

Moringa Oleifera as possible solution against malnutrition



Nutrition & Health

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Preface and Acknowledgements

This thesis is the final outcome of my Bachelor in Nutrition & Health at the CAH Vilentum, Dronten. During the internship at HONKO Mangrove Conservation & Education I gained experience in public health and nutrition. The thesis subject is focused on the project I was involved in during my time in the organization and the skills I have developed through my four years of study.

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Summary

Malnutrition is a well-known and serious public-health problem throughout Africa. Madagascar is one of the poorest countries where 92% of the population lives below the poverty line. The combination of nutritional insecurity, poor health and poverty has a huge effect on the general welfare of people. The biggest problem is that people in developing countries do not have enough money to buy nutritious food. Especially in the countryside people do not have a large choice of food. The World Health Organization (WHO) has reported hunger and related malnutrition as the greatest threat to the world's public health. Madagascar is one of the countries where malnutrition is the highest public health problem.

The organization Honko Mangrove Conservation & Education was founded in 2007. The NGO works with five villages (Ambotsibotsike, Ambondrolava, Tanambao, Belitsake and Belalanda) in the commune de Belalanda. The main objective of the Organization is to help the community reforest their mangrove by educating them on the importance of the ecosystem and to increase education of the local people in the subjects of health and nutrition. The community is characterized by poverty. General health conditions are bad and the child mortality is high. The results of the survey showed that the people have low income and an unbalanced/poor diet. The main food source is rice. Unfortunately rice has a low nutritional value. The minority of people have three meals a day, which is especially important for children and pregnant woman because of the higher nutritional requirements. Another important factor is the low level of education/lack of education and information about good or adequate nutrition. People of the villages have low or no basic education; just a few people have a secondary school leaving certificate (mostly people stopped after primary school). Furthermore the parents cannot afford to pay the school fee for the children. Also, children are a cheap working force to support the family with their daily activities.

One of the recent issues of Honko is it to improve the nutritional situation and the general health in the five villages. The poor soil conditions and the climate make it difficult to set up agricultural farming projects. The Moringa is a local, fast growing tree with a high nutritional value. There are 14 different varieties of Moringa out of different regions. The variety grown in Madagascar is the *Moringa Oleifera* (also known as Ben-oil tree, Cabbage tree, Horseradish tree, Drumstick tree, Mother's Best Friend or Miracle tree). Even in the dry season and during times of drought, the resistant Moringa tree continues to produce leaves. This tree also has other uses such as purifying the water supply, medicinal uses, and can even be processed to protect crops and other plants against insects. The local community does not use the tree in their diet, meanwhile in other parts of Madagascar the tree is being used as a food source to provide the people with nutrients and improve the daily diet.

Fresh Moringa leaves can be used as tea or directly with the food. Dry leaves are pounded to a powder, which can be used in a variety of ways. This process condenses the nutrients so that large doses of nutrition can be added to all kind of food a year-round. Although the leaves are particularly nutritious, every single part of the Moringa Oleifera has benefits; including the bark or roots.

The most important fact is the high nutritional value. The leaves of the Moringa tree are an excellent source of vitamin A, vitamin B vitamin C and other minerals. The leaves are also an outstanding

source of calcium, protein, potassium and iron. The level of amino acids such as methionine and cysteine is also high. The carbohydrate, fat and phosphorous content are low making the tree to one of the finest plant foods all over the world. The Moringa tree can be used in treating malnutrition in a local and cost-effective manner.

One of the most effective tools used to educate the people in the project area was to develop and present a series of presentations. These presentations helped educate the people within the project area better understand the benefits of the Moringa tree. Furthermore the use of the Moringa would be beneficial for the people in the project area as it is the most feasible way to improve the diets of the people in the community.

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1. Introduction

A healthy diet gives you energy, keeps your brain active and your muscles working. For *842million people* in the world food is a luxury because they do not have enough to eat. The majority of hungry people *live in developing countries*. A poor diet is the reason for *45% of children deaths* who are under the age of five – that is 3.1 million children each year and one out of six children - roughly 100 million children - in developing countries is *underweight*.

Malnutrition (a person's food does not contain the right amount of nutrients) can be used to describe both under and over nutrition. This report and the connected project is focused on the under nutrition (when an individual does not consume enough food/ nutrients). It is a well-known and serious public-health problem throughout Africa. The combination of nutritional insecurity, poor health and poverty has a huge effect on the general welfare of people. The biggest problem is that people in developing countries do not have enough money to buy nutritious food, especially in the countryside where people do not have a large choice of food. The World Health Organization (WHO) has reported hunger and related malnutrition as the greatest single threat to the world's public health.

Madagascar is one of the countries where malnutrition is the highest public health problem. 27–51% of the woman and 49% of children under 5 in Madagascar are underweight. The right intake of nutrients is essential in the childhood to establish healthy growth, a strong immune system, proper organ formation/function and neurological and cognitive functions.

Many of the low-birth-weight babies have malnutrition related short-term and long-term health consequences. Malnutrition affects all groups in a community, but young children and pregnant woman are the most vulnerable because of their high nutritional requirements for development and growth.^{1 2}

Project objectives:

- What contains the normal diet in the project area
- Possibilities to improve the daily diet

Main research question:

Is there a *cheap* possibility to improve the *daily diet* in the villages Ambotsibotsike, Ambondrolava, Tanambao, Belitsake & Belalanda to improve the *nutritional deficiency*?

The research started with internal interviews and interviews in the project area. The method for collecting data and background information was: research into related literature.

¹ Malnutrition- Quantifying the health impact at national and local levels

² Child malnutrition- unicef

One of the key aspects was to find out regular eating habits, related problems, and a possible solution for the local population.

The content of this report will give HONKO an overview over the nutritional situation in the 5 villages. Honko will be able to use this information for related projects in the future to help local people in general health aspects (as nutrition).

2. HONKO Mangrove Conservation & Education

This section will describe HONKO Mangrove Conservation & Education, the main activities and the current situation of the organization.

2.1 Sector & main activities

Honko (*Honko* means mangroves in Malagasy) is a Belgian NGO (non-governmental organization) founded in 2007 in Ambondrolava, commune Belalanda (Tuléar), southwest Madagascar.

The NGO in basic terms works with five villages in the commune de Belalanda; Ambotsibotsike, Ambondrolava, Tanambao, Belitsake and Belalanda. The main objective was to help the community to reforest their mangrove by educating them on the importance of the ecosystem.

Furthermore establishing alternative incomes for the local people was another important objective. Therefore the founders Benjamin DeRidder and Carola Zardo established a mangrove information center and a community-managed mangrove reserve.

Degrease the degradation and preventing the mangrove forest is the focus of the organization. Conservation of natural resources and education of the local people are still the main issues (sector) of Honko.³

The main activities are:

- Livelihoods & Governance

Honko started up alternative livelihoods projects, which provides communities with an alternative source of income to reduce pressure on the mangrove forest.

- Apiculture (bee keeping)
- Local artisanal shop (vannerie products from the woman's association)
- Ecotourism
- Small-scale fish farming

- Conservation of natural sources

Undeniably the main part of the conservation is the mangrove restoration.

- Direct planting
- Nursery transplantation

Without the support from the village mangrove conservation is impossible. One major way in which Honko directly interacts with the community is with the local village association; Mamelo Honko VOI. That was founded with help of Honko and gives the people a central management structure to help achieve more for the community.

- Environmental Education

One main part of the activities of Honko is to educate the communities in which it works. It reaches from village-awareness raising events (competitions) to introducing environmental skills in local schools or nutritional education.

³ Honko Mangrove Conservation & Education

In the second half of 2012, Honko's own education center was completed. This building provides space for educational material, environmental education lessons/research workshops or pre mangrove visit talks.⁴

2.2 Organization structure

Honko is a non-profit organization (NGO). It is organized around specific issues (environment and education). That is why the NGO have to find other organizations (mostly with the same issues) to support them. Afterwards Honko can invest in the different local communities to set up different projects (Figure 1).

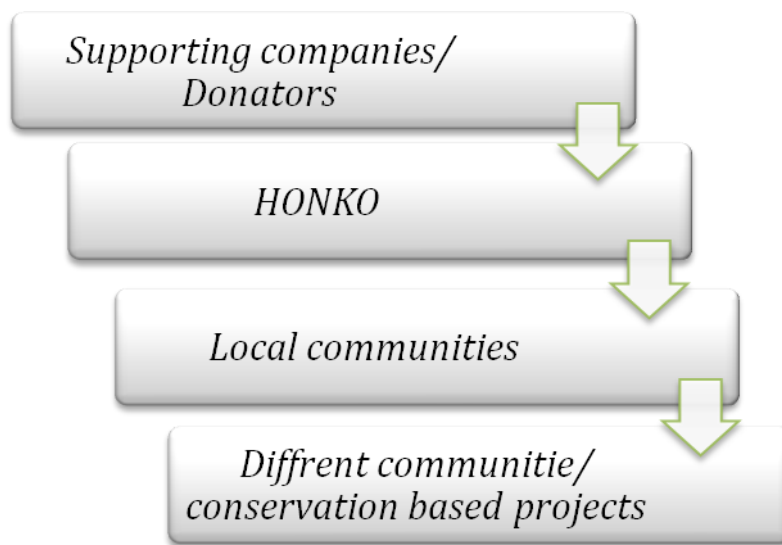


Figure 1. Organization flow diagram

Carla Zardo and Benjamin De Ridder started a small sized organization in 2007 in Ambondrolava where they until 2012. The project manager/ coordinator are allowed to work for a maximum of two years at HONKO, which means the management changes every two years (or earlier).

The present staff is the project manager Nina Hamilton and the project coordinator Tess May. They make the final decisions on different project. Lalas, the volunteer coordinator helps all volunteers and interns with different questions. Both the managers and the volunteer coordinator have a full time position. The socio organizer Josepha is responsible for the communication between HONKO and the world outside (cooperation partners). Josepha represents the organization at events/ fairs or meetings. Furthermore Josepha helps with communal projects. The tow guides take care of the boardwalk trough the mangroves and the tourists. If necessary they do small repairs around the center. The guard lives close to the center to take care of the center during day and night. He also helps with different projects around the mangroves. The socio organizer and the guides have a part time job at HONKO. Sarina, the cook is responsible for lunch and dinner for HONKO stuff during the week (Figure 2).

⁴ Honko Mangrove Conservation and Education,(2012), HONKO Plan VIVO

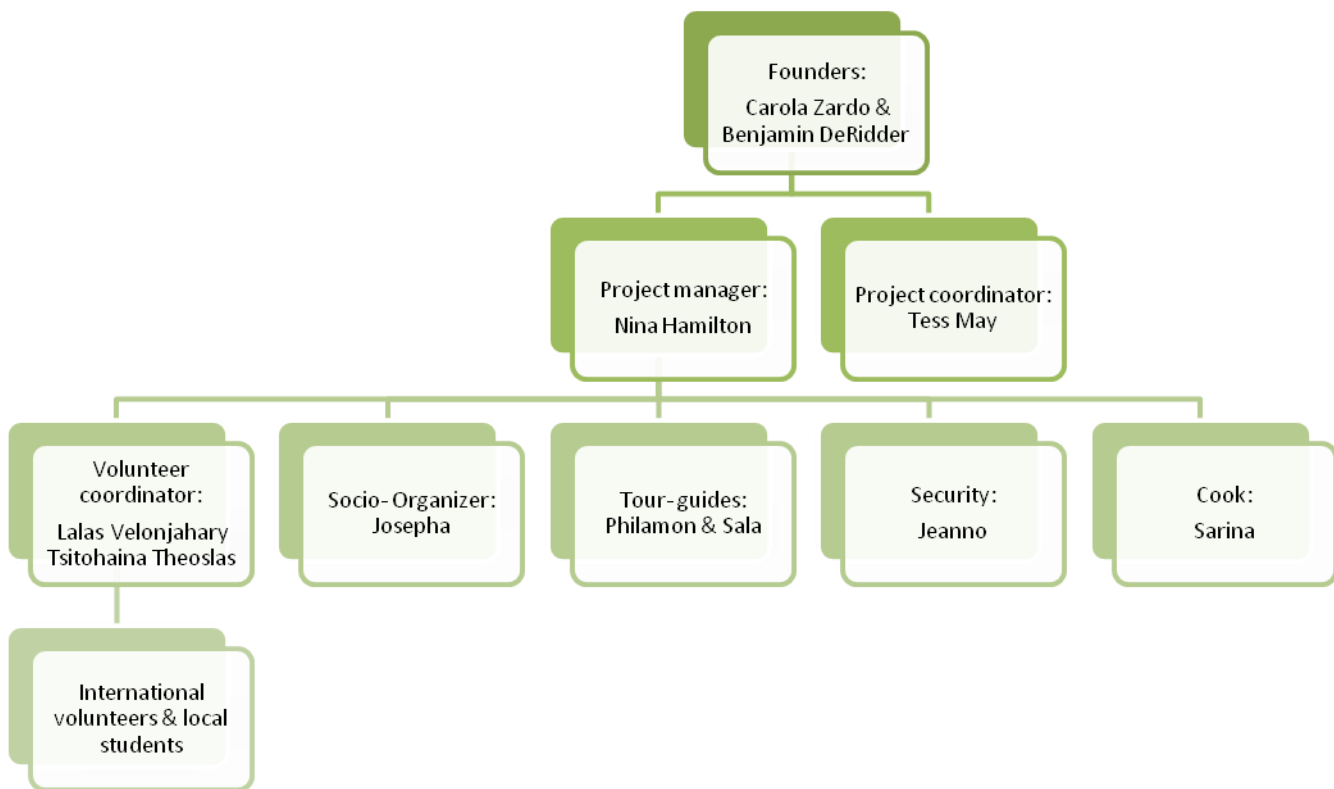


Figure 2. The organization

3. Malnutrition

This section will illustrate malnutrition throughout Africa, Madagascar and the project area. The section will describe the different types of malnutrition. Furthermore the section will illustrate the causes and symptoms of malnutrition.

3.1 What is malnutrition?

Africa's food security and nutrition situation continues to get worse. Malnutrition is a serious problem that begins when a person's diet does not contain the right amount (to less) of nutrients or the food does not provide the proper amounts of nutrients. Some diseases and malnutrition are pretty close. Sometimes a disease could be the result of malnutrition, sometimes it is a contributing factor because the immune system is weak. In fact, malnutrition is the largest single provider to diseases all over the world.

In the beginning malnutrition reduces physical and mental development, especially during the childhood. Stunting, for example, affects more than 147 million pre-schoolers in developing countries.

Malnutrition is directly related to food insecurity. Food insecurity can also be related to the type of food that is accessible to people in different areas. Even if a person consumes enough calories per day does not guarantee the right amount of essential micronutrients as vitamins and minerals. Insufficient calorie consumption often goes hand-in-hand with micronutrient malnutrition and can have health consequences.

Poverty and food shortage are linked to malnutrition and disease. People live on less than 0.50 cents a day, so they are unable to pay the prices for food at the market. Poverty is based on factors such as conflicts, disease epidemics, climate changes (droughts), violent conflicts, as well as fights over water and natural resources. More causes of malnutrition are listed below.

- Medical conditions (pain or diseases)
- Physical factors (poor teeth condition)
- Social factors (low income, reduces mobility)

Malnutrition is not the same as hunger. Hunger is the desire or need for food (= lack of food), malnutrition is lacking the right balance and types of food (= food is available, but not a good nutritional balance).⁵

*"A malnourished person finds that their body has difficulty doing normal things such as growing and resisting disease. Physical work becomes problematic and even learning abilities can be diminished. For women, pregnancy becomes risky and they cannot be sure of producing nourishing breast milk."*⁶

⁵ MADAGASCAR'S PILOT PROGRAM FOR COMMUNITY MANAGEMENT OF ACUTE MALNUTRITION

⁶ <http://www.wfp.org/hunger/malnutrition>

3.2 Malnutrition in Africa/ Madagascar/ the project area

The following section is a description and explanation of malnutrition in Africa, Madagascar and the project area.

3.2.1 Africa

Experts from different countries estimate that around 870 million people of the 7.243 Billion people in the world were suffering from chronic under nutrition. Almost all the affected people live in developing countries.

Africa, with 900 million inhabitants is the world's poorest continent. Every third African does not have enough food. The number of hungry people in Africa grew in the last years, from 175 million to 239 million. Many African countries are affected by long periods of rain or heat and the crops do not grow the way they should grow. The climate changes constantly which make it more difficult to grow crops and feed the people. The regions in West and East Africa are experiencing the worst food crises in recent years - 23 million people in 11 countries in the regions are affected by acute food insecurity and malnutrition.

In some countries, nearly half of the citizens (mostly adults) were infected by HIV. After a long fight against the disease, in many countries the number of people who become infected is dropping. Women still do not have authority over their own lives and millions of people who live with HIV in their bodies do not have access to the necessary medication. On the entire continent, corruption is a huge problem and lots of Africans have no access to education.

All of these facts, no access to education, diseases, poor soil conditions, climate changes, low hygienic standards, food insecurity and poverty are the a reason for malnutrition.⁷

3.2.2 Madagascar

Madagascar is one of the world's poorest nations 92 percent of the population lives in poverty. This means that it is not possible to afford the necessary nutrition. It is one of the 10 countries in the world with the highest percentage of chronic malnutrition and one of the 20 countries where the world's most underdeveloped children live. 50 percent of children under five years old have a developmental disorder. 38,000 children die every year before their fifth birthday, which means 104 children a day.

Acute malnutrition varies from 10 percent to 20 percent depended on the season. During the 'lean season' also called 'hungry' season(October to February) people do not have enough food, because the next crops will be harvested in the next period and food becomes scarce. Sometimes people must deal with one meal a day.

The access to safe drinking water and sanitation is poor.⁸

⁷ Sheeran. J. (WFP Executive Director), "Malnutrition and climate vulnerability in Africa", United Nations World Food Programme 2011

⁸ De Onis, M., Brown, D., Bössner, M. And Borghi, E. (WHO & UNICEF), "Levels & Trends in Child Malnutrition", 2012, UNICEF WHO-The World Bank Joint Child Malnutrition Estimates

3.2.3 Project area

It is documented that the south- west (project area) is the poorest region in Madagascar (Figure 3). Reasons are the poor soil (bad for growing fruits and vegetables), arid temperature and the low tourism (one of the most common source of income in Madagascar).

There are several programs against malnutrition started up by different governmental/ non-governmental organizations (Unicef, Welt Hunger Hilfe, WHO) all over Madagascar. The most active organization in Madagascar is the World Food Program. Cash and vouchers (cash transfers provide money to people who are struggling to provide food for their families and vouchers can be redeemed for food items or can be used in selected shops), school meals, food for assets (also known as Food for Work – to pay workers with food to start building a hunger-free future for their communities) are ongoing projects started up by the World Food program to reduce malnutrition.

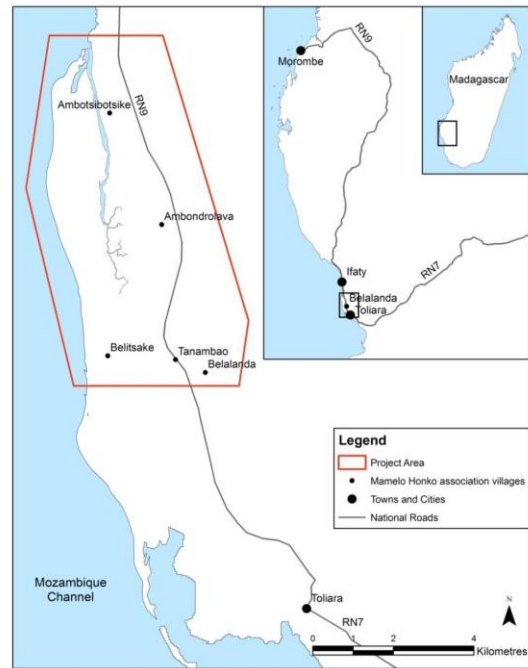


Figure 3. Project area

The project area is until now not part of a nutritional program. There are ongoing projects about conservation and agriculture, but (mal) nutrition is not included. That is a reason why material is rarely/ not available about (mal) nutrition in the country site of Tuléar.

There are 2 main problems which supporting malnutrition in the villages (in the project area):

1. Poverty

Many of the people can only afford to eat rice (2 or 3 times a day) which does not contain much nutrients.

That is one reason that the daily intake of the right amount of nutrients is too low. This is especially important for pregnant women, lactating mothers and young children.

2. Lack of education

People of the villages have a low basic knowledge; just a few people have a secondary school leaving certificate (mostly people stopped after primary school). Furthermore the parents cannot pay the fee for school.

3.2.4 The most effected group by malnutrition

Malnutrition is a huge problem in all groups of a community but children and pregnant woman are the most affected group, because of their high nutritional requirements for growth and development. For example the risk for a pregnant woman higher to give birth to a low birth weight (LBW) baby and the risk of morbidity and early death are higher.



Figure 4. Malnutrition-Disease-Poverty Cycle

The chance that a malnourished girl will become a malnourished mother is incredibly high. Low birth weight baby are more likely to be malnourished in their childhood and these malnourishes children grow up to undernourished adults and the cycle starts again. Experts call that phenomenon the malnutrition/ poverty related cycle (Figure 4). If people do not have enough money (poverty), they have an inadequate access to food and education. That is the reason for an unbalanced diet or an inadequate daily intake of nutrients what results to malnutrition, under nutrition and hunger. This is especially dangerous for pregnant woman and children. If people are undernourished the risk to become sick is higher and that means they cannot work, which results to less money and poverty.

In developing countries, poor parental conditions are responsible for 23% of all deaths among children younger than five years old. That means more than 2.6 million children each year, and a third of total child deaths worldwide. ‘Malnutrition is a silent killer that is under-reported, under-addressed and consequently under-prioritized’, so a staff member from a health program in Africa. One in three developing country preschoolers – 178 million children under the age of five – suffers from stunting as a result of chronic malnutrition. 80 percent of these children live in just 20 countries in Africa and the Asia Pacific region.

3.3 Different types of malnutrition

Each form of malnutrition depends on the lack of nutrients in the diet, for how long they are missing, the age and the gender of the person. The WHO called malnutrition a cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions.

There are two main types of malnutrition, the protein energy malnutrition (PEM) and the micronutrient deficiency disease (MDD). The protein energy malnutrition results from a diet lacking all major macronutrients (such as carbohydrates, fats and especially proteins) and energy (calories).

PEM is common in children and adults all over the world, but it affects children the most because of their high requirement in energy. It is the reason for 6 million deaths every year. In figure 5 it is shown that PEM is a big issue in Africa.⁹

⁹ Bössner, M. and De Onis, M. (WHO), ‘Malnutrition- Quantifying the health impact at national and local levels’, 2005, Environmental Burden of Disease Series, No. 12

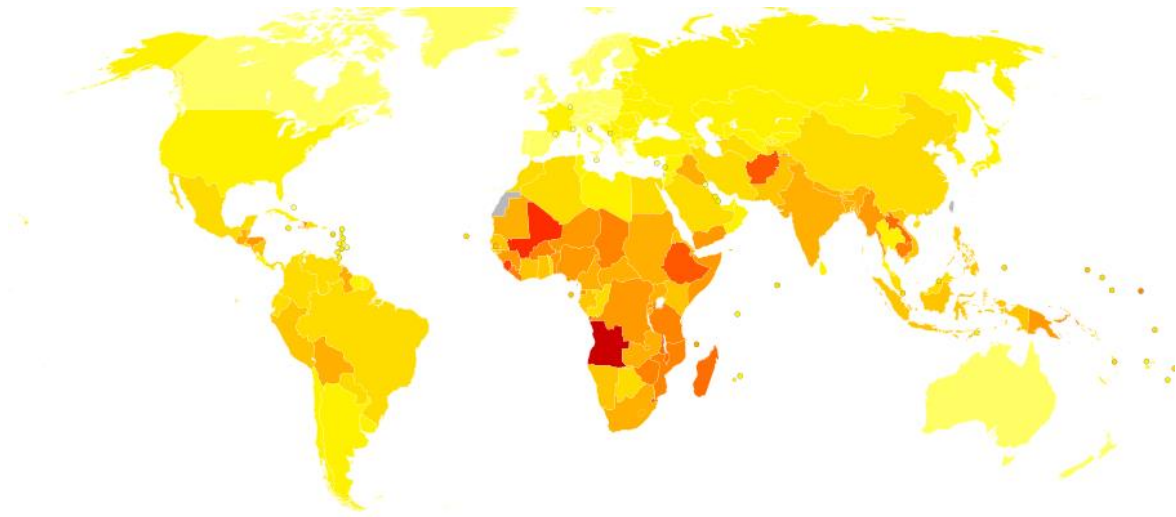


Figure 5. Protein energy malnutrition in the world

PEM includes:

- Kwashiorkor (protein deficiency)
- Marasmus (deficiency in calorie intake (energy))
- Marasmic Kwashiorkor (marked protein deficiency and marked calorie insufficiency signs present, sometimes referred to as the most severe form of malnutrition)

The micronutrient (see 5.2 Nutritional information) deficiency disease results from a deficiency of specific micronutrients. For example deficiencies in iron, vitamin A and zinc are ranked among the World Health Organization's (WHO) top in developing countries.

- Iron deficiency

Is the most prevalent form of MDD and it is present all over the world. Iron forms the molecules that carry oxygen in the blood. Symptoms of a deficiency include tiredness, less energy, slow cognitive and social development during childhood, difficulties keeping body temperature, reduced immune function, and glossitis (an inflamed tongue).

- Vitamin A

Vitamin A contributes to weakened immunity in all ages. A deficiency, for example, increases the risk of dying from diarrhoea, measles and malaria. It affects 140 million preschool children in 118 countries and more than seven million pregnant women. It is also a leading cause of child blindness across developing countries¹⁰

- Iodine deficiency

Iodine deficiency affects 780 million people worldwide. The most serious impact of a deficiency is on the brain, which cannot develop properly without iodine. 20 million children are born mentally impaired because their mothers did not consume enough iodine. The worst-hit suffer cretinism, associated with severe mental retardation and physical stunting¹¹

¹⁰ Nutrition's 5th Report on the World Nutrition Situation

¹¹ Vitamin & Mineral Deficiency, a global damage assessment report, Unicef

- Zinc deficiency

Zinc deficiency contributes to growth failure and weakened immunity in young children. It is linked to a higher risk of diarrhoea and pneumonia, resulting in nearly 800,000 deaths per year.¹²

3.4 Physical signs of nutritional deficiency

The table below illustrates typical signs of nutritional deficiency. Not all physical signs are a result of malnutrition. A disease can also cause a deficiency*.

Table 1. Physical signs of nutritional deficiency

Sign		Possible Deficiency
General symptoms	Fatigue/ tired Poor concentration Cold intolerance Disorientation Constipation Diarrhea	Protein-energy, iron, magnesium, potassium, vitamins B1, B12 and other B vitamins and vitamin C Iron, vitamins B1, B12, folate and possibly essential fatty acids Iron Thiamin, Niacin Dehydration, fiber, potassium, magnesium and folate Vitamin B3
Skin	Dry Itchy	Vitamin A, Essential Fatty Acids Iron
Hair	Dull, dry, thin, & pluck able	Protein, Essential Fatty Acid
Eyes	Eyelid lining & whites pale Bitot's spots Cornea dull, milky, hazy, dryness	Anemia Vitamin A Vitamin A
Mouth	Sore tongue Magenta tongue Glossitis Bleeding gums Cheilosis, angular stomatitis Cracking at the corners of the mouth	Iron, vitamin B12, B2, B3 and possibly other B vitamins Riboflavin Niacin, Folate, Vitamin B12 Vitamin C Riboflavin, Niacin, Iron, Pyridoxine Vitamin B12 Iron, vitamin B2 – riboflavin possibly other B vitamins
Muscular	Pain and cramps Muscle wasting	Magnesium, potassium, sodium, vitamin B1 and vitamin D Protein-energy

*

¹² Awah P. K., Bain L. E., Bernard N., Geraldine N., Kindong N. P., Sigal Y. and Tanjeko A. T., 'Malnutrition in Sub-Saharan Africa: burden, causes and prospects.', 2013, The Pan African Medical Journal

4. Moringa Oleifera

There are 15 different species of Moringa, this section will describe the species Moringa Oleifera, explain the different uses and the nutritional value.

4.1 History of Moringa Oleifera

The Moringa tree was first used by the old Roman, Greek and Egyptian civilizations; first described around 2000 B.C. as a medicinal herb.

Nowadays it is “rediscovered” in many areas around the globe.

The Moringa tree is a native widely growing plant of the Western Himalayas and India. There are 14 different varieties of Moringa out of different regions. The variety grown in Madagascar is the *Moringa Oleifera* and is also known as the Ben-oil tree, Cabbage tree, Horseradish tree, Drumstick tree, Mother’s Best Friend or Miracle tree. The leaves of the Moringa Oleifera are shown in figure 6.



Figure 6. Moringa Oleifera

The *Moringa Oleifera* tree is a fast growing broad-leave tree that grows up to 12 meters tall, four meters of which grow in the first year. Moringa is strong and grows well in dry climates and in areas with poor soil quality. The tree can be propagated from seedlings, seeds, or cuttings.

It is documented out of the old Ayurvedic medicine in India that Moringa prevents 300 diseases. Years ago the old Egyptians used Moringa oil as protection for their skin. Later, the Greeks found out that it can be just for healthful uses and introduced it to the Romans.

The Moringa plant spread eastward from India to some parts of China, Southeast Asia and the Philippines. From India it also spread westward to Egypt, the Horn of Africa and finally to the West Indies in America. Moringa is now grown all around the tropics.^{13 14}

4.2 Nutritional information

An individual needs a specific amount of certain vitamins, minerals, protein, carbohydrates, lipids, and water for a normal functioning and a good health. Most of them come from a healthy diet. The Moringa tree is a good source of the key nutrients a person needs for a healthy diet.

¹³ Fuglie, Lowell J., The Moringa Tree: A local solution to malnutrition?”

¹⁴ Albert, B., „The Moringa Tree Moringa Oleifera Moringaceae Family”, Village volunteers

On the basis of the amount required by the human body nutrients are classified in the following two categories: macronutrients and micronutrients.

Macronutrients:

Macronutrients (Table 2) are nutrients that provide the body with calories or energy. The prefix macro is Greek and means big or large, used because macronutrients are required in large amounts. There are three main groups of macronutrients protein, carbohydrates and fats.¹⁵

Table 2. Macronutrient in 100 g Moringa Oleifera*

	Fresh leaves	Dried leaves
Carbohydrates	12.5 g	41.2 g
Protein	6.70 g	29.4 g
Fat	1.70 g	5.2 g
Fibers	0.90 g	19.2 g
Calories	92 cal	329 cal

- Calories

Calories come from protein, fat and carbohydrates and are a measure unit for energy that the body uses for all of our physical and mental processes. The body breaks down calories to provide energy, the energy that is consumed in muscles or the brain and nervous system. How many calories a human needs per day is based on the basal metabolic rate (BMR). The BMR is the amount of energy the body needs to work and rest.

An individual adult needs approximately 2000 calories a day. Height, weight, gender, age and activity level affect the calories needed per day.

Basal metabolic rate at rest: (to calculate the minimal daily intake)

Man

$$\text{BMR} = 66 + (13.7 * \text{weight in kg}) + (5 * \text{height in cm}) - (6.8 * \text{age in years})$$

Woman:

$$\text{BMR} = 655 + (9.6 * \text{weight in kg}) + (1.8 * \text{height in cm}) - (4.7 * \text{age in years})$$

Example for an African woman:

$$\begin{aligned} \text{BRM} &= 665 + (9.6 * 48 \text{ kg}) + (1.8 * 162 \text{ cm}) - (4.7 * 22) \\ &= \underline{1314} \text{ calories/day (minimum daily intake of calories per day, by low activity level)} \end{aligned}$$

- Carbohydrates

Carbohydrates major function is it to provide the body with the energy (providing 3.75kcal (16kJ) per gram) all tissues and cells in our body need. Furthermore carbohydrates are needed for the central nervous system, the kidneys, the brain and the muscles (including the heart) to function without problems. They are stored in the muscles and liver and can later be used for energy.

¹⁵ De Jong, F.M, "Ons voedsel- Wat erin zit, hoe het gemaakt wordt & wat het met ons doet"

- Protein

Proteins are organic components made of small blocks of amino acids. They are necessary for growth (especially important for children, teens, and pregnant women), tissue repair, and immune function making essential hormones and enzymes, energy when carbohydrate is not available

- Fibers

Fibers, also known as lipids, have important functions as providing the structure of the body, caring the fat- soluble vitamins (A,D,E and K) proving the starting material to make many hormones (cholesterol). Furthermore fat is the most concentrated source of energy, it absorbs certain vitamins (like vitamins A, D, E, K, and carotenoids) and it provides cushioning for the organs.

Micronutrients

Micronutrients (Table 3) are different from macronutrients because they are necessary only in very tiny amounts. Nevertheless, micronutrients are essential for good health, and micronutrient deficiencies can cause serious health problems. Micronutrients are necessary for the healthy functioning of all your body's systems, from bone growth to brain function.

Vitamins

Vitamins are essential substances (nutrients) the body cannot produce. Vitamins are necessary for fundamental functions in the body such as energy production, blood clotting, growth, general health and they are a regulator of the metabolism. If it is not possible, for different reasons to eat enough vitamins, it can have different negative effects for the body. Every vitamin has a specific roll in our body.¹⁶

Table 3. vitamin contenet per 100gram Moringa Oleifera*

	Fresh leaves	Dried leaves
Vitamin A	6.78 mg	17.6 mg
Vitamin B1	0.06 mg	2.02 mg
Vitamin B2 (Riboflavin)	0.05 mg	21.3 mg
Vitamin B3 (Niacin)	0.8 mg	7.6 mg
Vitamin C	220 mg	15.8 mg
Vitamin E	448 mg	10.8 mg
Vitamin K	-	1.03 mg

- Vitamin A:

The official name is retinol. Retinol points to the retina, OL means it is an alcohol. Vitamin A has multiple functions; it helps to prevent cellular destruction or injury (specific for anti-oxidants), cellular differentiation (required for cells to maintain normal structure and function), growth, fertility/reproduction, immunity and skin health.

Signs of deficiency (common in developing counties in children under 5 years)

¹⁶ Hoffmann, I., Schneider, K., Leitzmann, C., (2011.)," Ernährungsökologie - komplexen Herausforderungen integrativ begegnen"

- Night blindness
- Appetite
- Risk of infection
- Dry or rough skin
- Growth failure
- Malabsorption
- Death

All vitamins in the vitamin B group are water soluble. They are similar to each other and depended on each other. The major function of all vitamins in the B group is related to energy production. A shortage can have consequences for all other vitamins in the group.

- VitaminB1 (Thiamine)

Next to the energy production it helps to support the tissue in the body, it is essential for growth and pregnancy and it is important for membrane and nerve conduction.

- VitaminB2 (Riboflavin)

Vitamin B2 is essential for protein, carbohydrates and the fatty acid metabolism. Furthermore like the other B vitamins it is an energy factor and important for growth. A shortage can be the reason for lip lesions or cracks at the corner of the mouth or eczema.

- VitaminB3

Vitamin B3 comes from the amino acid tryptophan. The most important function is the conversion from carbohydrates into glucose.

- Vitamin C

Vitamin C supports the immune system and fights against viral diseases such as colds and flu. It is an anti-oxidant as it protects blood vessels and the lenses in your eyes, helps keep body tissues strong, and helps heal wounds. Signs of deficiency are swollen inflamed gums, fatigue, weakness, loss of teeth, loss of hair, shortness of breath, muscle cramps, aching bones, joints, and muscles, loss of appetite, anemia, poor wound healing or bone fractures.¹⁷

- Vitamin E

Vitamin E protects body tissue from damage (free radicals). It also helps protect the immune system against viruses and bacteria. It is important in the formation of red blood cells and it helps the body to use vitamin K. Furthermore vitamin E can prevent cancer, heart disease, dementia and liver disease. A signs of deficiency is the hemolytic anemia.

- Vitamin K

Vitamin K is important for blood clotting, because without it blood would not clot. A deficiency is very rare, people with a deficiency are usually more likely to have bruises and bleed faster.

Table 4 shows there commanded daily intake of the vitamins for different groups.

¹⁷ De Jong, F.M, "Ons voedsel- Wat erin zit, hoe het gemaakt wordt & wat het met ons doet"

Table 4. RDI Vitamines in microgram (µg)

	Vit. A	Vit. B1	Vit. B2	Vit. B3	Vit. C	Vit. E	Vit. K
Babies	400- 500	0.2	0.2	2	34- 35	2.9- 3.6	5.0- 10.0
Children	500- 1000	0.2 - 0.5	0.2 - 0.5	7.0- 11	45- 55	7.1- 10.1	20- 45
Adult Women	800	1.1	1.1	13	70	3.9- 9.9	45- 65
Adult Men	1000	1.1	1.1	17	70	11.8- 13.0	65- 80
Pregnant Women	1000	1.4	1.4	17	90	10.5	65

Minerals

As like vitamins, minerals support the body to growth, to stay healthy and they help to regulate different body processes. The body uses minerals for different functions such as building bones, transmitting nerve impulses, making hormones or conducting a normal heartbeat. Table 5 shows the mineral content per 100 gram Moringa.

Table 5. Mineral Contents in Moringa Oleifera per 100gram*

	Fresh leaves	Dried leaves
Calcium	440 mg	2.185 mg
Copper	0.07 mg	0.49 mg
Iron	0.85 mg	25.6 mg
Magnesium	42 mg	448 mg
Phosphorus	70 mg	252 mg
Potassium	259 mg	1.236 mg
Zinc	0.16 mg	3.41 mg

- Calcium

It is linked to many of the functions that vitamin D plays in the body. Calcium is important during the childhood years. It builds strong bones and teeth and assists in blood clotting. Calcium helps prevent osteoporosis, stabilizes blood pressure, It supports normal brain function and helps with the communicating between cells. Deficiencies are common in pregnant and breastfeeding/nursing women and can cause rickets, bone pain and muscle weakness.

- Copper

Copper is essential for proper functioning organs and metabolic processes. It works together with iron to help the body build red blood cells. It also helps keep the blood vessels, nerves, immune system, and bones healthy.

- Iron

The human body needs iron to make hemoglobin and myoglobin (hemoglobin is found in red blood cells and myoglobin is found in muscles). Iron is also a part of many proteins in the body.

- Magnesium

Magnesium helps the body to repair cells by providing energy, it helps to regulate normal nerve and muscle function, supports the immune system, keeps the heart beat steady. Deficiencies can result in weakness, tiredness, vertigo, convulsions, nervousness, cramps and heart palpitations.

- Phosphorus

The main function of phosphorus is to form bones and teeth. It plays also an important role in how the body uses carbohydrates and fats. It is also needed to make protein for the growth and repair of cells and tissues. Phosphorus also helps the body make energy (ATP). Phosphorus works together with the B vitamin group and supports the kidney functions, nerve signaling and muscle contractions.

- Potassium

Potassium is a very important mineral for the human body, it is essential for the brain and the nerves. Furthermore it builds protein, break down and use carbohydrates, builds muscles and it controls the acid-base balance

- Zinc

It is needed for the immune system and it plays a role in the splitting of cells, cell growth, healing wounds, and the breakdown of carbohydrates. Zinc is also needed for the senses (smell and taste). During pregnancy, infancy, and childhood the body needs zinc to grow and develop properly.

Table 6 shows the recommended daily intake (RDI) for different groups

Table 6. RDI Minerals in milligram

	Calcium	Copper	Iron	Magnesium	Phosphorus	Potassium	Zinc
Babies	200- 450	0.3- 0.5	5.0- 7.0	35- 60	100- 275	400- 700	4.0
Children	700- 1100	0.5- 2.5	7.0- 8.0	90- 185	460- 500	3000- 3800	5.0- 7.0
Adult Women	700- 1000	1.5- 3.5	15- 16	250- 300	500- 700	4500- 4700	9.0
Adult Men	700- 1000	1.5- 3.5	9.0- 11.0	300- 350	500- 700	4500-4700	10.0
Pregnant Women	900-1000	2.0- 3.5	11.0- 14.0	300-350	700- 1250	5100	12.0- 15.5

Furthermore are there different factors that affect the vitamin and mineral need of an individual:

- Age (infants have higher needs due to growth)
- Gender (women need more iron and calcium)
- Food Choices (vegetarian)
- Climate (hotter climates require less Vitamin D due to sun exposure)
- Level of Physical Activity (increased activity requires additional micronutrients)
- Drugs (some drugs affect vitamin and mineral absorption)
- Clinical Conditions (cancer & HIV/AIDS patients require additional micronutrients)

There are non-essential and essential amino acids (Table 7) those cannot be synthesized by our body, 20% of amino acids must be supplied directly by diet (isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine). Non-essential amino acids can be synthesized by the body (liver) so it is not necessary to get them from food.

Amino acids are used in a lot of body processes from regulating different body functions to regulating the brain functions and they activate vitamins and other nutrients. They build up protein

and when protein is digested it is broken down to amino acids (break down protein). Furthermore amino acids are good for skin, eyes, heart, intestines, bones and muscles.¹⁸

Table 7. Amino Acids per 100 gram *Moringa Oleifera**

	Fresh leaves	Dried leaves
Arginine	406.6 mg	1.027 mg
Histidine	149.8 mg	536 mg
Isoleucine	299.6 mg	932 mg
Leucine	492.2 mg	1.730 mg
Lysine	342.4 mg	1.036 mg
Methionine	117.7 mg	280 mg
Phenylalanine	310.3 mg	1.420 mg
Threonine	117.7 mg	1.080 mg
Tryptophan	107 mg	510 mg
Valine	374.5 mg	875 mg

The Moringa tree has unique nutritional qualities. It is documented that just three tablespoons of fresh leaves will provide a one-five year old child with their calcium for a day, and about 75% of iron and half of the protein a child needs to grow and develop the body and mind. Furthermore the child would get all the daily needs of potassium, B vitamins, copper and all the essential amino acids. For a pregnant/lactating woman, four tablespoon of fresh leaves could supply a third of the daily calcium requirements as well as it would provide the necessary amount of iron, protein, copper, sulfur and B vitamins. Moringa leaves are a good source of vitamin C and the leaves are great sources of minerals like calcium, iron, copper, manganese, zinc, selenium, and magnesium.¹⁹

**Measure unit per 100 gram Moringa:*

One tablespoon of fresh Moringa leaves = one teaspoon of dried Moringa leaves

3/4 cup dried Moringa powder = 100 gram

1.5 cup fresh Moringa leaves = 100 gram

The nutritional value in Moringa powder (dried Moringa leaves) is similar to the fresh leaves. Around three teaspoons are enough for a one-five year old child and four teaspoon of the Moringa powder is enough for a lactating/nursing woman.

In general is it recommended to eat two till four tablespoons of fresh or two till four teaspoon dried Moringa powder a day.

4.3 Different uses of the *Moringa Oleifera* tree

Moringa can be used for individuals and for animals alike. All parts of the tree can be used in different ways. The following part describes the different uses of the Moringa tree.

¹⁸ Earth Goodness Ltd, "The Moringa- *Moringa Oleifera*- The Miracle tree
<http://www.themoringa.com/nutritional-values>

¹⁹ Doerr, B. and Cameron, L., "Moringa Leaf Powder"

4.3.1 As food

The most used part of the Moringa tree is the **fresh leaves**. It is the best to pick the growing tips when there are young, because they get tougher as they are older. The leaves must be removed from the wooden stem. The stem is not going to get soft during cooking. The leaves can be used the same way as spinach. Another easy way to use them is it to steam the fresh leaves for a few minutes and to add some spices.

It is also possible to dry the fresh leaves, crush or pound them to make **leave powder**. The powder can be used for sauces but at the same time it can also be used as an addition to the daily diet (in rice, beans or vegetables).

Flowers can be cooked to make a tea or to be mixed with other food. They can be fried in butter to eat them as a snack.

The pods can be eaten from when they first appear, later they will become tough and hard. The taste is similar to asparagus. The best way to prepare them is to cook or boil them till they are tender, even the older pods can be used. The preparation of the pods is comparable to green beans.

Seeds can be used from the time they appear on the tree until they turn yellow, when peel starts to get hard. To cook the seeds they have to remove from the pod. The seeds in the pods are surrounded by a thin sticky bitter layer, which will disappear during cooking. The seeds can be used as green peas. Older ones can be used for oil extraction. They contain 35% oil.

When the seedling is over 60 cm tall **the roots** can be used as well. The bark should be completely removed and it will be similar to horseradish.

The **resin** in the bark can be used to flavor food.

4.3.2 As medicine

Moringa Oleifera is next to a food supplement also useable as natural medicine. The fresh leaves can be used to relieve headaches, to stop bleeding from a shallow cut by apply a dressing of fresh leaves around the cut. Furthermore have the fresh leaves an anti-bacterial and anti-inflammatory effect on wounds or insect bites on the body. Moringa leave extracts can be used against bacterial or fungal skin irritations. Leaf tea treats diarrhea and putting fresh or dried Moringa in food has lots of micro- and macro nutrients so it is a useful part in treating malnutrition. The flowers can be used as tea for stomach problems or a cold. The juice out of flowers is useful for urinary problems. Row pods can be used as a de-wormer. The oil of the seeds can be used as a relaxant for epilepsy and it stimulates the urination. Furthermore they have antibiotic and anti-inflammatory properties to treat arthritis, rheumatism, gout, cramp, sexually transmitted diseases and boils. It is the best to roast and pound the seeds to get the oil.

4.3.3 Other uses

Fertilizer

The seed membrane cannot be eaten and contains harmful substances. But it contains a high level of protein and makes a good fertilizer. It is perfect to use as a fertilizer in small scale agriculture.

Fencing

The trees can be used as a fence. It is a good wind protection and spends shade for hot days. It is fast and easy to grow and if cuttings are planted close together they will form a fence for cow's, goat's or pigs.

Pesticide

By digging Moringa leaves into the soil before planting, damping off disease (*Pythium debaryanum*) can be prevented among seedlings.

Cleaning product

It is possible to use crushed leaves to clean cooking utensils.

Fuel wood

The wood is not good to build houses because it is light, but it is perfect for cooking.

Oil

The seeds consists out of are 28% oil. It can be used for cooking, making soap, as a lubricant for machinery and extraction of essential oils in perfume.

Water purifying

The seed powder can be used as for cleaning dirty well water. The seed powder removes 90% of bacteria contained in dirty well water.²⁰

4.4 Cultivation/ caring of Moringa Oleifera

All species of Moringa are easy to grow, simply because they tolerate a wide range of soil and rainfall conditions. The minimum rainfall is estimated at 250 mm and the maximum is estimated by of 3,000 mm. The tree has a long taproot what makes it possible to survive during long periods of drought. The temperature range is between 25-38 degrees Celsius. That is why it is not possible to grow Moringa in Europe. Normally the tree flowers once a year. During its first year, it can grow up to 4 meters, and it will reach up to 12 meters in height.

Seeds can be planted year round, but it is better to soak the seeds in water overnight before seeding the seeds (see presentation 2 for the villages). Seedlings can be transplanted after 4-6 months when they are 60-90 cm high. The planting hole should be one part sand and one part compost even if Moringa is a pretty strong tree. It will support the tree to grow and it ensures a fast growth. It is most effective to plant seedlings in the late afternoon to avoid exposure to the sun immediately after planting. Do not water heavily after planting.

Another possibility is it to plant from cuttings. Cuttings should be 45 cm to 1.5 m long and the mother plant should be healthy. They can be planted directly. Cuttings should be placed in light and sandy soil. Plant one-third of the length in the ground.

The Moringa trees do not need much water. But it is important to water a seedling or a seed in the ground during the first months. To stimulate the production of more branches and pods, cut off the central growing tip to reach the branches easily. Moringa trees will generally grow good without a fertilizer. The tree is generally is resistant to most diseases. Insects as termites could be a problem in some areas and some insects could eat the leaves as like cows, sheep, pigs and goats. It is better to protect the tree from livestock by set up fencing.²¹

²⁰ Earth Goodness Ltd, "The Moringa- Moringa Oleifera- The Miracle tree

²¹ Albert, B., „The Moringa Tree Moringa Oleifera Moringaceae Family“, Village volunteers

5. My project in the villages

This section will describe the project in the villages Ambondrolava, Amboutsiboutske, Belalanda, Belitsake and Tanambao.

5.1 Method

A structured interview (also known as a standardized interview or a researcher-administered survey) is a research method used in survey researches. The main concern is to make sure each interview is exactly the same (questions in the same order). This ensures that a comparison can be made between the sample groups.

The survey, shown in addition 5, was started up to find out the common eating habits and the normal daily intake of food and nutrients. The chosen method was interviews, which is the most common method of data research in healthcare. Furthermore a face to face discussion with the 'human subjects' was possible, which is the best and most personal way to find out more about the people themselves and the common eating habits.

The chosen interview method was open questions. Closed questions limit the response of the interviewee and do not enable the research group to think deeply or test the real feelings or values. The answers were written down during the conversation and afterwards compared. The results are shown in 5.3.2 in graphs.

In total 70 people, mostly woman, were interviewed. That is around 12 people per village (more information about the focus group in the following paragraph 5.2). To get a general overview of the nutritional situation people from different layers of the local population, gender and age were chosen. For example the youngest mother was 17 while the oldest mother was 57.

5.2 Target group

The target group of the project is the participation of five communities (especially women and children) Ambotsibotsike, Ambondrolava, Belitsake, Tanambao, and Belalanda in the province Tuléar. In total the 5 communities' count for 4 500 inhabitants (information from HONKO).

The population in the project area suffers from income-related poverty. There is small-scale agriculture and fishing in the mangrove/ocean.

The population in the villages is growing fast, because of better resources and worse family planning (contraceptives, birth control). 71% of the population is under 21 years therefore 43% of the population is under the age of 5 years (high- risk group).

54% of the total population is women. Women are mostly responsible for the food a family eats during the day and to take care of the kids. That is the reason mostly woman were interviewed. Another reason for interviewing women is due to the fact they are responsible for preparing meals and deciding on what the families would eat. Men are seen as the stronger gender, which is why they are responsible for the hard/physical work.

Furthermore there are several ethnical groups (Table 8) in the project area (Tagnalagna, Atandroy, Masikoro, and Vezo).²²

Table 8. Ethical Groups

Village	Main Economic Activities	Ethnic composition	Infrastructure
Ambondrolava	Agriculture Fishing (mangrove)	Tagnalagna 60% Atandroy 15- 20% Masikoro 15%	1 school* 1 shop
Tanambao	Fishing (sea) Agriculture	Vezo 90 % Other 10%	1 school* 2 shops
Belalanda	Agriculture Charcoal production	Vezo 80% Tagnalagna/Masikoro 20%	2 schools* 1 hospital 1 commune >10 shops
Ambotsibotsike	Fishing (sea)	Vezo 90% Others 10%	1 school* 4 shops
Belitsake	Fishing (sea)	Vezo 90% Others 10%	1 shop

*The school system in the villages is difficult. Children of different ages are together in one class. Not all children go to school; sometimes kids are working.

²² Honko Plan Vivo

5.3 Interviews in the villages

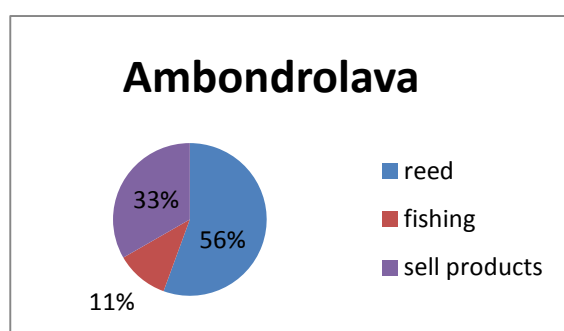
This part is about the questionnaire in the 5 villages and an evaluation of the survey.

5.3.1 The survey

1. Economy:

The first part of the survey was about the economy in the villages. The economy is one of the most contributing factors towards malnutrition. Many people within the project area have a low income and have little or no education. These factors lead to a poor diet which can cause malnutrition.

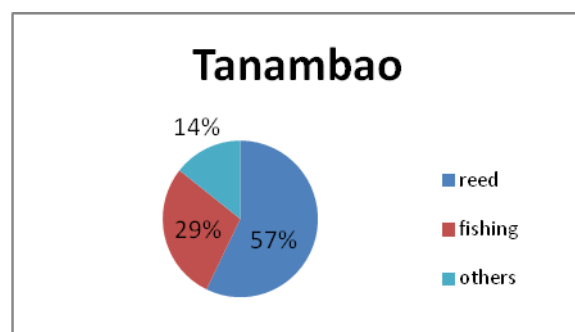
a) Main source of income?



The main source of income in Ambondrolava (Figure 7) is cutting and selling reed.

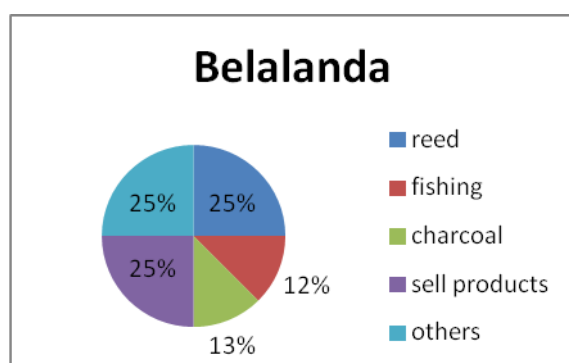
People (most of the time woman) cut reed in the morning and let it dry for 1 day. After one day it is ready to use and people sell it at the market for less than 0.20/ 0.30 cent per pack. Fishing and small shops (typically inside/ in front of people's homes) are the two other main sources of income within this village but do not generate much money within the village.

Figure 7. Main source of income



The main source of income in Tanambao (Figure 8) is also reed. Ambondrolava and Tanambao are the smallest and poorest villages. Both are located inland, which is the reason that reed is the main source of income. Like Ambondrolava there is also fishing and other small "business's" in the area.

Figure 8. Main source of income



Belalanda is the biggest village of the 5 as it has a market where people from all villages sell their products. Cut/ sell reed, fishing, making charcoal and selling products in a small shop (most of the time in the own house) or at the market are the main sources of income (Figure 9).

Figure 9. Main source of income

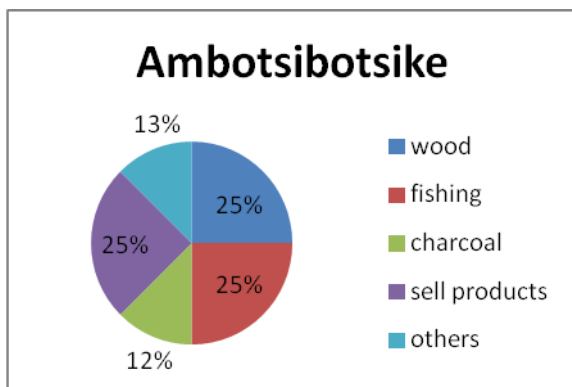


Figure 10. Main source of income

Ambotsibotsike (Figure 10) has a lot of small shops, which is why one of the main sources of income is selling products. Furthermore it is common to sell wood or to go fishing in the ocean. Ambotsibotsike is one of the wealthier villages, which could be reason that people do not use reed as the main source of income. People use also other sources of income as sewing or making mosquito net.

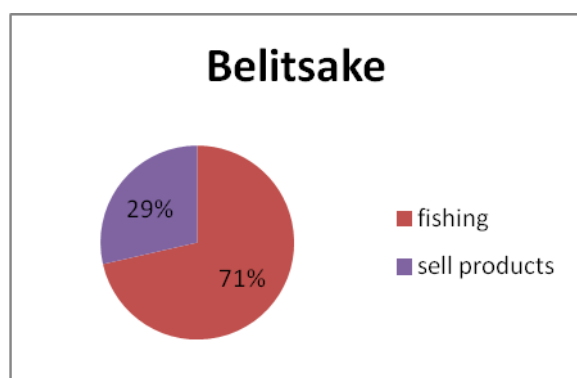


Figure 11. Main source of income

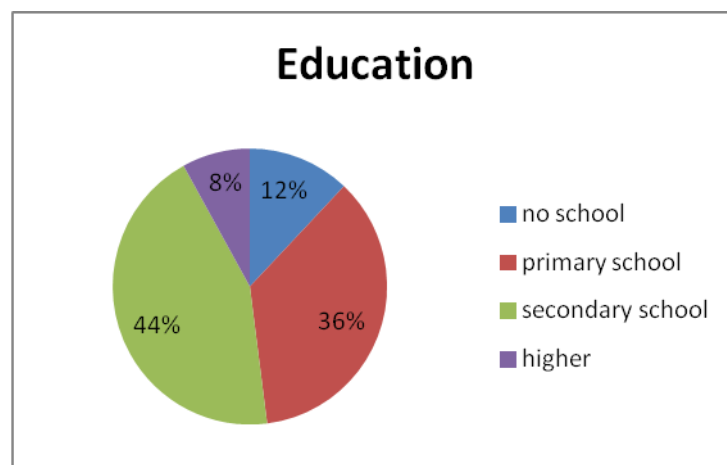
Belitsake (Figure 11) is an isolated fishing village on the ocean. The main source of income is fishing. Furthermore there are some small shops where people sell products. Belitsake is also one of the wealthier villages.

b) How often do they leave the village?

The main reason why people leave the village is it to sell products at the market (Belalanda or Tuléar). The women from Ambondrolava, Tanambao, Belitsake and Ambotsibotsike walk to Belalanda to sell different products at the market every day. Tuléar is a two hour walk (ca.12km) which takes too much time. People do not leave the village to buy food. Mostly one person, with a Sharety, gets a bag of rice (that is all the people need) and sells it to the rest of the village.

c) What is the level of education?

Figure 12 shows the level of education. A lot of people do not have a school certificate. The reasons they stopped with their education is listed below.



- Parents diet
- Marriage
- Pregnant
- Not motivated
- No money
- Work

A low level of education could be the reason for a poor nutrition (people do not know what is good).

Figure 12. Level of education

2. Associations:

The next part was about membership in different associations/ local communities or clubs. All over Madagascar are different associations which support people in different topics, as agriculture, healthcare, work, education and so on

a) Are you part of an association?

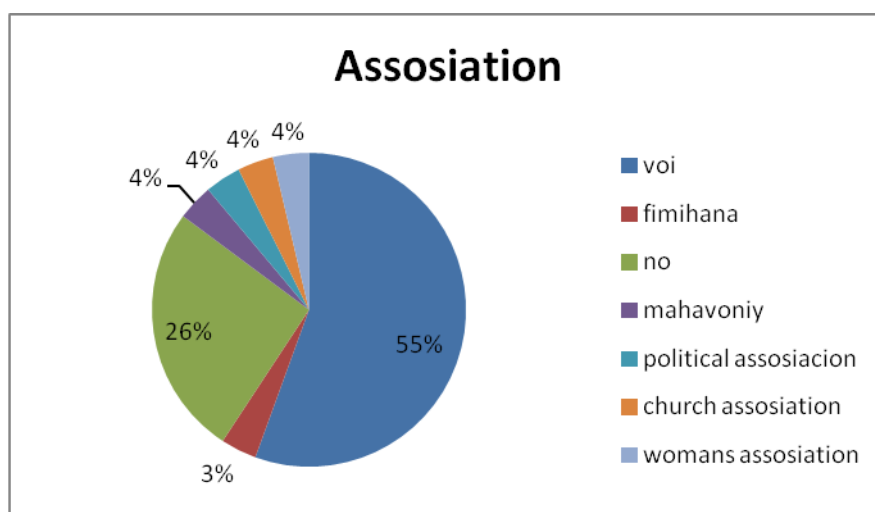


Figure 13. Assosiations

The most common association in the project area is the VOI (Figure 13). VOI is a local management association, which manages the mangrove in collaboration with Honko. Furthermore are people member of political (fimihana, mahavoniy, and others) and church associations. None of the association is connected

to nutrition or health. It was significant that most of the people in Belitsake are not part of any association.

3. Recreation:

The following part was about recreation and free time activities to find out if their daily activities are related to nutrition (gardening) or a healthy lifestyle.

a) What do people do if they are not working?

Lots of people do not do anything in their free time (Figure 14). Family is really important to

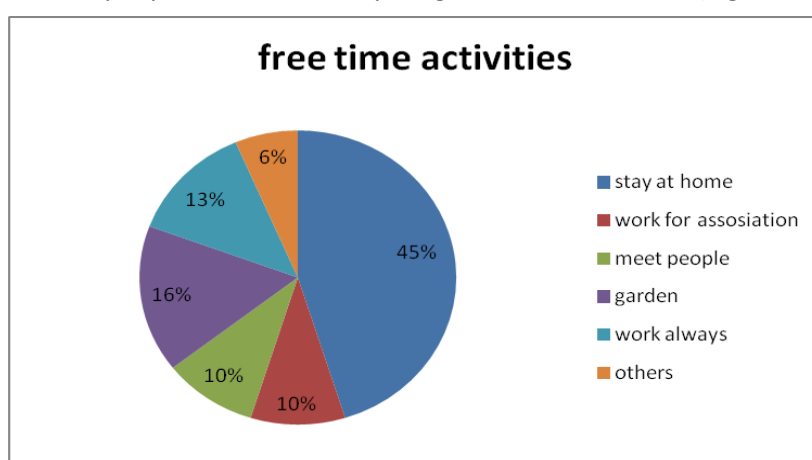


Figure 14. Free time activities

Malagasy people, which could be the reason that many of the interviewees say they stay at home and take care of the children. There is rarely a connection to a healthy lifestyle. The soil conditions are bad, which makes gardening difficult and time intensive (keep the garden healthy and in shape). Some people have their own secondary activities including

but are not limited to sewing and making clothes. Free time activities are not connected to a healthy lifestyle.

b) What are children doing if they do not attend school?

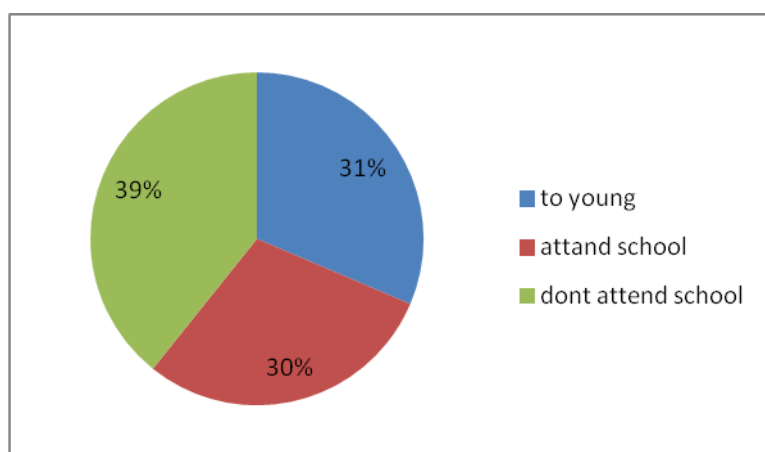


Figure 15. Percentage children in school

Almost half of the interviewees said that their kids do not attend school because there are more important things kids should do during the day (Figure 15).

All kids who do not attend school are working. The school fees are a big problem, and the most families cannot pay them.

The low level of education could be a reason for the poor nutrition. Nobody (at home or in school) teach kids how to eat healthy.

4. Health:

This part is about the general health in connection to the daily diet.

a) Common illnesses in your family?

Mostly people answered this question with 'no, we are never sick and we do not have any problems'.

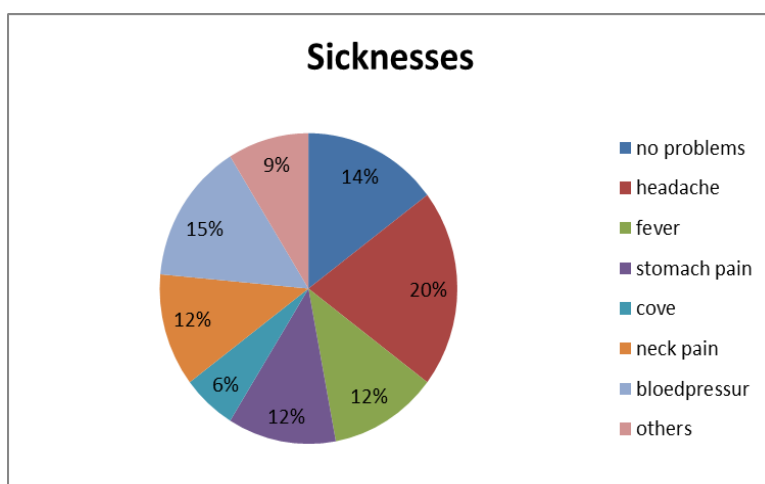


Figure 16. Common illnesses

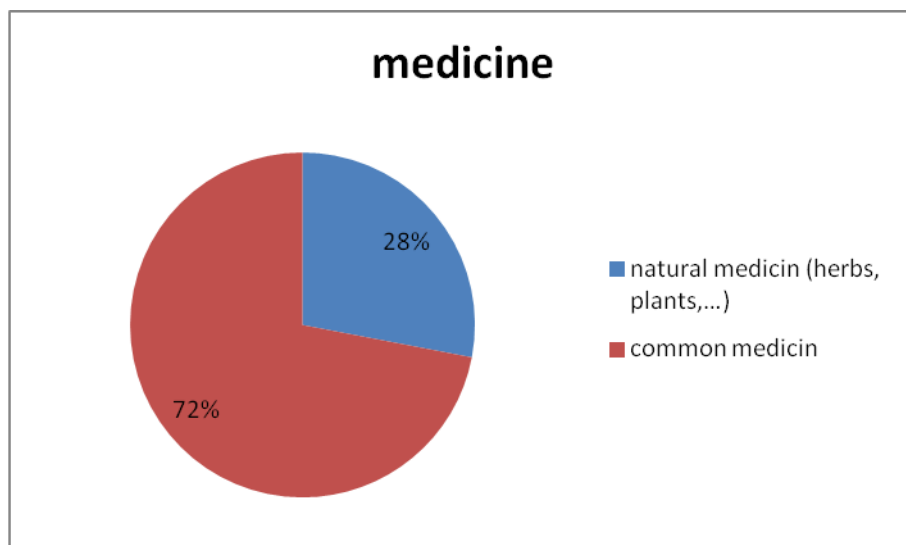
It was particularly noticeable that the interviewees were skinny with dry skin and the majority looked fatigued. Local people do not see the diet as a possible reason for different sicknesses. Figure 16 shows common sicknesses.

b) Where do people go if they are sick?

Local medicinal specialists are not common in the villages. If people need a doctor they need to go to the hospital and pay by themselves. In some villages there are nurses to help during the pregnancy, birth and during the first weeks with the newborn. Plants are not used to prevent deceases.

c) What kind of medicine?

Surprisingly plants, leaves and other sources of natural medicine are not commonly used in the



project area. This could be a reason why the people in the project area do not use the Moringa tree. The majority of people (all ages) use painkillers for different kinds of diseases (Figure 17).

Figure 17. Medicine

d) Is there a local medicine specialist? (see question 4b)

In Belalanda there is a hospital, but people do not like it (they prefer Tuléar). In some villages there is a nurse especially for pregnancy, birth and babies. Local medicine specialists are not common in this region.

5. Environment:

The next part was about the environment especially about water. Both malnutrition and inadequate water supply and sanitation are linked to poverty. Water, sanitation and hygiene have a direct impact on various diseases (e.g. Diarrhea).

a) Where is the water from?

All people get their water from water sources close to/ in the village (public or private). The quality and the amount water dependent on the season. In every village is at least one public water source.

b) What kind of wells do you have?

There are 2 different types of wells

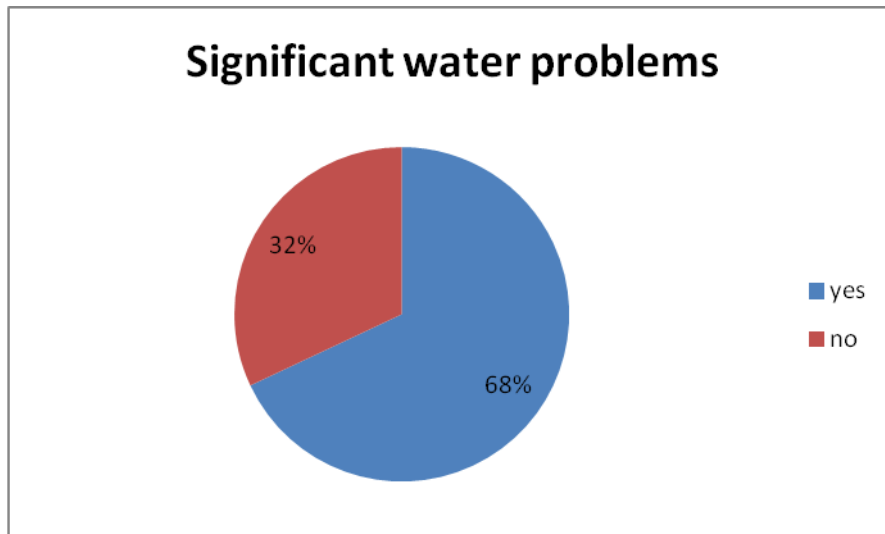
1. Well out of stone
2. Hole in the ground

c) How far is the water source from your house?

The distance can be 10 meters and up to 1000 meters (one kilometer). Some people have their own little water hole behind the house.

d) Significant water problems?

Lots of people have problems with small animals or dirt in the water, shown in figure 18. Often



children play in the water and the water gets dirty because of this. Sometimes the well has no cover. During the rainy season (October to February) the water supply becomes worse and can be contaminated. The water is not comparable to European standards.

The villages are close to

Figure 18. Significant water problems

the coast, which means the water is salty. People do not see dirty water as a possible reason for health problems.

e) Where do you cook on?

Everybody uses a stove. Wood is the cheapest source which is the most used in Ambondrolava and Tanambao. People in Belitsake use 'sharbon' (charcoal). People in Ambotsibotsike and Belalanda use both, wood and charcoal.

f) Open fire or cook pot (stove)?

All people use a stove comparable to a grill, but for pans.

g) Is it a fuel efficient stove?

Nobody uses a fuel efficient stove, because it is too expensive and it takes longer to cook. A fuel efficient stove would be a good investment, because fewer coals are needed. People could save money and buy other important things (food).

6. Agricultural activities

This part is about all agricultural activities and the use of agricultural products.

a) Do you have crops?

Half of the interviewed people have crops (Figure 19) in their garden (small scale). People do not

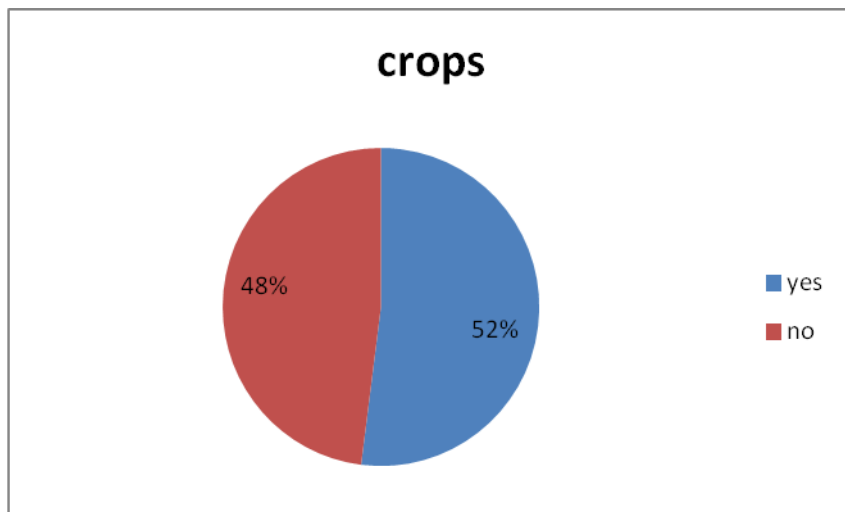


Figure 19. Crops

keep the crops. Gardening is a full time job. People bring the crops to the market or sell them at their house to make money.

The most common crops are corn and sweet potatoes. The leaves of the sweet potatoes are also sold and used, which both generates more money and eliminates waste and can be seen as an advantage.

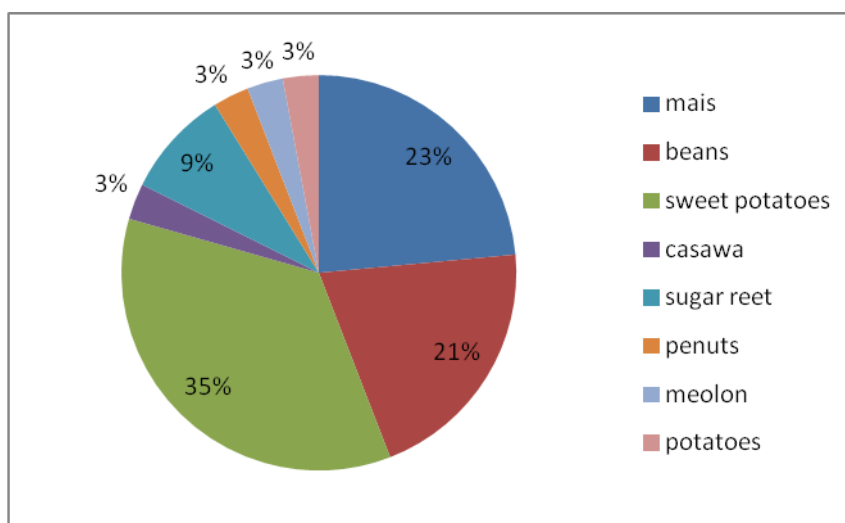


Figure 20. Overview crops

Figure 20 is an overview over the different kinds of crops people grow and sell afterwards. Even the bad quality products are sold.

b) Do you have animals?

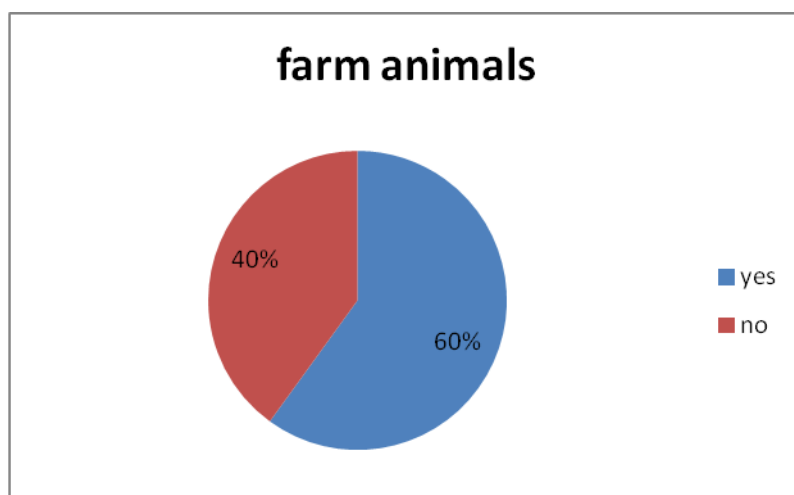


Figure 21. Farm animals

More than half of the interviewed people have farm animals (60%) the other 40% do not have farm animals, shown in figure 21.

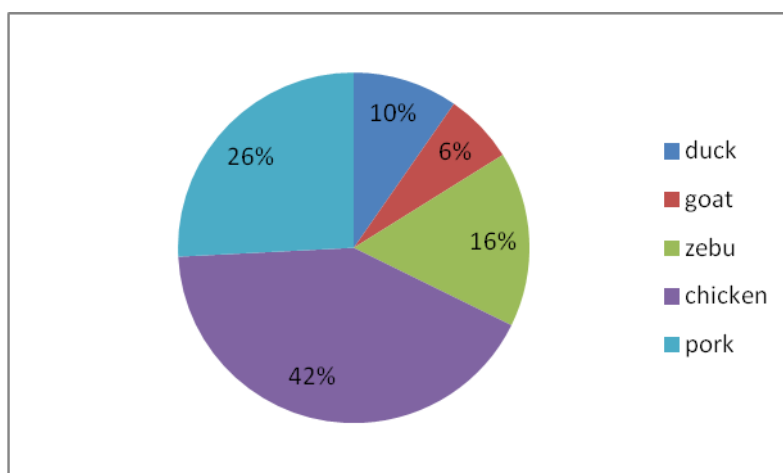


Figure 22. Overview farm animals

Figure 22 is an overview of the farm animals in the project area. Like the crops animals are not for their owners' consumption.

Zebus are not sold, because they are used to pull the sarety (wagon), to transport all kind of materials to the city to sell them there.

c) SARETY- do you have it?

The minority has a sarety (wagon). This is due to the lack of people who own the zebus, as these animals are needed to pull the sarety and transport products to the market. The majority sells their products at the market in Belanda.

d) Did you hear about the Moringa tree?

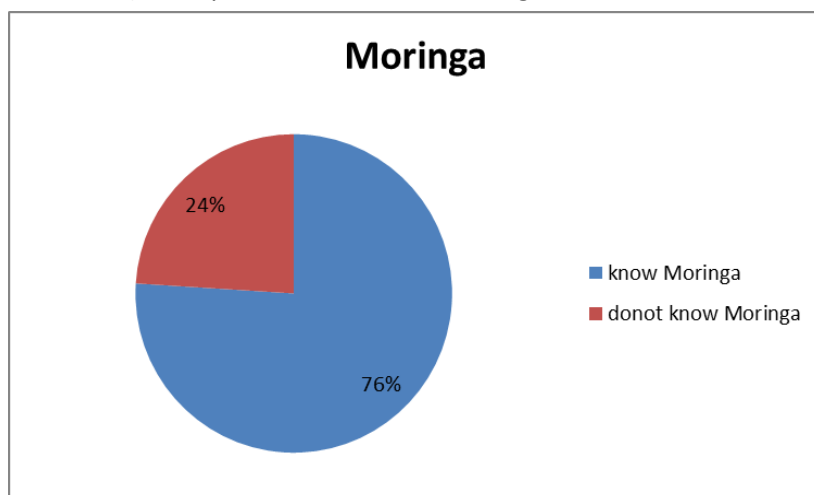


Figure 23. Moringa Oleifera

Lots of people know the Moringa tree, but nobody use the tree. A reason could be the fact that people do not use plants at all. Furthermore nobody understands the nutritional value and the health benefits of Moringa (lack of education or information) (Figure 23).

7. Nutrition:

The 7th part is about the daily diet, what people eat most for breakfast, lunch and dinner. This section will illustrate the daily intake and the variety of the food.

a) Which vegetables /fruits do you eat most?

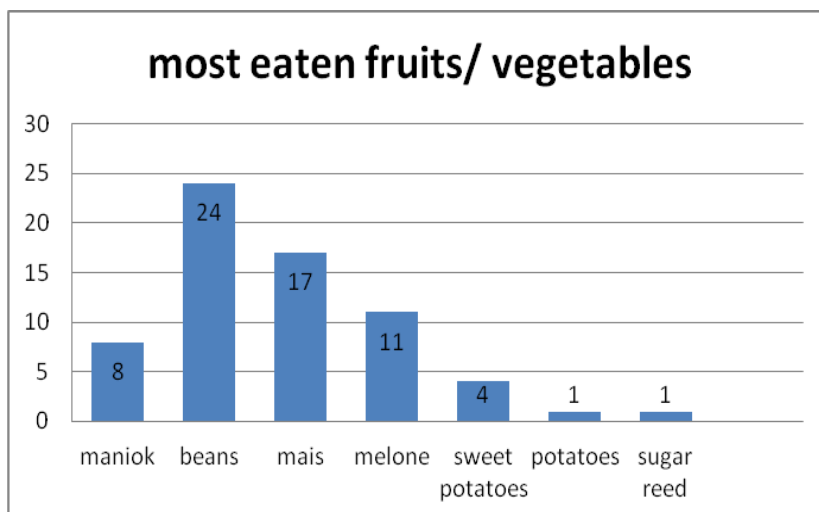


Figure 24. Used fruits/ vegetables

The minority eats fruits/ vegetables. Beans and mais are the cheapest.

Figure 24 shows the most eaten fruits and vegetables. People only eat fruits and/or vegetables if there is some money left or if the quality of their own harvest is too bad to sell. Furthermore it depends on the season.

The most important ingredient for every meal is rice.

This question was hard to answer for the focus group.

b) Which rice and beans do you use?

All people choose the cheapest products on the market.

- Loij or Cabaro- These beans expand the most. People think their stomach will be full faster
- Imported rice- Is cheaper than the local rice

c) What do you use as main ingredient for ...

○ Breakfast

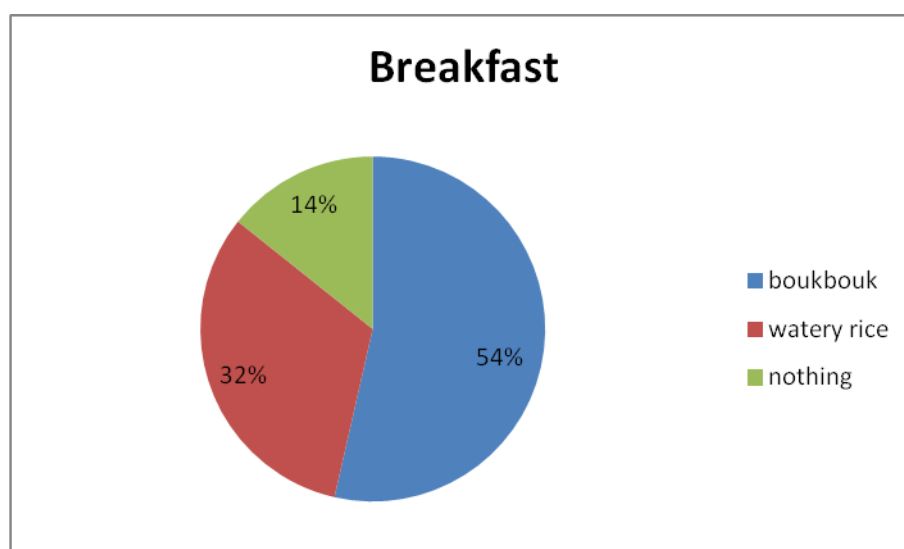


Figure 25. Breakfast

The majority eats 'boukbouk' (Figure 25) for breakfast. That is a ball out of water, flour, carbonate, (sugar) and water fried in a pot full of oil. Mostly it is one ball (5cm) per person. The nutritional value is low, the fat and the sugar provides the people with energy. Otherwise people eat watery rice or nothing.

○ Lunch

Blank rice is the most common dish for lunch (Figure 26). If there is some money or some leftovers from their own harvest they use it. Some people do not eat lunch.

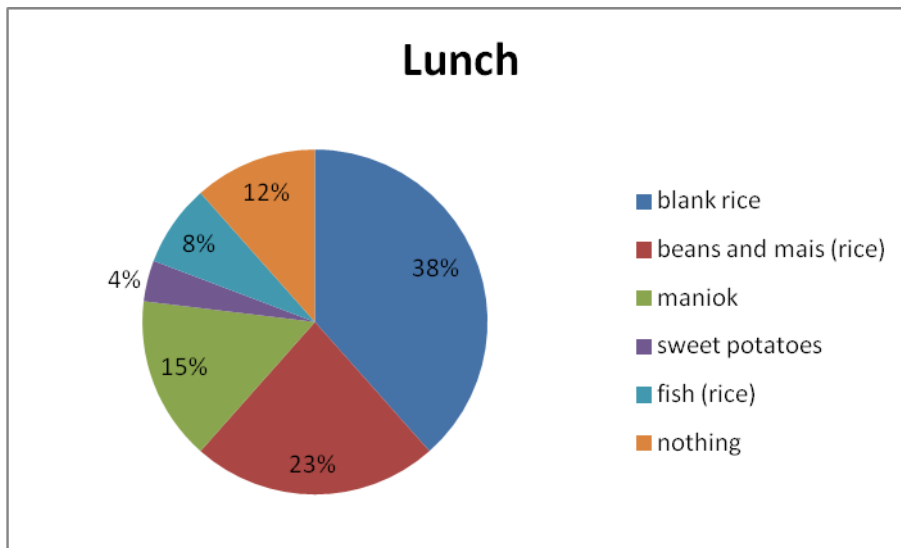


Figure 26. Lunch

Unfortunately rice is a poor source of essential nutrients. A rice based diet could be a reason for micronutrient malnutrition.

○ Dinner

Blank rice is also the most common dish for dinner (Figure 27). Most of the people can not afford more than rice every day/ every meal.

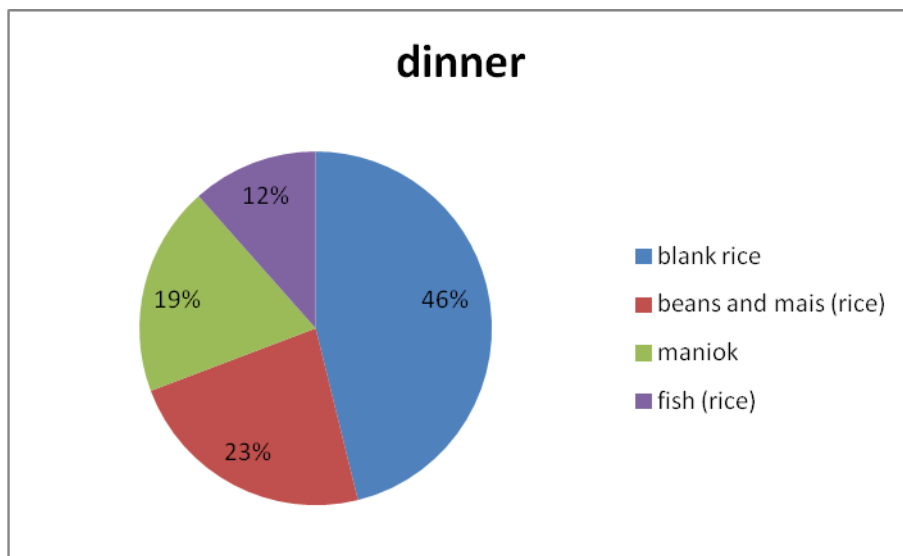
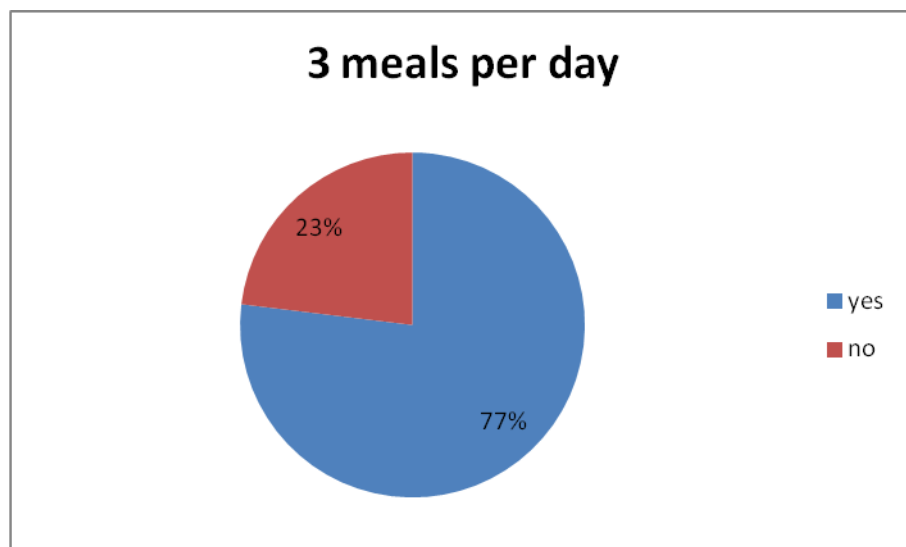


Figure 27. Dinner

On special days like a funeral people eat rice with vegetables or fish/ sometimes meat in honor to the deceased.

d) Do you eat 3 meals a day?



The minority does not eat three meals a day, shown in figure 28. An unregulated, poor diet is one of the most common reasons for malnutrition in Africa.

Figure 28. Meals per day

e) Religious, specialties in food?

The majority eats everything, but cannot afford to eat everything. Just a few people have specialties in food, for example do Muslims not eat pork. That is the only specialty in the project area.

f) How often do you eat meat?

What stood out is that people in the villages do not eat meat. Once or twice a year is it normal to eat meat. So, just for special celebrations (called 'fumba') they slaughter an animal and eat it with the whole family (contains mostly around 20 people or more).

5.3.2 Evaluation of the survey

The most important parts of the survey focus on the economic and the nutrition aspects. The economies in the villages are not stable, the income is low (poor infrastructure, government instability, corruption and the impact of diseases on the population of all ages). The main source of income is cutting and selling reed, the market for reed is large and the price low. People have to feed their families with a few cents per day. The low income could be a reason for the low level of education and the poor diet. People cannot pay the school fees for their children and every working force is needed to feed the family. The low income and no future opportunities are the main reason for the unbalanced diet in the villages.

The graphs show clearly that rice is the most used food. Some people can only afford to eat rice three times a day. Unfortunately, rice is a poor source of many essential micronutrients (Table 9).²³

Table 9. Nutritional facts of white rice per 100 g

Nutrients	Value (amount and % daily intake)
Calories	130
Total Fat	0.3 g

²³ Zimmermann, R. and Qaim, M., Potential health benefits of *Golden Rice*: A Philippine case study."

Cholesterol	0 mg
Sodium	1 mg
Dietary fiber	0.4 g (1%)
Potassium	35 mg (1%)
Total carbohydrates	28 g (9%)
Protein	2.7 g (5%)
Calcium	1%
Iron	1%
Vitamin B6	5%
Magnesium	3%

White rice is low in micronutrients. Some important nutrients are lost during polishing. The problem is that unpolished rice cannot be stored, because the outside layer. It contains nutrients which are rich in lipids, which is the reason for oxidation (makes rice rotten and not tasty). It does not have a large amount of vitamins and minerals and is quickly digested. Experts say, a diet without balance and an excess of white rice will lead to hunger and eating more frequently. A rice based diet is the primary reason for micronutrient malnutrition. Iron, zinc and vitamin A deficiencies are common in rice consuming countries and can cause for example a low work productivity, reduced mental capacity, blindness, stunting or in the worst case (child) mortality.

The micronutrient deficiency can be improved by food based approaches or by supplementation programs. Supplementation programs will not work without founding and support from different local organizations. On the other hand include food based programs local sources, which means they are also sustainable

5.4 Project content/ details

The community based project covered health and nutritional aspects. The main issue of the project was to teach the inhabitants of the villages how to use the local sources Moringa Oleifera, to improve their general health and to reduce malnutrition.

The project was split in 3 different sections.

- I. General Moringa presentation (see addition 1)
- II. Specific Moringa presentation (see addition 2)
- III. Cooking demonstration

The general presentation (see addition 1 and 2 for the first presentation and translation in English and French) was the first presentation in the villages (Figure 29). Based on the outcomes of the survey, the presentation was about general information's about the Moringa Oleifera. The majority of people know the tree, but almost nobody knows about the nutritional health advantages and how to use it (see also 5.3.1 The survey).

The main objects in the presentation were:

- What is Moringa?
- What are the nutritional advantages?

The main points in the second presentation (see addition 3 and 4 for the second presentation and the English translation) were how to plant, dry and use Moringa in the daily life. Both presentations were in Malagasy because the local communities are not familiar with other languages.



Figure 29. First presentation in Belitsake

The cooking demonstration was planned to take place in Ambondrolava with the Honko cook Sarina. The main goal was to show people how to prepare meals with Moringa along with the basic information's on paper (presentation) and to let them try at the end of the session.

The easiest way to add Moringa to a meal is to add the powder to everything people can eat. Dependent on gender and age the amount of the Moringa (fresh or dried) is different.

Here are a the recipe ideas for the villages (cheap, easy and nutritious)

- Sprinkle it on top of your rice and sauce
- Grilled fish with Moringa
- Moringa tea
- Moringa peanut butter (mashed peanuts)
- Fresh Moringa salads

“Two rounded spoonful of leaf powder will satisfy nearly all of a woman's daily iron and calcium needs during pregnancy and breast-feeding. Three rounded teaspoon of leaf powder will satisfy about 14% of the protein, 40% of the calcium, and 23% of the iron and nearly all the vitamin needs for a child aged 1-3.”²⁴

²⁴ Fuglie, Lowell J. The Moringa Tree: A local solution to malnutrition?”

6. Discussion

In many developing countries long-term (chronic) malnutrition is a well-known and serious problem. It is documented that the south-west (project area) is the poorest region in Madagascar. The reasons are poor soil (bad for growing fruits and vegetables), arid temperature and the low amount of tourism (one of the most common source of income in Madagascar). The area is characterized by a low level of education and poverty. Malnutrition in the area is not only caused by a lack of food. World-wide, people can be malnourished because they do not eat the right kinds of food. Even if families eat enough, peoples diets may be lacking in certain nutrients. In addition, basic health and education services in most of the country are severely lacking, even non-existent. These can affect behavior, which also plays a significant role in the treatment of malnutrition.

“Nutrition is not low fat. It is not being hungry and feeling deprived. It’s nourishing your body with real whole foods so that you are consistently satisfied and energized to live life to the fullest.”²⁵

At the beginning of the internship project, a research was made on common eating habits , health and the economic situation. Therefore different people from all layers of the local population, gender and age were selected. An advantage was the personal contact with the research panel. The villagers provided tours around the communities. Furthermore people in the village invited the project group to try a traditional meal. These aspects created a good opportunity to see how people live within the project area. The survey showed clearly that the expectations were right and that the diet in the villages is unbalanced and poor (in all layers of the population). The most consumed product is rice, and as already described rice has a low nutritional value. Many people do not eat more than two times a day, because they cannot afford it. People with access to fresh fruit and vegetables (small scale agriculture) have to sell their products to earn some money to survive. The reasons of food insecurity and malnutrition in the area are diverse and lots of factors are connected (for example poverty, lack of education, climate change, government policy and corruption, sociocultural and religious factor or gender).

It was too difficult to start up agricultural farming projects because of the bad soil conditions, and because people have to invest lots of money and time to grow it, which they do not have. The local tree Moringa Oleifera is a common tree in Africa. Not only is the tree special because all parts of it are useable, but also and most important is the high nutritional value. Moringa would be a good addition to the existing poor diet. The leaves of the Moringa contain vitamin A, vitamin B vitamin C, minerals and amino acids, which are essential nutrients for a person’s diet. One of the most effective tool used to educate the people about the Moringa Oleifera tree was to develop and present a series of presentations (Appendix 1 and 3). These presentations helped educate the people within the project area to understand why the Moringa tree could be useful.

Illustrated in data from different reports and according to the research in the villages, it is clear that only an investment in health, nutrition and education will lead to an improvement in the project area and lift individuals out of malnutrition. For the majority of people it is not feasible to improve the diet by growing their own crops. Moringa Oleifera is the only possible and cheap solution against malnutrition in this region. There are lots of nutritional projects all over Africa and Madagascar, but not in the villages Honko works with.

²⁵ Unknown author, World Food Programme

It is unsure if the people in the villages accept the tree. It is typical for the local people to have a fear of new things, and to prefer things that are familiar and common. It is Honko's mission to lead the people and show them more about the Moringa tree to help them out of the current situation.

7. Conclusion & Recommendations

Malnutrition is a “hidden hunger” because malnourished people look (most of the time) normal, but their physical and mental conditions are not as good as people with a normal balanced diet. Worldwide the cases of chronic malnutrition have been reducing throughout the last decades, but the future challenges in the fight against food insecurity and malnutrition is still large. The problems in the project area are poverty, the related insufficient diet and the lack of education and information about good/ balanced nutrition. Malnutrition in early childhood can be the reason for permanent damages in the brain and pervasive developmental disorders. A balanced diet during pregnancy and the child development stage helps a person stay healthy and strong throughout later stages of their life.

It is feasible to use the Moringa Oleifera tree to treat the poor diet in the villages in a local and cost-effective manner. The leaves of the Moringa tree have a high nutritional value, it is a “quick- fix” to the unbalanced diet with low amounts of nutrients in the villages, especially for the high risk group children, pregnant girls/woman and lactating mothers. Furthermore is the tree sustainable and easy to use.

Although are there several recommendations in relation to the internship project, HONKO Mangrove Conservation & Education and the project areas. Below illustrates those recommendations, if implemented properly these recommendations can help the community develop and move forward.

A. Recommendations for Honko Mangrove Conservation & Education:

Honko should continue with following health and nutritional projects in the villages. This could happen through the mentioned recommendations. The fight against malnutrition in the villages should be one of the long term goals of the organization.

- Additional nutrition presentations

Teach the importance of a balanced, nutritious diet and show how food choices affect the health-how people feel today, tomorrow, and in the future.

- Show the causes and effects of malnutrition

Insufficient nutrition can be caused by different reasons (unbalanced diet, eating too little, missing a nutrient or medical conditions).

- Monitor eating habits and usage of Moringa Oleifera

Another survey could be helpful to find out if people use Moringa. If it is not used it is a good possibility to find out the reasons why.

- Organize a Moringa cooking demonstration

It is important to show people how to cook and use the Moringa tree. Let people try that the leaves will have only a small or no effect on the taste of the food they eat when using it as an ingredient.

- Set up a Moringa nursery/ prevent the people with seeds
- Show other uses of the Moringa tree

Other uses could make the tree more interesting. For example the tree can help purify water, especially during the rainy season when the water is dirty.

B. Recommendations to the local community members:

A typical meal in the villages consist of watery rice or bouk bouk (a ball out of water, flour, carbonate, sometimes sugar and water) fried in a pot full of oil in the morning. Rice, sometimes with fish or beans during lunch and in the evening (not all people eat three times a day). It would be possible for the villagers to eat all needed macronutrients per day with cheap local sources. Rice or sweet potatoes(seasonal) as a good source of carbohydrates. Beans, eggs, crabs and talapia (local fish in the mangroves) as a source of protein, while peanuts are a good source of fat to cover the level of macronutrients. Although possible, is it not feasible for the majority of the villagers to grow their own crops and use them as a source of micronutrients. This is due to the poor soil condition and time it takes to grow the crops (fruit and vegetables). It is difficult to improve the level of micronutrients in their diet simply because people cannot afford to buy extra fruit or vegetables. The Moringa Oleifera tree is the only possible solution to add micronutrients to the existing diet.

C. Recommendations to use Moringa in the daily diet:

- The easiest way to use Moringa in the daily diet is to sprinkle dried or fresh Moringa Oleifera one time a day over the rice.
- Another easy recipe is it to mix fresh (two till three-tablespoons) Moringa leaves with one cup of peanuts and pound everything. The result will be peanut butter with Moringa leaves. The nuts provide macronutrients while the Moringa provides the micronutrients. It can be eaten with the watery rice in the morning.
- Make a Moringa pesto. Mix two or three-tablespoons of fresh Moringa leaves with oil, three or four garlic cloves, two or three small onions and pound everything together. The pesto can be eaten with rice or on top of the fish.

Heating above 50 degrees Celsius will kill some of the nutrients. It is not recommended to cook with Moringa. The family members should add Moringa individually, dependent on gender and age. Nursing/lactating woman should use more because of the higher nutritional requirement. Furthermore is it important to use Moringa once a day and regularly.

8. References

- Albert, B., „The Moringa Tree Moringa Oleifera Moringaceae Family”, Village volunteers
- Awah P. K., Bain L. E., Bernard N., Geraldine N., Kindong N. P., Sigal Y. and Tanjeko A. T., 'Malnutrition in Sub-Saharan Africa: burden, causes and prospects.', 2013, The Pan African Medical Journal
→ <http://www.panafrican-med-journal.com/content/article/15/120/full/>
- Bössner, M. and De Onis, M. (WHO), 'Malnutrition- Quantifying the health impact at national and local levels', 2005, Environmental Burden of Disease Series, No. 12
- De Jong, F.M.,(2008), “Ons voedsel- Wat erin zit, hoe het gemaakt wordt & wat het met ons doet”, Fontaine Uitgevers B.V.
- De Onis, M., Brown, D., Bössner, M. And Borghi, E. (WHO & UNICEF), “Levels & Trends in Child Malnutrition”, 2012, UNICEF WHO-The World Bank Joint Child Malnutrition Estimates
- Doerr, B. and Cameron, L., “Moringa Leaf Powder”, (2005), Echo Technical Note
- Earth Goodness Ltd, (2012) “The Moringa Oleifera- The Miracle tree”
<http://www.themoringa.com/nutritional-values>
- Facebook. (2014), Honko Mangrove conservation & Education
<https://www.facebook.com/honkomangrove?fref=ts>
- Facebook (2014), World Food Programme
<https://www.facebook.com/WFPBerlin?fref=ts>
- Fuglie, Lowell J., The Moringa Tree: A local solution to malnutrition?”
- Hoffmann, I., Schneider, K., Leitzmann, C., (2011.),” Ernährungsökologie - komplexen Herausforderungen integrativ begegnen”, oekom Verlag
- Honko Mangrove Conservation and Education, (2012), HONKO Plan VIVO, Ambondrolava, Madagascar
- Honko Mangrove Conservation & Education
<http://honko.org/our-initiatives/index.html>
- Institute of Medicine, Food and Nutrition Board, “Dietary Reference Intakes for Calcium, Phosphorous, Magnesium, Vitamin D, and Fluoride”, National Academy Press, Washington, DC
- Interview:
- HONKO, Socio- organizer & Master student Biodiversity and environment- Josepha
 - HONKO, project coordinator- Tess May
 - HONKO, project manager- Nina Hamilton
 - HONKO guide- Sala
 - HONKO, Volunteer coordinator- Lalas
 - Local people project area
- Mason J.B., Vitamins, trace minerals, and other micronutrients, (2011), Cecil Medicine. 24th ed. Philadelphia, chap. 225.

Miller del Rosso, J., MADAGASCAR'S PILOT PROGRAM FOR COMMUNITY MANAGEMENT OF ACUTE MALNUTRITION, (2008), Review by the United States Agency for International Development

Price, Dr. M. L., "The Moringa Tree", (2007), ECHO Technical Note

Von Grebmer, K., (2008), "Welthungerindex, Herausforderung Hunger", JEM Online (journal fuer ernahrungsmedizin)

→ <http://www.kup.at/kup/pdf/8586.pdf>

Sheeran. J. (WFP Executive Director), "Malnutrition and climate vulnerability in Africa", United Nations World Food Programme 2011

The Moringa Tree, Moringa Oleifera, Is Called Mother's Best Friend, Chapter 11 on Human Health for information on using moringa in water clarification.

→ <HTTP://WWW.ECHONET.ORG/PUB&STORE/ATOZ.HTML>

Unicef flyer- child malnutrition

Zimmermann, R. and Qaim, M., Potential health benefits of Golden Rice: A Philippine case study." (2004), Food Policy 29 page147-168

9. Appendix

Addition 1. General presentation



Honko
Mangrove Conservation
& Education

Hazo mahatserike ny- Bodo monongo na ananambo



- Te ho salama tsara lalandava ve ianao?
- Te hisakana mialoha ireo karazana aretina 300 ve inao?
- Maniry fahasalamana tsara ho an' ireo fianakavianao ireo ve ianao?

Mihinana moringa(ananambo)!



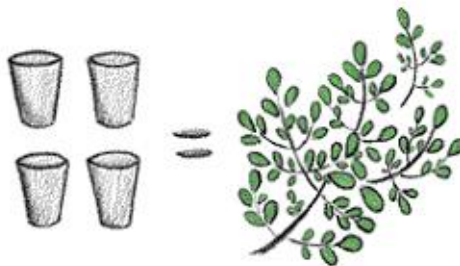
Inona moa ny moringa?



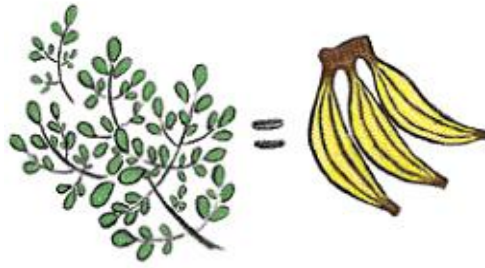
Ny moringa dia hazo tena manandanja...
Ny olona rehetra dia afaka mamboly azy



Mihoatra ny efatra ny vitamine A hita ao amin'ny
karoty ny hita ao amin'ny moringa, miaro amin'ny
aretina maro koa



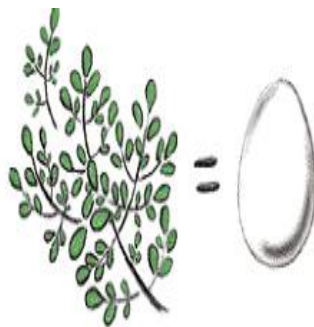
Mihoatra ny efatra ny calcium hita ao amin'ny
ronono, izay mampatanjaka ny taolana sy ny nify no
hita ao amin'ny moringa



Mihoatra ny telo ny potassium ao amin' ny kida(akondro) izay mahasalama ny atidoha sy ny ozatra no hita ao amin'ny moringa

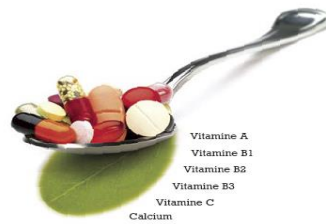


Mihoatra ny fito ny vitamine C hita ao amin'ny orange,izay manampy miady amin'ny aretina no hita ao amin'ny moringa



Manakaiky mitovy ny protein hita ao amin'ny atody,izay mampatanjaka ny ozatra no hita ao amin'ny moringa.

Hoatra ny mitahiry vitamine eo akaikinao ny fambolena azy



Vitamine A
Vitamine B1
Vitamine B2
Vitamine B3
Vitamine C
Calcium
Chrome
Cuivre
Fer
Magnésium
Manganèse
Phosphore
Potassium
Protéines
Zinc

Ny moringa dia tsara ho an'ny:

- Zaza mihoatra ny enim-bolana
- Vehivavy bevohoka
- Vehivavy mampinono



- Dité (poudre moringa) telo sotrokely isanandro no omena ny zaza, izay manampy azy amin'ny fitomboany sy ny fahasalamany ary ny fahatanjahany



Malaky mitombo, taona raiky efa mahatratra 3 metatra

- Tsy mila asiana zezika, afaka maniry amin'ny tany rehetra.
- Mandritran'ny taona ianao dia afaka maka vokatra.
- Enim-bolana ny nambolena azy ianao dia efa afaka mahazo vokatra.



Mamboly moringa ianao dia miaina ara-pasalamana sy lafiamanana



Addition 2. General presentation translation

English	French	Malagasy
The Miracle Tree	l' arbre de miracle	Hazo mahatserike ny Bodo monongo na ananambo.
Do you want to stay healthy?	Voulez vous rester saint?	Te ho salama tsara lalandava ve ianao?
Do you want to prevent 300 diseases?	Voulez vous prévenir 300 maladies?	Te hisakana mialoha ireo karazana aretina 300 ve inao?
Do you want a healthy family?	Voulez vous une famille sainte?	Maniry fahasalamana tsara ho an'ireo fianakavianao ireo ve ianao?
Eat Moringa!	Mange du Moringa!	Mihinana moringa(ananambo)!
What is Moringa? It is a very important tree... That everyone can grow.	Moringa, c est quoi? C'est un arbre très important... Tout le monde peut le grandir.	Inona moa ny moringa? Ny moringa dia hazo tena manandanja... Ny olona rehetra dia hafaka mamboly azy.
4 times as much vitamin A as carrots, to shield against disease	4 fois plus de vitamine A que de carottes, pour protéger contres des maladies	Mihoatra ny efatra ny vitamine A hita ao amin'ny karoty ny hita ao amin'ny moringa, miaro amin'ny aretina maro koa
4 times as much calcium as milk, for strong bones and teeth	4 fois plus de Calcium que du lait, pour des os et des dents forts	Mihoatra ny efatra ny calcium hita ao amin'ny ronono,izay mampatanjaka ny taolana sy ny nify no hita ao amin'ny moringa.
3 times as much potassium as bananas, for healthy brain and nerves	3 fois plus de potasse que des bananes, pour des cerveaus et nerves saints	Mihoatra ny telo ny potassium ao amin'ny kida(akondro) izay mahasalama ny atidoha sy ny ozatra no hita ao amin'ny moringa.
7 times as much vitamin C as oranges, to help fight illness	7 fois plus de vitamine C que des oranges, pour aider battre contres les maladies	Mihoatra ny fito ny vitamine C hita ao amin'ny orange,izay manampy miady amin'ny aretina no hita ao amin'ny moringa.
Nearly equal protein as eggs, to build muscles	La même quantité de proteines comme des oeufs, pour construire de musculature	Manakaiky mitovy ny protein hita ao amin'ny atody,izay mampatanjaka ny ozatra no hita ao amin'ny moringa.
It's like growing vitamins at your doorstep	C'est très facile de laisser grandir de Moringa, c'est	Hoatra ny mitahiry vitamine eo akaikinao ny fambolena azy

comme laisser grandir des vitamines à votre porte		
Moringa is good for: <ul style="list-style-type: none"> - Children over 6 months - Pregnant woman - Nursing mothers 	Moringa est bien pour: <ul style="list-style-type: none"> - Des enfants plus de 6 mois - Des femmes enceintes - De femmes maternelles 	Ny moringa dia tsara ho an'ny: <ul style="list-style-type: none"> - Zaza mihoatra ny enim-bolana - Vehivavy bevohoka - Vehivavy mampinono -
3 teaspoons of moringa powder a day will help a child grow and keep it healthy and strong	3 petits cuillères de Moringa poudre par jour va aider un enfant de grandir et rester saint et fort	Dite (poudre moringa) telo sotrokely isanandro no omena ny zaza, izay manampy azy amin'ny fitombohany sy ny fahasalamany ary ny fahatanjahany
It is easy to grow It grows fast (3 meters in the first year) <ul style="list-style-type: none"> - Doesn't need fertilizer, grows in the most soil conditions - You can harvest leaves year round - You can harvest leaves in just 6 months 	C'est facile à grandir Ca grandit vite (3 mètres dans la première année) <ul style="list-style-type: none"> - Pas besoin de fertilization, grandit dans la plupart de conditions de la terre - Les feuilles sont prêt a récolter toute l'année - Apres 6 mois de planter, les feuilles de moringa sont prêt pour manger 	Malaky mitombo, taona raiky efa mahatratra 3 metatra. <ul style="list-style-type: none"> - Tsy mila asiana zezika, afaka maniry amin'ny tany rehetra. - Mandritran'ny taona ianao dia afaka maka vokatra. - Enim-bolana ny nambolena azy ianao dia efa afaka mahazo vokatra.
Plant moringa and live a healthier, happier life.	Plante Moringa et vie une vie plus sainte et plus heureuse	Mamboly moringa ianao dia miaina ara-pasalamana sy hafaliana!

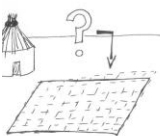
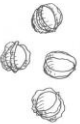
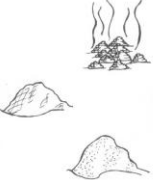

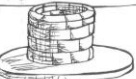
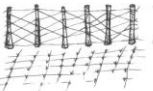

Addition 3. Specific presentation



Hazo mahatserike ny morenga!

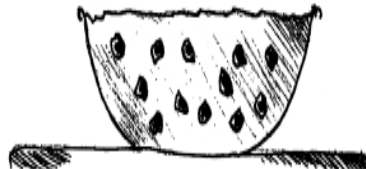
Atao akory fambolea azy, fanamahia, fampiasana azy eo amin'fianantsika.

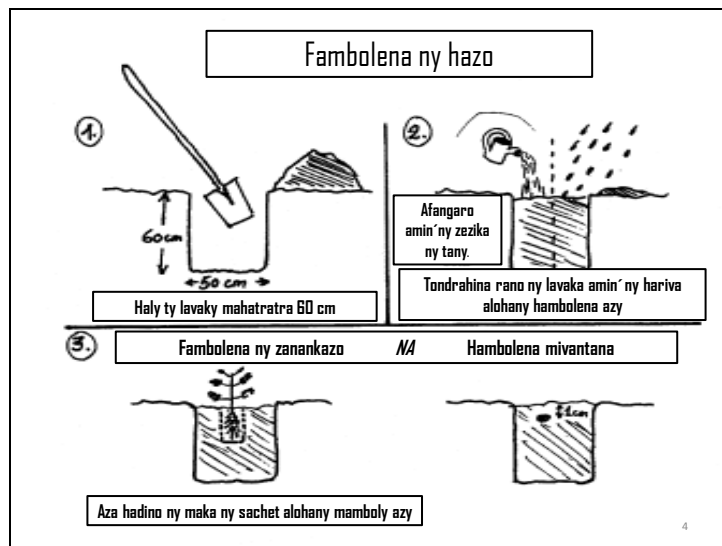



<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Zavatra ilana amin'fikarakarana azy anaty zaridaina: </div>  <p>Toerana asina azy</p>	 <p>Voan' ny morenga</p>	 <p>Zezika sy fasika</p>	 <p>Angady kely/meso</p>
 <p>Rano</p>	 <p>Valany</p>	 <p>Sachets plastiky asiana zana-kazo</p>	

Dingana I:

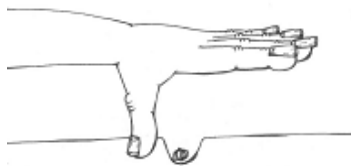
Alona anaty rano ny voany mandritra ny alina



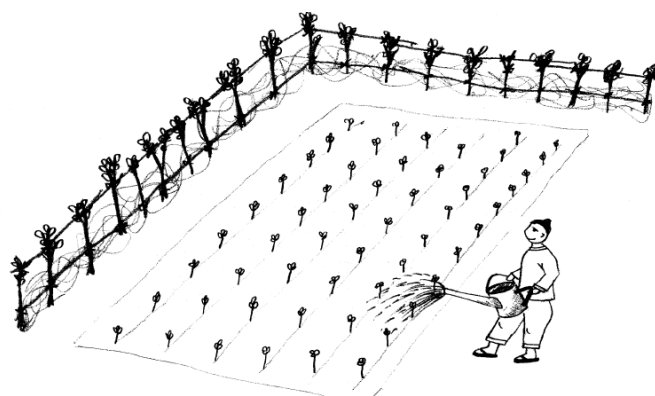


Dingana faha 2:

Ambolena ny voa atao lavaka l ankihibe ny halaliny ao anatin'ny fasika sy zezika mifangaro



5



Tondrahana isan' andro ny zanankazo.

6



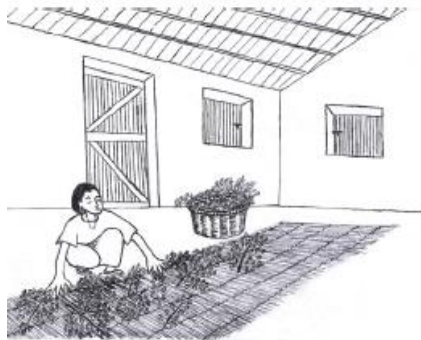
Afaka mangalaky raviny amin'iny morenga iny ianao
rehefa afaka l metatra ny halavany

7



Tsy atapy amin'ny toerana azon'ny biby ny Morenga

8



Ahahy na atapy amin'ny toerana malomaloka ny tahony
misy ny raviny rehefa hanamaina azy

9



Raha atapy mivantana amin' ny masoandro koa izy dia
mampihena ny otrik' aina ao amin' ny raviny

10



Atapy indray rehefa avy nalaina amin' ny
tahony

11



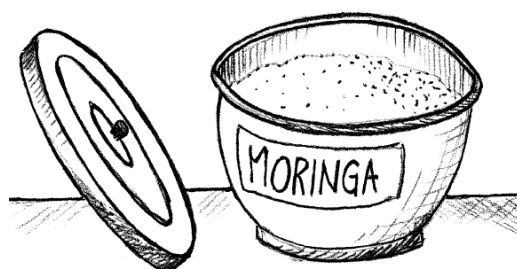
Mampiasa akalo sy leo andisanana ny raviny
rehefa maina

12



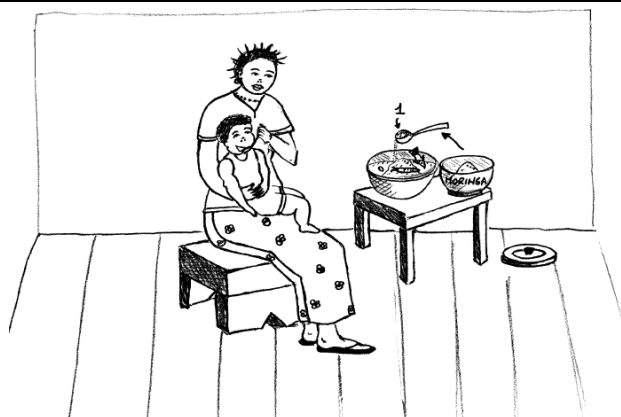
Sivanina amin' ny maromaso rehefa avy eo
ary ariana ny faikany

13



Tahirizina anaty boaty ny podra morenga efa
vita ary afaka ampiasaina lalandava
amin' izay

14



Afaka afangaro amin' ny sakafo rehetra hohanina
hoan' ny fianakaviana

15

Ary ny fianakavianao rehetra dia ho ara-
pahasalamana sy ho halifaly miaraka amin' ny
Moringa.



16

Addition 4. Translation specific presentation

English	French	Malagasy
Miracle Moringa! How to plant, dry and use Moringa in your daily life.	Not necessary	Hazo mahatserike ny morenga! Atao akory fambolea azy, fanamahia, fampiasana azy eo amin'fianantsika.
Necessary ingredients for a good garden: <ul style="list-style-type: none"> - Seeds - Manure & Sand - Hoe/cutlass - Location - Water - Fencing - (Plastic bags) 	-	Zavatra ilana amin'fikarakarana azy anaty zaridaina: <ul style="list-style-type: none"> -Voan'ny morenga -Zezika sy fasika -Angady kely/meso -Toerana asina azy -Rano Valany Sachets plastiky asiana zana- kazo
Step 1 Soak the seeds in water over night.	-	Dingana 1 Alona anaty rano ny voany mandritra ny alina.
Planting the tree Dig the planting hole 60 cm deep Mix some manure with the soil. Water the hole the evening before planting Planting a seedling Don't forget to remove the sack. Direct seeding	-	Fambolena ny hazo Haly ty lavaky mahatratra 60 Cm. Afangaro amin'ny zezika ny tany. Tondahina rano ny lavaka amin'ny hariva alohany hambolena azy Fambolena ny zanankazo Aza hadino ny maka ny sachet alohany mamboly azy Hambolena mivantana.
Step 2 Plant seed 1 thumbnail deep in a mixture of sand and manure.	-	Dingana faha 2 Ambolena ny voa atao lavaka 1 ankihibe ny halaliny ao anatin'ny fasika sy zezika mifangaro.
Water seedlings daily	-	Tondrahana isan'andro ny zanakazo.
Harvest leaves after tree is at least 1m high	-	Afaka mangalaky raviny amin'ny morenga iny ianao rehefa afaka 1 metatra ny halavany
Place harvested branches away from animals	-	Tsy atapy amin'ny toerana azon'ny biby ny Morenga.
Spread or hang branches out in a shady area to dry	-	Ahahy na atapy amin'ny toerana malomaloka ny tahony misy ny raviny rehefa hanamaina azy.
Direct sunlight will reduce the amount of nutrients in the dried leaves.	-	Raha atapy mivantana amin'ny masoadro koa izy dia mampihena ny otrik'aina ao amin'ny raviny.

Once dry, remove leaves from branches	-	Atapy indray rehefa avy nalaina amin'ny tahony.
With a mortar and pestle, pound dry leaves till a fine powder is made	-	Mampiasa akalo sy leo andisanana ny raviny rehefa maina
Sieve the pounded leaves through a medium sized strainer, to get larger pieces out.	-	Sivanina amin'ny maromaso rehefa avy eo ary ariana ny faikany
Store in an air tight container; your Moringa powder is now ready to be used and enjoyed	-	Tahirizina anaty boaty ny podra morenga efa vita ary afaka ampiasaina lalandava amin'izay.
Put Moringa powder in all your dishes, for your entire family.	-	Afaka afangaro amin'ny sakafo rehetra hohanina hoan'ny fianakaviana.
Your entire family will now be healthier and happier, thanks to Moringa.	-	Ary ny fianakavianao rehetra dia ho ara-pahasalamana sy ho halifaly miaraka amin'ny Moringa.

Addition 5. Survey villages

1. Economy:

- a) What is your main source of income?
- b) How often do you leave the village?
- c) What's the level of education?

2. Associations:

- a) Are you part of an association?

3. Recreation:

- a) What do people do if they are not cooking/ working?
- b) What do children who don't attend school?

4. Health:

- a) Common illnesses in your family?
- b) Where do people go if they're sick?
- c) What kind of medicine?
- d) Is there a local medicine man?

5. Environment:

- a) Where is the water from?
- b) What kind of wells do you have?
- c) How far is the water source from your house?
- d) Significant water problems?
- e) Where do you cook on?
- f) Open fire or cook pot (stove)?
- g) Is it a fuel efficient stove?

6. Agricultural activities

- a) Do you have crops?
- b) Do you have animals?
- c) SARETY- do you have it?
- d) Did you hear about the Moringa tree?

7. Nutrition:

- a) Which vegetables /fruits do you eat most?
- b) Which rice and beans do you use?
- c) What do you use as main ingredient for ...
 - Breakfast
 - Lunch
 - Dinner
- d) Do you eat 3 meals a day?
- e) Religious, specialties in food?
- f) How often do you eat meat?