardens and homesteads. Commercially cultivated Moringa trees account for an estimated annual harvest of 10 tons of pods, while another estimated 2860 metric tons of Moringa pods are being harvested in homestead gardens.

Other data from the Bangladesh Bureau of Statistics (Ref: Bangladesh Bureau of Statistics – Estimation of Horse Radish Tree 'Sajina' – 2009-2010) show that Moringa oleifera is only cultivated in the Blue Gold Polders of the Khulna Region (Figure 5.2). No cultivation takes place in the Blue Gold Polders of the Barisal and Patuakhali Regions. Blue Gold is not active in Jessore, but as this is the region where the probably only Moringa-processing company of Bangladesh (Moringa Pvt. Limited) is active, the disaggregated data for Jessore were included in table 5.2. The Bangladesh Bureau of Statistics does not have estimations for the cumulative area of Moringa that is grown in homestead gardens.

The data of the Bangladesh Bureau of Statistics confirm the main findings of the farmer survey. Commercial cultivation of Moringa oleifera is rare in Southern Bangladesh. In the Barisal and Patuakhali Regions Moringa cultivation does not happen at all on agricultural lands. The average harvest per tree is higher in Jessore than in Khulna. However, the data are not exhaustive and conclusive, e.g. there were no data available for the estimated area under cultivation in Jessore, nor are there data available for homestead gardening.

Table 5.2

Moringa Cultivation in the Blue Gold Polders & Jessore

Zila / Region	Number of trees			Cultivated area (acre)	Average yield fruit bearing tree (kg)	Annual harvest pods (kg)
	Fruit bearing	Not fruit bearing	Total			
Khulna	19364	7539	26903	20	19	368
Bagerhat	13982	7762	21744	11	10	140
Satkhira	16021	2717	18738	10	20	320
Khulna Region	49367	18018	67385	41	17	828
Barisal	0	0	0	0	0	0
Jhalokathi	0	0	0	0	0	0
Perojpur	0	0	0	0	0	0
Bhola	0	0	0	0	0	0
Barisal Region	0	0	0	0	0	0
Patuakhali	0	0	0	0	0	0
Barguna	0	0	0	0	0	0
Patuakhali Region	0	0	0	0	0	0
Jessore	21222	9971	31193	0	31	658
Jhenaidah	24337	7828	32165	0	30	730
Magura	13308	7120	20428	0	34	452
Narail	8699	2276	10975	0	34	296
Jessore Region	67566	27195	94761	0	32	2136

Moringa Pvt. Limited

The only Moringa-processing company in Bangladesh, Moringa Pvt. Limited, conducted a feasibility study on their business case (ref: Moringa Pvt. Limited – Feasibility Study on Moringa Project – 2012). They looked into current uses and the potential for Moringa-based products in Bangladesh.

As part of their feasibility study, the company surveyed 144 people in Jhenaidah of which 72.9 % worked in the agricultural sector. 75% of all surveyed people grew Moringa suggesting that it is a common tree in this area of Bangladesh.

All respondents said to be interested to earn more money from Moringa trees. 92% of all respondents owns unused but suitable land for Moringa and 90% of them would be interested to grow Moringa oleifera on their unused land. The Moringa Pvt. Limited study suggests that Moringa oleifera is a common tree in Jhenaidah and its cultivation can be expanded as farmers are interested to plant Moringa trees on their unused land.

Moringa Pvt. Limited also looked into the economic profitability of Moringa cultivation and compared the estimated profits of Moringa farming, under the scenario that farmers can sell the leaves at 7 BDT per kg, with the profits of tobacco farming. Tobacco is popular and every year more Bangladeshi farmers are shifting from rice and vegetable cultivation to tobacco cultivation. Reasons behind this are the relatively high prices, short cultivation cycle and relative price security of tobacco.

The profitability comparison suggests that intensive Moringa cultivation might be as profitable as tobacco farming. A promising outcome, but for the time-being the figures for Moringa are hypothetical and remain to be studied in greater detail. Critical questions can be asked about this comparison, e.g. is the (future) demand for leaves high enough to secure prices of 7 BDT per kg? Another question is whether the (future) Moringa sub-sector will be able to compete with the tobacco companies. The latter have their own agriculturists that travel around in Bangladesh to provide farmers with free inputs, contracts and technical support. Currently, the Moringa sub-sector does not have the capacity to practice such an 'active push-strategy'. On the other hand, this comparison is interesting for the Bangladesh Government and NGOs that want to promote alternatives for tobacco cultivation.

5.2.3 Key informants

Qualitative data were gathered from seven key informants. The data were gathered by physical meetings, e-mails and phone conversations. The full list of key informants that made this quick scan possible are given in table 5.3.

The different key informants all gave similar answers to the questions about current uses, future potential and value chain opportunities for *Moringa oleifera* in Bangladesh. No contradictory information was given. Therefore, the qualitative data from the interviews are hereafter presented in an aggregated way.

Table 5.3
Key informants

Informant	Position
Bert Jan Ottents	Managing Director ProFound
Hein Bijlmakers	Leader of Blue Gold Component 3, Agriculturist
Khalid Aurangozeb	Agriculturist at the Rural Development Academy Bogra
Matin Sarker	Retired Agriculturist at British American Tobacco in Bangladesh
Manzur Hossain	Professor of Botany, Rajshahi University
Tahmina Begum	Deputy Director Water Management for Department of Agricultural Extension & Project Director Transfer of Technology for Agricultural Production under Blue Gold Program (TTAP-BGP)
Zakiya Akhter & Sami Akhter	Founders and CEO (Zakiya Akhter) of Moringa Pvt. Limited

The key informant interviews resulted in the following findings, which largely correspond with the primary (farmer survey) and secondary data:

Current uses

- *Moringa oleifera* is not a crop of commercial interest in Bangladesh. The tree is grown in most areas of Bangladesh, but mainly in homesteads, along road sides, embankments and land borders;
- Consumption of the pods is popular, consumption of the leaves is less common and consumption of the flowers is rare. The pods are popular as vegetable and are used in curries. The pods are relatively popular and the market value is around 80-100 BDT per kilogram. The leaves are mashed and eaten;
- Regional differences have to be taken into account. Consumption of the leaves and flowers is more common in the North than in the South;
- The unrealized potential of *Moringa* can be attributed to a lack of knowledge / awareness of the benefits of the *Moringa Oleifera* products;
- It is an 'easy' tree that requires only little care and low management costs;
- There are 2 common varieties, 1 with short and thick pods and 1 with long and thin pods;
- The production of *Moringa oleifera* could be easily increased by using fallow lands, embankments, road sides, public areas near schools and other government buildings and homestead gardens.

Potential of Moringa

- More uses of the *Moringa* tree can be exploited in Bangladesh;
- Different organizations promote the cultivation of *Moringa oleifera* in rural Bangladesh. Examples are: Blue Gold promoted *Moringa* cultivation in Patuakhali among the farmers they work with; the Bangladesh Department of Agricultural Extension has been promoting *Moringa* cultivation since the 1990s; and different NGOs are promoting *Moringa* cultivation;
- At the moment, the promotion of *Moringa* is limited to small-scale farming only. Promotion of cultivation at a commercial scale is not yet being done;
- *Moringa oleifera* is saline intolerant. This might be a challenge in parts of the Blue Gold Polders.

Strengthening the Value Chain

- Given the high EU safety standards for food and food supplements, it appears to be most feasible to develop the local market in Bangladesh first. The export of processed products is challenging and likely to be hampered by legislative barriers on the short term;

- Export of raw materials to the United States of America and Europe seems to be feasible. Several European manufacturers of cosmetics started using Moringa oil in their products to differentiate themselves in the market. The Body Shop is using African Moringa Oil in its products;
- Several European manufacturers show their interest in Moringa-extracts and protein derivatives. European legislation only allows food supplements and extracts made from dried or powdered leaves. Jacob Hooy and Nutramin in the Netherlands and Hanoju are examples of companies in the EU that use Moringa leaf-based extracts in their products.

Brief description of Moringa Pvt. Limited

- Moringa Pvt. Limited is more interested in exporting raw materials to the EU market than exporting processed products. The safety standards for processed products are difficult to meet;
- Moringa Pvt. Limited does not intend to become a conventional business. They would like to see how Moringa yields benefits to a wider range of actors along the chain. The company was founded by Zakiya Akhter and Sami Akhter. The latter is a pharmacist with a large network in the business world. He got triggered when he got a request to export 50 tons of Moringa seeds to Colombia. He asked himself why people in Colombia want to grow this tree on a large scale, while the tree is only cultivated on a small scale in Bangladesh. Since then, he has been studying the benefits of Moringa oleifera;
- Moringa Pvt. Limited was founded in 2012. They spent the first 3 years on research & development. They have been marketing their first product - food supplements - since 6 months. Moringa Pvt. Limited sells the capsules for 100 BDT per 60 pieces to traders, such as pharmacies. The production costs of 60 capsules - including purchase of raw materials, transportation, cleaning, drying, processing, factory overhead costs and excluding research & development costs – is 35-45 BDT. Hence, they make a profit of 55-65 BDT on every box of 60 capsules. The current production capacity of the Moringa Pvt. Limited factory is 20,000 boxes (60 pieces each), which could be expanded up to 60,000 if there would be more demand. The current sales numbers are about 5,000 packages of capsules a month. The advisory price for pharmacies is 300 BDT, which is about 8.4 times cheaper than prices paid on the American market. Further research would be required to analyse whether the Moringa Pvt. Limited capsules are, in terms of quality, comparable with the ones marketed on the American market;
- Moringa Pvt. Limited has a plantation with 50,000 trees, which is planned to be doubled soon, and a processing plant in Jhenaidah (Jessore). The company also works with local contract farmers in Jhenaidah. They are the main source of raw materials (leaves) for the company. When the company started buying leaves from the farmers, they found curiosity and surprise among the farmers, who asked: 'Why do you want to pay us for the leaves? What will you use the leaves for?' Now that they got aware of the health benefits, they started using leaves for their own consumption too;
- Moringa Pvt. Limited has tested several new Moringa-based products for the market. They will soon start marketing a herbal health drink with Moringa roots as ingredient. Furthermore, they are in the process of getting permission from the Bangladesh government to market growth enhancers for poultry and agricultural crops;
- The company started research into using Moringa seeds as a water purifier, processed branches as natural insecticide and processed leaves as ingredient for baby foods. The latter would require nanotechnology for which facilities and capacity in Bangladesh are not sufficient. Moringa Pvt. Limited is considering to do the processing part for the baby foods in India or China.

5.3 Current Value Chain

The current value chain of Moringa in Bangladesh is mainly limited to farmers selling the pods of the trees to neighbours and local traders, who in turn sell them to the consumers. Moringa Pvt. Limited is a start-up company and likely the only Moringa leaf-processing company in Bangladesh. A schematic overview of the Moringa value chain is given below.

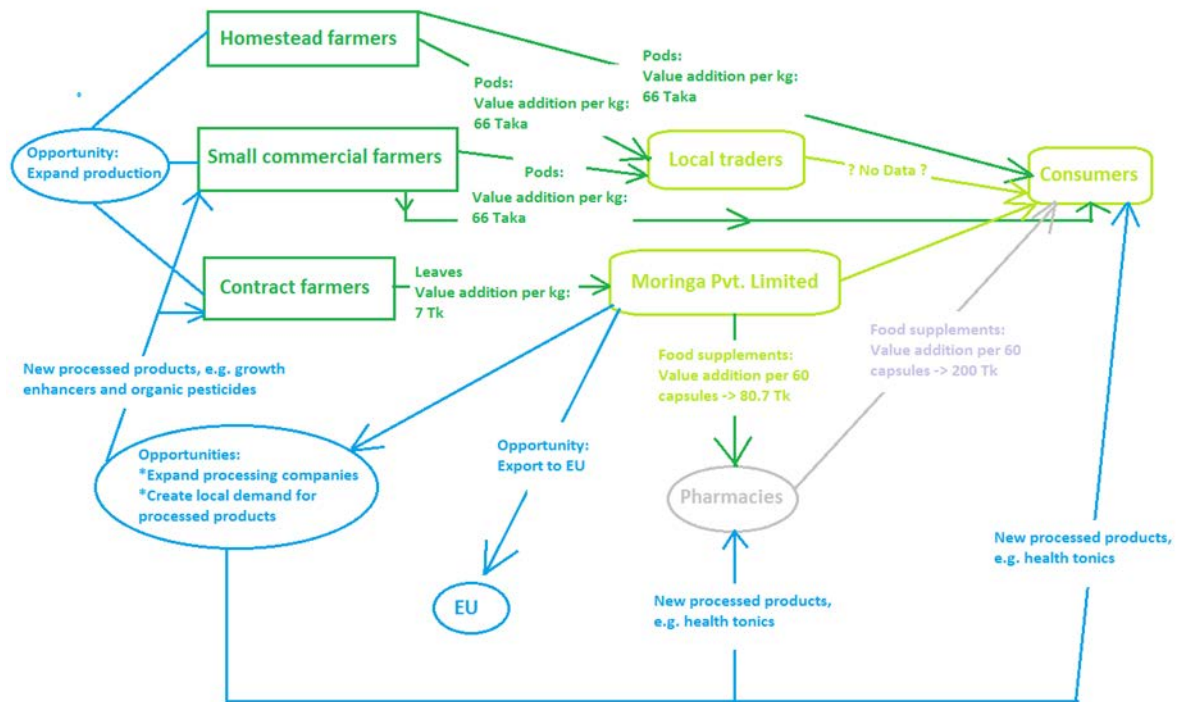


Figure 9 Market Map of the Current Value Chain (and Future Opportunities)

5.4 Preliminary conclusions on the Moringa sub-sector

To sum up, primary data suggest that *Moringa oleifera* is not a crop of commercial interest in Bangladesh. Only consumption of pods are popular and other uses such as leaves and flower consumption remain minimal.

Nevertheless, farmers interviewed recognize that Moringa has significant benefits and they wonder how profitable it can really become. Findings in this section suggest the need for a detailed cost and benefits analysis of Moringa farming whereby pods and leaves are produced and sold to the market.

6 Recommendations

The present report explores the uses of Moringa worldwide, gives an account of the Moringa value chains existing in different countries, describes the dynamics seen in the EU market -paying special attention to the Dutch market- and outlines the status of the sub-sector in Bangladesh. In addition, a stakeholder workshop was held in Bangladesh to validate partial research findings and discuss the way forward. Annex 1 outlines the most important salient points of the event.

Based on the findings of both the desk-based research and workshop, we provide a list of activities to be conducted in two major Blue Gold areas: nutrition security and income generation.

Nutrition objective

- Create a general awareness campaign on the benefits of consuming Moringa leaves. Possibility to link up with FAO, USAID, NGOs working on nutrition, Ministry of Health and family Welfare or even media/websites;
- Include the topic of Moringa in on-going Blue Gold nutrition activities and projects;
- Expand the acreage of Moringa once varieties and crop practices have been tested.

Income generation objective

Blue Gold's innovation fund is available to explore some activities around Moringa that require further investment. The activities to be funded can be:

- Bridge the market development gaps;
- 1. Study the feasibility of production and business plan of Moringa Pvt Ltd – market assurance (short term);
- 2. Clarify the certification or import requirements of natural ingredients for health products into EU. This will serve as an input for future business plans around Moringa production for exports;
- 3. Establish links with different organizations in Netherlands and explore opportunities for export of Moringa. Some organizations to be contacted are Centre for the Promotion of Imports from developing countries (CBI), Netherlands Enterprise Agency (MMF), Dutch Good Growth Fund, PROFOUND, natural ingredients experts (IN2NI);
- Upon confirmation of market demand by Moringa Pvt Ltd, design of a pilot project on collection & washing & drying at village level and quality control in cooperation with / to supply Moringa Pvt Ltd.

The order in which activities are carried out will depend on Blue Gold's priorities and planning.

Annex 1: Workshop report

Report by Niels van den Berge

Date: 6th of August 2015

Location: Hotel Lake Castle, Dhaka

Introduction

Blue Gold and CDI Wageningen jointly organized a workshop with strategic stakeholders to discuss the preliminary findings of this study and to identify ways forward. Present in the workshop were representatives of: Blue Gold, the Department of Agricultural Extension, Moringa Pvt. Ltd. and CDI Wageningen UR.

Background of the workshop

Among other priorities, Blue Gold works on strengthening the value chains of different agricultural products, such as sesame and poultry. Blue Gold identified Moringa as a tree with agribusiness potential and decided to commission a study on the value chain of the different Moringa uses both worldwide and in Bangladesh.

The first part of the workshop consisted of a validation of the findings gathered during the desk-based research study. The second part focused on the challenges and opportunities faced by actors in the cultivation of Moringa in Bangladesh. The third part explored the strategic options available for Blue Gold going forward.

FIRST PART OF THE WORKSHOP: validation of findings and exchange of knowledge among participants

Previous promotion of Moringa

- The Department of Agricultural Extension promoted Moringa in the 1980s to cope with draught. Indeed, Moringa trees consume relatively little water. As a result of the promotion campaigns, Moringa can be found along roadsides almost all over the country. In Barisal, promotion of Moringa failed somehow;
- Moringa is popular in many African countries to fight malnutrition, boost immune systems and to treat HIV patients.

Different uses of Moringa

- In Rajshahi, consumption of Moringa leaves is popular. In the rest of Bangladesh, people eat mainly pods and have little interest in the leaves;
- People say that consumption of Moringa reduces the risk of pox;
- The pods are being consumed and yield relatively high prices. However, if you cook the pods at temperatures above 52 degrees Celsius, the nutritional value is substantially reduced.

Cultivation

- Moringa is native to Bangladesh. Therefore the trees are not vulnerable for pests when cultivated extensively. However, when Moringa is cultivated intensively, the risk of pest and diseases increase;
- When extensively cultivated, no fertilizers need to be added to the trees. However, fertilizers will be required when the production is to be intensified;
- Moringa trees are vulnerable for waterlogging. This is a challenge in the Blue Gold areas. The trees need to be cultivated on high lands.

Potential of Moringa in Bangladesh

- There is a big local market in place for the pods;

- Moringa trees could be cultivated on road sides, embankments and public places, such as school grounds;
- The seeds have a water purifying potential;
- In terms of economic profitability, the leaves are most interesting as relatively big amounts can be harvested at a time and the periods between different harvests are relatively short;
- The farmers need to be trained to grow and harvest leaves;
- There is a high demand for pods in India. So, this offers opportunities for export;
- There is a new Moringa variety which yields up to 3 harvests a year, allowing for intensification of the pod production;
- The branches can be used as a fertilizer;
- It would be possible to grow and harvest pods and leaves from the same tree. This would require training though. Farmers need to stop harvesting leaves at the right time, so that the pods can start growing;
- 500 ton is the maximum annual harvest of leaves, according to Moringa Pvt. Ltd.

Markets

- The pods are both sold in local markets and in Dhaka;
- Farmers count flowers to estimate their pod production. Private actors often pay part of the final pod price in advance, based on the number of flowers;
- When all the pods on the tree are sold at once, men receive the money. When the pods are sold one by one, women receive the money;
- In the pod sub-sector, we can find middlemen that bring the pods from the farms to the markets.
- Farmers get a fair price for the pods. This might change once you start intensifying;
- It might be interesting to have a more in-depth value chain study done on Moringa in Bangladesh. Such a study could give more insight in prices, market mechanisms, actors on the market, etc.

Processing

- Transport and logistics need to be managed carefully as Moringa is very sensitive for sunlight and high temperatures;
- There are different technologies to dry Moringa leaves, such as machine drying, fridge drying and shadow drying.



Picture Workshop participants observing Moringa-based products

Export

- To be able to export pre-processed and processed products to Western markets, a company would need certification. There are certification companies in Bangladesh that could do it. GACP

certification is required to export powder and to export processed products GMP certification is required.

SECOND PART OF THE WORKSHOP: Challenges and opportunities of Moringa cultivation in Bangladesh.

Conclusions

- There are 2 outstanding uses; pods and leaves;
- Blue Gold will only promote extensive cultivation to avoid competition with other (food) crops and also due low suitability of most Blue Gold areas for intensive cultivation;
- The capacity for leave processing is currently limited, but could be expanded;
- It is required to train farmers on knowledge (e.g. harvesting time) and skills (e.g. how to harvest);
- Cultivation in the Blue Gold areas is difficult, but possible. Nurseries could be set up for the cuttings. Once the cuttings have grown roots, they can be planted in the field. Cultivation could also be possible on embankments, road sides and public spaces such as school grounds;
- Existing varieties (mainly 'sajina', Bangla name) are suitable for extensive cultivation as the leave quality is good and they grow pods all year round;
- Improved varieties might be required when the production has to be further intensified;
- Blue Gold will start awareness raising on the use and benefits of Moringa leaves and flowers; Awareness raising about Moringa will be included in the curricula of existing activities, such as Farmer Field Schools.

THIRD PART OF THE WORKSHOP: Strategic options for Blue Gold going forward.

Future steps (see section 6).

Annex 2: List of participants

Sl.	Name	Organization	Designation	Contact
1.	A.S.M. Shahidul Haque	Blue Gold	Private Sector Development Expert	01711832037
2.	Tanvir Islam	Blue Gold	Deputy Component Leader, C-4	01719676383
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4.	Md. Ashraful Islam	Blue Gold	Deputy Component Leader, C-3	01712512525
5.	Md. Shamim Alom	Blue Gold	Business Development Coordinator, C-4	01716303350
6.	Shusanto Roy	Blue Gold	Business Development Coordinator, C-4	01717525641
7.	Zahangir Alam	Blue Gold	Agriculturist	01715209046
8.	Karel T'Jonck	Blue Gold	Component leader, C-4	01987148393
9.	Hein Bijlmakers	Blue Gold	Component leader, C-3	017180016516
10.	Zakiya Akhter	Moringa Private Ltd.	CEO	01787658132
11.	Md. Sami Akhter	Moringa Private Ltd.	Advisor	0192999349
12.	Tahmina Begum	DAE	Project Director, DAE Blue Gold	01716481517
13.	Yeray Saavedra Gonzalez	Consultant	CDI Wageningen	--
14.	Niels van den Berge	Independent Consultant		01777979026

References

Animashaun, J.O and Toye, A.A, (2014). *Feasibility Analysis of Leaf-Based Moringa oleifera Plantation in the Nigerian Guinea, Savannah: Case Study of University of Ilorin Moringa Plantation*. Department of Agricultural Economics & Farm Management, University of Ilorin, P.M.B 1515, Ilorin, Nigeria.

Animashaun, J. (2013). *Prospects of Agriculture Enterprise for Sustainable Economic Development: Success Story of University of Ilorin Moringa Value-Addition Activities*. In Proceedings of the 4th International Conference of the African Association of Agricultural Economists, Hammamet, Tunisia, 22–25 September 2013.

Animashaun, J.O., et al. (2013). *An Assessment of the Determinants of Moringa Cultivation among Small-scale Famers in Kwara state, Nigeria*. Journal of Food science and quality management. Vol (11) 23-30.

Anwar, F., Ashraf, M. and Gilani, A.H. (2007). *Moringa Oleifera : A food plant with multiples medicinal uses*. Phyto therapy Res, Vol. 21 No 1, pp. 17 -25.

CBI (2015). *Buyer requirements: Natural Ingredients for Cosmetics in Europe*. Retrieved from CBI.eu

CBI (2015). *Buyer requirements: Natural Ingredients for Health Products in Europe*. Retrieved from CBI.eu

CBI (2015). *Channels and segments: Vegetable Oils for Cosmetics in Europe*. Retrieved from CBI.eu

CBI (2015). *Channels and segments: Natural Ingredients for Health Products in Europe*. Retrieved from CBI.eu

CBI (2015). *Trade statistics: Natural Ingredients for Cosmetics in Europe*. Retrieved from CBI.eu

CBI (2015). *Trade statistics. Natural Ingredients for Health Products in Europe*. Retrieved from CBI.eu

Crosby, G.W. (2007). *Soilless Culture of Moringa (Moringa oleifera Lam.) for the Production of Fresh Biomass*. PhD Thesis

European Union (2011). *Cosmetic products*. Retrieved from http://europa.eu/legislation_summaries/food_safety/animal_welfare/l21191_en.htm

Fahey, J.W. (2005). *Moringa oleifera: A Review of the Medical Evidence for Its Nutritional, Therapeutic, and Prophylactic Properties. Part 1*. Trees for Life Journal, 1:5

Foidl N., Makkar H.P.S., and Becker, K. (2001). *The potential of Moringa oleifera for agricultural and industrial uses*. In: Fuglie, L.J. (Ed.) (2001). *The miracle tree: the multiple attributes of Moringa*. CTA Publication. Wageningen, the Netherlands, 2001; pp 45-76.

Fugli, L.J. and Sreeja, K. V. (2011). *Cultivation of Moringa*. <http://Moringafarms.com/cultivation-of-Moringa/>

Fuglie, L.J. (Ed.) (2001). *The miracle tree: the multiple attributes of Moringa*. CTA Publication. Wageningen, the Netherlands, 2001; pp 45-76.

GIZ (2013). *Moringa Products - Opportunities and Challenges for Mozambique*.

Jahn, S.A. (1991). *The Traditional Domestication of a multipurpose tree Moringa stenopetala (Bak. f.) Cuf. In the Ethiopian Rift Valley*. Ambio, 1991; 20 (6): 244-247.

Makkar, H.P.S. and Becker, K. (1996). *Nutritional value and antinutritional components of whole and ethanol extracted Moringa oleifera leaves*. Animal Feed Science and Technology, 63 (1-4) 211–228

Musa D. Baba, Garba Yakubu, Jibril M. Yelwa and Lukman Haruna. (2015). *Costs and Returns of Moringa (Moringa oleifera) Production in Zuru Local Government Area of Kebbi State, Nigeria*. N Y Sci J 2015;8(1):36-40]. (ISSN: 1554-0200).

Omotesho, K. F., Sola-Ojo, F. E., Fayeye, T. R., Babatunde, R. O., Otunola, G. A., & Aliyu, T. H. (2013). *The potential of moringa tree for poverty alleviation and rural development: Review of evidences on usage and efficacy*. International Journal of Development and Sustainability, 2, 799-813.

Ojjako, F. O., Adikuru N. C. and Emenyonu C. A., (2013). *Critical issues in Investment, Production and Marketing of Moringa oleifera as an Industrial Agricultural raw material in Nigeria*. Journal. of Agricultural Research and Development, 10(2): 2011, 39 – 56.

Prakash Mishra, Pankaj Singh and Sanjay Singh (2012). *Processing of Moringa oleifera leaves for human consumption*. Bulletin of Environment, Pharmacology and life sciences, 2(1) 28–31.

Palada, M.C. and Chang, L.C. (2003). *Suggested Cultural Practices for Moringa*. International Cooperators Guide. March 2003. AVRDC pub # 03-545.

Pandey, A., K. Pradheep, R. Gupta, E. Roshini Nayar, and D. C. Bhandari, “‘Drumstick tree’ (*Moringa oleifera* Lam.): a multipurpose potential species in India, . Genetic Resources and Crop Evolution, vol. 58, no. 3, pp. 453–460, 2011.

Profound – Advisers in Development (2015). *Wild-collected botanicals and the EU market*. Published by the Trade for Development Centre – BTC (Belgian Development Agency).

Rajendran, T., Prahadeeswarran, M. (2014). *Marketing strategies for promotion of annual Moringa in Tamil Nadu: An Economic analysis*. Samzodhana – Journal of Management research. Vol. 2, Issue 1, March 2014.

Reyes-Sánchez, N., Spornody, E. and Ledin, I. (2006). *Effect of feeding different levels of foliage of Moringa oleifera to creole dairy cows on intake, digestibility, milk production and composition*. Livestock Science, 101 (1-3) 24-31.

Saint Sauveur, A. and Broin, M. (2010). *Growing and Processing Moringa Leaves*. Published by CDE CTA Moringanews⁵ / Moringa Association of Ghana.

The Smallholder Farmers Alliance (SFA) (2015). *Moringa: Export Market Potential for Smallholder Farmers in Haiti*.

⁵ Moringa News - The newly-founded Moringa Network, an association of non-profit, research, and business organizations, offers an excellent website with news about Moringa, a mailing list, database of Moringa research, Moringa links, and much more.

To explore
the potential
of nature to
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quality of life



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