# MORINGA

Export Market Potential for Smallholder Farmers in Haiti



Smallholder Farmers Alliance

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The Smallholder Farmers Alliance (SFA) applies a social enterprise model to help feed and reforest a renewed Haiti by establishing agroforestry cooperatives, building agricultural export markets, creating rural farm businesses and contributing to community development. To learn more visit: <u>www.HaitiFarmers.org</u>

# FOREWORD

February, 2015



Although moringa trees have long been grown and utilized in rural Haiti, it was not until the government launched an awareness campaign in 2013 that this unusual species began to garner broad public interest. Through that campaign we learned about the tree's many benefits, and before long stores and markets around the country were carrying the dried moringa leaf powder as nutritional supplements, morning tea and even peanut butter—and the oil extracted from moringa seeds has been showing up as a beauty aid. Meanwhile you hear about the tree's use for fodder for livestock and poultry, as feed for fish farming and even filtering water.

The government's campaign also sparked an interest in the possible export market for Haitian-grown moringa, and it turns out to be perfect timing as this "miracle tree" is now being hailed as the next superfood as well as a hot new trend in cosmetics.

The Smallholder Farmers Alliance, with support from the Embassy of the Netherlands in the Dominican Republic, has provided a valuable service by conducting the first commercial study looking into the potential for moringa as an agricultural export from Haiti, with a particular emphasis on small-scale farmers.

The result is more like a handbook for anyone interested in growing, processing and marketing moringa. It will be an invaluable resource for years to come for any farmers, associations, non-profits, producers, exporters and government ministries interested in capturing part of the burgeoning international moringa market for Haiti.

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## **OVERVIEW**

*Moringa oleifera* is a tree with a unique range of properties that make it one of the most versatile on the planet and known to many as the "miracle tree."

Moringa leaves have long been known to indigenous cultures for their nutritional and medicinal benefits, but only in recent years has this translated into dried leaf powder being used in nutritional supplements and medical treatments available to a broader public. There is no other tree leaf in the world with moringa's combination of protein, vitamin A, potassium, calcium and vitamin C.

Not only the leaves are valuable. The oil derived from moringa seeds is starting to be used for cosmetics, cooking, biofuel and machine lubricant. The young seed pods are a delicacy in some countries. Other parts of the tree have been shown effective in water filtration.

The potential of a tree like moringa must be balanced against a range of other considerations, particularly environmental. The good news is that it grows unusually fast under harsh conditions in the tropics up to 15 feet from seed in one year—and on marginal land with a minimum of nutrients and water needed. It also lends itself to agroforestry cultivation, growing well when interspersed with other crops.

Many people in the field of nutritional supplements are predicting that 2015 will mark the transition of moringa from a fad to a superfood phenomenon, while others in the cosmetics field are predicting its enthusiastic embrace within their industry.

The purpose of this study is to explore the unique and historic opportunity that exists for Haitian smallholder farmers to secure a portion of the rapidly expanding international export market for moringa leaf powder and moringa oil. Moringa thrives in Haiti, where it is known by various names: benzoliv, doliv and gabriyel. The leaves of the tree have long found their way into soups and stews, and moringa's medicinal properties have made it a trusted folk remedy. Farmers use it as fodder for animals, and its long and supple branches make it a favorite for weaving together as living fences. And due in large part to promotion by the Government of Haiti, there is a small but growing local market for moringa health and beauty products.

Haiti has several distinct advantages that make it well positioned to expand from a modest domestic market for moringa to also include a significant export market:

1. **Proximity to US**: The biggest market for moringa products is going to be the US. Haiti is next door and the export procedures, while not ideal, are considerably less complicated than those in many of the countries in Asia and Africa that currently supply most of the moringa at present.

2. **Predominance of Smallholder Farming**: One of the emerging trends in the food industry worldwide is customer preference for products grown by small-scale or smallholder farmers (including, but not exclusively, via various fair trade certifications) Haiti has an estimated one million smallholder farms that represent a significant portion of agriculture's role as representing 60% of employment and 40% of the country's GDP.

3. **Potential for Organic Certification**: There is a clear customer preference—and willingness to pay premiums for—organic products in both the food and cosmetics categories. While there is not a high level of organic certification at present in Haiti, there are well-qualified and internationally accepted certifiers now operating in the country. And the traditional lack

of chemical inputs in the agricultural sector means a much shorter time for such certification to be implemented as opposed to the usual five or six years for land treated with chemical fertilizers, herbicides and insecticides.

4. **Body of Knowledge**: There is a substantial and easily accessible body of knowledge from various sources pertaining to growing and producing moringa in Asia and Africa. This information covers a wide array of issues dealing with regulations, standards, product specifications, supplier qualifications and so on. In short, others in developing countries with circumstances not unlike those in Haiti have paved the way and their experience is largely open source.

5. **Residual Good Will Towards Haiti**: There exists a very strong interest among the general public in North America and Europe to assist in Haiti's recovery from the 2010 earthquake and other disasters that have beset the nation. Products that can demonstrate a tangible role in helping the economy and farmers of Haiti have the potential, when marketed as such, to tap into this good will.

The authors of this study reached out to a wide range of companies in North America and Europe that are current market leaders in selling products made with moringa leaf powder and moringa oil. Our initial questions centered on trying to gauge current and projected levels of moringa consumption and its related economic value. While moringa use is considered significant, it has yet to reach the level of a commodity with international trading standards. As a result, our findings are indicative rather than substantive. However, there was one wholly unexpected outcome of our approach to these companies: we began receiving large orders for smallholder-grown and organic certified Haitian moringa.

The follow-up to these provisional orders is being translated by the Smallholder Farmers Alliance (SFA) into a consortium of smallholder cooperatives and organizations in Haiti that will grow and process moringa for export. However, this falls outside the scope of this study and details about the companies —and the orders they have placed—have become proprietary to the new consortium initiative. What can be stated here is that there is a tangible interest in purchasing moringa leaf powder and moringa oil from Haiti. And if the initial and unsolicited orders are any indication, moringa could soon become an important agricultural export commodity from Haiti.

What does remain the purview of this study is to observe that while linking smallholders to formal markets can be challenging, various examples in other countries have demonstrated that it is possible to do so successfully. It is suggested that a similar approach can be taken in Haiti.

Based on the findings of the study, therefore, the following recommendations can be made:

1. **Production**: The cultivation of moringa trees needs to be expanded to achieve economies of scale in the production of both moringa leaves and seeds. The already existing small-scale farming sector should be supported to expand. Viable, clean and disease-free seeds should be available and yields should be increased by applying adequate cultivation techniques.

2. **Processing**: While the processing of moringa leaves is technically not complicated, a functioning logistics management system, including effective communication, cooperation and coordination between smallholders and transport services, needs to be implemented. Processing centers with high hygienic standards should be established and operated by associations or cooperatives. Adequate packaging should be used and farmers and associations should be supported and trained in processing methods.

3. **Commercialization**: The commercialization of moringa products in Haiti is still very informal and makes it difficult to get reliable information on production volumes and prices. To effectively exploit the existing market potential, the commercialization should eventually become more structured and formalized. National quality and food safety standards for moringa products need to be developed. More.

over, trainings as well as finance schemes concerning the compliance with international standards should be made available.

To better explore the potential of commercial production of Moringa products, the key challenge

is to overcome the identified bottlenecks in the value chain. This will only be possible through joint efforts by the private sector, including smallholders, associations and larger companies, and public institutions.

# **ACRONYMS**

CAS	Chemical Abstracts Service
CBI	Center for the Promotion of Imports from Developing Countries
CGMP	Current Good Manufacturing Practice
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DCs	Developing Countries
DSHEA	Dietary Supplement Health and Education Act
EFSA	European Food Safety Authority
EU	European Union
FDA	United States Food & Drug Administration
FLO	Fairtrade Labelling Organizations International
GACP	Good Agricultural and Collection Practices
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GLOBALG.A.P.	Global Good Agricultural Practices standards
GMP	Good Manufacturing Practices
GRAS	Generally Recognized as Safe
IFC	International Finance Corporation
INCI	International Nomenclature of Cosmetic Ingredients
IUCN	International Union for Conservation of Nature
MSDS	Material Safety Data Sheets
QC	Quality Control
UK	United Kingdom
US	United States
USA	United States of America
US\$	United States Dollars
WHO	World Health Organization

## **1. INTRODUCTION**

Haiti is largely deforested, with an estimated mere 2% of its original tree cover remaining. Agricultural practices currently deployed by local farmers are largely unsustainable, often feeding directly into a negative cycle of environmental degradation (deforestation and erosion/loss of topsoil), loss of livelihood opportunities and reduced resilience when facing food security challenges. The compounded problems resulting from deforestation has made the reforestation of Haiti a matter of national priority for the Government of Haiti.

Doing so, however, has proven to be a tremendous challenge, with the government often struggling to provide local farmers with sufficient incentives in order to complement their existing crops with productive tree crops. It is within this context that the Smallholder Farmers Alliance (SFA) has started deploying innovative, market-based development models that focus on the introduction of agricultural tree crops that help small-scale farmers in Haiti to restore tree cover, increase food production and improve livelihoods.

While various tree crops are currently being used within this framework, one in particular has recently received significant attention: Moringa oleifera, an extremely fast-growing, drought resistant tree that has been growing in Haiti ever since its nowforgotten introduction to the country decades ago. In Haiti known as benzoliv, doliv and gabriyel, moringa is increasingly recognized for its potential as a multipurpose tree crop, in fact being considered to be one of the most useful trees in the world (including by the World Health Organization). Virtually all parts of the tree are edible or can be processed for therapeutic, prophylactic, medicinal, cosmetic and industrial purposes. A variety of value-added products can be derived from the tree, meaning its contribution to rural livelihoods can be substantial in terms of providing additional sources of nutrition and cash income.

Globally, demand for two particular moringa products has been growing rapidly: the highly nutritious powder derived from the tree's dried leaves, and the high quality oil that can be extracted from the tree's seeds. The former, moringa leaf powder, is sold as a 'super food' in the international market for nutritional supplements. It is also increasingly the subject of interest from international organizations and institutions involved in the global fight against malnutrition. The latter, moringa oil, is highly coveted by international cosmetic companies for its excellent properties as an ingredient in fragrance and skin care products. The surging interest in moringa oil is illustrated by mainstream companies like The Body Shop, Garnier and Redken, which have all recently launched various product lines containing moringa oil.

While moringa trees can be found all over Haiti, they are mainly cultivated as a means of fencing smallholder household compounds and small farms. While some small-scale dedicated moringa farms exist, bigger and commercially operating farms are not yet established in Haiti. Local interest in moringa, however, has surged following recent information campaigns of the Haitian government as they attempt to make the population more aware of moringa's many powerful properties and uses. Although the market for moringa products so far remains largely informal, local demand for moringa products (moringa leaf powder in particular) is growing.

With international demand also growing, and considering Haiti's good access to major international markets (geographically to the US, and with preferential trade access to the EU), there is great potential to develop a commercial moringa sector in Haiti. Similar initiatives elsewhere in the world have shown that smallholder farmers can play an essential role in the development of a successful value chain for moringa products. Engaging local smallholders in a similar initiative in Haiti would not only provide them a group that constitutes one of the main drivers of the Haitian economy—with new income opportunities, it would also provide them with important nutritional inputs and a powerful incentive to contribute to the reforestation of Haiti.

The present study, the first conducted on this theme in Haiti, analyzes the potential of the commercial production and processing of moringa by smallholder farmers in Haiti. The study has the following objectives:

- 1. To provide an overview of the main characteristics and multiple uses of Moringa;
- 2. To map and analyze the current markets for moringa leaf powder in supplements and related

products, and moringa oil as an ingredient in cosmetic products, including regulations and requirements that need to be considered when entering the market; and

3. To provide suggestions for ways to structure a potential moringa value chain in Haiti, with recommendations for the technical and organizational considerations that should be taken into account in order to successfully grow and process moringa on a commercial basis in Haiti.

The present study combines desk and field research. After a review of existing literature, key stakeholders were consulted, both in Haiti and abroad. The various interview partners represented government agencies, research institutes, associations, small and medium-sized enterprises, as well as farmers.

## 2. CHARACTERISTICS OF THE MORINGA TREE

*Moringa oleifera* (hereafter referred to simply as 'moringa') is the best known and most widely cultivated of the 14 tree species belonging to the family *Moringacae*. It is native to the sub-Himalayan parts of Northern India, Pakistan, Bangladesh and Afghanistan, but has progressively proliferated and today can be found in tropical and sub-tropical regions all over the world.

Moringa is well known throughout the world for its characteristics as a highly resilient tree that grows very fast and is easy to propagate. It grows best in arid condition and has very low requirements in terms of nutrients, water and management (making it possible to grow moringa even on very marginalized soils). Moringa is highly resistant to drought and disease.

The tree is cultivated extensively throughout the tropics and subtropics. In India, it is often grown in plantations. Production in Africa is dominated by smallholder production systems and wild collection.

Requirement	Optimal Range (vs Absolute)	
Climate	Tropical or sub-tropical	
Altitude (ft)	0-6,500	
Temp. (°C)	20-35 (7-48)	
Rainfall (mm)	700-2,200 (400-2,600) (Irrigation needed for leaf production if rainfall <800mm)	
Soil Type	Loamy, sandy, or sandy-loam (it is recommended to avoid clay soils)	
Soil pH	5.5 - 7 (5 - 8.5)	
Soil Salinity	Low (<4 dS/m)	

Table 1 - Ecological Requirements Moringa (source: FAO EcoCrop, 2011)

#### **Climatic & Soil Requirements**

Moringa is widely adapted to the tropics and subtropics. Optimum leaf and pod production ideally requires high average daily temperatures of 25–35°C (77–86°F), well distributed annual rainfall of 1,000–2,000 mm (39-79 in), high solar radiation and well-drained soils. Growth slows significantly at temperatures below 20°C (68°F). Moringa can grow up to 2,000 meters (6,500 ft) elevation, although ideal elevation is less than 600 m (1,970 ft).

Moringa tolerates a wide range of soil types and pH (4.5–9), but prefers well-drained, sandy loam or loamy soils in the neutral pH range. It does not tolerate prolonged flooding or poorly drained clay soils (in fact it is recommended that clay soils be avoided when selecting plots for moringa cultivation). Light (sandy) soils are preferred for rooting branch cuttings directly in the ground.

In Haiti, moringa trees grow naturally and are spread over most parts of the country. Haiti's semi-arid and semi-humid zones provide suitable altitudes and sufficient rainfall. These favorable agro-climatic conditions allow for medium to large-scale cultivation of moringa trees. To increase plant yields for commercial production, however, irrigation systems may be required in some regions.



Figure 1 - Occurrence Moringa in the World

#### **Propagation & Growth**

Moringa is known to be very easy to propagate, growing up to 4.5 meters (15 ft) in the first year upon planting and under favorable conditions reaching a height of 6 - 15 meters (20-50 ft) (Orwa et al., 2009). Trees can be grown both by means of direct seeding as well as from cuttings. Even when grown from seeds it is possible to harvest relatively soon upon planting: in the right conditions leaves can be harvested as soon as 4 months from planting, while a tree can bear fruit (pods) within its first year. Trees grown from large cuttings can begin to produce pods even 6 to 12 months after planting.

Moringa can be used in intercropping systems as it provides semi-shade (Orwa et al, 2009a). For commercial production it is often grown as a monocrop (Radovich, n.d.). Yields can vary depending on cultivation methods used (i.e. spacing, irrigation, use of fertilizer, etc). Overall, the tree has very low requirements in terms of nutrients, water and management and is highly resistant to drought, making it possible to grow moringa even on very marginalized soils. Moringa is known to be pest and disease resistant, while fast growth allows it to regenerate quickly from any disturbance.

#### Varieties

Among moringa species, *M. oleifera* and *M. stenopetala* are the most commonly grown. Among these two *M. oleifera* is the most widely cultivated. In India, where commercial production of moringa is an important industry, two new strains ('PKM-1' and 'PKM-2') have been developed that have particular high yields to pod production. These selected lines are early flowering varieties that can produce market-ready pods within six months (Radovich, n.d.). While such varieties may be of interest when developing a new moringa sector, it is recommended that growers use locally adapted lines. The variety available in Haiti produces both high quality leaves as well as seeds suitable for oil production.



Figure 2 - Cultivating moringa leaves, pods and seeds

## **3. MULTIPLE USES OF MORINGA**

Also referred to as the "miracle tree", moringa has been revered for centuries in countries in Asia and Africa for its healing and nutritive properties as well as for its use in a wide variety of other applications. It is considered to be one of the most useful trees in the world, including by the World Health Organization (WHO). Use of moringa goes back to the ancient Egyptians, Greeks and Romans, who are known to have highly valued it for use in medicine, perfumes and body creams.

Moringa's nutritional properties in particular are highly impressive: almost every part of the tree is edible and has powerful medicinal properties. Fresh leaves from the moringa tree, for example, have been shown to contain more than 4x the amount of vitamin A of carrots, 7x times the vitamin C of oranges, 4x the calcium of milk, 7x the potassium of bananas, 3/4 the iron of spinach and twice the amount of protein of yoghurt (see Figure 2 below). They also contain large amounts of minerals, all the essential amino acids, and antioxidants. While the leaves are eaten throughout West Africa and in parts of Asia, people in the Indian sub-continent consider the trees' young seedpods a delicacy as well.

Although mainly known for its nutritional and medicinal properties, moringa is also used for a variety of other uses, including industrial ones. These include the use of moringa seed oil for biodiesel, the lubrication of fine machinery, and as an ingredient in cosmetic products. The seeds and seed cake are used for water purification. Box 1, below, shows some of the most interesting uses of the moringa tree. The following section will provide additional information on these and some of the most interesting other uses of various parts of the moringa tree.

#### BOX 1 - Many uses of Various Parts of the Moringa Tree

- Nutritional supplement (fresh and dried leaves). Leaves are a source of:
  - Highly digestible protein
  - High levels of vitamins (inc. Vitamin C, A
  - High levels of minerals (inc. iron, calcium, and potassium)
  - High levels of essential amino-acids (inc. carotenoids)

#### High Grade Oil (seeds):

- Used in cosmetic products (base oil for perfumes, body care)
- High quality, food-grade vegetable oil
- Lubrication of fine machines
- Water purification (seed cake) (Moringa seed cake can be used to replace alum....)

#### **Medicine** (all plant parts)

Bio fuel (biogas & biodiesel gained from leaves & seeds)

#### Agricultural Uses:

- Animal feed stock (leaves and treated seed cake)
- Biomass production (alley cropping)
- Bio-pesticide (soil incorporation of leaves to prevent seedling damping off)
- Fencing (living trees)
- Fertilizer (seed cake)
- Foliar nutrient (juice expressed from the leaves)
- Green manure (from leaves)

#### Other uses:

- Domestic cleaning agent (crushed leaves)
- Blue dye (wood)
- Gum (from tree trunks)
- Honey- and sugar cane juice-clarifier (powdered seeds)
- Honey (flower nectar)
- Pulp (wood)
- Rope (bark)
- Tannin for tanning hides (bark and gum)

## **3.1 USES OF MORINGA LEAVES**

Of all the different parts of the tree, the use of moringa leaves is probably among the most commonly known and best documented. From a medicinal perspective, practitioners of traditional medicine throughout the world have for centuries used moringa leaves to cure a host of diseases, from gout to various inflammations (arthritis among others) and fevers. More recent clinical studies show that moringa leaves are indeed packed with powerful nutrition and compounds that are linked to an array of medicinal properties, showing that the claims of these practitioners may not be that far off. Meanwhile, moringa leaves are also used for a wide variety of other uses, including animal feed stock, green manure, and as a potent foliar spray (resulting from plant growth hormones naturally present in the leaves).

#### Moringa Leaves for Human Consumption

Moringa leaves have exceptional nutritional value, containing a variety of vitamins, minerals, and all of the 9 essential amino acids (including two amino acids that are especially important for children's diets). The latter in particular is highly rare for a plant.

Furthermore fresh leaves of moringa also contain niazinin, niazimicin and niaziminin A and B which have hypotensive effect (lower blood pressure), all compounds that seem to be very rare in nature. Another phytochemical found in moringa is betasitosterol, which reduces the excess of cholesterol in the human blood. Carbohydrate, fat and phosphorous contents of the leaves are low. (For a more complete nutritional profile of moringa leaves see Annex I). Figure 3 shows a few selected nutritional values of fresh vs dried moringa leaves.

When used for human consumption, the leaves can be either cooked (treated much like spinach) or dried. Although drying the leaves decreases some of the levels of vitamins, it significantly increases the amount of most other nutrients present in the leaves (see Figure 3). Dried leaves can be used to prepare tea (or more accurately a *tisane*) or as a kitchen herb to be added to various dishes. The leaves are also commonly ground into a powder, which is then used as a nutritional supplement. This moringa leaf powder has recently begun to attract attention in Western markets as a new "green superfood," and as such can increasingly be found in health stores and online.



Figure 3 - Nutritional Value of Fresh vs Dried Moringa Leaves (source: Trees for Life)



Figure 4 - Map showing countries where Moringa grows (green) and countries where people suffer from malnutrition (red). (Source: Trees for Life)

Packing such powerful nutrition, various organizations worldwide have incorporated moringa leaves as an important element—or even the basis for—nutritional programs that aim to combat malnutrition. In one of the studies conducted within the framework of such a program in Senegal, Lowell Fuglie argues that, "for a child aged 1-3, a 100 g serving of fresh leaves would provide all his daily requirements of calcium, about 75% of his iron and half his protein needs, as well as important supplies of potassium, B complex vitamins, copper and all the essential amino acids. As little as 20 grams of fresh leaves would provide a child with all the vitamins A and C he needs." (Fuglie, 2001).

Findings like these, together with a wealth of anecdotal evidence on the subject, strongly suggest that the regular consumption of moringa leaf powder might be an effective and rather simple way to help combat malnutrition. In this regard, it should not be overlooked that moringa is generally widely available in nearly all parts of the world still affected by malnutrition (see Figure 4).

#### Moringa Leaves as Animal Fodder

The leaves of the *Moringa oleifera* tree have become mainly known for their high nutritional content and potential benefits for human consumption. However, because these leaves are high in protein and other essential nutrients, they may also provide benefits in livestock feed. Feeding animals moringa has been linked to increased milk production, increased nutrient uptake, and faster weight gain than with other feeds.<sup>1</sup>

In a study conducted by Reyes-Sanchez at the Swedish University of Agricultural Sciences in Uppsala, for example, milk production of dairy cattle that was fed only hay was compared with that of cattle fed hay supplemented with moringa. The results showed that adding 3kg of moringa to the hay increased milk production from 3.1 kg milk per day to

<sup>&</sup>lt;sup>1</sup> For example, see: Hunter & Stewart, 1993; Castellon & Gonzalez, 1996; Rocha & Mendieta, 1998; Nambiar & Seshadri, 2001; Sarwatt et al., 2004; Reyes-Sanchez et al., 2005; Kakengi et al., 2007, V.O. Asaolu, R.T. Binuomote, J.A. Akinlade, O.S. Oyelami and K.O. Kolapo, 2011.

5.1 kg milk per day (an increase of 65%). Results also showed that the inclusion of moringa as a protein supplement to low quality diets improved dry matter intake and digestibility of the diet, and increased milk production without affecting milk composition (Reyes-Sánchez, N and Sporndly E and Ledin I. 2006).

Another study conducted by Nikolas Foidl in 2001 showed that cattle that were fed 15-17 kg of moringa leaves daily, mixed with their regular feed, resulted in a 32% increase in daily weight gains for beef cattle; and 3-5 kg increase in birth weights (for Jersey cows, whose average normal birth weight is 22 kg).

#### Moringa Leaf Extract as Food Supplement

Another kind of product derived from the leaves are moringa leaf extracts, which are high in Vitamins (A, B, and C), minerals and have a high antioxidant activity. These and other similar moringa products are often further processed in Europe to be used as ingredients for cosmetics and food.

#### Moringa Leaf Extract as Foliar Spray

Studies have shown that moringa leaf extract can be used as a foliar spray to increase plant growth and as a green manure to improve soil fertility. This is mainly due to the presence of plant growth hormones occurring in moringa leaf extract (one of the active substances being Zeatin, a plant hormone from the cytokinins group).

Plants sprayed with moringa 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: 20-30% 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). In one trial, use of Moringa foliar spray increased maize yields from 60 to 130 sacks per hectare, while BIOMASA, a research institute in Nicaragua was able to grow coffee at 30 meters altitude, managing to produce beans in just 17 months (Makkar and Becker, 1996; Fuglie, 2001). Foliar spray derived from moringa leaves can easily be prepared by collecting fresh leaves, mixing and blending them with water in a blender, and then letting the mix stand. After a few hours, the mix can be filtered and is ready to be used as a foliar spray.

## **3.2 MORINGA OIL**

While the leaves are highly valuable, the moringa tree is also prized for seedpods have an oil content of 35-42% (for de-hulled seeds). Moringa oil is coldpressed from mature moringa seeds yielding an odorless, brilliant yellow oil with a slightly nutty flavor.

The seed oil of moringa contains approximately 13% saturated fatty acids and 82% unsaturated fatty acid and is high in omega-9 (80%). It has a particularly high level of oleic acid (70%), making it a great moisturizer as well as a potentially healthy source of fat in the diet (other vegetable oils normally contain only about 40% oleic acid). Reports have demonstrated antiseptic and anti-inflammatory properties. Moringa oil does not become rancid for several years after it is produced, and is generally considered to have a shelf life of 5 years.

Moringa oil is one of the most exotic and highly searched for oil's in the world; its excellent characteristics making it a highly valued ingredient in a variety of applications ranging from vegetable food oil to use in cosmetic products and other industrial applications such as lubricant for fine machinery.

#### Moringa Oil for Human Consumption

Moringa oil can be used as high quality vegetable food oil. It has a somewhat nutty flavor and a structure similar to olive oil. A highly stable oil, it is considered by many to be a healthier alternative to most other frying oils, making it suitable for use in stir-fry dishes and marinades.

Moringa oil is a concentrated source of food energy. Small amounts of moringa oil added to the diet of young children has been shown to provide them with a more varied and nutritious diet. Moringa oil is rich in vitamins A and C and unsaturated fatty acids.

#### Moringa Oil as Ingredient for Cosmetic Products

Moringa oil is among the most valuable oils in the production of skin care products and cosmetics because of its various antioxidants and skin rejuvenating qualities. Antioxidants help prevent skin and cell damages—as well as premature aging caused by free radicals—and their incorporation in skin care products is one of the latest trends in the cosmetics and skin care industry.

Due to its high levels of oleic acid (72%), moringa oil absorbs rapidly into the skin, moisturizing it and providing it with important nutrients. Moringa oil is light and spreads easily on the skin, making it highly suitable for massage and aromatherapy applications.

The perfume industry highly values moringa oil because it has the ability to absorb and retain even the most volatile scents (it is actually one of the choice oils for perfume manufacturers that still employ the *enfleurage*<sup>2</sup> process). This, in combination with its high oleic acid level and enduring shelf life, make it a popular choice for use in the production of expensive and natural perfumes and fragrances.

Finally, the moringa oil contains antiseptic and antiinflammatory properties which help heal minor skin complaints such as cuts, bruises, burns, insect bites, rashes and scrapes.

#### Moringa Oil for Biodiesel

Biodiesel derived from moringa oil is an acceptable substitute for petrodiesel when compared to biodiesel fuels derived from other vegetable oils (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 complete with food crops (FAO, 2011).

## 3.3 OTHER USES OF MORINGA SEEDS & PODS

#### Young Moringa Seedpods for Human Consumption

Young, green moringa seedpods, more widely known as 'drum sticks', are frequently used in the Asian cuisine. Taking the form of green beans, their taste is similar to that of asparagus. The unripe seeds are used like green peas, while the dried seeds can be ground into a fine powder used as a spice.

The pods are best for human consumption at the stage when they can be broken easily without leaving any visible strings of fiber. Young pods are prepared similarly to green beans, being boiled for a few minutes before being eaten. Because the weight is low on very young pods, however, most commercial production involves larger, more fibrous pods that are used in soups, stews, and curries.

#### Medical Uses of Moringa Seeds

Moringa seeds are used for their antibiotic and antiinflammatory properties to treat arthritis, rheumatism, gout, cramp, sexually transmitted diseases and boils. The seeds are roasted, pounded, mixed with coconut oil and applied to the problem area. Seed oil can be used for the same ailments. Roasted seeds and oil can encourage urination. They can also be used as a relaxant for epilepsy (Moringafacts.net).

Moringa seeds are also claimed to be effective against the skin-infecting bacterias Staphylococcus aureus and Pseudomonas aeruginosa. The seeds contain the potent antibiotic and fungicide terygospermin.

#### Water Filtration with Moringa Press Cake

Moringa press cake, the product left following the oil extraction process from the seeds, can be used to purify water, acting as a coagulant that clears water and reduces its bacterial concentration. This property, long known in China, Sudan and Egypt (where it was

<sup>&</sup>lt;sup>2</sup> Enfleurage is the process of extracting perfumes by exposing inodorous oils or fats to the exhalations of flowers.

used for cleaning water from the Nile for human consumption), is due to the presence of proteins that attract particles and bacteria, causing them to form sediments (2001, Foidl).

Having such strong coagulant properties—two seeds can be enough to treat a liter of very dirty water moringa press cake could potentially be used as a relatively cheap, natural, and non-toxic alternative to current industrial coagulants such as alum. The latter are often too expensive to produce in developing countries and require qualified personnel for proper use. Other uses could include wastewater treatment, cleaning of vegetable oils, and sedimenting fibers in the juice and beer industries (also see: 2001 Foidl; and Hitendra Bhuptawata, G.K. Folkardb, Sanjeev Chaudhar, 2007). Having been used in water purification, the residue of the press cake can be further used as animal feed or as a fertilizer.

#### Other Potential Uses of Moringa Seed Cake

Moringa seed cake can used to produce protein derivatives. Given its high levels of protein, moringa seed cake is being researched as an additional source of animal feed. However, it is said to have a bitter taste and contains several potentially antinutritional factors that would have to be removed by means of a special treatment (glucosinolates, haemagglutinins, alkaloids and a saponin). Moringa seed cake can also be used as a protein-rich plant fertilizer. It has also been found to be a rich nitrogen complement for crops.

## 3.4 USES OF OTHER PARTS OF THE MORINGA TREE

#### **Moringa Flowers**

Moringa flowers are considered a delicacy in many places. They are often mixed into other foods like salads. The flowers are also fried (in moringa oil) and eaten as a snack. Especially popular is tea made of moringa flowers which is considered to have nutritional benefits and to be a powerful medicine. Moringa flowers are used in Ayurvedic medicine to treat inflammations, muscle diseases, tumors and enlargement of the spleen. In traditional medicine, tea or juice made from the flowers is also used to treat urinary infection, cold symptoms, as a supplement for breast-feeding women to increase the milk flow, and also strengthening the liver function. Moringa flower tea is prepared by letting the flowers steep in hot water for at least five minutes, letting the distinctive flavor become infused before the tea is ready to be consumed.

Among various other uses moringa flowers also provide a year-round source of nectar for bees. At the time of writing, a few initiatives in Haiti were producing honey made by bees that were feeding nectar from moringa flowers. More recently the cosmetic industry has started using moringa flower extract in fragrance (e.g. The Body Shop).

#### **Roots of the Moringa Tree**

Modern medical studies have shown that moringa roots contain elements that can treat ovarian cancer, kidney stones (helping the body to flush calcium and phosphates from kidneys more efficiently, which can improve overall kidney function), and inflammations (reduces swelling). The roots can also help people who take pain medication to have longer and less interrupted sleep, and can be used for culinary purposes as well. Moringa roots contain concentrated phytochemical compounds that are found throughout the rest of the plant, and these can provide therapeutic benefits for many conditions. When using roots, caution should be exercised because of high concentrate of some elements, and sometimes it can contain paralyzing agents called spirochin that can be dangerous for sensitive individuals or if taken in larger quantity. Sauce made from moringa roots is similar to horseradish sauce and is used as a spice that can also serve medical purposes (hence the reference to moringa as the "horseradish tree").

## **4. THE MARKET FOR MORINGA PRODUCTS**

The current volume of moringa sold internationally is not sufficient to qualify it as a commodity on the global market, and hence the trade statistics for moringa products are only available in an aggregated form. The global market for moringa products is considered substantial, however, with current estimates of over US\$4 billion a year (CJP, 2013).

While moringa is used for a wide variety of purposes, two moringa products in particular stand out in terms of their commercial potential: moringa leaf powder and moringa oil as an ingredient for cosmetic products. Following an overall trend on the international market—where natural products have experienced strong market growth over the last decade—demand for these two natural products is strongly growing. This demand is mainly driven by consumers in developed and emerging economies (particularly the US, Canada and the EU), who are increasingly seeking out dietary supplements and cosmetics derived from natural sources. Box 2 outlines the major trends regarding the market for moringa products.

Over the past few years, an increasingly large variety of moringa products have spread into many markets and are now available on most health food websites and in many health stores worldwide. Moringa leaf powder is being discovered as a green 'superfood' by consumers and is increasingly sold as a dietary supplement, often at premium prices. Interest in and demand for the product is further increased due to a growing number of international organizations that use it as a powerful tool in their global fight against malnutrition (as pointed out in Chapter 3). Mainstream cosmetic companies like The L'Oréal Group—and its subsidiary brands like The Body Shop, Garnier, and Redken—meanwhile, have discovered moringa oil as one of best exotic vegetable oils currently available on the market and have launched various product lines with moringa oil as a key ingredient.

Until recently, the local Haitian market for moringa products remained largely undeveloped. In the past two years this has begun to change, due in large part to the Haitian government's recognition and active promotion of the potential of moringa to serve as a powerful tool in their efforts to combat both malnutrition and deforestation. Interest in moringa products is on the increase in local markets, resulting in growing demand for moringa leaf powder in particular.

The following chapter will provide a more in-depth overview of the international and local markets for moringa leaf powder and moringa oil as an exotic vegetable oil in cosmetic products. Given that demand for these products is highest in the EU and North American markets, the focus of this chapter (and this study in general) will be on these two markets in particular.

#### BOX 2 - Trends on the International Market for Moringa Products

Over the past decade, consumers have grown increasingly aware and critical about the products they consume. Essentially we are entering a time where being a hot new ingredient or product itself is not enough: new products that have the most promising market prospects are those that are exciting in their functionality while also having other requirements such as proof or third-party certification that they are produced in a sustainable manner, which increasingly includes more equitable trade relationships for the farmer (ITC, 2012). In short, the way forward is 'natural', 'sustainable' and 'ethical' (CBI, 2013); and ideally a combination of all three of those.

Key trends and market prospect areas:

- There is an increasing demand for dietary supplements and cosmetics derived from <u>natural</u> sources (not containing synthetic ingredients). Great opportunities exist in expanding <u>niche markets</u> and for exporters offering <u>exotic varieties</u>.
- Key market prospect areas are any natural cosmetics, cosmeceuticals and/or dietary supplements with active ingredients and <u>interesting functionalities</u> (e.g. those promising anti-ageing or containing ingredients that when taken make the consumer feel better). Interest is booming in products that are without (or low in) conservatives; contain anti-oxidants; and have high levels of omega 3 content (CBI, 2013).
- There is an increasing consumer demand for <u>ethically sourced</u> cosmetics and food (supplements). As a
  result, large EU and US companies are moving towards being <u>environmentally and socially responsible</u>.
- Certifications such as <u>Fairtrade</u>, <u>organic</u> and <u>GLOBALG.A.P.</u>, are an area of high market growth, both in the US and the EU (ITC, 2012; CBI, 2013). This not only provides opportunities for producers, but in the case of fair trade or other social certifications, guarantees of higher prices or premiums in the market, along with good working conditions for farmers or farm workers in the supply chain (ITC, 2012). From 2009 2011, producers reported a 19% increase in Fairtrade Premium returns and a 22% increase in value of Fairtrade sales (Fairtrade.net). The same trend explains the existence of sustainability initiatives such as the Union for Ethical Biotrade, FairWild, and the Rainforest Alliance.
- Consumers are looking for products that come with an <u>interesting story</u> (that make them 'feel good'). Producers (of cosmetics in particular) are looking for ways to differentiate their products on the market, amongst other in terms of specific marketing stories.

## 4.1 THE INTERNATIONAL MARKET FOR MORINGA LEAF POWDER

#### Market Overview: The International Market for Moringa Leaf Powder

On the global market, moringa leaf powder is used as a dietary supplement, falling into the same market category (Herbs & Botanicals) as 'green superfoods' like spirulina, barley grass and wheat grass. The global market for nutritional supplements (also referred to as the nutraceutical market) has seen a rapid growth over the past years, and this is a trend that is expected to continue. Interestingly, the tremendous growth of the nutraceutical market is strongly driven by the rising consumption of dietary supplements (which in 2013 took up a market share of 37%), and in particular a sharp increase in the sales of herbal and botanical supplements (RNCOS, 2013). Overall, the international herbal supplement and remedies market is expected to reach US\$ 93 billion by 2015 (Global Industry Analysts Inc, 2013).

The main markets for dietary supplements are the US, followed by Western Europe and Japan, all with an affluent middle class willing to invest in alternative health and food products. While the US dominates the overall market in nutritional supplements, Europe accounts for the largest share of the world market in *herbal/botanical* supplements and remedies. Asia-Pacific and Japan make up the other important market for botanicals, with the Asia-Pacific market (led largely by China and India) set to pave the way with the highest growth rate (10.5%) through 2017 (Global Industry Analysts, Inc, 2013).

Although moringa leaf powder is traded on an increasingly large scale, market data about trade volumes and market share are not available. Judging by the increasing number of products available on the international market (as well as the growing number of international producers), it seems safe to say that demand for moringa leaf powder products is growing. Various potential international buyers of moringa products confirm that there is demand for this product, expressing strong interest when asked if they would consider sourcing Haitian moringa leaf powder (see box 3).

In the US, moringa is increasingly becoming available in health shops, both online and offline. While the leaf powder has been sold for a few years already, stores like Whole Foods are also starting to carry 'consumerready' products like the Kuli Kuli health bars, which currently contain moringa sourced in Africa. Various US companies have started to produce their own moringa, most often in Central or Latin America.

Although moringa leaf powder as a dietary supplement is becoming increasingly popular, in the European food segment moringa leaves are currently mostly used in teas or energy drinks (BTC - Belgian Development Agency). They are marketed as caffeinefree energy boosters and as a superfood, with a composition comparable to spirulina. Under current EU regulation, only the whole or powdered leaves of moringa are allowed to be imported as food. Potential for import of other products derived from moringa leaves-such as leaf extract-remains limited as their status under the Novel Food Regulation is unclear (more about this in the next chapter). Industry sources, however, indicate that extracts from moringa leaves could have good commercial potential considering their high antioxidant activity along with mineral and vitamin content (BTC - Belgian Development Agency).

The current global market for moringa leaf powder is dominated by India, which meets more than 80% of global demand. That such a large percentage of global moringa production is taking place in India is largely due to the country's long tradition of including moringa in its food consumption. As a result, Indian moringa is grown on large plantations, making it possible for Indian wholesalers to sell moringa leaf powder at a comparatively low price (and most of the time online). More recently, the market has seen additions of various African companies that differentiate themselves by branding their moringa products as 'wild-collected' and/or grown by smallholder farmers. They claim their moringa leaf powder is, as a result, of a higher quality, while also providing a story that Western consumers consider important. The market is completed by a variety of Western retail shops that sell smaller packages to end consumers in the US and Western Europe (see Annex II for a sample of international producers of moringa products). Interestingly, it is not financially feasible to process moringa leaves in the EU. This is mainly due to the fact that moringa leaves need to be dried immediately upon harvesting and the cost of transporting loose dried leaves (higher volume as well as more weight due to stems) is much higher than transporting dried leaf powder. This means EU buyers are dependent on countries that produce moringa in powdered form in order to meet their demands.

While strong market growth means there is space for new entrants on the market for moringa leaf products, it will be essential for new players to differentiate themselves from the current major ones. In order to avoid competition with Indian (and increasingly Chinese) wholesalers that already offer moringa leaf powder at a comparatively low price, Haitian producers are most likely to be successful targeting market niches where they are less subject to rivals and can demand higher margins. Examples of such niches are companies or retailers that target the higher end of the market with high quality, exotic products that are certified sustainable, fair, and/or organic.

#### Pricing of Moringa Leaf Powder on the International Market

Overall, prices for moringa leaf powder on the global market fluctuate enormously, depending on quantity, quality, and end use of the product. Wholesale prices for Indian moringa leaf powder (the product sold on the largest scale) range from US\$ 2.26 - 7.90/lb, with an average price of US\$ 2.97/lb. (source: ZAUBA.com). A quick online search on Amazon and other websites selling moringa products shows that retail prices for moringa leaf powder can range from US\$ 14 - 38/lb, and up to US\$ 180/lb when sold as capsules or pills (e.g. at the online health shop www.hanoju.nl). Annex III provides a sample of some of the value-added moringa leaf powder products

currently available on the international market, including pricing.

## 4.2 THE INTERNATIONAL MARKET FOR MORINGA OIL

Exotic plant-based oils like moringa often have specific active and functional properties, making them particularly valuable for use in cosmetic products. Following health and wellness trends, Western consumers increasingly prefer cosmetics with ingredients derived from plants, rather than mineral oil. This trend-to consume 'truly natural' cosmetic products-is in line with other patterns in Western society, where consumers increasingly adopt green values and seek out companies that accept responsibility for social issues and the environment. In response to these trends, the cosmetic industry has begun to differentiate its products by using more exotic vegetable oils, in turn triggering a growing international demand (and thus higher prices) for oils derived from sources like moringa.

Global trade statistics are only available in an aggregated form for exotic vegetable oils. Besides moringa oil, which constitutes a minor proportion, this product group also includes apricot kernel oil, cupuacu butter, argan oil, baobab, papaya seed oil, shea butter and others. Moreover, the data does not allow for distinguishing between fully natural products and chemically refined products (CBI, 2009). Therefore, this chapter is largely limited to analyzing the general market trends for exotic vegetable oils, which includes moringa oil.

As illustrated in Figure 5, the volume of global imports of exotic vegetable oils was at a high level in 2007 (approximately 700,000 tons) and maintained a quite constant level during 2010 and 2011 (approximately 600,000 tons). The single most important importer was the EU, which imported around half of the volume from Developing Countries (DCs). As illustrated in Figure 6, the value of global imports of exotic vegetable oils

increased from around US\$ 1.05 billion in 2009 to almost US\$ 1.4 billion in 2011. This shows that exotic vegetable oils are an increasingly attractive high value-added commodity.



Figure 5 - Global imports (in volume) of exotic vegetable oils (2007-2011). (Source: Compilation GIZ (2013), based on data from ITC (ITC, 2013a; ITC, 2013b). For 2008, no aggregated data for global



Figure 6 - Global imports (in value) of exotic vegetable oils (2007-2011). (*Source: Compilation GIZ (2013), based on data from ITC (ITC, 2013a; ITC, 2013b).from ITC (ITC, 2013a; ITC, 2013b).* 

The EU is by far the largest market and, therefore, will be analyzed in greater detail (see Figure 7). In 2011, the EU accounted for almost half (49 per cent or US\$ 666.7 million) of global imports of exotic vegetable oils. The market in the US accounted for 7 per cent or US\$ 97.6 million. The remaining share of 44 per cent, or US\$ 595.9 million, was made up by imports of Asian countries, most importantly Japan, Malaysia and Singapore.



Figure 7 - Global imports (in value) of exotic vegetable oils in 2011 by region (Source: Compilation GIZ (2013), based on data from ITC (ITC, 2013a; ITC, 2013b).

Within the EU, the three largest importing countries (accounting for 26 per cent of global imports) were France, the Netherlands and Germany. Exotic vegetable oils are typically imported to the EU in crude form and then processed and refined inside the EU, which results in considerable value addition and mark-up. Thereby, a significant intra-EU trade with exotic vegetable oils is taking place, which is difficult to measure and generally underestimated (CBI, 2009).

Figure 8 shows that the price for exotic vegetable oils is considerably higher and has proven more stable than the one for more widely used vegetable oils. The world market price for exotic vegetable oils has grown from around US\$1,450 per ton in 2007 to



Figure 8 - World market prices for selected vegetable and exotic vegetable oils (2007-2011) (Source: Compilation GIZ (2013), based on data from ITC (ITC, 2013a; ITC, 2013b). For 2008, no aggregated data for global imports were available.

almost US\$2,300 per ton in 2011. Remarkably, it did not experience the same steep decline of the prices of other vegetable oils during 2009 and 2010.

With regard to the EU market, the price for exotic vegetable oils remained comparably stable between 2009 and 2011, while the prices for other vegetable oils increased sharply during the same period (see Figure 9).

It is important to note that the price spectrum in the group of exotic vegetable oils itself varies significantly. Moringa oil, together with argan and papaya seed oils, is at the very high end of this spectrum (CBI, 2009). One reason is the small amount of moringa oil that is currently available on the world market, which renders it a rare and expensive commodity. Moreover, the price obtained for moringa oil varies again depending on the quality of the oil (the ideal oil should be cold pressed, virgin, filtered, and not mixed). Finally, the price is influenced by the certifications (e.g. organic, Fairtrade) of the final product.



Figure 9 - EU market prices for selected vegetable and exotic vegetable oils (2007-2011) (Source: Compilation GIZ (2013), based on data from ITC (ITC, 2013a; ITC, 2013b).

Most demand for moringa oil for use in cosmetics currently comes from the US, but several European cosmetic manufacturers have picked up on it as a way to differentiate themselves on the market (BTC - Belg. Devt. Agency). With the cost of importing Moringa seeds being too high, most buyers on the EU and US markets source their moringa oil from plantations in India. Companies are also increasingly interested in moringa oil produced elsewhere (e.g. The Body Shop, which is sourcing from Africa). This is mainly due to the perception that moringa oil produced in African countries is of higher quality, while coming with a better story. In line with that development, various buyers have expressed serious interest in buying Haitian moringa oil that is certified organic and can be demonstrated to have been grown by smallholder farmers.

Although moringa oil can be used directly in cosmetics upon extraction (requiring little further refinement for its color, odor and stability), EU and US

companies often refine or process it further because of their own product specifications. Due to the high quality and equipment requirements this requires, such secondary processing occurs almost exclusively in Europe or the US.

An interesting observation can be made when comparing the market for moringa oil with that of moringa leaf powder: the market for moringa oil is less dominated by Indian wholesalers. One of the main reasons for this is the popularity of young moringa seedpods as a culinary delicacy in India. This means production of young seedpods competes with the production of mature pods required for moringa oil production.

#### Pricing of Moringa Oil on the International Market

Similar to moringa leaf powder, the prices for moringa oil vary greatly depending on the quantity and quality of the oil, and certifications (e.g. organic, Fairtrade) of the final product. Prices also depend on fluctuating demand from Europe and the US. Moreover, demand from India and other Asian markets for fresh canned seed pods also influences the price of the oil. Prices for oil produced in India are lower, but these oils are not always considered the highest quality (BTC, 2014).

According to the trade statistics website Zauba.com, wholesale prices for moringa oil exported from India ranged from US\$4.05 - 16.70/lb over the period 2012 - 2014, with an average price of US\$10.31/lb. In liters, this translated to an average price of US \$32.13/L (minimum US\$18.5/L, maximum US \$79.64/L). Producers of moringa oil in various other DCs reported they were able to get around US \$15.45/lb for their moringa oil (sourced from local smallholder farmers) on the international market (source: Moringa Connect).

A quick online search on Amazon and other websites selling value-added moringa oil products shows that retail prices for moringa oil can vary wildly, ranging from US\$18/L for semi-wholesale packaging (of a pint of moringa oil) up to US\$650/L when sold as a 'serum' (sold on Amazon at US\$9.99/15ml). Annex III provides a sample of some of the value-added moringa oil products currently available on the market, including pricing.

## 4.3 THE LOCAL (HAITIAN) MARKET FOR MORINGA PRODUCTS

Until recently the local Haitian market for moringa products remained largely undeveloped. This has begun to change over the past two years following international trends along with the Haitian government's recognition (led by the Ministries of Health and Agriculture) of moringa's potential to serve as a powerful tool in the local fight against malnutrition and deforestation. In 2013 the government launched a large-scale information campaign aimed at informing the local population about moringa's many benefits. Over 500 schools were reached and a National Moringa Day was instituted on June 5th, 2013. In addition a publicprivate platform, the Haitian Moringa Network, was created to bring together all the main stakeholders with an interest in developing Haiti's moringa sector (see Annex IV which contains a list of potential stakeholders in the Haitian moringa sector).

The impact of these efforts has had results: local awareness of moringa (moringa leaf powder in particular) is clearly on the increase, and as a result demand for moringa products is growing. To meet this increased demand, more farmers, companies and/or organizations are starting to grow (and to a much more limited extent process) moringa, resulting in a variety of locally produced moringa products becoming available in the local market. While most of these initiatives are still operated on a largely informal basis, there is a clear interest (and potential) to develop more commercial moringa enterprises (more about this in Chapter 5, which describes the current value chain for moringa leaf powder in Haiti).

# The Local (Haitian & DR) Market for Moringa Leaf Powder

In Haiti, following global trends and information campaigns initiated by the government, the

benefits of moringa leaf powder are becoming increasingly well known. Many of those interviewed for this study, across all income groups, mentioned that they had heard about the benefits of consuming moringa leaf powder. More importantly, a substantial amount indicated they have recently started adding both fresh moringa leaves and moringa leaf powder as a supplement to their meals. As a result, demand for moringa leaf powder, albeit modest, is on the increase, with middle and higher income groups in particular expressing interest in buying the leaf powder.

The local market for moringa leaf powder is still very small and was described as being mostly informal. Farmers in rural areas often source from moringa trees in their garden or neighborhood and, if processed at all, dry and grind the leaves on their own (usually by using mortar and pestle). Consumers in Port-au-Prince are generally aware of informal traders or markets where they buy the product. Indeed, moringa leaf powder is most frequently sold at a few small shops throughout the capital, although various local products are also starting to appear in some of the capital's bigger supermarkets.

Perhaps not surprisingly, among the groups that are most interested in moringa leaf powder are NGOs that have nutrition and/or food security programs. Recognizing moringa's potential as a powerful tool in their fight against malnutrition, some NGO's have in fact started to grow their own moringa for use in feeding the local population. That said, other NGOs involved with nutrition and food security programs may very well constitute a potential market for Haitian moringa leaf products.

Although the focus of this research is on the potential to produce moringa products for the US, EU and Haitian markets, an important potential market that should not be overlooked is the Dominican Republic. Various Dominican moringa products have started to appear in the larger Dominican supermarkets over the past two years, signaling growing interest in moringa in that country as well. On top of that, the logistics and regulation required to export to the Dominican Republic might be easier than when exporting to the large international markets.

#### Pricing Moringa Leaf Powder on the Local Market

As is the case with moringa leaf power sold on the international market, prices for locally produced moringa leaf powder vary substantially: Pwodwi Lakay, a small company that focuses on selling its retail product to the local market, sells the powder for HTG 150/110gr (US\$14.4/lb). Another company, Aviti Natives, targets expats living in Haiti and sells its leaf powder for US\$4/50g (US\$36/lb). The company Plasbags S.A. retails various Haitian moringa products and are selling moringa leaf powder for US\$2.5 (60g) and US\$4.5 (110g), capsules for US\$12.5 (60 units) and peanut butter with moringa powder for US\$6.25 (200gr). They also sell moringa oil (1 oz/30 ml) for US\$10. Annex V provides a sample of some of the value-added moringa leaf powder products currently available on the Haitian market.

#### The Local (Haitian) Market for Moringa Oil

Demand for moringa oil is still very limited in Haiti. Part of this is due to the current attention for moringa leaf powder in Haiti, which is much easier to produce (and thus more widely available). Furthermore, the equipment required to produce moringa oil is largely unavailable in Haiti. The resulting start-up costs for locals interested in producing moringa oil can be prohibitive. Higher production costs also results in higher prices, making moringa oil too expensive for most people in the local market.

That said, two groups have recently started producing moringa oil on a small-scale: DLBioCarburants a relatively new company that produces various types of seed oils including moringa oil, and the ARN Foundation, an NGO that produces the oil to generate income for their other projects. There is some interest in local production of value-added moringa oil products, most notably from Ayiti Natives, a Haitian company that produces natural cosmetics products with exclusively Haitian ingredients. At the time of writing of this report, DLBioCarburants sold small batches of moringa oil for US\$25/L (or US\$80/gallon).



Figure 10 - Examples of Value-added Moringa Products

## 5. ACCESS TO INTERNATIONAL MARKETS: REGULATIONS & STANDARDS

Haiti has various advantages in terms of access to some of the main international markets for moringa products. As a "least developed country," Haiti enjoys preferential access to the EU, qualifying for the EU's Everything But Arms initiative. This grants duty free and quota free market access for virtually all exports from these countries. Also, Haiti's proximity to the US means that in terms of geographic access, it is less than an hour away (at least by air) from one of the world's other main global markets for moringa products.

While the international market—and the North American and EU markets in particular—offer great opportunities for exporters of moringa products, they are also demanding marketplaces. In order to be able to export to these markets, suppliers have to meet an array of regulations and requirements. With regard to moringa products, the most relevant are related to sanitary and phytosanitary standards, which together define the requirements for product safety and for animal and plant health.

Since high product quality is one of the buyer's main concerns, various common standards and supplier qualifications exist that help buyers ensure they consistently end up with high quality products. Product traceability and compliance with Good Manufacturing Practices (GMPs), alongside a host of other potential supplier qualifications, are becoming of increasing importance.

Finally, following international consumer trends, many global retailers increasingly demand, or greatly value, compliance with internationally recognized voluntary standards, such as GLOBALG.A.P. (Good Agricultural Practices), Fairtrade or organic. These voluntary standards may be of particular relevance for new exporters to the international market, as they can function as proof of reliability for potential buyers (2013 - CBI - Market Competitiveness).

The following provides further information on specific regulations, requirements and selected (voluntary) standards that need to be considered when planning for the export of moringa products to the international market.

## 5.1 INTERNATIONAL REGULATIONS FOR MORINGA LEAF POWDER

#### EU Regulations Relevant for Moringa Leaf Powder

The EU has developed a sophisticated system of regulations and standards to guarantee consumer health and safety, and to take into account social and environmental aspects.

Moringa leaf powder falls under the category of "nutritional supplements," which the EU defines as "concentrated sources of nutrients, or other substances, with a nutritional or physiological effect, the purpose of which is to supplement the normal diet" (European Commission, 2006). Nutritional supplements are food products that, when imported to the EU, need to comply with the regulations concerning public health, particularly food hygiene. This includes food safety standards, general hygiene provisions, the application of the Hazard Analysis and Critical Control Points (HACCP) system and productspecific requirements. While the compliance with these regulations is normally controlled at the point of entry, pre-export inspections are reportedly possible in certain cases. As a principle, there are shared obligations between the food business operators, importers and the respective authorities in EU member states and exporting countries. Given the

strict regulations, importers typically require that all producers have a food safety system in place, e.g. to make sure that the necessary phytosanitary certificate is issued by the Ministry of Agriculture in the respective exporting country (GIZ, 2013).

#### Moringa Leaf Powder & the EU Novel Food Catalogue

An important piece of regulation with regard to food products in Europe is the EU's Novel Food Catalogue. It lists products of plant and animal origin and other substances subject to the Novel Food Regulation ((EC) No. 258/97), and serves as orientation on whether a product will need authorization under this regulation. Essentially food or food ingredients that were consumed to a significant degree before 15 May 1997 (when the Novel Food Regulation was signed) are not subject to the Novel Food Regulation. That said, if foods and/or food ingredients were used exclusively in food supplements, new uses in other foods require authorization under the Novel Food Regulation. EU countries may also restrict the marketing of a product through specific legislation.

Moringa oleifera leaves and pods (containing the seeds) are not novel. This means that these products are not subject to the Novel Food Regulation, although specific legislation may restrict the placing on the market of moringa leaf powder as a food or food ingredient in some EU Member States. It is recommended to always check with the national competent authorities. Importantly, as of yet only whole and powdered moringa leaves are allowed to be used as, or in, food as well as, or in, food supplements according the EU Novel Food Regulation.

#### Health Claims

Moringa is currently not registered in Europe as a pharmaceutical ingredient or herbal medicine in that the European Food Safety Authority (EFSA) has not approved any submitted health claims for moringa. Therefore no health claims for moringa are authorized to be used in the EU.

#### **US Regulations Relevant for Moringa Leaf Powder**

Similar to the EU, the US has developed its own systems of regulation and standards to guarantee consumer health and safety.

With regards to moringa leaf powder, one of the regulations that applies is the Dietary Supplement Health and Education Act (DSHEA), passed in 1994. The DSHEA clarified rules about how US companies could market botanical products like moringa powder on the US market (ultimately resulting in a boost of sales of these products). Importantly, moringa has been consumed in the US in foods prior to the passage of the DSHEA in 1994, and as such does not need a new dietary ingredient notification for use in supplements.

There is no official approval process or certificate issued by the FDA to approve the sale of any food product or dietary supplement. However, the FDA has established stringent regulations, called Good Manufacturing Practices (GMPs), to ensure the safety and manufacturing of foods sold in the US.

With regards to GMPs for dietary supplements, the FDA in 2007 published its final rule entitled Current Good Manufacturing Practice (CGMP) In Manufacturing, Packing, and Labeling Or Holding Operations For Dietary Supplements. The regulation establishes the minimum CGMPs necessary for activities related to manufacturing, packaging, labeling, or holding dietary supplements to ensure the quality of the dietary supplement. Foreign firms that export finished dietary supplement products to the US must satisfy the requirements of this regulation. However, the small number of foreign products in the FDA dietary supplement sales database suggests that relatively few foreign firms do so. The foreign firms that will be most affected by this regulation are suppliers of natural ingredients for use in dietary supplement products. Although suppliers of dietary ingredients are not directly covered by the regulation, the need of manufacturers to meet the ingredient specifications required by the regulation will indirectly affect foreign suppliers (as well as domestic suppliers) (ITC, 2012).

#### The FDA GRAS Affirmation Process

In order to ensure consumers that a product is considered safe, many companies that produce or sell dietary supplements choose to go through the self-affirmed "GRAS" affirmation process. GRAS is the acronym for the phrase 'generally recognized as safe', referring to a safety affirmation process of food and functional food ingredients that applies under sections 201(s) and 409 of the Federal Food, Drug and Cosmetic Act (the Act). While any food and functional food ingredients are normally "subject to premarket review and approval by FDA," this process can be avoided if a "substance is generally recognized, among qualified experts, as having adequately shown to be safe under the conditions of its intended use" (ITC, 2012).

In order for a company to get a GRAS affirmation for a product, they are required to send a 'GRAS notice' to the FDA, with a reasoning (ideally backed by experts) as to why a product should be considered GRAS. The FDA does not provide a 'yes' or 'approved' answer to GRAS notices, but can respond either that they do not agree with the reasoning, or that they 'have no questions.' Companies are free to market the ingredient with or without submitting a notice, as the GRAS notification process is a voluntary process. However, many companies will prefer to wait to get an answer from the FDA before marketing due to legal and safety issues.

Companies may prepare notifications themselves, but usually they will hire a group of experts to help them do this as a GRAS panel. This group of experts usually consists of approximately two or three individuals who are qualified in the field to review the data and make a determination (such as a toxicologist, a food scientist, a pharmacologist and/or a chemist). If a company wants a GRAS notice for a new or proprietary ingredient, they will have to complete safety studies first, and ideally have those studies published in the public domain. Some companies will hire a full service laboratory to do the safety studies and GRAS notification for them, such as Covance (www.covance.com).

Another option is for a company to create a GRAS panel and accompanying documentation, but instead of notifying the FDA, to keep this information inhouse and go to market (as no premarket approval is required by the FDA). This is possible because there is no requirement by the FDA that they are notified of a company's decision (and reasoning) why a particular product is GRAS. Instead, companies are only required to make sure a product is GRAS, and they only need to share their reasoning of how and why they have determined this if the FDA requests evidence. The costs of creating a GRAS panel usually depends on the consulting fees for the gualified experts, and the costs of the safety studies can vary widely depending on how novel the ingredient is, its scope of use, and if there is already pre-existing published information available (ITC, 2012)

While moringa leaf powder is not automatically considered GRAS, various established companies have GRAS notices for the moringa leaf powder products they sell. If these companies work with suppliers, they may require these suppliers to provide them with details about the the manner in which they process their products in order to make any necessary changes to their GRAS notice.

#### Health Claims

Although moringa has been evaluated in a many scientific studies, FDA has classified moringa as a food supplement and not a medicinal product. As such, it is not allowed to claim any health benefits or to recommend moringa products for any medical condition. This is not to suggest that such health benefits are not used in marketing of individual products, only that such practices fall outside FDA guidelines.

## 5.2 INTERNATIONAL REGULATIONS FOR MORINGA OIL AS AN INGREDIENT FOR COSMETICS

The US and EU both work to ensure the safety of cosmetics for consumers through various types of regulation. In the US, the cosmetics industry is regulated by the Food and Drug Administration (FDA), which has been granted broad regulatory authority under the federal Food, Drug and Cosmetic Act, enacted in 1938. The 27 EU member states have transposed the European Union Cosmetics Directive, enacted in 1976, into national law. Each member state has health authorities, which then regulate cosmetics within their respective national boundaries according to the law.

In contrast to many developing countries, neither the EU nor the US imposes a requirement for government licensing or premarket approval of cosmetic products. Instead, both jurisdictions rely on manufacturers to substantiate the safety of their products prior to marketing, list all ingredients on the product label and comply with any restrictions that are established for cosmetic ingredients and products.

#### EU Regulations Relevant for Moringa Oil

Moringa oil, when used in the cosmetics industry, needs to comply with the EU Cosmetics Directive that specifies the requirements concerning the composition, labeling and packaging of cosmetic products (European Union, 2011). Moringa oil is already included in this Directive. Companies that export to the EU are supposed to handle in accordance with the Good Manufacturing Practice of the European Federation for Cosmetic Ingredients (CBI, 2013). Ingredient names must comply by law with EU requirements by using INCI names (see below).

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) (GIZ, 2013). 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 (UK REACH Competent Authority, 2012).

#### **US Regulations Relevant for Moringa Oil**

The agency charged with oversight of cosmetics in the US, the Food and Drug Administration (FDA), has no authority to require pre-market safety assessment as it does with drugs. With the exception of color additives, cosmetic products and ingredients are not subject to FDA pre-market approval authority, essentially making them among the least-regulated products on the market. Companies and individuals who market cosmetics have a legal responsibility for the safety of their products and ingredients (website FDA).

In the US there are no regulations setting forth specific GMP requirements for non-drug cosmetics (ITC, 2012). However, under the Food, Drug, and Cosmetic Act and the Fair Packaging and Labeling Act, certain accurate information is a requirement to appear on labels of cosmetic products, and products must be safe for consumers under labeled or customary conditions of use.

#### **INCI & CAS Numbers**

In order for any natural ingredient to be used in cosmetic products it must be registered with an INCI and CAS number. INCI stands for International Nomenclature of Cosmetic Ingredients and is a systematic name coined by the International Nomenclature Committee to describe a cosmetic ingredient. INCI names are mandated on the ingredient statement of every consumer personal care product, allowing the consumer to identify the ingredients. INCI numbers are used internationally, and as such apply both to the EU and US markets.

CAS stands for Chemical Abstracts Service (CAS), a division of the American Chemical Society. A CAS

number is a unique numerical identifier assigned by Chemical Abstracts Service (CAS) to every chemical substance described in the open scientific literature.

Moringa oil is already registered as a cosmetic ingredient and as such already has its own CAS and INCI number (CAS Number: 93165-54-9, EINECS/ ELINCS No: 296-941-1). *Moringa Oleifera* Seed Oil is classified as an emollient and skin conditioner and no restrictions applied upon writing of this report (applying to EU only).

## 5.3 COMMON STANDARDS & SUPPLIER QUALIFICATIONS

With increasingly critical end-consumers, one of the main concerns of retailers is to guarantee a constantly high product quality. They therefore seek to establish direct links with producers and processors of natural products like moringa leaf powder and moringa oil. Following market trends, aspects like traceability are becoming more and more important, as is compliance with Good Manufacturing Practices (GMPs) and a variety of other potential supplier qualifications.

#### Traceability

'Traceability' is a concept developed in industrial engineering and was originally seen as a tool to ensure the quality of production and products. Economic literature from supply-chain management defines traceability as, "the information system necessary to provide the history of a product or a process from origin to point of final sale."

Traceability is particularly important in the food sector: food traceability systems allow supply chain actors and regulatory authorities to identify the source of a food safety or quality problem and initiate procedures to remedy it. It is also becoming an increasingly common element of public (both regulatory and voluntary) interventions and of private systems for monitoring compliance with quality, environmental, and other standards. Furthermore, it is also a way for companies to address consumer interest in the "world behind the product", for example by demonstrating that the ingredients used in their products were grown and harvested in a sustainable, ethical manner.

The benefits of traceability for consumers, government authorities, and business operators are widely recognized. However, traceability requirements constitute a new set of challenges for smallholder farmers in developing countries where they often lack the resources to comply with increasingly strict standards. This applies in particular to requirements for tracking and monitoring environmental and supply chain variables, often done by means of sophisticated technologies (also see: World Banks "Global Markets, Global Challenges/ Improving Food Safety And Traceability While Empowering Smallholders Through ICT")

Support for traceability projects designed to connect small-scale producers to global markets comes from a variety of sources, including NGOs and development agencies. An example of a traceability intervention that is particularly relevant in connection with potential oil processing in Haiti is an IFC project in Palestine. This IFC project improved the competitiveness and export prospects for West Bank olive oil by assisting small and medium-size enterprises in implementing a basic traceability program to maintain quality, including managing data related to the sources of oil, pressing, handling, storage, and packing operations (Foodreg, n.d.).

Another example can be found in Moringa Connect, a company that is working with smallholder moringa farmers in Ghana, and which uses GPS as part of their basic traceability system. This system not only helped their farmers to know the exact land area where they were growing their moringa, but is also allowed them to see exactly where the seeds they acquired locally came from.

#### **Supplier Qualifications**

Buyers may request a variety of information from their suppliers. The more established, larger manufacturers or brand holder companies on the international market have supplier-qualification programs requiring suppliers to qualify before they can sell to the manufacturer. In some cases, the buyer's purchasing department is not authorized to make a purchase until after the Quality Control (QC) unit has inspected and qualified the production site(s) in the country of origin.

To qualify as a supplier, the buyer's QC unit may carry out a Good Agricultural and Collection Practices (GACP) inspection if the supplier is a producer of botanical raw materials, or a GMP inspection if the supplier is a producer of value-added extracts or oils. Questionnaires may be used if a physical inspection cannot be carried out. Copies of valid certification documents and inspection reports may be requested by the buyer. For each ingredient, the buyer will have detailed written specifications. Below are other potential requirements of a supplier-qualification program (information provided by the ITC):

#### Material Safety Data Sheets (MSDS)

These are information forms that state the properties of a given substance (the raw material) which are considered important in workplace safety including: procedures for handling or working with that substance in a safe manner; physical data (melting point, boiling point, flash point, etc); toxicity; health effects; first aid; reactivity; storage; disposal; protective equipment; and spill- handling procedures. Formats vary by country. Normally, for an agricultural raw material product, an MSDS is not required.

#### Toxicology/Safety Testing

In the US, companies are legally required to assure the safety of their products. Even though this burden lies on the product manufacturer/brand holder, many manufacturers pass on this responsibility to their suppliers. If the raw material is an agricultural product (without proprietary processing), testing is not normally required (as the ingredient is already established on the market) unless it is a new product. In this case the buyer might ask a supplier for safety testing or references.

#### Identity & Quantitative Compositional Breakdown

This includes: the Latin name of the plant; part(s) of the plant used (e.g. flower, leaf, root, fruit pulp); identity of any solvents used in extraction; ratio of solvent to botanical prior to extraction; and the recent yield after extraction. In the case of a multicompositional mixture, the full disclosure of components within the mixture is required.

#### **Certifications**

Proof of relevant certification. Examples are transaction certificates and/or Fairtrade International (FLO) certification.

#### Status (if listed on Redlist, by the IUCN or in CITES)

In the case of botanicals, buyers will often want to know if the botanical is listed on either the Redlist (The World Conservation Union Redlist of Threatened Species (see www.redlist.org)), IUCN (the International Union for Conservation of Nature), or in CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora, (see www.cites.org)).

#### Pricing Schedule

Some buyers will ask to see a pricing schedule with pricing in price per kilogram, including the manufacturer and distributor price (if applicable). Some buyers will also want to know production costs in the case of fair trade certified produce.

#### Raw Material Specifications

A certificate of analysis and specifications is normally required for dietary supplements (herbal medicines) including acceptable ranges for each specification. Physical descriptions are also necessary, including the description of the odor and color, as are special handling or shipping requirements.

#### Analytical Test Method for All Tests Appearing on the Certificate of Analysis

If the product is a processed botanical product (such as extraction), and carries a specification sheet, the methods for determining reference standards and testing should be disclosed.

#### Microbiological Analysis

Buyers typically set an upper limit for the acceptable colony forming units per gram or millilitre (ml), as determined by aerobic count or most probable number. Micro-organisms that are often restricted are gram-negative bacteria Staphylococcus aureus, Candida albicans, Enterococcus species, or Aspergillus niger. Products with high water content often require microbiological testing (except for fresh produce), as they may be more susceptible to microbiological contamination.

#### Trace Contaminants/Impurities

This might include: heavy metals, pesticides, iodine, 1,4-dioxane, ethylene oxide, residual catalysts, processing aids, and reaction by-products (residual monomers).

#### Environmental Impact

If the product is a harvested botanical (especially those harvested from wild environments), information on the sustainability of harvesting may be requested. In the case of a processed product, there may be requirements for information relating to biodegradability (or other degradation pathways), aquatic toxicity, volatile organic compounds (VOC) content, accumulation and persistence, treatability in a public owned treatment plant, bio-concentration and adsorption.

#### Lot Samples

Most buyers require samples from separate production lots in order to test internally and assess average quality.

### **5.4 VOLUNTARY STANDARDS**

As outlined in an earlier chapter, voluntary standards and initiatives, such as GLOBALG.A.P., Fairtrade, and organic play an increasingly important role. Other examples are FairWild certification from the Rainforest Alliance. A number of global retailers have made public commitments to increasingly source their products from producers that possess these, and other, certifications. It should be noted that moringa products, such as moringa leaf powder and moringa oil, are highly specialized products for niche markets, where these labels in essence are "de facto" mandatory given the prevailing consumer preferences. Table 2 gives on overview of selected voluntary standards that seem particularly relevant for exports to the EU and US markets; they will be explained in greater detail in the following sections.

#### GlobalG.A.P.

GlobalG.A.P. (formerly EUREPGAP) began in 1997 as an initiative of retailers aiming to agree on standards for the development of good agricultural practices (GAP) in order to ensure food safety. Today, GlobalG.A.P. is a private sector body that sets voluntary standards for the certification of agricultural products worldwide. The GlobalG.A.P. standard is primarily designed to reassure consumers about how food is produced on the farm by minimizing detrimental environmental impacts of farming operations, reducing the use of chemical inputs and ensuring a responsible approach to worker health and safety as well as animal welfare. GlobalGAP acts as a practical approach to GAP anywhere in the world. The standards have the following key aspects:

- Technical production standards: to ensure sustainable agriculture by means of integrated pest management and integrated crop management, so as to minimize the impact of residues on man and the environment;
- Hygienic standards: to prevent chemical, microbiological or physical contamination of the harvested crops taking place;
- Working environment: to ensure workers health and to prevent social abuse of workers; and
- Traceability: to ensure that, if a problem occurs, the product is traceable to the farm where it was grown.

Today, most global retailers in the food sector demand the certification from their suppliers (GlobalG.A.P., 2013). GLOBALG.A.P. certification can be obtained from authorized private agencies. Individual producers and groups of producers can apply for certification, the cost of which depends on the certification agency chosen and the time spent on the inspection. In addition to the certification fee, the producer must pay an annual fee to GLOBALG.A.P. in order to maintain the certification. In Haiti, third party certification for GLOBALG.A.P is done by Scientific Certifications Systems (SCS).

#### **Fair Trade**

Another promising certification for moringa products is fair trade, which seeks to improve the trading and, thereby, living conditions of producers in developing countries. The fair trade standards aim at establishing a partnership between producers and consumers. Therefore, the standards apply not only to the production process, but also to the commercialization and trading conditions. Fair trade certification can be applied for by a group of producers in a cooperative, farmer associations or large farms with an organized labor force.

There are various fair trade organizations on the market and they use different marketing strategies and certification bodies for their labels. Among the most common and respected organizations are Fairtrade Labeling Organization (FLO), the World Fair Trade Organization and Fair Trade USA. In Haiti, third party verification for FLO is done by ECOCERT Organic Standards (EOS - www.ecocert.com/haiti). Fair Trade USA is certified by the above mentioned Scientific Certifications Systems (who also certify for organic).

#### Organic

In Haiti, traditional agricultural production is mostly 'de facto' organic. Therefore, organic farming has a significant potential in the country. Organic production systems focus on environmental conservation and on food quality and safety. Although standards for organic farming have been mainly developed by private institutions, a number of countries also have national organic standards and regulations, although that is not the case yet in Haiti. In Haiti, ECOCERT as mentioned above, also offers organic certification under three standards: European standard (EOS), American standard (NOP: National Organic Program) and JAS, which is Japan's national standard. Another company that has provided organic certification in Haiti is ONECERT.

It is important to note that any certification agency offering services in Haiti must be officially recognized in the country where the product is to be sold. While the specifics for organic certification vary, Box 3 below provides an overview of some of the most important requirements.

STANDARD	PARTICULARLY RELEVANT FOR	MAIN OBJECTIVES OF THE STANDARD	CERTIFYING ORGANIZATION
GLOBALG.A.P.	Export-oriented medium and large scale agro-industries and producer groups.	Improvement of food safety and traceability of products.	Certificates are issued by GLOBALG.A.P. approved certification bodies (CBs).
Fair Trade	Small scale producers that are organized in associations and producers with an organized labor force.	Improvement of the trading, and thereby living condition for producers in developing countries; promotion of the concept of sustainability.	Private fair trade organizations such as FLO-CERT. In Haiti: Ecocert and Scientific Certification Systems (SCS)
Organic	Small, medium and large-scale production.	Improvement of food quality and safety and environmental conservation.	Ecocert Scientific Certification Systems

Table 2 - Overview of Selected Voluntary Standards

#### BOX 3 - Selected Requirements & Information for Organic Certification in Haiti

- + Farmland needs to be free from prohibited synthetic chemicals for a specific number of years
- Synthetic chemical inputs, such as fertilizers, pesticides and genetically modified organisms, cannot be used
- Organic products need to be separated strictly from non-organic ones
- Detailed production and sales records need to be provided

With regards to organic certification in Haiti a few things can be observed:

- Certification is granted to co-operatives of small holder farmers. In order for farmers to be certified they
  must be apart of a co-op.
- ♦ The cost of certification is between 6,000 7.000 EUR. The certificate is valid for one year.
- Random inspection will be carried out during the one-year period. Assessment is done on basis of inspection of the entire production process: from the planting stage to the end product (planting method, processing plant, packaging).

## 5.5 REASONS FOR SLOW COMMERCIALIZATION OF MORINGA

Although there is clearly a market and growing demand for moringa products, from the literature it is difficult to make out why moringa has not yet been more widely commercialized. A few factors may have contributed to this situation:

- Although the medicinal properties and health benefits of moringa are widely documented (more than 250 publications can be found online) almost no scientific studies on moringa's properties have been conducted by recognized academic or scientific institutions. This makes it harder for companies to market their products with health claims.
- Information about best practices for moringa cultivation (and processing) is increasingly available. However, relatively little research has been done on large-scale commercial production of moringa (tree management, harvesting techniques, agronomy economics etc.). Similarly, there are almost no longer-term studies available on the 'economics' of moringa.
- Product quality of moringa available on the global market has at times been inconsistent. This can partly be attributed to natural variation and the nature of small-scale production. However, it may also have been a result of inadequate cultivation and harvesting practices, resulting in a lesser quality product.

## 6. HAITIAN MORINGA PRODUCTS: STRUCTURING THE VALUE CHAIN

When developing or upgrading a value chain for moringa products, and given that moringa is a multipurpose tree with a large variety of uses, the first step is to identify the product to be produced (leaf powder, oil, animal feed stock, etc.) and for which market. From this knowledge a specific production plan and actions can be developed (e.g. cultivation practices, harvesting and processing practices, marketing) that are tailored to optimize production of these specific products under specific conditions. The suggestions in this chapter focus on establishing a supply chain resulting in moringa products-moringa leaf powder and moringa oil in particular-that are sourced, produced and marketed in an ethical and sustainable way, and are suitable for export to the international market.

The first sub-chapter provides a brief overview of the current value chain of moringa leaf powder in Haiti (there is no current value chain of moringa oil in Haiti). The sub-chapters that follow provide suggestions for ways to upgrade and/or structure the respective supply chains for Haitian moringa leaf powder and Haitian moringa oil. Since key elements of the commercialization of both these products are the same, a specific sub-section is dedicated to consideration with respect to this aspect of both supply chains.

## 6.1 THE VALUE CHAIN OF MORINGA LEAF POWDER IN HAITI

Moringa leaf powder is still a new product on the Haitian market and is not yet produced on a commercial scale in Haiti. The quality of the moringa leaf powder products currently available on the local market varies enormously. This has mainly to do with a lack of clear processing standards which results in processing and packaging practices that range from adequate to clearly inadequate (mainly from a hygiene perspective). That said, the market has seen the entry of a few new retailers that are starting to experiment with processing techniques that allow for higher quality products. Although still on a small scale, some of these products are starting to come to market.

The market for moringa leaf powder was described as being rather informal. Given that no commercial production of moringa leaf powder currently exists in Haiti, the value chain for this product is short. Figure 11 illustrates the links in the value chain, which are described in greater detail below.



#### **Cultivation of Moringa Trees**

As described in Chapter 2, moringa trees are found throughout Haiti. Apart from those growing wild, they are mainly cultivated as a means of fencing smallholder household compounds and small plantations. While a few small-scale Moringa farms exist (mostly run by organizations that operate nutrition programs), bigger, commercially-operating farms are not yet established in Haiti. The interviewed smallholders stated that they mostly did not fertilize, water or prune trees, but only harvested the leaves. One of the main constraints mentioned by smallholders and rural households was the loss of leaves due to ruminant animals, particularly goats.

#### **Collection of Moringa Leaves**

The collection of Moringa leaves is mainly carried out by smallholder families, often by women and children. It is a part-time activity for farmers who also produce other crops such as corn, beans and a variety of other staple crops. The leaves are usually directly consumed in the respective household or further processed. In some cases, fresh leaves are sold to one of the few existing retailers of moringa leaf powder products, often based in the capital Port-au-Prince.

#### **Processing of Moringa Leaves**

The processing of leaves is often performed by women. The leaves are stripped from their branches and left to dry in the open for between two and four days, depending on the humidity of the climate. Some of the organizations that are growing moringa for their nutrition programs use converted shipping containers to dry the leaves, resulting in dried leaves of higher quality.

Commonly, the dry leaves are pounded in a wooden mortar. A few larger initiatives are using locally available flour mills to grind the dried leaves into powder. Depending on end use, the resulting powder is packaged in various ways, ranging from small plastic bags to more solid plastic or glass containers.

Overall, the largely informal processing results in a great variation in the granulation grade of the powder and irregular package sizes. Open-air drying of the leaves results in losses due to climatic influences and ruminants. Moreover, basic hygiene standards cannot always be guaranteed. The plastic bags used are generally not fit for the purpose, as they allow oxidation and the consequent rapid deterioration of nutritional value.

#### **Commercialization of Moringa Leaf Powder**

The commercialization of moringa leaf powder follows a simple and informal system. Processors sometimes sell the powder directly to the end consumer, but more often sell it to intermediaries or the few retailers that currently sell moringa leaf powder. The bigger retailers mainly consist of a few small companies that repackage the bulk leaf powder into smaller retail size units and then sell in a few small shops and the bigger supermarkets in the capital Port-au-Prince.

#### **BOX 4 - Commercialization of Moringa Leaf Powder for Lower-Income Groups**

With regards to the commercialization of moringa leaf powder, it is worth mentioning Sakala, a Haitian NGO that currently runs a youth leadership program in the Cite Soleil section of Port-au-Prince. As part of its activities, Sakala has established a small urban moringa plantation with a modest moringa leaf processing space. Whereas most retailers target the more lucrative high-end market, Sakala is exploring a commercialization model that also enables low-income groups living in Cite Soleil to have access to moringa leaf powder. They do so by deploying local youth in selling small, one-serving size packages of moringa leaf powder that cost only cost 5 Haitian Gourdes (US\$0.08); a price low enough for the product to be affordable for the local population.

As shown in Chapter 4, the price for 100 grams of moringa leaf powder varies greatly between approximately HTG 150 - 300 (US\$3.18 - 6.36). Price mainly depends on the target group, with the lower end of the price spectrum covering products targeted for more informal local markets and the higher end targeted towards the luxury end of the market in Haiti.

## 6.2 UPGRADING/STRUCTURING THE VALUE CHAIN OF MORINGA LEAF POWDER IN HAITI

In order to exploit the existing market potential for moringa leaf powder in Haiti and abroad, one of the key challenges is to upgrade the value chain and thereby make the product competitive for both local and international markets.

Since there is currently little to no local knowledge available about commercial moringa production practices, it is recommended that every step outlined below be accompanied by adequate training for the relevant stakeholders involved. An excellent source of information on best practices for moringa leaf production and processing is the manual "Growing and Processing Moringa Leaves", developed by MoringaNews and the Moringa Association of Ghana. Many of the guidelines referenced below have been quoted from this particular manual.

#### **Inputs Supply: Propagation of Moringa Plants**

Currently, seeds for moringa plants are only reproduced through collection from wild-growing moringa trees. For an intensive or semi-intensive production, however, it is essential that seeds stem from trusted sources in order to guarantee that they are viable, clean and disease-free. Ideally, the seeds quality needs to be analyzed and improved with regard to the following determinants:

- Seed germination;
- Yield capacity; and
- Leaf nutrient quality.

There are currently no enterprises active in seed multiplication and sale, and moringa seeds are not yet commercialized in Haiti. A way to improve access to high quality seeds is the establishment of a number of seed farms throughout the country.

Studies should be conducted to establish the local sub-species of *Moringa oleifera* best adapted to the local climate and soils, and which provide the highest yields. Additional studies could be conducted into the impact of various local cultivation methods on yields and determining the leaf/seed quality of Haitian moringa.

Meanwhile, local seeds can be selected from prime trees and be used for breeding. Seeds should not be stored over long periods as they lose viability (germination capacity) after about one year. Sources of certified seeds can also be found in other countries producing moringa (e.g. India, Ghana, Tanzania, and Nicaragua).

Moringa could also be grown from cuttings cultivated in nurseries. However, these seedlings are more prone to attack by pests and their root system is less deep, rendering it more easily affected by climatic variables such as drought or wind.

# Cultivation Practices for Commercial Leaf Production

In order to produce moringa leaves (and pods) that are suitable for commercial processing, a stable production basis is required. It is highly challenging to do so by means of collection from wild growing trees only: yields of these trees may be low and unreliable, and more importantly, of vastly varying quality.

This means that, ideally, leaves harvested from trees found in the wild are a complement to leaves collected from larger planting sites. Cultivation techniques (e.g. spacing, irrigation, pruning) on the larger sites can be adjusted in order to ensure sustainable land use practices.

#### Planting

As outlined in Chapter 2, moringa grows on fairly poor soil. Consequently, it does not compete with food crops for rich soils. When choosing new planting sites, marginalized lands that are currently not in use make for a good option.

For leaf production, various spacing options can be considered (Moringanews / Moringa Association of Ghana, 2010):

- Intensive production: plants are spaced 15 x 15 cm or 20 x 10 cm, with conveniently spaced alleys (for example every 4 meters) to facilitate plantation management and harvests. These intensive systems are appropriate for commercial production but require careful management. Weeding, manuring and disease prevention require more skill because of high density. Although rotations of intensive plots can be used when mixed with other crops, intensive spacing by itself is perhaps not the most sustainable way to use land in the longer term.
- <u>Semi-intensive production</u>: trees are spaced 50 cm to 1 m apart. For small fields (and thus for smallholders) producing leaves from trees spaced at 1 meter is perhaps the best option. It gives good results with less maintenance. Fresh leaf weight yield is 1 to 5 kg per tree and year, which is the equivalent of 10,000 to 50,000 kg/ha per year. This is estimated to be reduced to around 1/6th of the volume after processing into powder. One hectare of moringa plantation would therefore result in between 1.67 kg and 8.3 kg of leaf powder after processing (Foidl, Makkar, & Becker, 2001).
- <u>Agroforestry</u>: Moringa trees can be sown in alleys and associated with other crops. The distance between moringa rows must be 1.5 - 4 meters, and they must be oriented East-West to ensure that intercrops receive enough sun. From the three methods mentioned here, the agroforestry method is by far the most sustainable in terms of long-term land use.

#### Productivity & Yields

Corresponding yields have not been widely reported ,and where they have been reported, the results widely vary (see table 3 below). It should be noted that productivity can vary substantially between seasons. A trial plantation in Nicaragua showed yields as low as 45 metric tons per hectare in the dry season and up to 115 metric tons per hectare in the rainy season. The months of June, July and August produced the highest harvest volumes, whereas the last three months of the rainy season (February, March, April) yielded the lowest (Sanchez et al, 2006).

In African studies (Togo, Benin) most of the harvests took place during the wet or cool seasons. During their dry season there was sometimes only one harvest, or none at all, to allow the plants to regenerate.

#### Maintenance

For commercial leaf production, the right care and maintenance of the moringa trees will greatly affect yields. Since moringa grows extremely fast even in its first year, it is essential to give trees a good shape when they are still young. Regular pruning is required obtain bushy leaf-growth, and will help to harvest the leaves at later stages of the trees maturity. Pruning for leaf production should be done at a convenient height (between 3 and 5 feet), depending on planting schemes.

Moringa can germinate and grow without irrigation when sown in the rainy season. However, for optimal growth, it is advisable to irrigate plants regularly during the first three months after seeding. Irrigation should be done sparsely but regularly and may be needed in order to produce leaves all year long. Mulching will help reduce loss of soil moisture and minimize irrigation needs during the dry months.

Fertilization must be done during land preparation, before seeding. After 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 (pruning can also be done at this time). If there are two rainy seasons, two applications are advised. Manure should be organic (no chemical fertilizers).

#### **Collection & Transport**

#### Harvesting

Shoots and leaves are ideally harvested manually, although mechanical harvesters could also be used for large-scale intensive leaf production. A high level of hygiene should be maintained. Produce should be harvested at the coolest time of the day: early morning or late in the evening. It is important to make sure there is no dew on the produce before harvesting, especially in the morning, to avoid rot during transport.

#### **Transportation**

Transportation in moringa leaf production is a very critical step in ensuring high quality leaves for consumption (Moringanews / Moringa Association of Ghana, 2010).

There are two main options:

• Cut big branches and transport whole to the processing center, if nearby, before defoliating (stripping or removing the leaves from the branch).

• Leaves can be tied together in bunches by their stem or better, thinly spread out on trays or mesh to reduce temperature build up.

Freshly harvested material should be transported to the processing center as quickly as possible to avoid deterioration. Fresh moringa leaves, transported loosely, should be well ventilated. For shorter distances aerated baskets or perforated plastic containers should be used to transport the fresh leaves. Avoid open vehicles. Under no circumstances should people or goods be placed on top of leaves. Transportation should be during cooler times of the day: early morning, evening or night. Leaves being transported over long distances should be in airconditioned or refrigerated vans to keep them cool until delivery at the processing center.

Due to the rapidly perishable nature of moringa leaves, the processing into moringa leaf powder needs to start directly after harvesting and transporting the leaves to the processing site. A functioning logistics management system is therefore a critical element in the value chain. It requires smallholders to communicate, cooperate and coordinate their harvest with transport services to the processing center to maintain the quality of the leaves and avoid deterioration (Moringanews / Moringa Association of Ghana, 2010).

Country	Technique	Yield (mt/ha/yr)	Source
Nicaragua	Intensive (1 million plants/ha, 9 harvests per year, irrigation, fertilization)	580	Foidl et al (2001)
N/A	Intensive (1 million plants/ha, 7 cuttings per year)	490-560	Radovich (n.d.)
Senegal	Intensive (1 million plants/ha, 6 cuttings per year, irrigation)	40-80	Olivier (n.d.)
N/A	Semi-intensive smallholder (1m x 1m)	10-50	Radovich (n.d.)
Niger	Semi-intensive smallholder (1m x 1m, 18 harvests per year)	47	Gamatie & Saint Sauveur (2006)
Togo	Semi-intensive smallholder (1m x 1m, 7 harvest per year)	5-10	Sogbo et al (2006)
Benin	Semi-intensive smallholder (1m x 1m, 7 harvest per year, irrigation every 5 days)	6	Ogoudadje & Saint Sauveur (2006)
Benin	Intercropping (500 plants / ha, 6 harvests)	1-2	Ogoudadje & Saint Sauveur (2006)

Table 3 - Moringa Production Yields (Fresh Leaves) using Various Cultivation Techniques

#### Processing of Moringa Leaf Powder

Processing should start immediately after harvesting and transporting the leaves to the processing point. The processing center needs to be equipped with:

- A washing station for washing the fresh leaves;
- A drying room (or solar drying equipment); and
- A burr mill (or a commercial hammer mill).

The following steps and guidelines are provided in the manual "Growing and Processing Moringa Leaves" (referenced throughout this chapter):

#### 1. Stripping the Leaflets

Strip all the leaflets from the leaf petiole. This can be done directly from the branches if the leaves have not been stripped off the main branch before transportation. At this stage, diseased and damaged leaves are discarded.

#### 2. Washing

Wash leaflets in troughs using clean potable water to remove dirt. Wash leaves again in 1% saline solution for 3-5 minutes to remove microbes. Finally wash again in clean water. Leaves are now ready for drying. Drain each trough after each wash: fresh leaves must always be washed with fresh water.

#### 3. Draining

Strain water from the leaves in buckets that have been perforated, spread leaflets on trays made with food-grade mesh and leave to drain for 15 minutes before taking them to the dryer.

#### 4. Drying

In order to produce moringa leaf powder, moisture content of dried leaves should not be higher than 10%. There are three main methods for drying moringa leaves.

• <u>Solar drying</u> (recommended for both small and large scale processing): solar drying is recommended for both small and large scale processing, particularly for those in rural communities where there is no electricity. A variety of designs is available online, and an effective example is provided in the manual provided by Moringanews. Leaves should be spread thinly on a mesh and dry in the dryer for about 4 hours (temperature range can be between 35°C–55°C on a very sunny day). The final product should be very brittle. Loading density should not exceed 2 kg/m2.

- Mechanical drying (recommended for large scale leaf processing): a variety of electric or gas hot-air dryers is available on the market. Drying temperatures should range between 50°C and 55°C. If temperature exceeds 55°C, leaves will "burn" and turn brown. Leaves should be dried until their moisture content is below 10%. This method is recommended for large scale leaf processing as it ensures year round production. Loading density should not exceed 2.5 kg/m2.
- Room drying (not recommended for commercial production): this method is not recommended for commercial purposes since room-dried leaves cannot be guaranteed mold-free with the maximum recommended moisture content of 10%. It is included here as a reference for producers of moringa leaf powder that may not have access to the equipment mentioned above, but still could upgrade their processing methods. When using the room drying method, spread the leaflets thinly on mesh tied on racks (mosquito net mesh can be used) in a well-ventilated room. This room should be insect, rodent and dust proof. Air circulation can be improved by using ceiling and floor level vents protected with a clean filter to keep the sun and dust out. It is possible to use a fan, but the air must not be directly oriented towards the leaves, as it can increase contamination with germs in the air. It is advisable to turn the leaves over at least once, with sterile gloves, to improve uniform drying. Leaves should be completely dry within a maximum of 4 days. The loading density should not exceed 1 kg/m2.



Figure 12 - Example of a Solar Dryer Set Up Using a Shipping Container (at ARN Foundation, Arcahaie, Haiti)

<u>Note</u>: the use of standard-size metal shipping containers, which are readily available in Haiti, has been shown to produce results for "room drying" that suggest it is, in fact, a viable option for commercial production for smallholder farmers. These containers, when outfitted with solar-operated vents, can result in product that can be used in high quality moringa leaf powder.

#### 5. Milling

Mill dry leaves using a stainless steel hammer mill. For personal or household use, leaves can be pounded in a mortar, or milled with a kitchen blender. Small-scale processors can use a burr mill or rent/ acquire a commercial hammer mill for routine milling of their products.

#### 6. Sieving

Sieve the leaf powder if needed. When you mill with a hammer mill, the fineness of the product will depend on the size of the screen used in milling. If too coarse, sift using a sifter with the desired screen size. Recommended particle sizes are:

- Coarse (1.0mm 1.5mm)
- Fine (0.5 mm 1.0mm)
- Very Fine (0.2mm 0.5mm)

#### 7. Drying the Leaf Powder

Moringa leaf powder strongly attracts moisture and the product can reabsorb humidity during or after milling. It is easily contaminated by molds and the particles of finely milled powder are more easily penetrated by bacteria. For this reason, moringa leaf powder should be dried at 50°C for 30 minutes to reduce moisture content considerably below 7.5%.

#### 8. Packaging and Labeling

The following steps and guidelines are recommended with regards to the packaging and labeling of moringa leaf powder.

- Personal hygiene: all persons involved in the packaging of moringa leaf products must ensure that, while on duty, personal cleanliness and hygiene are maintained. Personal protective equipment (PPE) such as head caps, nose masks, disposable gloves, etc. must be used at all times.
- Packaging in bulk: the temperature and humidity must be controlled in the packaging room, to avoid re-humidification of the product. After drying, the powder is left to cool and packed into clean, single-use polythene bags and sealed. This is enclosed in a second polythene bag and heat-sealed. This is to maintain freshness and dryness prior to further use. The bags should be stored in a cool, dry place.

- *Final packaging:* the temperature and humidity must be controlled in the packaging room, to avoid re- humidification of the product. Moringa leaf products should be packaged in clean, dry and opaque containers made of materials that do not affect the quality of the product. Each package must be properly sealed to prevent content leakage as well as moisture absorption.
- *Labelling*: each package of moringa leaf product must be legibly marked with the following information:
  - a) Name of product
  - b) Net content
  - c) Name and address of producer
  - d) Country of origin
  - e) Lot / batch identification number or code
  - f) Instructions for use
  - g) Production date
  - h) Nutritional information (optional)

#### **Production & Processing Costs**

Processing fresh leaves into leaf powder produces around 12.5% to 15% of leaf powder per unit of fresh

#### **BOX 5 - Getting Started with Moringa Production**

Until specific processing centers for Moringa production are in place, fresh leaves could alternatively be washed and dried on-farm before transportation. An existent food mill, such as a corn or cassava mill, could be used. However, given that strict hygienic standards need to be met great attention must be paid to the conditions of these mills and the cleaning methods: Moringa Leaf Powder strongly attracts moisture and is easily contaminated by molds. The particles of finely milled powder are also more easily penetrated by bacteria. leaves. Detailed processing costs are rarely available, although the MoringaNews network has published figures for some African countries. In Senegal, production costs were calculated at US\$4.30 per kg of leaf powder and in Benin at US\$2.80 (Olivier, n.d.; Ogoudaja, 2006). It is important to keep in mind that these numbers are coming mostly from smallholder farms and so there is potential for economies of scale for a bigger operation.

## 6.3 STRUCTURING THE VALUE CHAIN OF MORINGA OIL IN HAITI

In comparison with the production of moringa leaf powder, the production of moringa oil is a complex process that can result in high production costs. Although quite a few elements in the supply chain for moringa oil are similar to those in the chain for moringa leaf powder, a few key elements are different (in particular the processing phase). This sub-chapter will focus on those aspects that are different.

# Cultivation Practices for Commercial Oil Production

#### Spacing & Pruning

Trees must be spaced substantially wider when aiming to produce fruits or seed. In order to maximize seed yield, trees must be at least 8 feet apart. In contrast to the cultivation of moringa trees for leaf powder production, the trees that are planted with the aim of harvesting the seeds as input for moringa oil production do not need to be pruned. Depending on water and manure management, each tree can produce between 15,000 and 25,000 seeds per year (Foidl, Makkar, & Becker, 2001).

Various seedpod/seed yields have been described depending on various cultivation methods and management. Mean yields of 375 pods/tree/year have been reported for mature trees that are part of pollarded 'living fence' plantings (yielding 0.8 kg of clean seeds/tree without any management for pod production). Optima, a company that has grown moringa in Tanzania, forecast their overall plantation

yields at 250 pods/tree and around 1 kg of seed/tree (at 800 trees/hectare). This is similar to a project in Malawi, which arrived at a similar forecast "minimum maintenance" yield of 1 kg of seed/tree/year from a living fence for planning purposes (MAFE Report Malawi, p74 - preview). Optima, however, indicated that they expected yields to peak from year 4 onwards, at around 3kg/tree, without the use of synthetic fertilizer. Optima states that one worker can harvest 3,500 pods (containing 14 kg of seeds) in a day (Optima, 2001).

#### **Collection & Transport**

Pods should be harvested as early as possible when they reach maturity, i.e. when they turn brown and dry. Fruits should open easily. Seeds are extracted, bagged, and stored in a dry place. Seeds are not as sensitive to transport as leaves and can be extracted, packed and stored in a dry place for some time before transportation for processing.

#### Processing

The manufacturing of oil requires quality seeds with the same degree of ripening. The process of turning the seeds into the oil stretches from the seeds' initial transport after harvest through their temporary storage and dehulling, to their pressing, filtering and packaging.

#### Removing Foreign Materials From Seeds

To assure quality oil from the press the seeds going into the press need to be free from foreign objects, weed seed, molds, and other contaminants. Cleaning and storing the oilseeds correctly following harvest will preserve the quality of the seed and preserve that quality through to the finished oil.

#### Shelling (Dehulling)

In order to increase oil extraction efficiency it is recommended that the moringa seeds are first dehulled (the process is also referred to as decortication). A range of manual and mechanical decorticators are available in Haiti. Following the decortication, the outer husk has to be separated from the kernels by winnowing.

#### Extracting the Oil

The oil extraction itself is a more complex process and constitutes a challenge, particularly for smallholders without adequate equipment. Technically, various methods of extraction can be used to extract moringa oil from the seeds. Among these are water assisted oil extraction (boiling the seeds), manual pressing, expelling and extraction by means of solvents. The first two are not very efficient and have high labor requirements, meaning they should only be considered when producing oil at a very small scale (e.g. for personal consumption). While highly efficient, using solvents involves very substantial capital costs and is only economic at large scale. While this method may be suitable when producing moringa oil used in biofuels, it is not suitable for producing the oil required for use in natural cosmetic ingredients (and human consumption).

The ideal method, therefore, is expelling the oil by means of an oilseed press (expeller). Oilseed presses have a reasonably good efficiency, are a continuous method and as such are suitable for larger scale production of moringa oil. When aiming to produce for the international market (and in order for the oil to maintain the properties that make it so valuable) it is crucial that the oil is cold pressed. Using expellers allows for this, since they mechanically separate the oil from the seed without the addition of heat or chemicals (temperatures should not exceed 49°C).

For an oilseed press to operate properly, the incoming seed must be clean and of the proper moisture content. Stored grain and seeds can have up to 10% moisture content, but this is too high for pressing and will produce meal that is gummy and will not produce oil as it passes through the press: the moisture in the seed ties up the oil and does not allow the oil and meal to separate as it should.

All grains have moisture contents at which they press best. A general rule to start from is that the ideal moisture for pressing is in the 7 - 8% range. If the moisture content of the seed being pressed drops too low the temperature of the press head increases

#### **BOX 6 - An Introduction to Oilseed Presses**

An oilseed press (see images below) is the heart of an oilseed pressing operation. Available small oilseed presses are of two major types; screw presses (expeller press) or reducing screw/cage presses. Many are made overseas while at least one is now available from a US manufacturer (www.oilpress.co).

Oilseed presses vary in size and the amount of oil expected varies between seed types. As a result, the capacity of an oil seed press is often given in the weight of seeds that can be processed per hour. Depending on the material processed, the expected oil output will vary greatly. For canola, about 1/3 of the seed weight going into the press will be produced in oil, while the remaining 2/3 will be meal. Other seeds will give different oil and meal ratios. Presses of these types are typically rated in the 3 kg (6.6 lb) to 100 kg (220 lb) of input material per hour range.

It is very hard to find information on the yields that have been achieved pressing moringa seeds with different presses. DLBioCarburants, the one company that is currently pressing moringa oil in Haiti is using two presses similar to the one on the left photo, below. The company manages to obtain 9-10 gallons of Moringa oil from 100 kg of de-hulled seeds. Another person contacted for this study reported yields of 120ml of oil from 1kg of seeds (that had not been de-hulled).

Professional oil expellers like the one shown below can be costly, commonly ranging from US\$7,000-12,000. One way to make such a motorized oil press accessible to small-scale producers would be for an association or cooperation of smallholders to jointly invest in its acquisition.

Press manufacturers (not an exhaustive listing):

- Ag Oil Press (www.agoilpress.com / www.oilpress.co)
- Egon Keller (www.keller-kek.de)
- Kern Kraft (www.oelpresse.de)
- Komet (www.ibg-monforts.com)
- Piteba (www.piteba.com)
- Tabypressen (www.oilpress.com)
- Tokul (www.tokultarim.com)





when pressing and will make it difficult to stay under the 120F (50C) temperature limit for cold pressed oil. if that is important to the operation. Lower moisture content seeds result in higher press temperatures and a lower yield of oil. Moisture content is often the culprit if pressing is difficult.

#### **Filtration**

While the pressing operation can be modified to reduce the amount of particles in the oil, some cleaning of the oil will be needed to remove potentially unwanted particles. Filtering of oil can be done in different ways depending on the cleanliness of oil desired as the final product (i.e. crude vs more refined). Four of the most common filtering methods are settling, bag filters, cartridge filters and filter presses. Of these the first, and particularly the last, are most relevant.

The least expensive and simplest filtering is done by settling the particles out of the oil. Settling may be done after the oil is pressed as a separate step, or it may be ongoing as oil is collected from the press. After a period of time when the oil is considered "clean," the oil is siphoned, drained, or pumped from the tank leaving the residue behind on the bottom of the container. Although settling is a good first step in filtration, it may not provide the cleanliness standard needed for end use.

Filter pressing is considered the most reliable filtration type and the current standard to clarify oil. Although the initial investment required to acquire a filter press is higher than that for the other methods, it may in fact be the most inexpensive filtering system over the lifetime of the equipment (UV, Oilseed Fact Sheet: Oil Filtration).

#### Packaging

Once the oil is filtered it should packaged into High Density Polyethylene (HDPE) or specially lined metal containers; capped with nitrogen to prevent oxidation; appropriately labeled; and stored in a cool place until dispatch. Typical packaging size are 4.3kg, 23kg, or 180kg.

## 6.4 COMMERCIALIZATION OF HAITIAN MORINGA PRODUCTS

Although there is a growing demand for moringa leaf powder, its commercialization still remains very informal. Reliable market information, such as production volumes and prices on the national and international markets, is difficult to obtain. Information about market requirements and the steps required in order to export moringa products from Haiti is also hard to obtain. The same applies to information about the standards and minimum quality requirements that have to be met in order to produce for the international market. This kind of information and data, however, is indispensible for producers to make informed business decisions. To effectively exploit the existing potential, commercialization should become more structured and formalized.

A big step in this process would be the development of mandatory national standards for the Haitian moringa sector. Many countries with moringa leaf powder production have such standards in place to define the minimum requirements and standards for the various respective moringa products they produce. Having an institution in Haiti that would develop classifications, standards, norms and regulations—and that would be responsible for overall standards and quality in the Haitian moringa sectorcould greatly improve the quality of Haitian moringa products. The development of such an institution could benefit from examples provided by other countries that commercially produce moringa. An example is Ghana, which has developed its own national moringa leaf powder standards as well as a Good Practices Guide and an Inspection Guide. Ultimately, the creation of national standards in Haiti would provide a strong incentive to further invest in moringa production given that it increases the market value of the product by enhancing the trust of traders as well as of consumers.

The current information campaigns that aim to inform the local population about the many benefits of moringa consumption, can eventually be expanded with broader marketing campaigns. Such campaigns could stimulate the creation of local Haitian brands for moringa products, and potentially even result in a national brand or certification (e.g. "Certified by the Haitian Moringa Growers Association"). Since the 'story' behind Haitian moringa products is arguably one of its unique selling points, it is highly recommended that this is reflected in the branding of the products (and particularly in those destined for export to the international markets). Broader marketing campaigns, however, should only be started once critical production volume and the required level of quality are achieved.

To effectively tackle the various challenges in the value chain of moringa leaf powder, it is recommended that both the horizontal and vertical coordination between all involved actors be improved. Horizontal coordination between the producers is necessary to achieve economies of scale and to reduce transaction costs. Smallholder farmers, in particular, should form viable associations or cooperatives to achieve a higher accumulated production volume, to profit from joint production management, product marketing and price bargaining, and to improve access to finance.

Vertical coordination between producers, wholesalers and retailers is necessary in order to identify and best exploit business opportunities. To exploit these opportunities, producers and producer associations should also be supported in establishing strong links to national and international wholesalers and retailers. Business relations with larger retail shops and international supermarket chains could also be promising.

Finally, extension services should be established that provide the producers with the necessary knowledge, skills and technology to improve their competitiveness. This in particular applies to the requisites for oil extraction, where equipment may be costly and a rigorous control of plant material can be demanding. One option could be providing this type of extension service through exiting farmers associations, cooperatives or NGOs focused on improving agriculture.

## 7. RECOMMENDATIONS

The present study has shown that there is a potential in Haiti to commercially produce and export moringa products. However, this will require various changes in the production, processing and commercialization processes and practices. In this regard, the following key recommendations can be made:

#### 1. Production

The cultivation of moringa trees needs to be expanded to achieve economies of scale in the production of both moringa leaves and seeds. The already existing small-scale farming should be supported in order to expand.

- Seeds: the availability of viable, clean and disease-free seeds must be guaranteed in order to grow and cultivate moringa trees of good quality. In the short-term, local seeds can be selected from prime trees and be used for breeding. Certified seeds could also be imported. Eventually it is recommended to develop and certify national moringa seeds. In order to do so studies should be conducted to identify the subspecies of *Moringa oleifera* that are best adapted to the climate and soils of Haiti, and which guarantee the highest yields. A way to improve access to high quality seeds is the establishment of a number of seed farms established throughout the country.
- <u>Cultivation techniques</u>: although moringa trees grow naturally in Haiti due to the country 's favorable agro-climatic conditions yields could be increased by applying specific cultivation techniques. Current small-scale practices should be complemented by larger scale planting sites that are still smallholder-managed. Cultivation techniques (e.g. spacing, irrigation, pruning) on the larger sites should be varied in order to ensure sustainable land use practices. Available

information, such as best practice manuals, and trainings should be provided on the most adequate cultivation techniques, including irrigation and pruning practices

 Organization of producers: horizontal coordination between producers should be improved to achieve economies of scale and to reduce transaction costs. Smallholders, in particular, should form viable associations or cooperatives to achieve a higher accumulated production volume and to profit from joint production management. Technical advice should be offered to set up well-functioning organizational structures and to apply good management practices.

#### 2. Processing

While the processing of moringa leaves is technically not complicated, it requires a functioning logistics management system. In contrast, the processing of moringa oil is a technically more demanding process with higher investment costs involved. Moringa oil processing also requires adequate machinery in order to guarantee consistent quality and quantity. A high level of hygiene should be maintained at all stages of the processing phase.

 Logistics management: transportation of moringa leaves in particular is a very critical step in ensuring high quality leaves for consumption. Due to the rapidly perishable nature of moringa leaves, the processing into moringa leaf powder needs to start directly after harvesting and transporting the leaves to the processing site. A functioning logistics management system is therefore a critical element in the value chain. It requires smallholders to communicate, cooperate and coordinate their harvest with transport services to the processing center to maintain the quality of the leaves and avoid deterioration. The transport of moringa leaves should be carried out in closed receptacles, e.g. boxes, which require air-conditioning or refrigeration for longer distances.

- Processing centers: in the case of moringa leaves, specific processing centers with a washing station, a drying room and a burr mill should be installed to guarantee the fulfillment of hygienic standards. Oil extraction is a more complex process and constitutes a challenge, particularly for smallholders without adequate equipment. In order to make high quality oil, however, equipment like a seed oil expeller (cold press) and a filter press are required. As the necessary investment costs often exceed the financial capacity of smallholders, processing centers should be established and operated by associations or cooperatives.
- <u>Packaging</u>: moringa leaf powder should be put in opaque packages that prevent moisture absorption and should not be stored for over six months as the powder quickly loses its quality. Once filtered, moringa oil should packaged into High Density Polyethylene (HDPE) or specially lined metal containers and then capped with nitrogen to prevent oxidation.
- <u>Extension services</u>: farmers and associations should be supported and trained in processing methods to improve their competitiveness. Such services could also be provided under the framework of out-grower schemes.s

#### 3. Commercialization

The commercialization of moringa products in Haiti is still very informal and makes it difficult to get reliable information of production volumes and prices. The same applies to information about requirements to access international markets. To effectively exploit the existing market potential, the commercialization should become structured and formalized.

- Standards and certification: a big step in structuring commercialization would be the development of mandatory national standards for the Haitian moringa sector. Defining such minimum requirements and standards for moringa products would great improve the quality of the products and provide a strong incentive for further investment in moringa production. They would also increase market value of products by enhancing the trust of traders as well as that of consumers. Effective examples of standards other moringa producing countries can be used to facilitate this process (e.g. Ghana). To access international markets, moringa products should comply with voluntary standards, such as fair trade, GLOBALG.A.P., or organic labels. Organic standards seem promising given that traditional agricultural practices are already "de facto" organic.
- Improve access to information: reliable market information on the national production of moringa products should be regularly collected. Information about best growing practices and requirements to access international market should be made available. One of the institutions that could play an instrumental role in this is the Haiti Moringa Network.
- Facilitating access to international markets: both the horizontal and vertical coordination between all involved stakeholders needs to be improved. Horizontal coordination between the producers is necessary to achieve economies of scale and to reduce transaction costs. Smallholder farmers, in particular, should form viable associations or cooperatives to achieve a higher accumulated production volume, to profit from joint production management, product marketing and price bargaining, and to improve access to finance. Vertical coordination between producers, wholesalers and retailers is necessary in order to identify and best exploit business opportunities. In order to exploit these opportunities, producers and producer associations should also be

supported in establishing strong links to national and international wholesalers and retailers.

• <u>Marketing</u>: the current information campaigns about moringa could eventually be expanded with broader marketing campaigns. Such campaigns could stimulate the creation of local Haitian brands for moringa products, and potentially even result in a national brand or certification. Since the 'story' behind Haitian moringa products is arguably one its unique selling points, it is highly recommended that this story is reflected in the branding of Haitian moringa products (and particularly in those destined for export to the international markets). Broader marketing campaigns should only be started once critical production volume and the required level of quality are achieved.

## 8. CONCLUSION

Moringa is a tree with many uses and excellent potential for commercial production in Haiti. It grows naturally in the country due to the suitable land and excellent climatic conditions. Moringa's characteristics make it a crop that can be grown in areas unsuitable for commercial production of more traditional crops.

Following international trends, the market for valueadded moringa products has seen a significant increase in growth over the past few years. There is demand for moringa leaf powder and moringa oil, both at the national as well as the international level. Various potential international buyers have expressed concrete interest in sourcing moringa products from Haiti.

Moringa is currently not grown on a commercial scale in Haiti. In order to meet demand, existing small-scale activities need to be significantly expanded in scale and number of growing sites. Developing national standards for moringa products would greatly improve the quality of these products and provide a strong incentive for further investment in moringa production. They would also increase market value of products.

In order to access international markets, growers need to be able to ensure compliance with international regulation and standards, be able to offer high quality and continuous supply, and ideally be compliant with voluntary standards like GLOBALG.A.P., Fairtrade, and organic (all growth markets). Differentiated products can be developed for the local market. Organizations running local nutrition programs could make for a potentially interesting local market for Haitian moringa leaf powder.

To tap into these opportunities, a significant marketing campaign is required. Western consumers are increasingly looking for natural products that are sourced ethically and sustainably, and that come with an interesting story. Since one the unique selling points of Haitian moringa products is arguably its great story (natural products that benefit smallholders and the environment), this should be reflected in the branding.

Ultimately, it is clear that the opportunity exists. The challenge now will be in structuring an efficient value chain; something which will only be possible through joint efforts by the private sector, including smallholders, associations and larger companies, and public institutions. That this indeed can be done is demonstrated by success stories in other countries, where smallholders have proven to be highly instrumental in successfully operating Moringa value chains that cater to the international market.

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# **ANNEX I - Moringa Nutritional Profile**

ELEMENT	FRESH LEAVES	DRIED LEAVES (POWDER)
Dry matter Proteins Total ash (= total minerals)	20-25% 5-7 grams 2-3 grams	90-95% 20-26 grams 8-11 grams
Minerals Calcium (Ca) Potassium (K) Magnesium (Mg) Phosphorus (P) Iron (Fe) Manganese (Mn) Zinc (Zn) Copper (Cu)	350-550 mg 200-500 mg 80-120 mg 50-120 mg 5-8 mg 1,2-2,5 mg 0,4-0,6 mg 0,2-0,3 mg	1600-2200 mg 800-1800 mg 350-500 mg 200-600 mg 18-28 mg 5-9 mg 1,5-3 mg 0,7-1,1 mg
<u>Vitamins</u> Vitamin C Vitamin A (as ß-carotene) Vitamin E (as a-tocopherol)	120-200 mg 1500-4000 μg eq. retinol 150-200 mg	15-100 mg 4000-8000 μg retinol eq. 80-150 mg

Mean nutritional values of 100 grams of Moringa Oleifera leaves\*

\* Note: Values can vary depending on many factors such as environmental conditions (soil, climate), farming methods (irrigation, fertilizers...), maturity of the leaves (dark green, mature leaves are generally richer than light green, young ones), harvesting season, and to a lesser extent, the genetic background of the trees.

## **ANNEX I (cont.) - Moringa Nutritional Profile**

Table 2. Nutritional value of <i>Moringa oleifera</i> .* Moringa pods, fresh (raw) leaves and dried leaf				
powder nave snown them to contain the following per 100 grams of edible portion:				
Component analyzed	Pods	Leaves		
Moisture (%)	86.9	/5.0	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	
Fiber (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	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 -thiamin (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	
Phenylanaline (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	

\* From The Miracle Tree: Edited by Lowell Fuglie

\*\* The B-carotene found in moringa is a precursor to retinol (Vitamin A). There are around 25 kinds of B-carotene. Efficiency of retinol production varies among types. Research is still required to know more about the B-carotene types in moringa leaves, particularly with what efficiency they are converted to retinol, and how much is lost or inactivated due to various moringa-processing methods.

# ANNEX II - Sample of International Producers Moringa Products

Company Name	Origin of Moringa	Description	Moringa Products
Grenera www.grenera.com	India	<ul> <li>Wholesale Moringa products.</li> <li>Pioneer in the manufacturing and distributor of health foods, Moringa being the flagship product.</li> <li>Annual Revenue: US\$5 Million - US\$10 Million (source <u>AliBaba</u> <u>com</u>)</li> </ul>	Moringa Leaf Powder Moringa Oil
Organic Veda/Ancient Greenfields PVT LTD <u>www.organicvedaMor-</u> inga.com/organicveda.html	India	<ul> <li>Specialize in high productivity oil seeds, organic Moringa healthcare products</li> <li>Self proclaimed "INDIA's largest producer and exporter of Moringa oleifera around the world for more than a decade.</li> <li>Annual Revenue: US\$2.5 Million - US\$5 Million (source <u>AliBaba.com</u>)</li> </ul>	Moringa Leaf Powder Moringa Oil
SANTAN	India	Sell Natural Botanical Herbs	Moringa Leaf Powder Moringa Oil
Moringa Exports	India	<ul> <li>Largest supplier for Moringa products to the Pharmaceutical, Cosmetic and food Industries.</li> <li>Located in the southern part of India which is the largest Moringa cultivating area in the world.</li> <li>Incorporated in 2003</li> </ul>	Moringa Leaf Powder Moringa Oil
Aromaaz International <u>http://www.aromaazinter-</u> <u>national.com/moringa-carri-</u> <u>er-oil</u>	India	<ul> <li>Indian wholesaler of essential oils</li> </ul>	Moringa Oil
Moringa Source	US	<ul> <li>Have their own farm in Ecuador, but also sources its leaves also from southern and central America, Africa and India.</li> <li>All their Organic Moringa products are grown and processed there.</li> </ul>	Moringa Leaf Powder Moringa Oil
Moringa Connect	Ghana	<ul> <li>Working with smallholder farmers in Ghana</li> <li>Retailing Moringa leaf powder and Moringa oil under their own brand</li> </ul>	Moringa Leaf Powder Moringa Oil
Caribbean Natural Products <u>http://www.caribnatural-</u> products.com/	N.A.	<ul> <li>Offers a wide variety of cosmetic raw materials and ready-to-use items</li> <li>Global distributor of unique and innovative ingredients for Personal Care and Cosmetics products. CNP's portfolio includes a wide range of raw materials for applications in personal care, salon, spa, and aromatherapy, such as botanical extracts, conditioning agents, essential oils, exfoliators, moisturizers, natural plant butters, organically certified oils.</li> </ul>	Moringa Oil
KuliKuli	US	US company that produces various Moringa based products, including the world's first Moringa health bar.	Moringa Leaf Powder Moringa Nutrition Bars

Table continues...

# ANNEX II (cont.) - Sample of International Producers Moringa Products

Company Name	Origin of Moringa	Description	Moringa Products
Raintree Farms http://raintreefarms.com	Uganda	Producer Moringa leaf powder and oil in Uganda.	Moringa Oil
Asili Oils	Rwanda	Asili Natural Oils is a supplier of natural ingredients to customers in the personal care and specialty oil industries around the world	Moringa Oil
Kosia Naturals	Ghana	Producer of cosmetic products containing Moringa oil.	Moringa Oil
Moringa Miracles	Malawi	Producer Moringa leaf powder and oil in Malawi.	Moringa Leaf Powder
EarthOil Plantations	Kenya	Supplying organically-certified pressed and essential oils, and other natural extracts, Earthoil is one of the few organisations who have expertise in the entire supply chain – from growing and processing, to freight and distribution, to oil analysis and market knowledge.	Moringa Oil (& other essential oils)
africrops! <u>http://africrops.de/</u> <u>http://www.africrops.com/</u>	Various African Countries	Large scale importers of Moringa in Europe and the US	Moringa Leaf Powder, Moringa oil, other Moringa products
Moringa Delight	Nicaragua	US Moringa Delight own and operate "the largest Moringa farm in the world" (over 72 hectares, in Leon, Nicaragua). They also retail various Moringa products.	Moringa Oil, Moringa leaf powder, Moringa seeds
Caribbean Labs & Traders	Dominican Republic	Caribbean Labs & Traders is a Dominican company specialized in the development of cosmetics for the spa and hotel industry. The company currently already sells various cosmetic products containing Moringa oil.	Cosmetic Products containing Moringa Oil
Ayiti Natives	Haiti	Ayiti Natives is a Haitian company that develops natural cosmetic products containing essential oils, herbs and nuts that are native to Haiti. They are currently experimenting with small scale retail of Moringa oil and have indicated interest in scaling up their current activities.	Moringa Oil and moringa leaf powder.

# ANNEX III - Sample of Value-added Moringa Products on the International Market

PRODUCT	COMPANY	QUANTITY	SOLD	UNITS		PRICE	
Oil	Earth Moringa	ml	120	ml	100	US\$	8.32
Oil	Botanical Beauty	ml	15	ml	100	US\$	66.60
Oil	Dr. Adorable	ml	240	ml	100	US\$	8.41
Oil	Moringa Source	ml	60	ml	100	US\$	20.00
Oil	Zokiva Nutritionals	ml	180	ml	100	US\$	19.97
Oil	Green Virgin Products	ml	120	ml	100	US\$	24.99
Oil	Buy Africa	ml	470	ml	100	US\$	10.62
Oil	Moringa Source	ml	120	ml	100	US\$	15.00
Oil	Moringa Tree of Life	ml	30	ml	100	US\$	33.00
					average	US\$	22.99
					max	US\$	66.60
					min	US\$	8.32
Leaf Powder	Earth's Moringa	g	500	g	100	US\$	3.00
Leaf Powder	Organic India	OZ	8	g	100	US\$	5.56
Leaf Powder	Organic Veda	lb	1	g	100	US\$	4.40
Leaf Powder	Global Moringa	lb	1	g	100	US\$	3.52
Leaf Powder	2Tre	OZ	8	g	100	US\$	5.70
Leaf Powder	Grenera	g	240	g	100	US\$	8.13
Leaf Powder	Zoffs	kg	1	g	100	US\$	3.04
Leaf Powder	Sun Potion	g	111	g	100	US\$	14.40
Leaf Powder	Moringa Delight	OZ	8	g	100	US\$	10.99
					average	US\$	6.53
					max	US\$	14.40

Table continues...

3.00

US\$

min

# ANNEX III (Cont.) - Sample of Value-added Moringa Products on the International Market

PRODUCT	COMPANY	QUANTITY	SOLD	UNITS		PRICE	
Capsules	Moringa Delight	Units	120	Net w gr	100	USD	41,58
Capsules	Organic Veda	Units	120	Net w gr	100	USD	35,06
Capsules	Perfectly Natural Herbs	Units	180	Net w gr	100	USD	48,82
Capsules	Pure Moringa	Units	60	Net w gr	100	USD	75,71
Capsules	Organic India	Units	90	Net w gr	100	USD	39,17
Capsules	Moringa Source	Units	120	Net w gr	100	USD	39,56
Capsules	Only Natural	Units	90	Net w gr	100	USD	26,34
Capsules	Best Naturals	Units	60	Net w gr	100	USD	36,60
					average	USD	42,80
					max	USD	75,71
					min	USD	26,34

# **ANNEX IV - Stakeholders in the Haitian Moringa Sector**

Stakeholder	Туре	Interest in Moringa	Contact
Haiti Moringa Network	Public/Private Platform	• Interest in setting up Moringa sector in Haiti	Michel Chancy moringa@agriculture.gouv.ht
Haitian Ministry of Agriculture	Haitian Govt.	<ul> <li>Interest in setting up Moringa sector in Haiti</li> <li>Use of Moringa as an agro-forestry crop</li> </ul>	Michel Chancy moringa@agriculture.gouv.ht
Haitian Ministry of Environment	Haitian Govt.	<ul> <li>Interest in Moringa as potential tree crop in reforesta- tion efforts</li> <li>Aerial bombing with Moringa seeds</li> </ul>	Mr. Louverture Ostine ostinelouverture@yahoo.fr
Haitian Ministry of Health	Haitian Govt.	Using Moringa in nutrition programs	Joseline Marhone joselinemarhone@yahoo.fr
Haitian Ministry of Education	Haitian Govt.	<ul> <li>Educating population about benefits consumption Moringa</li> </ul>	N.A.
FAO	UN Institution	Support with Moringa studies	Frits Ohler (country director) frits.ohler@fao.org
Ayiti Natives	Company / Private Sector	<ul> <li>Currently small scale production of Moringa leaf powder, Moringa oil and Haitian natural cosmetic products.</li> <li>Interest in setting up Moringa processing site in Cite Soleil</li> </ul>	Caroline Sada (CEO) sadacaroline@yahoo.com
Plasbags S.A.	Company / Private Sector	Retailer of Moringa leaf powder	Bernard Audant Patrick Pierre Louis
Philip Fils-Aime	Company / Private Sector	<ul><li>Moringa grower (near Arcahaie)</li><li>Sells plants</li></ul>	Philip Fils-Aime
N. Alfieri Noel	Company / Private Sector	<ul> <li>Produces Moringa powder, Moringa salve, Moringa peanut butter</li> </ul>	magdon2007@yahoo.fr
BND	NGO	<ul> <li>Running school feeding programs in Haiti</li> <li>Interested in incorporating Moringa in nutritional products</li> </ul>	Rob Padberg rpadberg@bnd.org
Soul of Haiti	NGO	<ul><li>Small-scale Moringa production</li><li>Nutrition program</li></ul>	Ailish O'Reilly aoreilly@soulofhaiti.ie
Children Nutrition Program (CNP)	NGO	<ul> <li>Nutrition programs</li> <li>Have started educating and promoting Moringa amongst the rural communities, and planted a few (Moringa) gardens in the mountainous areas. They have been looking for a way to turn it into an income generating project.</li> </ul>	Taryn Silver (Program Director) tsilver@cnphaiti.org
Terre des Jeunes	NGO		Antji Daniel OUACHÉE <u>terredesjeunesnordhaiti@gmail</u> <u>com</u> antjilela@yahoo.com

Table continues...

# ANNEX IV (cont.) - Stakeholders in the Haitian Moringa Sector

Stakeholder	Туре	Interest in Moringa	Contact
Edward Berrouet	Company / Private Sector	• Interest in setting up Moringa sector in Haiti	edwardberrouet@yahoo.com
Sakala	NGO	<ul> <li>Currently operating small-scale Moringa plantation in Cite Soleil, P-a-P</li> <li>Starting with small-scale processing</li> </ul>	Daniel Tillias datillias@gmail.com
DLBioCarburants	Company / Private Sector	<ul> <li>Currently operating the only commercial Moringa oil processing site in Haiti</li> </ul>	David Louis dlbiocarburants@gmail.com
IAM Ayiti	Company / Private Sector	<ul><li>Currently growing Moringa</li><li>Interest in becoming the standards setting institution</li></ul>	Bernhard Poitevien <u>binou41@hotmail.com</u>
l'Atletique d'Haiti	NGO	<ul> <li>Currently operating small-scale Moringa plantation in Cite Soleil, P-a-P</li> </ul>	Robert Duval (President) jmfrduval@gmail.com
CLADINS	NGO	<ul> <li>Small youth leadership program.</li> <li>Currently running a small social business project where they give community members in Canaan settlement area Moringa trees, then buying the leaves back from people to make nutritional powder. Just in the begin- ning stages.</li> </ul>	Ken Cazeau (coordinator)
ARN Foundation/ Signa Haiti	NGO	<ul> <li>Currently operating one of the largest Moringa growing sites n Arcahaie, Haiti (they claim to have 500,000 trees in the ground). Running a good quality processing site where the produce leaf powder.</li> <li>Also produce Moringa oil</li> </ul>	Myriam Duret myriam.2207@hotmail.com
Pwodwi Lakay	Company / Private Sector	<ul> <li>Small scale growing + processing Moringa leaf pow- der</li> <li>Member of Haiti Moringa Network)</li> </ul>	Jean Yves Herve
Haiti Timber Re- Introduction Project	NGO	• Member of Haiti Moringa Network)	Melissa Sanon <u>msanon@hashaiti.org</u> htrip@hashaiti.org
AVSI	NGO	Member of Haiti Moringa Network)	Federica Pozzi
Plan Developman Entegre (PDI)	NGO	Member of Haiti Moringa Network)	Alix Macajoux <u>plandevi@yahoo.fr</u> pamalix@yahoo.fr
Ansamn pou yon Demen Miyo an Ayiti (ADEMA)	NGO	• Member of Haiti Moringa Network)	

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Table continues...

# ANNEX IV (cont.) - Stakeholders in the Haitian Moringa Sector

Stakeholder	Туре	Interest in Moringa	Contact
Sant Fomasyon Sitoyen pou Apiye Devlopman (CEFAD)	NGO	Member of Haiti Moringa Network)	cefcadhaiti@yahoo.com
Asosyasyon Pou Devlopman Latan (ADEL)	NGO	Member of Haiti Moringa Network)	
Mouvman Peyizan Papay (MPP)	NGO	Member of Haiti Moringa Network)	
CHIBAS	NGO	<ul><li>Member of Haiti Moringa Network)</li><li>Research in Jatropha oil and biodiese;</li></ul>	Gael Pressoir gael.pressoir@gmail.com
North Coast Development Corporation	NGO	<ul> <li>Member of Haiti Moringa Network)</li> <li>Small scale production of Moringa leaf powder</li> <li>Have been growing Moringa for a few years now, primarily as feed for goats, and secondarily as processed food for their human customers.</li> </ul>	William Pitts williamhpitts@aol.com
Gwoup Apwi pou Lekol Fondamantal an Ayiti (GAEFH)	NGO	<ul> <li>Working with 1560 women farmers in Petit Goave</li> <li>Two Moringa plantations in Leogane zone (30,000 trees in the ground on two plots of 4 hectares together))</li> <li>Focus on producing Moringa leaf powder for nutrition programs</li> <li>Member of Haiti Moringa Network</li> </ul>	Nora Dupuy Maryse Denis gaefh@yahoo.fr marysedenis07@gmail.com
Koperasyon Agrikol Peyisan Oganize Latibonite (KAPOLA)	NGO	Member of Haiti Moringa Network)	wmoise@gmail.com
Asosyasyon Fanm Sent Terez Davila-Ayiti (AFASDAH)	NGO	<ul><li>Member of Haiti Moringa Network)</li><li>Production Moringa leaf powder</li></ul>	<u>afasda2003yahoo.fr</u>
Fwatenite pou Devlopman Ekonomik ak Sosyal Swazon	NGO	Member of Haiti Moringa Network)	fradesorganisation@yahoo.fr
CPR/3	NGO	<ul><li>Member of Haiti Moringa Network)</li><li>Production Moringa leaf powder (sold on Amazon)</li></ul>	
Quisqueya University	Academic Institution	Possible input for long term studies Moringa	
ECOCERT	Certifying Company	Main provider of organic certification in Haiti	Ketty Paquiot <u>kpaquiot@yahoo.com</u>
ONECERT	Certifying Company	• Provider of organic certification in Haiti	

# **ANNEX V - Sample Moringa Products Available on** Haitian Market



Moringa Powder Ayiti Natives





Moringa Powder Terre des Jeunes



Moringa Powder AFASDAH

# ANNEX V (cont.) - Sample Moringa Products Available on Haitian Market



Moringa Tea ARN Foundation/SignaHaiti



Moringa Oil



Moringa Peanut Butter



## ANNEX VI - SFA Press Release Announcing Haiti Moringa Study

## **COMMERCIAL MORINGA PRODUCTION STUDY IN HAITI**

Exploring National and International Markets for Smallholder Farmers

PORT-AU-PRINCE, HAITI, Sept. 23, 2014 – "It is hard to rein in the use of superlatives when describing the benefits of the *Moringa oleifera* tree, long known to rural Haitians for its highly nutritious leaves eaten raw or added to soup," said Hugh Locke, President of the Smallholder Farmers Alliance (SFA), when announcing a commercial Moringa production study in Haiti. "Rich in vitamins A, B, C, D and E, the leaves also contain unusually high levels of calcium, potassium and protein. In addition, the tree's abundant bean seeds contain oil that has a range of applications."

Moringa's rising popularity in Haiti—where it is also known as benzoliv, doliv and gabriyel—has been marked by a government-led awareness campaign promoting the tree's benefits and cultivation, particularly aimed at schools. Michel Chancy, secretary of state for animal production with the ministry of agriculture, has been leading these efforts and sees the tree's additional value as fodder for livestock and poultry, as well as feed for fish farming.

"Moringa has tremendous potential as a nutritional supplement," said chef José Andrés, whose World Central Kitchen organization helps deliver food-based programs to improve conditions in Haiti, "and particularly if it translates to an opportunity to support smallholder farmers."

The SFA study, which is made possible with support from the Embassy of the Netherlands in the Dominican Republic, is focused primarily on two areas-the potential of local production of dried Moringa leaves to be used as a nutritional supplement and of oil extracted from Moringa seeds for use in the cosmetics industry. The research is being conducted with an emphasis on the potential for small-scale farmers to be involved in both growing and processing Moringa.

The study aims to provide an overview of the current market for Moringa products, including opportunities and requirements for market entry. It will also analyze the requirements to grow and process Moringa on an expanded commercial scale in Haiti.

In order for the study to have maximum impact, input is being provided by a very diverse group that includes AIM-Ayiti (Association Internationale Moringa Ayiti), Ayiti Natives, Ayiti Organics, FAO-Haiti, Fondation Seguin, l'Athlétique d/Haïti, Kreyòl Essence, Nomad Two Worlds, North Coast Development Corporation, Sakala, Trees That Feed Foundation, World Central Kitchen and Wynne Farm Ecological Reserve.

The study is being conducted over a three-month period and will result in a report to be published before the end of the year presenting findings and recommendations. In the course of responding to requests for market information, a variety of international companies have already expressed interest in sourcing Moringa from Haiti.

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## **ANNEX VII - Vogue Magazine Moringa Article**

An article about the Moringa tree from the May 2013 issue of Vogue (page 206).

REVERED BY THE ANCIENTS, THIS NUTRIENT-RICH TREE IS RIPE FOR REVIVAL.

each-blossom masks blended in Tang Dynasty China, camellia oil slicked into geishas' hair, avocado balms popularized by the Maya-some traditional beauty rituals still intrigue, centuries later. Given the trend toward all-natural ingredients, there's much to be learned from those who navigated field and forest in search of potent remedies. But one botanical powerhouse, the moringa tree, seemed largely lost in the annals of beauty history, until its recent revival in skin care. Like so many good secrets, it was hidden in plain sight.

Native to the Himalayan foothills, the moringa is resilient, fast-growing, and well traveled, flourishing in balmy locales from the Philippines to Ethiopia. Ancient Egyptians pressed the seeds, found inside drumstick-shaped pods, into an oil so prized it accompanied the dead to the afterlife. Rich in oleic and other fatty acids, moringa boasts 46 antioxidants and 36 anti-inflammatory



compounds—a powerful combination for moisturizing and rehabilitating skin.

The Body Shop has an entire collection of moringa-laced products; the hydrating oil is also popping up in Jane Iredale's new PureGloss lip glosses and Decléor's anti-pollution Hydra Floral eye, lip, and face masks. Valérie Grandury, founder of the Los Angeles skincare line Odacité, looked to northern India to track down the coldpressed oil for her organic face serum A Winter in Paris.

Kosia Asiamah, a New Yorkbased hairstylist, has a shorter supply chain: Her family operates a ten-acre moringa grove in her native Ghana. She uses the oil to fortify the hair and skin products in her Kosia Naturals line, while her husband, Jude Ken-Kwofie, harvests the tender leaves to make powdered supplements and teas for his It's Moringa range. In addition to robust levels of vitanin C, iron, and calcium, moringa contains all essential amino acids.

A study out of the Philippines found that moringa tea can lower od sugar in hyperplycemic nationts:

blood sugar in hyperglycemic patients; Jed Fahey, Sc.D., a nutritional biochemist at the Johns Hopkins School of Medicine, has studied moringa for the last fifteen years and reports that the plant may have anticarcinogenic properties. Ancient Sanskrit texts lauded moringa's myriad therapeutic uses proof, perhaps, that history repeats itself. —LAURA RECENSIONE beauty >208

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# **ANNEX VIII - TIME Magazine Moringa Article**



## FORGET KALE. TRY THESE THREE REAL SUPERFOODS

Josh Schonwald @TasteofTommorow, Oct. 28, 2014

They can purify water, feed a family of four for 50 years, and help combat climate change — and you've probably never heard of them.

Don't get me wrong. I'm a fan of kale.

But kale is absolutely, positively not a superfood.

A superfood is high in protein, low in fat, gluten-free, loaded with omega-3s, bursting with antioxidants and overflowing with folate, fiber and phytonutrients. But the vast majority of what gets called a superfood these days should be called "health food." Yes, health food is a perfectly suitable descriptor for goji berries, pomegranates and chia seeds.



To get an idea of a true superfood, look at quinoa. The Andean grain is more than just a high protein, low-fat, gluten-free alternative to rice or pasta. Quinoa is not only one of the only plants in the world that provides a complete source of protein. It is also an extraordinarily resilient plant. You can grow it at just about any altitude, from sea-level up to 13,000 feet. It can withstand a wide range of temperatures, and needs very little water to survive. There's a reason why the United Nations General Assembly declared 2013 "The International Year of Quinoa" and not "The International Year of the Goji Berry."

Kelp is another example of a true superfood. It's not merely high in protein, low in fat and loaded with hearthealthy antioxidants. It grows at turbo speed (9 to 12 feet in three months) without the need for fresh water or fertilizer. Kelp could provide the world with a vast new source of sustainable protein — and potentially reduce greenhouse gas emissions. (Kelp forests are carbon sinks.)

Real superfoods possess super-traits — like the ability to grow astronomically fast in some of the world's harshest climates. Or the ability to make dirty water safe for drinking. Or the ability to feed a family of four for 50 years. Here are three superfoods, largely unknown in the United States now, that will quite possibly become the next quinoa.

#### The Moringa Tree

It's often called the "the miracle tree" or the "tree of life." In the Philippines, they call it a "mother's best friend." In Senegal, it's the "never die tree."

# **ANNEX VIII (cont.) - TIME Magazine Moringa Article**



Virtually every part of the moringa tree (Moringa oleifera) — pods that taste like string beans, leaves redolent of spinach, seeds reminiscent of peanuts, roots that taste like horseradish — is edible and packed with nutrients. A small serving of the humble-looking moringa's tiny leaves has seven times the amount of vitamin C of an orange, four times the calcium of milk, and four times the beta-carotene of carrots, according to nu-

trition researcher C. Gopalan's Nutritive Value of Indian Foods. Not surprisingly, the tree, which is native to north India, is developing a cult following among natural foods enthusiasts.

But the slender, scrawny looking tree has got far more than nutrition going for it. The moringa might be the fastest growing valuable plant in the world — it grows up to 15 feet, from seed, in its first year. Because it's drought-resistant, the moringa can grow freakishly fast in precisely the hot, dry subtropical areas where malnutrition is most prevalent, and where other crops wither (hence "the never die" nickname).

The moringa is also a promising biofuel and medicinal source. For hundreds of years, people have been using the moringa for everything from cooking oil and cosmetics to animal feed and cleaning agent. But undoubtedly the most amazing quality of the moringa is that it can purify water. Just drop some crushed moringa seeds in a bucket of dirty, unsafe water, and within about an hour, that water will be safe to drink. Scientists say it's because the moringa seeds produce chemicals that cause dirt and bacteria and other pollutants to settle. The moringa seed could provide a simple yet valuable tool in poor communities where diarrhea caused by water-borne bacteria is one of the biggest sources of childhood fatalities, according to a paper in Current Protocols in Microbiology.

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