

Improving Health and Poverty Reduction
Through Growing *Moringa oleifera* Lam.
in Botswana

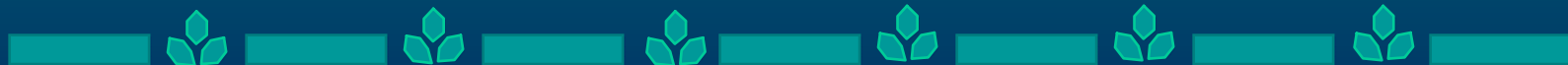


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Presentation Outline

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1.0 Introduction

❖ Problem and its causes:

malnutrition and use of poor quality water (i.e. muddy or turbid waters of streams, rivers, lakes and reservoirs) are the fundamental causes of:

❖ The increasing incidence of diseases such as:

- Xerophthalmia
- Anaemia
- Cretinism
- Water-borne diseases:
(Malaria;Typhoid;Diarrhoea;Cholera;Hookworms;
Round worms;Whipworm;Urinary bilharzias)

Sources: Raymond *et al.* (1994), Folkard and Sutherland (1996)



“This has also resulted in poor economic growth in developing countries” (FAO and ISLI, 1997; Panga, 2002)

❖ It is estimated that 2 billion people, especially women and children, suffer from lack of vitamins and essential minerals in developing countries with Africa having the highest proportion of undernourished children

(Kavishe, 1993; MEPD, 1996; Cote et al., 1997; FAO and ISLI, 1997; AVRDC, 1998)

Nutrient deficiencies in rural areas are attributed to:

- unavailability of appropriate foods,
- low purchasing power and quite often
- improper food processing techniques

leading to the excessive losses of nutrients.

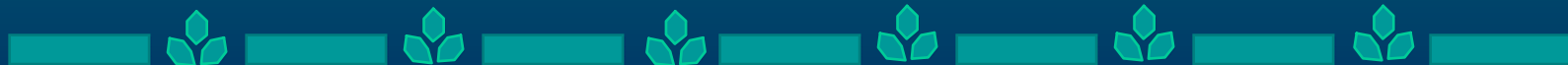


What needs to be done to solve the identified problem:

To reduce diseases and promote economic growth in the developing countries there is a need to improve the health of population, especially that of the most vulnerable women and children.

This can be achieved through:

- ❖ Eating a diverse and well balanced diet e.g. dairy products, eggs, liver, fish liver oil and fruits (**AVRDC, 1998; Gibson et al., 2000**) and
- ❖ Improving the quality of household water supply using either:
 - The low-cost natural coagulants such as *Moringa oleifera* Lam. (syns. *Moringa pterygosperma* Gaertn, family *Moringaceae*) (horseradish or drumstick tree) seeds (**Olayemi and Alabi, 1994; Folkard and Sutherland, 1996**) or
 - Expensive chemicals such as Aluminium sulphate or alum ($\text{Al}_2(\text{SO}_4)_3$) and synthetic polyelectrolytes (**Folkard and Sutherland, 1996**).



Limitations of the Proposed Solution:

- ❖ **The consumption of sufficient, diverse and well-balanced diets and use of chemical coagulants by the resource-poor people, however, is limited by their high costs and unavailability in many developing countries.**
- ❖ **Additionally, chemical coagulants are also known to be associated with pollution problems (e.g. Alum floc can generate large amounts of sludge, a source of pollution when it is discharged to water bodies)**

(Folkard and Sutherland, 1996)



What has been Done to Solve the Problem:

In an attempt to reduce hunger and improve nutrition and water supplies in order to improve health conditions, some resource poor-people in developing countries use *M. oleifera* and other species as a source of food and coagulant aid.

(Jahn, 1988 b, c; Evans, 1991; Olayemi and Alabi; Mayer and Stelz, 1993; Folkard and Sutherland, 1996; Panga, 2002)



2.0 Description and Ecological Requirements of *Moringa oleifera*

Description:

- ❖ *M. oleifera* Lam. (syns. *Moringa pterygosperma* Gaertn) also known as horseradish or drumstick tree belongs to the *Moringaceae* family (Evans, 1991, Folkard and Sutherland, 1996; Fuglie, 2001).
- ❖ It is a fast-growing, highly coppicing and drought resistant medium-sized tree species native to northern India but widespread (Jahn, 1988; Panga, 2002)
- ❖ It has been introduced in many tropical countries, Arabia, South East Asia, Pacific and Caribbean Islands, Central and South America and Africa (Ramachandran *et al.*, 1980; Coote *et al.*, 1997; Fuglie, 2001).



Ecological requirements of *Moringa oleifera*:

- ❖ In its natural habitat the absolute maximum temperature varies from about 38°C to 48°C and the minimum temperature from about -1°C to 3 °C (**Nautiyal and Venkataram, 1987; Coote *et al.*, 1997**).
- ❖ It thrives well in areas having an altitude ranging from sea level to 1200 m (**Coote *et al.*, 1997**)
- ❖ It performs well in areas receiving 750 to 2000 mm-average annual rainfall (**Coote *et al.*, 1997**)
- ❖ It prefers alluvial sandy soils though it will grow in a variety of soils apart from stiff clays (**Coote *et al.*, 1997**)
- ❖ The tree grows even in marginal soils and with very little care (**Morton, 1991; Folkard and Sutherland, 1996**)
- ❖ *Moringa oleifera* is propagated from seeds or cuttings (**Morton, 1991; Folkard and Sutherland, 1996**)



3.0 Benefits of *Moringa oleifera*:

Every part of the *Moringa* tree is said to have beneficial properties that can serve humanity.



Leaves:
Nutrition
Medicine



Pods:
Nutrition
Medicine



Flowers:
Medicine



Seeds:
Water purification
Medicine
Cooking oil
Cosmetics
Lubricant



Bark:
Medicine

Gum:
Medicine



Roots:
Medicine

Plate 1: Multiple uses of *Moringa oleifera* plant parts

3.1 Water Purification Capacity of *Moringa oleifera*

- ❖ *M. oleifera* seeds have been shown to have outstanding flocculating and anti-microbial properties as compared with other traditionally used plant species (Jahn, 1988 b,c, Evans, 1991)
- ❖ Very good flocculating and anti-microbial properties are due to three active ingredients (Eilert *et al.*, 1981; Jahn, 1986, 1987, 1988 a, c; Mayer and Stelz, 1993) including:
 - commercial ben-oil,
 - the flocculant and
 - the anti-microbial substance, 4(α -L-rhamnosyloxy) benzylisocyanate (RI) found only in the white kernel (cotyledons).
- ❖ Some studies revealed that while the most commonly used coagulant alum ($\text{Al}_2(\text{SO}_4)_3$) performs well when the water pH is 7. *M. oleifera* seed powder is effective at different pH levels (Mayer and Stelz, 1993; Folkard and Sutherland, 1996).
 - This makes *M. oleifera* seed powder ideal in developing countries where it is very often not possible to effectively control the influent pH prior to coagulation.



3.2. Nutritional qualities of *Moringa oleifera*

- ❖ Other uses of *M. oleifera* include food (e.g. leaf vegetable and immature pods rich in vitamins and minerals), dry season fodder, mulch and fuelwood supply. (FAO, 1988; Jahn, 1988c; D'Souza and Kulkarmi, 1993; Folkard and Sutherland, 1996; Makkar and Becker, 1997; Fuglie, 2001, Panga, 2002; www.treesforlife.org/moringa/book, 2005)
- ❖ Growing *Moringa oleifera* is like growing multi-vitamins at your doorstep. www.treesforlife.org/moringa/book, 2005
- ❖ The tender leaves and pods of moringa contain a wealth of essential, disease-preventing nutrients including proteins (27%), calcium, iron, phosphorus and vitamins A, B and C. www.treesforlife.org/moringa/book, 2005
- ❖ They even contain all of the essential amino acids, which is unusual for a plant source. www.treesforlife.org/moringa/book, 2005 www.treesforlife.org/moringa/book

“There is increasing recognition that all the essential amino acids including S-containing amino acids contained in *M. oleifera* leaves are higher than the adequate concentration when compared with the recommended amino acid pattern of FAO/WHO/UNU reference protein for a 2 to 5 years old child” (Saint Sauveur, 1993; Makkar and Becker, 1997).

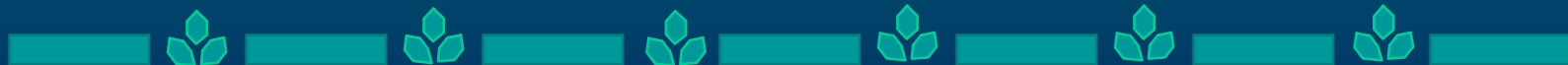


Plate 2: Multi-vitamins contained in *Moringa oleifera* leaves
www.treesforlife.org/moringa/book



- Vitamin A
- Vitamin B1
- Vitamin B2
- Vitamin B3
- Vitamin C
- Calcium
- Chromium
- Copper
- Iron
- Magnesium
- Manganese
- Phosphorus
- Potassium
- Protein
- Zinc



3.2.1 Nutritional contents of *Moringa oleifera* leaves compared to common foods

There is an old saying:
“Moringa leaves prevent 300 diseases.”



Now modern science is proving that these tiny leaves are packed with incredible nutrition that can strengthen our bodies and prevent many diseases.

Amazing, but true

Proteins, the building blocks of our bodies, are made of amino acids. Usually, only animal products such as meat, eggs and dairy contain all of the essential amino acids. Amazingly, Moringa leaves also contain them all.

2 times the Protein of Yogurt



Vitamin C strengthens our immune system and fights infectious diseases including colds and flu. Citrus fruits such as oranges and lemons are full of vitamin C. Moringa leaves have even more.

7 times the Vitamin C of Oranges



Potassium is essential for the brain and nerves. Bananas are an excellent source of potassium. Moringa leaves are even better.

3 times the Potassium of Bananas



Vitamin A acts as a shield against diseases of the eyes, skin and heart, diarrhea, and many other ailments. Carrots are very high in vitamin A, but Moringa leaves are even higher.

4 times the Vitamin A of Carrots



Calcium builds strong bones and teeth, and helps prevent osteoporosis. Milk provides a lot of calcium, but Moringa leaves provide even more.

4 times the Calcium of Milk



These figures reflect gram-for-gram comparisons with Moringa leaves.*



Plate 3a: Nutritional contents of *Moringa oleifera* compared to bananas, milk, yogurt, orange and carrots www.treesforlife.org/moringa/book, 2005

It's like growing multi-vitamins at your doorstep.



Moringa leaves compared to common foods*

Nutrients	Common foods	Fresh Leaves	Dried Leaves
Vitamin A	1.8 mg Carrots	6.8 mg	18.9 mg
Calcium	120 mg Milk	440 mg	2003 mg
Potassium	88 mg Bananas	259 mg	1324 mg
Protein	3.1 mg Yogurt	6.7 mg	27.1 mg
Vitamin C	30 mg Oranges	220 mg	17.3 mg

* *Nutritive Value of Indian Foods*, by C. Gopalan, et al, and *The Miracle Tree – Moringa oleifera: Natural Nutrition for the Tropics*, by Lowell Fuglie, ed. More information: www.treesforlife.org/moringa



Plate 3b: Nutritional contents of *Moringa oleifera* compared to bananas, milk, yogurt, orange and carrots



Fresh Leaves

Gram for gram, fresh leaves contain about:

- 4 times the Vitamin A of Carrots
- 7 times the Vitamin C of Oranges
- 4 times the Calcium of Milk
- 3 times the Potassium of Bananas
- $\frac{3}{4}$ the Iron of Spinach
- 2 times the Protein of Yogurt



Dried Leaves

Gram for gram, dried leaves contain about:

- 10 times the Vitamin A of Carrots
- $\frac{1}{2}$ the Vitamin C of Oranges
- 17 times the Calcium of Milk
- 15 times the Potassium of Bananas
- 25 times the Iron of Spinach
- 9 times the Protein of Yogurt

Plate 4: Nutrients contents of fresh and dry leaves of *Moringa oleifera*.

www.treesforlife.org/moringa/book, 2005



3.2.2 Edible Oil from *Moringa oleifera* Seeds

Mature seeds of *Moringa oleifera* provide edible oil that has been shown to have high stability and similar fatty acid composition (i.e. fatty acid profile of the oil being 73% oleic acid) as olive oil (Folkard and Sutherland, 1996; Tsaknis *et al.*, 1998).

The oil from *M. oleifera* can also be used in lubrication, soaps, and cosmetics and as lamp fuel (FAO, 1988; Morton, 1991; Folkard and Sutherland, 1996).

See locally made press used to extract oil from *Moringa oleifera* seeds- Photos DSC O2068, 02070 & 02071.



Other Uses of Moringa oleifera Plant Parts

(FAO, 1988; Jahn, 1988c; Morton, 1991; D'Souza and Kulkarni, 1993; Folkard and Olayemi and Alabi, 1994; Southerland, 1996; Coote et al., 1997):

- ❖ Fragrant / tender flowers are also used as a source of vegetables and bee forage (i.e. good nectar flow)
- ❖ Twigs with leaves as fodder
- ❖ Green leaves as mulch
- ❖ Solid wood as energy source
- ❖ the press cake left after oil extraction from the seeds can be used as a soil conditioner or as fertilizer and has the potential for use as a supplement for livestock and poultry
- ❖ The barks, gums and pulp are used for mats, printing and paper making respectively

M. oleifera can also be used as:

- honey tree
- living fence
- source of income (i.e. selling seeds, pods, truncheons and leaves).



3.3. Medicinal Properties of *Moringa oleifera*:

All parts of the tree are used in a variety of natural medicines with the powdered seed being incorporated into an ointment to treat common bacterial infections of the skin.

(Quisumbing, 1978; Morton, 1991; Limaye *et al.*, 1995; Ezeamuzie *et al.*, 1996; Folkard and Southerland, 1996; Palada, 1996 Fuglie, 2001; www.treesforlife.org/moringa/book, 2005)



Leaves:

- **Heal ulcers**
- **Have a stabilizing effect on blood pressure**
- **Have a very potent depressive effect on the central nervous system:**
 - **muscle relaxation**
 - **decreased body temperatures**
 - **increase sleep time**
- **Used to treat anxiety**
- **Lower blood sugar levels**
- **Used to control glucose levels in cases of diabetes**
- **Remedy for diarrhoea, dysentery and colitis (inflammation of the colon)**
- **Used as a diuretic (to increase urine flow)**
- **Recommended in cases of gonorrhoea**
- **Treat conjunctivitis**
- **Skin antiseptic**
- **Reduce glandular swelling**
- **Expel intestinal worms**
- **Treat fevers and bronchitis**
- **Treat eye and ear infections**
- **Treat scurvy and catarrh (inflammation of the mucus membrane)**
- **Prescribed for anaemia**
- **Increase a woman's milk production**



Flowers:

- ❖ Cure muscle diseases and inflammations
- ❖ Cure tumors and enlargement of the spleen
- ❖ Alleviate sore throat and catarrh
- ❖ Eye wash
- ❖ Treat hysteria
- ❖ Anthelminthic
- ❖ Used as a tonic, diuretic and abortifacient
- ❖ Relieve cold symptoms



Roots:

- ❖ Laxative
- ❖ Purgative
- ❖ Diuretic
- ❖ Appetizers and digestives
- ❖ Cleanse sores and ulcers
- ❖ Treat epilepsy, nervous debility, hysteria and scurvy
- ❖ Treat rheumatism, asthma and gout
- ❖ Treat lumbago, enlarged spleen or liver
- ❖ Treat internal deep-seated inflammations and calculous affections
- ❖ Cardiac and circulatory tonic
- ❖ Treat fevers and skin diseases
- ❖ Relieve cold symptoms
- ❖ Carminative (promotes gas expulsion from the alimentary canal)
- ❖ Agent to induce blistering
- ❖ Relieve lower back or kidney pain
- ❖ Relieve earache, toothache and intestinal spasm



Gum:

- ❖ Diuretic
- ❖ Skin tonics
- ❖ Abortifacient
- ❖ Used for dental caries and intestinal complaints
- ❖ Treat fevers, dysentery and asthma
- ❖ Treat syphilis and rheumatism
- ❖ Treat typhoid
- ❖ Relieve headache and earache



Seeds:

- ❖ **Remedy for abdominal tumors**
- ❖ **Reduce the pain**
- ❖ **Reduce inflammation of arthritis**
- ❖ **Ease back pain**



Seed Oil:

- ❖ **Treat prostrate and bladder troubles**
- ❖ **Treat gout, rheumatism and skin diseases**
- ❖ **Treat hysteria and scurvy**
- ❖ **Used as a tonic and a purgative**



4.0 Impact of *Moringa oleifera* on Human Health and Economies

- ❖ Studies in southwestern Senegal on pregnant or breast feeding women (Fuglie, 2001) revealed that after consuming *Moringa oleifera* leaves:
- ❖ Children increased their weight and improved overall health
- ❖ Pregnant women recovered from anaemia and had babies with high birth weights
- ❖ Breast-feeding women increased their production in milk.



4.1 Uses of Moringa oleifera and Cost of its Products

Moringa plant part	Uses	Cost
Fresh leaves	- Food (Highly nutritious vegetable for HIV/AIDS affected and non-affected people)	Free of charge
Dry leaves	-Improved health condition of HIV affected and non-affected people -Treated heart problems -Improved milk production of breast-feeding mothers and health condition of the babies	Free of charge P 40.0 per 80 g; P 5 per table spoon
Seedlings		P 18.0 / seedling P 15.0 / seedling P 39.0 / seedling
Oil Seeds	Treat skin diseases, edible Oil extraction + tree planting Tree planting	P 40.0 /50 ml P. 159.6 per kg Free of charge



4.1. Cost analysis:

Costs of seeds of 15 different *Moringa oleifera* Provenances tested at BCA and Tanzania:

-Indian Provenances:	US \$ 30.0/kg
-Netherlands Provenances:	Euro 80/ kg
-Malawi Provenances:	US \$ 50/kg

Based on the current Botswana's cost of *Moringa oleifera*:

- **Leaf powder: BWP 40-100 or US \$ 9-25/80 g**
- **Seedling: BWP 40 or US \$ 10.0/seedling**
- **Seed oil: BWP 40 or US \$ 9.0/ 50 ml/ 200 g seeds**
- **Seeds: P 159.60/kg**

"It can be noted that growing the Moringa tree can generate income for the resource-poor people and thus alleviate poverty in rural areas".



For example:

A Moringa tree plantation with:

- ❖ A tree population of 10,000 stems/ha
- ❖ Producing 2 tons of dry leaves (leaf powder) and
- ❖ Yielding 4 tons of seeds, can generate P 3,629,500.00 (US \$ 625,000.00) from leaves and P1,045,296.00 (US \$ 180,000.00) from 1,000,000 litres of seed oil and P638,400.00 from selling seeds.
- ❖ If the seedlings were sold, the farmer could earn a total of BWP 580,720.1 (US \$ 100,000/10,000 seedlings).

-Assuming that 100 ha are planted with moringa trees the income generated from only leaves and seeds may be: P 531,319,680.00

“This, therefore, clearly demonstrates how *Moringa oleifera* may be the future green diamond of Botswana and other developing countries”



5.0. Gaps of Knowledge and what Remains to be Done

- ❖ Although *M. oleifera* is wide spread in many African countries, the original sources of these genetic materials are not known.

-the material therefore, is most likely of narrow genetic base.

“Given dangers of planting materials based on a narrow genetic base, there is a need to evaluate provenances of the species in various parts of African countries”

- ❖ In addition to increasing wood biomass productivity, pod, seed and leaf quality, broadening the genetic base will serve as an insurance against pests, diseases and climatic fluctuations.

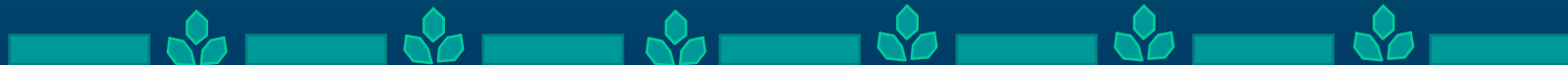


- ❖ A study is, therefore, needed to evaluate *M. oleifera* provenances in terms of productivity, pod, seed and leaf nutritional quality, as well as broadening the genetic diversity of *M. oleifera* to be used for planting in Africa
- ❖ The planting of *M. oleifera* has been in form of monoculture and in some instances interplant with food crops.
- ❖ There have not been any systematic studies to evaluate the effect of various management techniques on pod/seed, foliar and wood biomass production.

“It is therefore of interest to determine how spacing and pollarding height (cutting back of the stem to induce production of more branches) influence pod/seed, foliar biomass and wood production”.



- ❖ Past experience with village afforestation programmes in various countries has showed that emphasis on woodlot (monoculture) establishment instead of including other options such as trees on farm led to modest success.
- ❖ This was attributed to neglect of weeding during the peak time when labour was directed to food crop production. In addition, limited land parcels contributed to low adoption.
- ❖ It is therefore, of interest to test the effect of intercropping *M. oleifera* with food crops on the performance of trees and crop yields.
- ❖ Apart from the biophysical constraints associated with innovations, studies indicate that adoption or rejection of proven technologies is also influenced by institutional framework, socio-economic and cultural constraints of the people



- ❖ We are also proposing to investigate socio-economic issues so that the constraints and priorities of the smallholder farmers are taken into consideration right from the start.
- ❖ In addition, we are proposing to assess adoption rate and factors influencing planting of *M. oleifera*.
- ❖ Understanding the factors influencing adoption will contribute to generation of useful information on how adoption and dissemination of planting and managing *M. oleifera* in Botswana and Tanzania can be enhanced in the future.



6.0 Practical significance of the results from the proposed studies

- ❖ The results from the proposed studies will assist policy makers and development organisations concerned with improved nutrition, hunger-aid and poverty alleviation in rural areas of the tropical developing countries in getting information on productivity, management and utilization of *M. oleifera*.
- ❖ More importantly is the fact that the results from the proposed study will provide the resource-poor people in tropical rural areas with technological experience in improving nutrition and an additional income generation alternative.
- ❖ this therefore, will result in improved health conditions and improved socio-economic conditions of the rural people, especially the most vulnerable women and children.
- ❖ Introducing *M. oleifera* tree species into the local agroforestry systems may also assist in rehabilitating degraded lands and reducing emissions of greenhouse gases to the atmosphere.

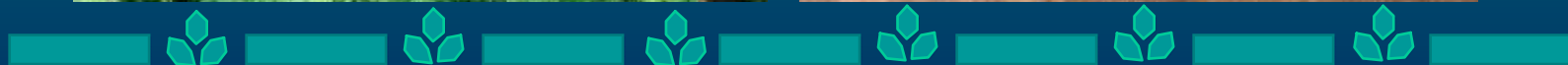


7.0 Conclusions and Recommendations

- ❖ *Moringa oleifera* have the potential to alleviate poverty and deliver the nutrition needed to prevent and cure diseases and save millions of lives of the population of Botswana, Africa and other developing countries.
- ❖ More studies, however, are needed to assess the potential of *M. oleifera* in providing food, water purification and increased incomes of resource poor farmers in selected areas of Botswana and Africa.
- ❖ *Moringa oleifera* may indeed be the green diamond of Africa and other developing countries.



Silvicultural management of *Moringa oleifera* seedlings at BCA's Forestry Nursery in Gaborone, Botswana



9.0 Acknowledgements

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