Project plan (draft):

The Moringa Innovation and Start-up Centre, Robekeh Village, Sierra Leone

1. Summary

The Moringa Innovation and Start-up Centre is the first agricultural approach of the well established bilateral interrelationship of the German non governmental and non profit organisation Löwe für Löwe e.V. and the partner NGO Loewe for Loewe r. S. Sierra Leone.

The intention of the project is to make manyfold use of the multipurpose tree Moringa oleifera in order to establish a demonstration farm in combination with education facilities. At the same time a tied connection with scientificly working institutions in Sierra Leone is planned.

This project plan informs about this intention and invites further interested parties to join the project.

2. Background

Since 1998, the German NGO Löwe für Löwe e.V. established a long-term/ strong relationship with a NGO Löwe für Löwe in Sierra Leone. Löwe means Lion and is on the one hand the traditional symbol of the city of Braunschweig where the German NGO is located but on the other hand the symbol of Sierra Leone and even part of the countries name. The lion, therefore, is a symbol for the strong partnership between our organisations. Our aim is to provide support for people in need, demonstrating how effective private engagement can be.

In the first years, the promotion of health and education as well as the poverty reduction were the focus of our work. In the following we would like to present you all projects in which we are currently engaged. All of them are implemented in Sierra Leone and are located around Freetown:

2.1. Health projects

- Since 2007 we habe a cooperation with the Katelena-clinic in Freetown. It was our concern to provide as many children as possible and our employees with free medical care. Furthermore, Löwe für Löwe supports renovations and the procurement of hospital furniture, medical devices, dressing materials, etc. to Katelena clinic, to Adra Hospital in Waterloo and the hospital of Dr. David Koroma in Rokel.
- The Lion for Lion Health Center was launched in Brigitte Village in April 2010 and offers health care services for several thousand people in the region. Three nurses trained in midwifery and with many years of working experience have been employed. Furthermore, a doctor from the Katelena clinic supports the nurses' daily work alternately by providing treatment to the patients twice a week. Besides, there is also a small pharmacy attached to the health centre, where patients can receive their medication locally.
- In addition to primary health care and obstetric, health education and vaccination are conducted by the nurses, both in the health centre and the nearby villages. To protect against malaria the nurses distribute mosquito nets, especially to women who are pregnant or have young children, while they provide information and condoms during courses to address issues of family planning and HIV/Aids prevention.

- The Lion for Lion health centre is officially part of the programme “Under Five”, a comprehensive public health programme for children under five years, pregnant and breastfeeding women. Overall, this makes an important contribution to reducing child and maternal mortality alike.
- During the Ebola epidemy (2014 - 2016) the *Lion for Lion Health Center* was operating while many other hospitals and health posts were closed. The staff went to all households within the catchment area of the Center to inform people how to prevent Ebola infection. As a result of that there was no single Ebola case at all in Brigitte Village, Kissi Town, Bonga Wharf and other villages within the catchment area. At the center they screened the patients and treated many people who came with other diseases than Ebola, many pregnant women among them being rejected in other hospitals before. In February 2015 it was chosen to be the best health post among 144 in peripheral health units: The Ministry of Health and Sanitation and partners like UNICEF and Concern International awarded the “IPC Team Choice Award” to the *Lion for Lion Health Center*.


MINISTRY OF HEALTH AND SANITATION

IPC TEAM CHOICE AWARD

Awarded to

Lion For Lion Community Health Post

as part of the project:

The Infection Prevention and Control (IPC) and Screening of Suspected Ebola Cases in Peripheral Health Units

Awarded this 28th day of February, 2015

District Health Management Team (DHMT)

Ebola Response Consortium (ERC)

CONCERN worldwide

In Partnership with:

Ministry of Health and Sanitation (MoHS) of the Government of Sierra Leone

Ebola Response Consortium (ERC)

Centers for Disease Control and Prevention (CDC)

UNICEF

ERC

unicef

- Once a year there is a surgical relief mission for children in Sierra Leone implemented by surgeons from Germany. Within the surgical relief mission for children in Sierra Leone the *Lion for Lion Health Center* does the screening of kids within the catchment area and our local employees are in charge of the daily transport of the children to the hospital and back. Furthermore, the board of the children during hospitalization will be guaranteed by our organization since the families lack the financial means to do so. The medical follow-up isalso assured by the *Lion for Lion Health Center*.
- Since the rate of illiterate people in Sierra Leone is still above 50 % the radio is an appropriate media to pass on information to people. In 2015 Löwe für Löwe started the radio programme „Welbodi talk“ at Star Radion. Two nurses of the *Lion for Lion Health Center* and sometimes also guest speakers inform about different health topics every other Saturday.

2.2. Sponsorships

The civil war in Sierra Leone ended officially in January 2002. However, most people in Sierra Leone still live in poverty. Children are particularly affected: Many of them are severely malnourished and upon falling sick they do often not receive medical care, since their parents cannot afford the doctor. Neither can they attend school due to the school fees. For these children to attend school and have adequate nutrition sponsorships were provided. Sponsoring is organised for the “Brigitte Village Community School”, the Moringa-project and the Lion for Lion Health Centre.

2.3. Container shipping

Since 2001 Löwe für Löwe has been shipping containers loaded with relief goods to Sierra Leone. Many committed people have been supporting us in collecting, transporting, sorting, packing the relief goods and of course loading the container. The cost of shipping the container to Sierra Leone has been funded by GIZ and/or donations.The last container shipping was in 2018. It contained for instance medical equipment for the health centre and cooperating clinics in Sierra Leone, an ambulance, needed tools, bicycles, sewing machines.

2.4. Children´s home

In 2001, Löwe für Löwe e.V. built a children's home according to local standard in Devil Hole, a suburb of Freetown. It has had become home and family to the children who lost their parents during war. Two permanent female staffs have taken care of the children who have been provided with food and clothing, attend school and vocational training and receive medical care. The home was closed in 2016 when the kids were full-aged but some of them are still supported until they complete school and /or vocational trainings.

2.5. Primary schools

On the 8th December 2004 the first primary school was launched in Devil Hole nearby the children's home. Initially, the children had to bear a long walk to school in the next town every day. However, the school in Rokel was incredibly over-crowded; 80-100 children of three levels were taught in a single classroom.

The primary school has been a private school for eight years recognised by the Sierra Leonean state. The operating costs, teaching materials, maintenance, etc. have been financed by Löwe für Löwe e.V. mainly through project sponsorships and donations, whereas the salaries of the seven deployed teachers have been secured through teacher sponsorships. In 2013 we have handed over the school to the community that takes care of everything now, including salaries for the teachers.

In 2015 we opened the second primary school in Brigitte Village at the Peninsular Freetown Highway. The “Brigitte Village Community School” is still a private school but we applied to the government to become a “government assisted” school. We expect that recognition in August 2018. If accepted the government will take care of the teacher’s salaries and some other costs.

2.6. Microcredits

Children are most vulnerable to poverty. Hence, supporting a family through micro-credits for them to start a business will definitely benefit the child too. With a donation of only 100 € we enable a family to bail out of poverty in the long run. Consequently, Löwe für Löwe e.V. co-operates with the Komra Women Sierra Leone.

Recently, we have brought a new project to live, the Moringa project.

Moringa is a tree that is widely used in all tropical regions worldwide and is spread in Sierra Leone already. An intensive use, nevertheless, does not take place. On the one side we will use Moringa to reduce the so called "hidden hunger" of children, where children suffer by malnutrition and micronutrient deficiency. On the other side we will establish a training centre for different stakeholders on how to cultivate and make use of the Moringa trees, improving the situation of smallholders by adapted infrastructure and start-up induction .

3. The first step: the Moringa Project

Moringa oleifera is a so-called multipurpose tree native to the sub-Himalayan areas of India, Pakistan, Bangladesh, and Afghanistan. It is widespread in the tropics and used worldwide. The whole plant and all plant parts are used.

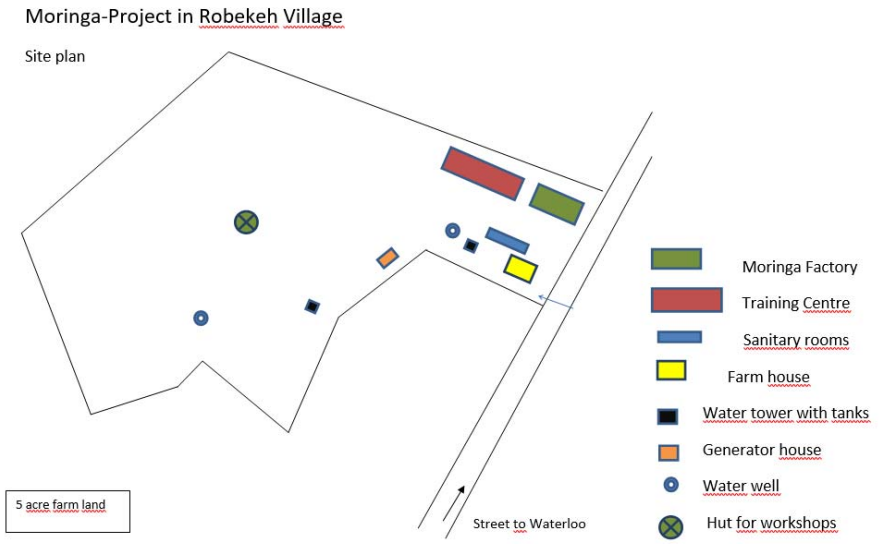
The advantages of the Moringa tree have been pointed out in Sierra Leone since 2010 by a non-government organisation. Moringa was spread all over the country due to its manifold uses including the chance of combined organic horticulture approaches for subsistence of smallholder farms. Since then, knowledge about the Moringa tree was accumulated, but did not lead to a large-scale production and exploration of Moringa in Sierra Leone.

In 2013, Löwe für Löwe e.V. adopted this idea and started with its first agricultural initiative. The project we called the "Moringa Project". The Moringa Project was designed as the first step on the way to the future goal to establish the *Moringa Innovation and Start-up Center* (MISC) as a second step. The idea behind the MISC has three aspects: a) demonstrate to farmers how to create income for subsistence of their families, b) producing appropriate healthy food ingredients to fight anaemia of children in cooperation with the *Lion for Lion Health Centre* and c) forming a nucleus for entrepreneurship development in the region.

Consequently, the Moringa Project is targetd to gain own experience with Moringa cultivation, prepares the infrastructure for the MISC, defines responsibilities between partners and finds solutions for funds.

3.1. The location

Suitable arable plots have been prepared (2,5ha) recently, plant material has been produced and the first trees planted. A farm house (with rooms for storage, accommodation and an office) and two water wells have been constructed and co-workers for the handling of the experimental station have been employed.



Project area in the near of Robekeh Village: all buildings apart from the farm house and the generator houseunder construction, not yet electrified

3.2. Use of the Moringa tree

Moringa oleifera is a so-called multipurpose tree native to the sub-Himalayan areas of India, Pakistan, Bangladesh, and Afghanistan. It is widespread in the tropics and used worldwide. We intend to use the whole plant and all plant parts and make prducts of it:

3.2.1. Alley cropping: With their rapid growth, long taproot, few lateral roots, minimal shade and large production of high-protein biomass, Moringa trees are well-suited for use in alley cropping systems.

3.2.2. Live fencing: A common use of Moringa trees is to produce live supports for fencing around gardens.

3.2.3. Animal forage: Leaves are readily eaten by cattle, sheep, goats, pigs and rabbits. Leaves can also be used as food for carp and other fish.

3.2.4. Domestic cleaning agent: Crushed leaves are used in some parts of Nigeria to scrub cooking utensils or to clean walls.

3.2.5. Dye: The wood yields a blue dye which was used in Jamaica and Senegal.

3.2.6. Fertilizer: The seed cake, although unsuitable as animal feed without treatment to remove the alkaloid and saponin content, can be used as a protein-rich plant fertilizer.

3.2.7. Gum: The gum produced from a cut tree trunk has been used in calico printing, in making medicines and as a bland-tasting condiment.

3.2.8. Honey clarifier: Powdered seeds can be used to clarify honey without boiling. Seed powder can also be used to clarify sugarcane juice.

3.2.9. Honey producer: Flowers are a good source of nectar for honey-producing bees.

3.2.10. Ornamental: In many countries, Moringa trees are planted in gardens and along avenues as ornamental trees.

3.2.11. Plant disease prevention: Incorporating Moringa leaves into the soil before planting can prevent damping off disease (Pythium debaryanum and others) among seedlings.

3.2.12. Pulp: The soft, spongy wood makes a poor firewood, but the wood pulp is suitable for making newsprint and writing paper.

3.2.13. Rope-making: The bark of the stem of the tree can be beaten into fibre for production of ropes or mats.

3.2.14. Tannin: The bark and gum can be used in tanning hides.

3.2.15. Active substances of plant parts: Moringa is used for “tired blood” (anaemia); arthritis and other joint pain (rheumatism); asthma; cancer; constipation; diabetes; diarrhoea; epilepsy; stomach pain; stomach and intestinal ulcers; intestinal spasms; headache; heart problems; high blood pressure; kidney stones; fluid retention; thyroid disorders; and bacterial, fungal, viral, and parasitic infections.

It is also used to reduce swelling, prevent pregnancy, boost the immune system, and increase breast milk production. People use it as a nutritional supplement or tonic. Moringa is sometimes applied directly to the skin as a germ-killer or drying agent (astringent). It is also used topically for treating pockets of infection (abscesses), athlete’s foot, dandruff, gum disease (gingivitis), snakebites, warts, and wounds.

3.2.16. Oil from Moringa seeds: used in food, perfume, and hair care products, and as a machine lubricant.

3.2.17. Seed cake: used as a fertilizer, food for cattles and also to purify well water and to remove salt from seawater.

3.2.18. Cooking: Moringa has numerous applications in cooking throughout its regional distribution. The fruits or seed pods, known as drumsticks, are a culinary vegetable commonly used in soups and curries. The leaves are also commonly eaten with many culinary uses, and the flowers are featured in some recipes as well.

Traditional dishes do not exist in SL and will be part of the demonstration kitchen of the MISC.

3.3. Cultivation practice

In order to spread the idea of Moringa cultivation through the MISC we will test the following cultivation conditions:

3.3.1. Soil preparations

In tropical cultivation, soil erosion is a major problem. Therefore, the soil treatment has to be as shallow as possible. Ploughing is required only for high planting densities. In low planting densities, it is better to dig pits and refill them with the soil. This ensures good root system penetration without causing too much land erosion. The pits must be 30 to 50 cm deep, and 20 to 40 cm wide.

During the installation of the demonstration farm all appropriate soil preparation means are evaluated and optimized for SL conditions.

3.3.2. Propagation

Moringa can be propagated from seed or cuttings. Direct seeding will be done because the germination rate of M. oleifera is high. Moringa seeds will be germinated year-round in well-draining soil. Cuttings of 1 m length and at least 4 cm diameter will be used for vegetative propagation.

3.3.3. Planting

For intensive leaf production, the spacing of plants will be 15 x 15 cm or 20 x 10 cm, with conveniently spaced alleys (for example: every 4 m) to facilitate plantation management and harvests. Weeding and disease prevention might be difficult because of the high density. In a semi-intensive production, the plants will be spaced 50 cm to 1 m apart. This hopefully will give good results with less maintenance.

Moringa trees can also be cultivated in alleys, as natural fences and associated with other crops. The distance between Moringa rows in an agroforestry cultivation is usually between 2 and 4 meters.

On the demonstration farm, different combinations of plants will be tested and the economic return of such mixed cultivation systems tested.

3.3.4. Breeding

In India, the diversity of wild types is large. This gives a good basis for breeding programs. In countries where Moringa has been introduced, the diversity is usually much smaller among the cultivar types. Locally well-adapted wild types, though, can be found in most regions. The evaluation of the genetic heterogeneity of Moringa in SL is not known exactly. Different proveniences, therefore, will be included in the Moringa-project.

Because Moringa is cultivated and used in different ways, there are different breeding aims. The breeding aims for an annual or a perennial plant are obviously different. The yield stability of fruits is an important breeding aim for the commercial cultivation in India, where Moringa is cultivated as an annual. On less favourable locations, perennial cultivation has big advantages. Erosion is much smaller with perennial cultivation. In Pakistan, varieties have been tested for their nutritional composition of the leaves on different locations. The different breeding aims result in a different selection. India selects for a higher number of pods and dwarf or semi dwarf varieties. Breeders in Tanzania, though, are selecting for higher oil content.

The Moringa-project will define potential breeding aims for future breeding programs in SL.

3.3.5. Yield and harvest

M. oleifera will be cultivated for its leaves, pods, and/or its kernels for oil extraction and water purification. The yields probably will vary widely, depending on season, variety, fertilization, and irrigation regimes. Harvest will be done manually with knives, sickles, and stabs with hooks attached. Pollarding, coppicing and lopping or pruning are recommended to promote branching, increase production and facilitate harvesting.

3.3.6. Fruits

When the plant is grown from cuttings, the first harvest probably can take place 6–8 months after planting. Often, the fruits are not produced in the first year, and the yield is generally low during the first few years. By year two, we hope to produce around 300 pods, by year 3 around 400–500. We hope that a good tree will yield 1000 or more pods. In India, a hectare can produce 31 tons of pods per year. Under North Indian conditions, the fruits ripen during the summer. Sometimes, particularly in South India, flowers and fruit appear twice a year, so two harvests occur, in July to September and March to April.

Our project will estimate these harvest intervals under SL conditions and will study storage conditions for fruits and seeds, as well as drying techniques for leafs.

3.3.7. Leaves

Average yields of 6 tons/ha and year in fresh matter can be achieved. The harvest probably will differ strongly between the rainy and dry seasons, with estimated 1120 kg/ha per harvest and 690 kg/ha per harvest, respectively. The leaves and stems will be harvested from the young plants 60 days after seeding and then another seven times in the year. At every harvest, the plants are cut back to within 60 cm of the ground.

The cultivation of M. oleifera can also be done intensively with irrigation and fertilization with suitable varieties. Trials in Nicaragua with 1 million plants per hectare and 9 cuttings/year over 4 years gave an average fresh matter production of 580 metric tons/ha/year, equivalent to about 174 metric tons of fresh leaves.

The Moringa-project will start with an attainment of 0,5 tons/ha and year of fresh matter.

3.3.8. Oil

One estimate for yield of oil from kernels is 250 l/ha. The oil can be used as a food supplement, as a base for cosmetics, and for hair and the skin care.

3.3.9. Pests and diseases

The Moringa tree is not very much affected by serious diseases in its native or introduced ranges. Nevertheless, severe insect pests are found, including various caterpillars such as the bark-eating caterpillar, the hairy caterpillar or the green leaf caterpillar. The budworms Noctuidae are known to cause serious defoliation. Damaging agents can also be aphids, stem borers, and fruit flies. In some regions, termites can also cause minor damage. If termites are numerous in soils, insect's management costs are not bearable.

The development of an integrated plant management strategy, therefore, will be important.

4. The second step: the “Moringa Innovation and Start-up Centre (MISC)”

The Moringa-project is planned to be transformed into a demonstration farm connected with education facilities and consultancy services, called “Moringa Innovation and Start-up Centre (MISC)” in tied co-operation with the Njala University.

One of the aims of the MISC is to explore all possibilities to make use of the Moringa tree under Sierra Leonean conditions. The focus lies on health care uses but rapidly will be widened to agricultural, household and technical uses. Evaluation of undesired side effects will be included.

The inclusion of co-operations with different governmental and private partners (e.g. departments of the Njala University in Njala, the Sierra Leone Agricultural Research institute (SLARI), research institutions from abroad, scientific or voluntary networks) will guarantee the scientific and charitable exploration of agricultural, technical and medicinal aspects of the Moringa tree. Nearby own facilities for diagnosis and analyses should complement the centre and allow education of students on-farm.

Furthermore, the offer of a start-up consultancy service should lay the basis for small-scale entrepreneurial actions of the MISC.

The project consists of five interacting parts co-ordinated by the Lion for Lion management:

- Agricultural aspects, including cultivation, harvest, and post-harvest treatment
- Technical processing of plant parts and life cycle engineering of delivered products
- Quality control and analytics
- Education and capacity building
- Innovation management and start-up induction

4.1. Agricultural aspects

Methods of sawing, cutting proliferation and (later in vitro-cultivation) will take place.
Four different scenarios for Moringa production will be tested (three different densities and one mixed cropping system). Fertilization, irrigation, mechanization of processes and other agricultural measures will be adapted to the plantation area and variability estimated. Frequency of harvesting, quantity of harvested fresh material and other important parameters for economically viable Moringa production will be monitored and optimization approaches worked out.

Overall we will follow the organic horticulture and farming approach. The Moringa plantation is going to be designed as mixed cultivation systems for subsistence of smallholder farms.

Lion for Lion staff will take over the agricultural aspects advised by specialists of the Njala University.

4.2. Technical processing of plant parts and life cycle engineering of Moringa products

The main aim of the project is the production of a food supplement to overcome anaemia of children. Therefore, in a first step leaves of the Moringa tree have to be produced in a desired quality and quantity to be the basis of a study at the hospital.

The leaves have to be harvested carefully, dried with solar driers, ground and formulated to be offered as tablets or pills. This is important to enhance the acceptance for the medicine. The

whole processing is intended to be possible on farm. This allows demonstrating the process of preparation as well as the origin of the material. For this main product, we are highly dependent on foreign partners who assure the technical solutions for the process and the energy supply.

To stay credible it is important that we demonstrate the process and preparation and origin of the material. Hence, the leaves of Moringa are processessed by scientists of the Njala University in tied co-operation with the German Sustainable Manufacturing & Life Cycle Engineering Research Group of the Technical University Braunschweig.

4.3. Quality control and analytics

The production of Moringa trees on the one hand and the pharmaceutical use of Moringa leaves on the other hand requires a laboratory with certain equipment appropriate for the desired analytics. In the first case soil nutrient and fertilizer content has to be assessed, in the latter case the content of active substances in the plant material have to be controlled as an input for standardized product processing.

The preparation of samples should be possible on farm. The analytical laboratory should be located at the Njala University and could be offered for capacity building there, too.

4.4. Education and capacity building

There are different target groups for the following educational aspects: Preparation of healthy food based on Moringa, horticultural aspects for farmers (mixed cropping), information about product quality and marketing, multipurpose use of Moringa. Analytics and pharmaceutical aspects.

Because the farm will be run as a demonstration farm most of the non-university-trainings should be carried out on farm. Analytics should be discussed and performed at Njala University. The technological aspects will be divided in a demonstration part on farm and trainings in Njala University and on farm. Responsible are different local representatives eventually together with foreign advisers.

4.5. Innovation management and start-up induction

The Moringa project starts with the main product “tablets of Moringa leaves for pharmaceutical use”.

During this first phase, by-products of the main product are used, which could be tested on farm: for the kitchen, for oil production and so on (see above). During the project further useful outcomes will be identified on the experiences with the by-products.

Basing on main products a commercialization of Moringa products is desired. Here, Moringa products might besuch not containing Moringa material but being useful for the production of Moringa (and other, comparable plants). Terra Preta, plant growth promoting microorganisms, mycorrhizae are examples for this.

While an idea-management will be established between all co-workers of the Moringa project, the Lion for Lion group will invite voluntary students of the international organisation ENACTUS – Mannheim to find specific solutions with local stakeholders and to develop appropriate business concepts for new products.

5. Partners

Dr. Eldred Tunde Taylor - Senior Lecturer - Institute of Environmental Management and Quality Control -Njala University

Mr. Johnny Norman - Senior Lecturer - Department of Crop Sciences - Njala University

Mr. Edwin Sam Mbomah - Acting Director - Institute of Environmental Management and Quality Control - Njala University

Mr. Joe Milton Beah - Research and Teaching Assistant, Institute of Environmental Management and Quality Control - Njala University

Mr. Michael Benya - Sierra Leone Agricultural Research Institute (SLARI)

Brigitte Amara-Dokubo, Prof.Dr.Anant Patel, Dr. Carolin Vietz, Dr. Falko Feldmann, M.Sc. Adelina Garamow, MSc. Jasmin Sauer … - Löwe für Löwe e.V. – Braunschweig, Germany

Prof. Dr. Anant Patel – University of Applied Sciences – Department Process engineering and alternative fuels – Bielefeld, Germany

Prof. Dr. Christoph Herrmann, M.Sc. LennarthBüth & M.Sc. Max Juraschek – Technical University Braunschweig – Institute of machine tools and production technology – Braunschweig, Germany

Dr. Carolin Schneider – Company “Institute for Plant Cultivation” – Solkau , Germany

Dr. Stephan Winter – Leibniz Institute DSMZ -German Collection of Microorganisms and Cell Cultures

Dr. Falko Feldmann - Julius Kühn-Institut – Federal Research Institute for Cultivated Plants, Braunschweig, Germany

Dr. Heinrich Hagel, - University of Hohenheim - Food Security Center (FSC), Stuttgart, Germany

ENACTUS-Mannheim – University of Economics, Mannheim Germany

6. Next steps

2019 The half of the Moringa experimental farm is planted, the first leaves are harvested.

Wells are working, Constructions like the cited houses are planned and can be built

An energy concept is being worked out as the basis for the Center´s electrification concept

2019 Planning of the processing procedures of Moringa leaves are ready and a financing concept for necessary machines made

Fundraising initiated.