Federal Ministry of Food and Agriculture
Federal Office for Agriculture and Food

Aquaculture and innovative vegetable production in Malawi

The project “Ich liebe Fisch” – Fish for Life

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Photo: © Bernd Ueberschär

“Knowing is not enough; we must apply. Willing is not enough; we must do”
(Goethe)

Malawi is a small land-locked country in southeast Africa. It covers an area of approx. 120,000 km²; equal to about a third of the size of Germany. Political conditions can currently be regarded as stable, an important prerequisite for the long-term engagement of research and development projects.

31 percent of the country is covered by forest and bushland, 20 percent is arable land and 15 percent are meadows and pastures. Lake Malawi covers 25 percent of the country. It is the third largest lake in Africa, the ninth largest in the world and a lake with one of the most diverse fish populations (more than 1000 endemic fish species). Four tilapia species of the genus *Oreochromis* are important for human nutrition. Among them, the species *Oreochromis karongae* (Chambo) is regarded as the most commercially valuable tilapia species for Malawi. Besides, a catfish species, the kampango (*Bagrus meridionalis),* is also fished and exported.

Almost 90 percent of the population (approx. 19.2 million) work in agriculture, usually as small-scale and subsistence farmers. With the exception of smaller uranium deposits, Malawi does not have any significant mineral resources. Tobacco is the most important export good. Since 2007, the tobacco trade has contributed an average of about 50 percent to export revenues. Other export goods are tea, coffee, soy beans and sugar. Malawi’s land-locked location and almost non-existent infrastructure makes trading difficult. The unreliable power supply represents a further burden for the economy. The capacities of Malawi’s hydro power plant on the Shire, the country’s largest river, no longer meets the needs of the rapidly growing population. Solar power supplies can help in individual cases.

The United Nations still classify Malawi as a low developed country. Among others, Germany supports Malawi's development with funds amounting to 16 million euros, including from the special initiative "One World – No Hunger". With an average annual income per capita of around 350 US Dollars, Malawi is one of the 20 poorest countries in the world. In 2017 about a third of the population was starving, 37 percent of the children were malnourished. The percentage of undernourished children is one of the highest in the world.

Fish production and supply in Malawi

Traditionally, fish is an important food in Malawi. On average, each person in Malawi eats about 9.5 kilograms per year (Germany: approx. 15 kg). For many years, particularly the population living at Lake Malawi was able to obtain sufficient supplies of fish. However, as a consequence of overfishing since the early 1990s, fully grown tilapia can now only rarely be found in fishermens nets (3-5 % of catches). The majority of the catch, around 70 percent, consists of small freshwater sardines (usipa).

Based on the first ponds established for fish farming by the former colonial power Great Britain and with the support of various organisations, a vibrant aquaculture sector has developed in Malawi. Around 6000 small-scale fish farmers manage around 9000 ponds. In addition, there are also two large commercial fish farms. In total, around 150,000 tonnes of fish were harvested from aquaculture and fishing operations in 2016. Yet, rural aquaculture is far from exhausting the production capacity of the ponds. Currently, the fish farmers only produce about 3,500 tonnes a year. The main reasons for this is the lack of fingerlings, poor quality fish feed and a lack of knowledge on optimal pond management.

Typical scene at a pond

Project goals

The aim of the project "Ich liebe Fisch" is to improve the nutritional situation of the rural population and to increase the added value in the rural regions of Malawi through more efficient aquaculture production and an innovative combination of fish and vegetable production.

Two communities in regions with different geographic and ecological characteristics were selected as pilot regions for the project (Mchinji and Nkhotakota). These communities and selected fish clubs (groups of families who jointly manage their ponds) receive substantive support from the project (e.g. fingerlings and young plants, seeds, feed, fertiliser) and intensive advice through a variety of training courses.

The Fraunhofer Research Institutuion for Marine Biotechnology and Cell Technology (EMB), the Association for Marine Aquaculture (GMA) and the Malawi partners, including the Li-

Fact sheet: The project "Ich liebe Fisch"	
Country and region	Malawi, Sub-Sahara-Region, South-East Africa
BMEL program	International research cooperation for global food security Research cooperation for global food security and diversified agriculture for a balanced nutrition in Sub-Saharan Africa
Project title and abbreviation	Improving Community Health-Nutrition Linkages through Solar Energy Based Fish and Crop Integrated Value Chains Project acronym: Ich liebe Fisch (Fish for life)
Project goals	• Improving the supply of fish to rural communities through optimised breeding conditions for endemic tilapia species • Establishment of a solar-powered hatchery to improve the supply of fingerlings of local tilapia species to respective aquaculture farmers • Use of an integrated aquaculture-agriculture (IAA) approach and simple aquaponic techniques • Accompanying the practical measures with training courses to impart expert knowledge and built capacities • Examination of the socio-economic situation, health and dietary habits of families in rural areas before and after the project • Supporting the development of a network and a knowledge platform to guarantee the sustainability of the measures even after the end of the project
Implementing organisations and partners	• Fraunhofer Research Institution for Marine Biotechnology and Cell Technology (EMB) • Association for marine aquaculture mbH (GMA) • Lilongwe University of Agriculture & Natural Resources, Aquaculture and Fisheries Science Department (LUANAR-AQF) • Lilongwe University of Agriculture & Natural Resources, Department of Human Nutrition and Health (LUANAR-HNH) • Lilongwe University of Agriculture & Natural Resources, Department of Food Science and Technology (LUANAR-FST) • Quantum for Urban Agriculture and Environmental Sanitation (QUALIVES) • Innovative Fish Farmers Network Trust (IFFNT) In total, 25 employees jointly work in the frame of the project including several Masters and PhD students. The project cooperates with other organisations operating in Malawi, for example the German Corporation for International Cooperation (GIZ), the German Agro Action (Deutsche Welthungerhilfe e.V.) and church organisations in Malawi.
Project sites	For the implementation of the project, two communities were selected in geographically and ecologically different regions (Mchinji, on the western border of the country; Nkhotakota, in central Malawi next to Lake Malawi). The solar-powered hatchery was established on the farm of the Bunda College.
Project duration and budget	2016–2019, total budget 1.26 million EUR
Funding agency	The German Federal Ministry of Food and Agriculture (BMEL), project executing agency Federal Office for Agriculture and Food (BLE)

Fish is harvested

longwe University of Agriculture & Natural Resources, Malawi NCOs and local networks will implement and accompany the scientific, technical and practical measures.

Establishment of a solar-powered hatchery

A hatchery was built on the fish farm at the Bunda College (Lilongwe University of Agriculture) to optimise the supply of Chambo fingerlings.

Solar energy supporting the operations of the hatchery

The hatchery was equipped with a solar power system (1.7 kW) so that water and venting pumps, heaters and lights can be operated permanently. The public power grid – albeit very unreliable – and a diesel power generator serve as a backup.

Breed stock selection and production of 'all-male' fingerlings

In the tilapia aquaculture, the best results can be achieved if only male fish are reared in the ponds. The correct conditions for an all-male population of fingerlings are set in the larvae stage by using androgenic feed (usually methyltestosterone). This causes the sex of female fish to reverse ("sex reversal"). In order to avoid the need for the use of hormones in future, breeding trials are being carried out with the aim of producing pure homozygous YY super males that only produce male offspring.

Training courses on integrated agriculture-aquaculture

Programs for combining fish farming and vegetable production have been around since the 1990s. The results of these projects show that the farms have been able to increase productivity by 10 percent, the income of the farm members by 60 percent and the fish consumption of the local population by approx. 200 percent due to integrated agriculture and aquaculture programs (*Dey et al. 2007*). Typical applications in Malawi are polycultures of poultry and

Aquaponic systems

Aquaponic systems combine fish farming with the cultivation of crops in a closed water and nutrient cycle. The system works by utilising the excrements from fish farming as nutrients for the plants. The required input of nutrients for crop production are added via the fish feed.

The specific goal of the "Ich liebe Fisch" project is to develop simple aquaponic systems made from locally available materials that can also easily be replicated (Barrel Aquaponics). This allows fresh vegetables and fish to be produced even in the dry seasons. The amount of water required to produce vegetables is only ten percent of what is needed for field farming; the energy for the small pumps can be supplied by solar power systems.

Empirical study

At the start of the project, a survey was conducted to examine households in Mchinji/Nkhotakota (98/88) belonging to the intervention group and households in Mchinji/Nkhotakota (101/99) belonging to the a control group. The project assistants from Lilongwe University completed the questionnaires together with the villagers. Most of the interviewees were female (69%); the average age was 19. The majority of ponds and fields are farmed in "clubs" on jointly managed land.

The results show that the situation is not favourable. Food insecurity is very high in both districts. Accordingly, between 30 % (Nkhotakota) and 34 % (Mchinji) of the children are underdeveloped. Nkhotakota also has an increased rate of diseases and low dietary diversity.

fish farming, the use of goats and cow manure to fertilise the ponds and the production of vegetables on the banks of the ponds. The pond water, which is rich in nutrients, is used for efficient watering of the vegetables. In turn, plant residues that cannot be used serve as fish feed in the ponds.

Evaluation of socio-economic and health-related parameters

Within the frame of the socio-economic component of the "Ich liebe Fisch" project the health status, the dietary habits and the economic situation of rural families is examined through an empirical study prior and after the implementation of the project measures in order to assess the success of the project.

Trainings to disseminate expert knowledge

To consolidate the measures of the project and to ensure their implementation beyond the end of the project, trainings on integrated agriculture-aquaculture and aquaponics, fish stocking and the production of feed, breeding fingerlings, pond management, monitoring, fish harvesting, fish processing, food processing hygiene, product development, marketing strategies and nutritional counselling are provided. The teaching materials produced during the course of the project, such as simple brochures (in English and the national language Chichewa), information sheets, image and sound materials as well as web resources support the knowledge transfer.

Development of a network and a knowledge platform

To facilitate an exchange between the farmers participating from the various regions in the project, trainings are organised with farmers from various communities. Also, emphasise is put on the creation of new and the revitalisation of existing 'care groups'. Particularly knowledgeable members of the clubs act as multipliers in care groups. They are supported by the project.

Mid-term review with regard to achieving the project objectives

The project 'Ich liebe Fisch' already passed two-thirds of its duration. Much has been achieved as planned, some project activities will shortly be completed, whilst some project goals have been postponed, as this is often the case with projects in developing countries. The overall purpose of the project will be achieved: The Malawian partners have a great interest in ensuring that the project is completed successfully.

Establishment of a solar-powered hatchery

Based on proven technology, a specialized hatchery was adapted to the conditions in Malawi and the particular species, and installed on the farm of the

In the frame of cooking courses men and women learn how to prepare the produced fish in different ways

Children taste the new dishes

Cultivation of maize on the dams of the ponds

Male fingerlings of Chambo

Bunda College along with a solar power system in spring 2018. The construction of the plant was completed at the end of April in 2018. The start of the breeding season in November 2018 marked the beginning of the testing phase.

All-male fingerlings

The trials are still on-going. The results achieved so far are currently being analysed and taken into account for the creation of a very efficient broodstock for breeding.

Trainings

A total of ten trainings which were all well attended, have so far been held since the beginning of 2017. All participants learned how to prepare their ponds with traditional tools (slashers) and how to feed the fingerlings with higher-quality fish feed (35% protein). Besides the distribution of fingerlings and feed, seeds for pumpkins, rapeseed, Chinese cabbage and amaranth were also provided. They shall be planted on the dams or close to the ponds and shall be irrigated with water from the ponds.
The integration of fish and vegetable production was particularly successful in those areas, where farmers already used to grow vegetables. Occurring problems with pests were difficult to solve independently using suitable pesticides. Therefore, the upcoming trainings will include a specialist on plant breeding.
After fishing-off the ponds, around 80 women received trainings on wholefood diets and the preparation of new products from fish, maize and cassava. The new products were well received and can be sold profitably on the market in the future. The profits will be used to purchase fish stocks and vegetable seeds.

Aquaponic

To demonstrate that simple aquaponic systems can be fully functional under local conditions, a simple 'Barrel Ponics' system was developed. It was made from wood, plastic barrels and simple pipe material. A mini solar power system was used for the pump; the fish tank is aerated based on the Venturi principle so that no additional aeration pump is required. The first tests with this system are encouraging.

Development of networks

Most fish farmers in Malawi suffer from the low productivity of the fish production. Partly, this is also caused by a lack of know-how about the best way to manage the ponds. Therefore, in cooperation with the partner IFFNT, the project has established a technology platform to facilitate the exchange of knowledge. In addition, focus groups were formed with the objective of promoting regular (fortnightly) meetings in the participating communities. The aim is to exchange experiences in all areas related to fish production, processing and marketing. The farmers consider the opportunity for personal discussions and exchange particularly valuable. This exchange is an important contribution to the sustainability of the "Ich liebe Fisch" project, especially beyond the end of the project.

Theses of students

Currently, four master theses and one doctoral thesis related to the project topics are being prepared. The results are incorporated into the project measures.

Summary and outlook

The long-term prospects of the success of the 'Ich liebe Fisch' project are very good. Besides the low availability of fingerlings, knowledge gaps and frequent power failures, it was also revealed that low feed quality for the growing and adult fish had so far not been sufficiently recogniced by the farmers: Industrial pellet feed with added fish meal is too expensive, left-overs from the processing of maize are not nutritional enough. The local production of fly larvae could be a sustainable, affordable and environmentally friendly solution for the production of nutritious fish feed for the small-scale aquaculture communities. This measure should also be added to the project. ∎

Literature

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