

## The miracle tree with tremendous natural multipurpose activities MORINGA OLEIFERA



The latin name of the MIRACLE TREE is Moringa Oleifera. It is a tree native to India and cultivated in all sub-tropical areas. Though moringa oleifera is most common, there are a dozen other known species within the genus, which means they share the same underlying biochemical structure.

This tropical multipurpose tree, resistant to drought, is fast growing. It easily reaches three meters in height, just ten months after planting. A tree can reach twelve meters height with a trunk of thirty cm wide. 1000 trees per hectare are usual, and, they quickly flower and fruit. It is also called “nebeday” or the tree that never dies. It tolerates a wide range of soils and rainfall conditions.

This tree produces flowers, leaves, pods, and, seeds, that each do uncommon and very particular things and activities.

Scientifically speaking, although few people have heard of it, moringa sounds like magic, with incredible natural properties.

Moringa could become one of the world’s most valuable plants, at least in humanitarian terms, but also for commercial purposes. Moringa promotes environmentally sound economic development.

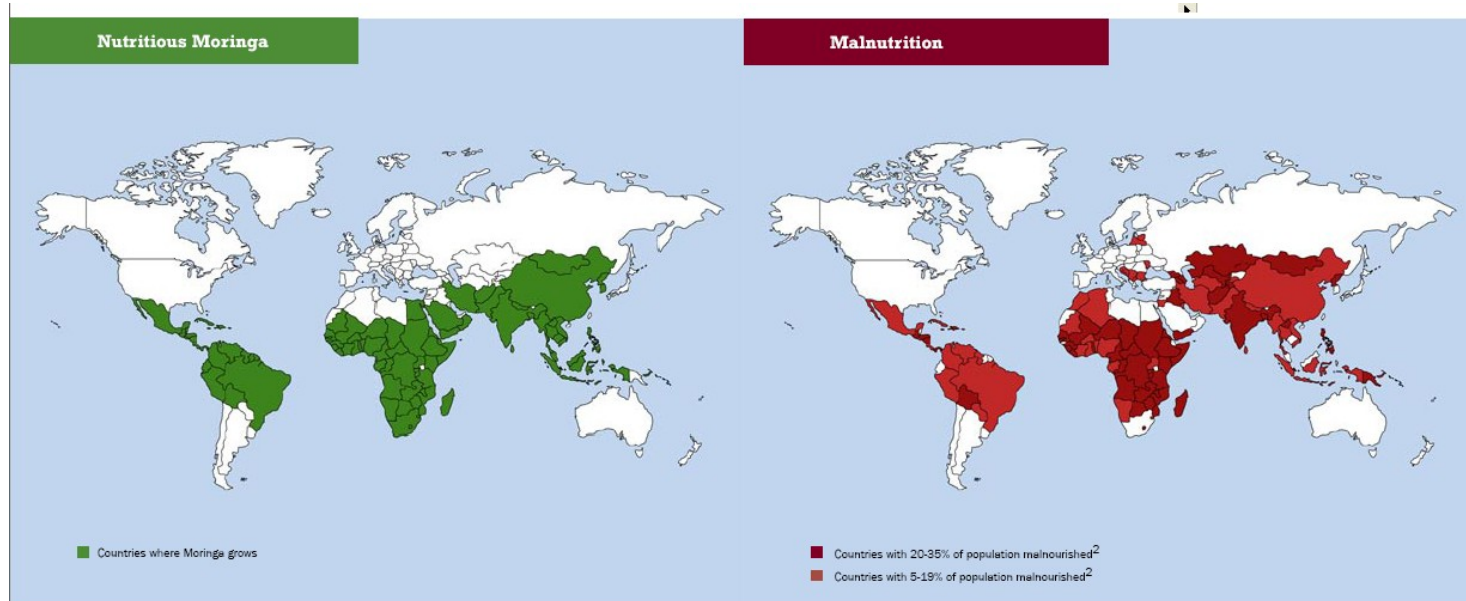
Now, there is an interest from entrepreneurs for the miracle tree, because all its parts are used for nutritional and pharmacological properties, but also to purify and clear water.

Use moringa, a plant with a multitude of natural attributes, encourage sustainable activities for better livelihoods, and develop programs generating for women. Mr. Lowell Fuglie has discovered all those magic and tremendous properties to help developing countries.

Moringa has a direct impact on health, nutrition, agriculture, water, sanitation, biodiversity and environment. Moringa responds to the following criteria : environmental and financial sustainability, realism and results, innovation, biodiversity, education and awareness.



**One tree per family can save them : provide safe water and fight malnutrition**  
**Same map for sanitation problems and water diseases**



The Moringa tree **grows**...

...precisely **where** people **need** it most.

Moringa Oleifera tree is the most popular underutilized tropical crops, and, it is a great shame when you have a look to this map. It is growing fast, drought-tolerant, and, must be cut back several times to make it branch out more. It will readily sprout again and all the valuable products will remain within safe. It seems to thrive in impossible places and never dies. It is the plant soldier through saharan-sahel-scale droughts, growing up straight and tall like a mast. It can be developed easily from seeds or cuttings, and, compost or manure are not necessary. It can be densely seeded with high yielding. It can become a real carbon fund. The light shade of the tree is a considerable help to most vegetables. Flowering can be induced through small watering to have a nearly continuous yield.

Moringa is one of the most useful trees in the world, with a huge amount of benefits. The plant possesses many valuable properties which make it of great scientific interest. Moringa is reminder of what nature can do, a pure endless natural resources, and, this is why it is so important to preserve natural biodiversity.

The world map is interesting, as we can check that rural and urban populations can easily benefit from the assets of the moringa, but also the poorest people by contributing to their food security, sanitation, drinkable water, and, health. One tree per family can cover all their needs, and, respond partly to the humanitarian problems. Introduction of this plant can be beneficial for farmer and the surrounding eco-system.

Moringa Oleifera is considered as “miracle tree” because all its parts are used, especially for their pharmacological, nutritional and purifying water properties. Leaves are eaten as vegetables, and, pressed, they are used in traditional pharmacology to treat many ailments. The fruits are mainly used in condiments or cooked as vegetables. Flowers produce a nectar and have anti-inflammation properties. Moringa seeds are rich in proteins and oil, and, are traditionally used for beauty care. Seeds are also used for water purification. The wood provides a blue dye and its is used for live fences. Medicinal qualities offer to treat diabetes, to enrich anemic blood, to staunch a skin infection, to be an antibiotic, to heal gastric ulcers, and, to care eyes.

Thus, this tree offers very interesting opportunities as food supplement, nutrition, vegetable, oil, water treatment, green manure, foliar spray, natural fertilizer, livestock feed, fodder, medicine, cosmetic and care products.

## **Lack of sanitation and drinkable water is the world's biggest health threat**

People on planet earth are polluting fresh water sources at an alarming rate, as water is more and more scarce, and, drought is constantly increasing. Disease is rampant in third world countries because of polluted drinking water. Half of the world's population has little or no sanitation systems to prevent contaminated drinking water and they lack any means to purify their water. Bill Gates stated that ten million children die every year due to contaminated drinking water.

The lack of sanitation and of clean drinking water for some one billion people has dramatic consequences: about four billion cases of diarrhoea are reported annually, of which two million ends in death. Every day about 6000 children die for lack of clean drinking water. To improve the living standard of the underprivileged, the United Nations has formulated Millennium Development Goals (MDG), which aims at reducing half the number of people without access to safe water by the year 2015. This ambitious task presupposes that for the next ten years, a million people per week will benefit from an improved sanitation and water supply, if the formulated goals are reached. This target can only be met if case strategies, approaches and methods of sanitation and drinking water supply are changed. House-hold-centred approaches involving as much of the target population as possible is such a strategy, with the use of locally available resources. The promotion of low-cost and replicable methods including high use of locally natural available resources is a potential option to face the challenge of the MDG.

DM competition and our proposal want to be a part of the answer to this challenge.

In this presentation or proposal, we have the chance to have the main ingredients or natural resources: the Moringa Oleifera tree, river Niger and the sun of Niger.



### **The MIRACLE MORINGA OLEIFERA SEEDS**

**1 - MORINGA SEEDS, a natural proven water purifier**

**Clean water and sanitation for all with the use of natural local resources:**

Today, more than one billion people in the developing countries use contaminated water for drinking and cooking purposes, and, have no access to clean water and sanitation at all. moringa will therefore be regarded as one of the remedy to reduce the incidence of waterborne disease which is on record as one of the main causes leading to high incidence of deaths in the developing world.

The latest research has established that crushed moringa seeds are capable of attracting and sticking fast to bacteria and viruses that are found in contaminated and turbid water. The seeds produce positive charges like magnets- attracting negative elements of bacteria and other toxic particles. This inspired the development of a revolutionary new natural sanitation water treatment that uses moringa seeds to purify water. This groundbreaking new discovery is going to revolutionize the sanitation and water treatment practices and will make clean water available for all people.

We saw previously that moringa is available in viable quantities and easy to cultivate in the tropical and semi-arid belt. We also know that the seed harvest has fallen dramatically, and, for example, sahelian population doesn't use moringa seeds at all. The fast growing, high yielding and drought tolerant nature of the moringa makes it particularly suited to purify the water in those sub-tropical areas. We must use it.

Furthermore, in association with the ICRISAT and INRAN base in Niger, managed by Professor Dov Pasternak, a new variety of moringa – the PKM1 - has been developed. This PKM1 is a very heavy producer of seeds, and, big seed production should be easily carried out. In sahel countries, the PKM1 variety produces seeds only once a year during the January-March period. Hence the PKM1 is used for three months for seeds production, keeping in mind that we must pick up the seeds on the tree. Seed harvested for water treatment are allowed to dry naturally on the tree and must be harvested in the dry season (level of polyelectrolyte). We cultivate in Niger 5000 trees per hectare, and, the quantity of seeds per tree is approximately 300 grams, or, one ton per hectare. Seeds are round with a brownish semi-permeable seed hull.

### **Moringa Oleifera cake acts a bio-flocculant for water treatment and sanitation:**

The interest on natural biological flocculants for cleaning contaminated turbid water is not new. However, of all plant materials that have been investigated over the years, the seeds from moringa have shown to be one of the most effective as a primary natural coagulant for water treatment, even if the potential of the moringa seeds as water purification has been almost overlooked.

According to the researchers of the University of Leicester, managed by Mr. Geoff Folkard, the vegetable moringa seed may easily help solve the third world's water woes. They have found that when the seeds are dried, crushed and added to water, the seed power acts as a coagulant binding the particles and bacteria. After a short while the coagulated particles, known as a floc, sink to the bottom and clear water can be poured off. The coagulated solid matter is easy to be removed. It works on the basis that opposites attract: when mixed with water the crushed seeds produce positively charged proteins which attract the negatively charged particles and bacteria. The mixing action causes them to collide, coagulate and stick to each other: the seeds naturally reduce the turbidity of the raw water by 90 per cent leaving clear the water of solids, but also removing 90 to 99 per cent of the bacteria. Now, it is scientifically proved that moringa seeds, a natural substance locally available from villagers, give great purification results, with no harmful effects, better as those obtained with expensive commercial chemicals, as alum (alum residues may be carcinogenic). The results indicate the viability of moringa as a natural coagulant-flocculant for highly turbid river water. Inlet river turbidity in excess of 300 NTU was consistently reduced to below 10 NTU in the finished water. Then using moringa as sanitation process meets the needs for water treatment in developing countries, as it is simple, robust, and, affordable by all with no maintenance.



### **Moringa Oleifera cake acts as water softener:**

We saw that moringa seeds act as flocculant and coagulant to remove the water turbidity and bacteria, to concentrate them in the coagulated sediment. It was observed that in addition to turbidity reduction, the hardness was also reduced to 70% after coagulation and two hours settling. The softening property of the moringa was studied and checked by the University of Newcastle, and, the experiment shows that calcium hardness was reduced faster, but not magnesium. The observed pH independence of moringa softening would be an asset, especially in tropical developing countries, where savings can be made on importation of the chemical used for pH adjustment. Moringa seeds can also soften surface water and groundwater from wells!!!

### **Moringa Oleifera cake for agricultural water productivity:**

Results of those two previous paragraphs show that moringa seeds have considerable natural potential to be used in the treatment of dirty or river water, with the elimination of suspended particles or turbidity, and, softening properties.

Then, better environmental agricultural water productivity can be highly increased for drop by drop gardening and farming, with reduced water use, in any rural communities, for small scale facilities.

Moringa seeds respond and improve productivity of safe water for food with a reduced degradation and depletion of soils and ground water resources. Through lower agriculture-related pollution and less water-related diseases, the use of the natural moringa seeds offers good environmental safety practices and guarantees better nutrition. This safer water agriculture will improve health, and, will reduce the level of poverty, especially at the household levels and for resource-poor farmers, as they will use a safe free natural seed.



### **Moringa Oleifera cake for distilling water:**

Whether water is well treated with seeds, some harmful micro-organisms will remain which must be removed either by chlorination, boiling or distilling. Boiling water is not necessary to kill pathogens: water treated at 65 degrees Celsius is safe. While pasteurizing will solve a lot of disease problems, it does not address other things found in water as chemical contaminants (arsenic), pesticides and heavy metals. These need to be eradicated by distillation, and, there is an effective way of using the sun to distil water, especially in Niger, at the village or rural community level.

If we have water with no more suspended particles or turbidity, it will be easier to distil any brackish water after moringa seeds treatment. The solar distiller for clean Sahel water production, a selected proposal as finalist at the last DM2005 with the Niger CDR NGO, managed by Mr. Ahmadou Gambo, will be highly improved and efficiency increases, as solar vaporization will be quicker and easier for a production of distilled litres per square meter per sunny day. This environmentally-sound method will provide clean and pure water to the rural villages, suffering of thirst and drought. Distilling innovative systems must be opened in sunny climate throughout the world, where electricity, fuel and wood are scarce and expensive.

Obviously, boiling water will also be easier and quicker, with less use of wood consumption or burning.

### **Moringa Oleifera cake for drinking water:**

As our water after moringa seeds treatment contains less than 30NTU, water pasteurization must be developed and implemented in the sunny countries, as Niger, where sun is constant. The sun's energy can be used to heat water to pasteurization temperature at 65 degrees Celsius, which kills most pathogens, as bacteria, viruses and cysts. Sunlight and UV-A (radiation effect) and infrared light (thermal effect) proved to be efficient in the water disinfection and inactivation of bacteria and viruses, and, PET plastic bottles proved to be adequate containers for the treatment. Then, we reach a sustainable water disinfection method which only makes use of locally available resources (moringa and sun), easily replicable with no costly infrastructure. This SODIS solar radiation method has been developed by Switzerland teams, promoted worldwide, and, use now with great success by more than one million persons. Our plus is to add an agro-biodiversity treatment. This new safely pasteurizing water technology must become common practice to naturally improve water supply systems, for the first time, in sub-saharian and sahelian countries, as its is already developed in east Africa and India. WaterHealth International with UV lights and filtration does quite the same job with great success.

## **2 – MORINGA SEEDS presentation at household level**

### **How looks like the super wonder moringa seeds?**

As we saw before, moringa seeds are unfortunately not used by the population in Sahel countries, in spite of their natural coagulants properties that could be very easily used at the household level for sanitation and health. The average weight per seed is 0,3g, and, one seed is required to purify one contaminated litre.

To prepare the seeds for use as a sanitation coagulant, remove the seeds black coat including the "wings". The white kernel is then crushed to a powder using a press, or, by placing in a cloth on top of a stone and crushing. Two heaping teaspoons or five grams of the powder should be mixed with a cup of clean water inside a bottle. The water and moringa kernel powder should be shaken for five minutes to form a paste. This paste is then poured through a cloth strainer into twenty litres of the water to be purified. The crushed seeds powder, when added to water, yields matter soluble proteins that possess a net positive charges. Then the natural miracle starts: water is quickly stirred, and, then slowly for ten minutes. Impurities will sink to the bottom, easy to take away, removing 99% of impurities. Clear water can be poured off and stored in PET bottles. Excellent clarification is obtained if a small cloth bag filled with the powdered seeds is swirled round the turbid water. Dosing is usually according to a 1-3 per cent solution for perfect yield.

Two teaspoons of crushed seeds will treat twenty litres of water. One tree would provide enough natural free water treatment and sanitation for five or six people for a year.

This very simple water purification treatment has been almost totally overlooked, though it can help to provide safe, cheaply produced drinking water that could save millions of people from diseases or death, caused by impure water. For our DM proposal, that means for rural communities leaving along the river Niger, this sanitation process at the household level to purify turbid river water is a gift of Nature.

Here, you can see the dried seeds with their wings, then with their black coats, and, the white magic kernels. The kernel is smaller than a coffee- bean, and, the crushed powder must me mixed with water.



Our river water is now clarified, and, stored in PET (and not PVC) bottles. The simplest way to kill bacteria in contaminated water is to heat it. We have seen that pasteurization with UV effect or sun exposure of the bottle will kill other harmless bacteria. Drinking water does not have to be sterile, free of micro-organisms, but this household process will achieve the inactivation of pathogenic diarrhoea. The desired UV sterilization, to kill the coli and coli forms bacteria, is to heat the water at 65 degrees Celsius, during three hours.

Women will fill the PET bottle to  $\frac{3}{4}$ , will close it and shake it for twenty seconds, to fill it then completely with water. Sunlight transforms PET plastic material into photoproducts with a good transmittance for UV-A-radiation, and, oxygen helps to kill the micro organisms. After shaking for oxygen activity, the bottle must be filled completely in order to avoid any air pocket, which partly reflects sunlight radiation. Then they will place horizontally during three hours the bottle face to the sunlight, better on a corrugated iron sheet to increase water temperature. It is safer to use plastic bottles as it is optimally the best ratio surface/volume, and, you can consume the treated water directly from the bottle, to avoid the risk of water recontamination.

The bottle, a carrier of messages to a community, can initiate discussions on how drinking water should be transported, stored and treated, and, the links between water quality, personal hygiene, sanitation and diarrhoeal control thus established.

We have applied the proven laboratory experiments to a household level, showing that an efficient inactivation of faecal coli forms is sufficient exposure of the water to the sun (500W/m<sup>2</sup> during at least four hours) in an appropriate container with clear water (water turbidity less than 30 NTU), that means all conditions we have in the thirsty Niger to improve drinking water quality, sanitation, and, health awareness campaign.

Successful installation of this sanitation method requires that the users also receive instruction and be involved in the planning stage. We have to emphasize the need for education to reach a significant improvement of the health situation, with correct water handling at the household level, improvement of personal hygiene and provision of adequate sanitation facilities. The addressed population must show its interest and acceptance with this method. Target users require extensive training, guidance and monitoring until they change their drinking water handling practices.

During education and training of the population about water treatment and sanitation, we also must answer to few problems, as to know if water left out in the sun has heated enough to eliminate contamination. An ingenious solution is the WAPI or Water Pasteurization Indicator developed by the University of California, Berkeley. WAPI is a polycarbonate tube, sealed at both ends, and partially filled with a blue soybean fat that melts at 69 degrees Celsius. The tube hangs on a string inside a water jar with the wax end up, and, once the water around it becomes hot enough to kill the bacteria about 69 degrees Celsius and to ensure adequate sterility, the wax melts running from the top part of the tube to the lower end. The WAPI is reusable and durable to see if water is safe to drink.

During the three months rainy seasons, the problem of getting drinking water is resolved with the rain that is recovered, and, can be easily treated with moringa seeds. PET bottles for water sterilization will be exposed more times on cloudy days.

Moringa seeds, sun exposure and training could provide safe drinking water for millions of families, with this innovative natural home-based water purification. This process will help families to learn the simple steps to use water purification and to drastically cut diarrhoea deaths.

### 3 - MORINGA SEEDS, an attractive income for farmers and women

#### **Moringa Oleifera seeds - a wonder biodiversity plant:**

The high market value for the multipurpose moringa seeds makes the case for promoting the cultivation of the seed a strong one. The growth of moringa trees by smallholder farmers and rural communities should be actively promoted as a means of providing sustainable income and revenues for them and for women.

Seeds can purify water, but they also contain 40 per cent by weight of oil, with the remaining press cake containing the active ingredients for natural coagulation. It gives a higher yield per hectare than either sunflower or ground nuts. The brilliant yellow moringa edible oil is of high quality and has a high market value for vegetable and cooking oil with 70% oleic acid, similar to olive oil plus the proteins. The gap between demand and production for vegetable oil has widened. For example, the demand for oil in Malawi and few African countries is greater than present production, so soya bean oil must be imported from South America. Moringa's potential is a great source of first rate vegetable and cooking oil, providing added value to what may be regarded as a by-product, and, avoiding imported products using foreign exchange.



The seed cake left over after the easy oil extraction process can be used as a protein-rich plant soil fertilizer for better environmental agriculture water productivity, with lower agriculture-related pollution. Moringa seeds allow sustainable bio-agriculture with a reduced degradation and depletion of soils. This biodiversity program emphasizes the virtuous circle of the nature, with a high respect of the environment, which makes the cultivation of moringa an attractive proposal for commercial farmers improving their income.



## **Moringa Oleifera oil - a bounty of benefits:**

The oil of the moringa seeds has been well known since ancient times and was traditionally used in medicine, for beauty care and religious ointments, because of its excellent stability and good perfume-fixation properties, retaining volatile substances. The oil contains palmitin, olein, and, a peculiar fatty matter yielding an acid by saponification, called benic or behenic acid. All these nutrients contribute to developing beautiful, healthy-looking skin, but also soap production and cosmetic oil, aromatherapy supply houses and fragrance preparations.

An important trend in cosmetics is the exploration of new ingredients from natural sources. Moringa has become the focus of an extensive research program that led to the development of new active ingredients and potential benefits for skin and hair care. Proteins isolated from the seeds have shown very interesting properties due to their low molecular weight and their strong cationic behaviour. The pure oil obtained by pressure of the seeds is also of very high interest in cosmetic applications. The promising properties of the peptide fraction of the moringa seeds allow testing anti-pollution and purification of skin and hair.

The cosmetic industry wishes to develop innovative products and concepts while respecting ecological and human values. Clarins, for example, uses this purifying and detoxifying action in their facial cleanser to neutralize environmental aggressions.

The culture and the production of moringa extracts provide major benefits to local communities, local villagers' farming co-operatives and women's group as an incremental income generation through new diversified farming activity, and, a sustainable development of rural conditions and infrastructures, respecting the environment.

**Conclusion:** Moringa Oleifera seeds must be actively promoted and harvested on a large scale in developing countries, especially in the sunny hot areas for the following reasons:

- one tree with 300 grams of seeds provides sanitation and water treatment for one family
- natural water treatment and sun's energy offer safe drinking water
- easy sanitation process at household levels with no maintenance
- stop the water-related diseases and diarrhoea
- introduction of environmental agriculture water production
- lower agriculture-related pollution with biodegradable fertilizer and compost
- production of edible vegetable oil
- traditional medicines improvement to treat bacterial skin infections
- fair trade label for cosmetics sales
- important source of revenue and sustainable income for the women
- large scale production to develop commercially viable products
- many environmental and fair trade value added products even for exportation
- new economy avoiding import products using foreign exchanges.

Moringa is the perfect example of the third world producing what it does not consume and increasingly consuming what it does not produce. Moringa is a gift of the nature, a pure magic natural agro-biodiversity able to save billion of thirsty people in the world with a better health and sanitation. Plus, as Moringa Oleifera is really a "miracle tree", don't forget that moringa leaf, a perfect absolute concentrate of vitamins, is able to eliminate any malnutrition on developing countries.

For any information, contact: Eric LEMETAIS – Consultant – 11 rue Clément Marical – 76600 Le Havre FRANCE. Tel: 00 33 2 32 85 01 40 – Mob: 00 33 6 80 65 76 76  
Mail: [eric.lehavre@wanadoo.fr](mailto:eric.lehavre@wanadoo.fr) or [L2i.consultants@wanadoo.fr](mailto:L2i.consultants@wanadoo.fr)