

Project update

Project title (Acronym):	Development of Milkfish (<i>Chanos chanos</i>) and Kimarawali (<i>Stolephorus delectatus</i>) Solar Drying-Cooling Technology, Value Addition and Quality Assurance
Geographical focus:	Kenya/Coast/tbd
Call reference:	"Innovative approaches to process local food in Sub-Saharan Africa and Southeast Asia" (Bekanntmachung des BMEL: Innovative Ansätze zur Verarbeitung lokaler Lebensmittel in Subsahara-Afrika und Südostasien)
Cooperating partners:	Fraunhofer Institut für Solare Energiesysteme ISE Innotech Ingenieursgesellschaft mbH Kenya Industrial Research and Development Institute KIRDI Kenya Marine and Fisheries Research Institute KMFRI Technical University of Mombasa TUM
Duration:	09/2018 – 12/2022
Budget:	1.094.604,34€

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Map of the target region

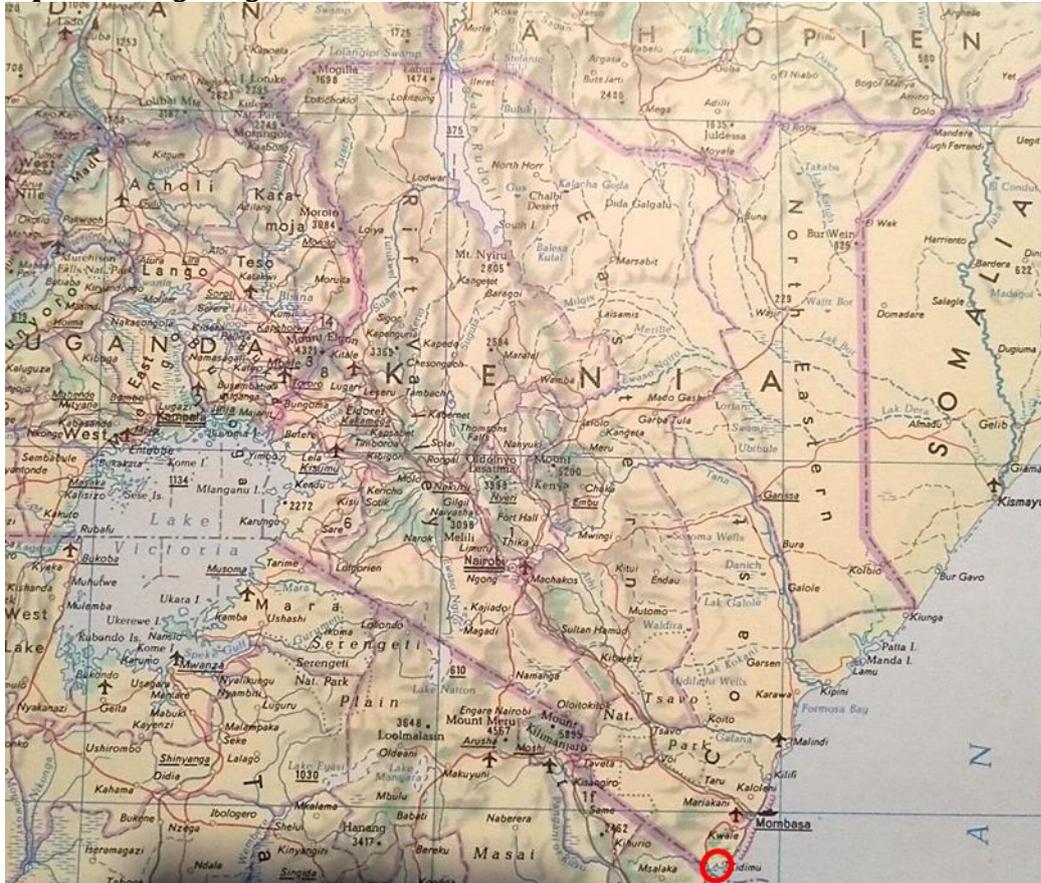


Fig. 1: Map of the target region in Kenya (Source: Haack Weltatlas, VEB Hermann Haack, Geographisch-Kartographische Anstalt, Gotha/Leipzig, 1972, 1. Auflage)

Aim of the project:

The aim of the project is the development of a 100% solar powered, off-grid system for the production of ice and the drying of fish. On the one hand, with the provision of ice for cooling during transport or temporary storage on the way between catching and processing or sale, and on the other hand with the drying capacity, two essential aspects for ensuring the preservation of fish are addressed.

The PV-electric operation of the flake ice machine in combination with adapted storage technology ensures optimal utilization of the daily production capacity with optimized plant operation. With the help of a solar thermal system, which is combined with the solar tunnel dryer, 24-hour operation is possible. Degradation processes of the material to be dried during the night hours can therewith be avoided. To produce high quality dried fish (premium nutritional value, texture and flavour), dehydration will be done through optimised control of temperature and humidity. Fish farmers will be trained on processing and quality assurance. Fraunhofer ISE and Innotech will partner with Kenya Industrial Research and Development Institute (KIRDI), Kenya Marine



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and Fisheries Research Institute (KMFRI) and Technical University of Mombasa (TUM) to design, develop and transfer the proposed technology package.

Results:

Based on the findings of the on-site analysis and supported by the results of the baseline survey, the system concept was adapted to produce ice instead of the originally planned cold storage. This led to a higher energy requirement to be covered. By means of simulation calculations, the system was designed and optimised taking into account climatic, technical and financial boundary conditions. In this context, a master's thesis on the life cycle analysis (LCA) for an ice production system powered by photovoltaics and batteries was prepared at Fraunhofer ISE, and various business models for marketing the ice were also considered in this context. Led by the partner Innotech, a double-deck dryer was developed, which, as already mentioned above, additionally enables continued operation during night hours. The Kenyan partners carried out a further analysis of the situation on site in order to be able to select the site for the installation of the first pilot system. Water quality and water availability for ice production were also considered as selection criteria.

For the system, as shown in Figure 3, a 40-foot sea container is to be used as the central element. This contains all the electrical components, such as inverters and batteries, as well as the solar thermal storage, pumps and also the entire measurement technology, including data acquisition and data transmission. The container is covered with a roof for energy generation and contains the photovoltaic modules and the solar thermal collector array. The dryer is installed close to the container in order to keep the hot water supply lines as short as possible. The ice machine as well as the cold storage room for storing the ice are set up directly at the container and thus in the shade under the roof.

The control and data acquisition of the active system components is done via openEMS. In addition, data transmission to Fraunhofer ISE or other partners will be realized via mobile network. Due to the restrictions caused by the Corona pandemic, the creation of a video tutorial was agreed upon in consultation with the project sponsor BLE, which is to show the system setup step by step. In spring 2021, the test setup of essential parts of the entire system for the shooting of the video tutorial took place on several shooting days.

The tutorial was then edited and dubbed. The finished video was made available to the partners in the non-public area on Youtube.

The organization of the transport of the SolCoolDry system in a sea container from Freiburg to Mwazaro turned out to be much more complicated than expected and could only be carried out successfully due to the high commitment of the partners.

Currently, the system is being assembled at the Mwazaro site by the partners in Kenya. The video tutorial as assembly instruction is extremely advantageous.

Key statements and policy advice:

The reduction of losses occurring between the catch and the sale of the fish to the end consumer must be achieved on the one hand by suitable technologies (cold storage on ice or also drying) and on the other hand accompanied by training and further education measures.



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Pictures

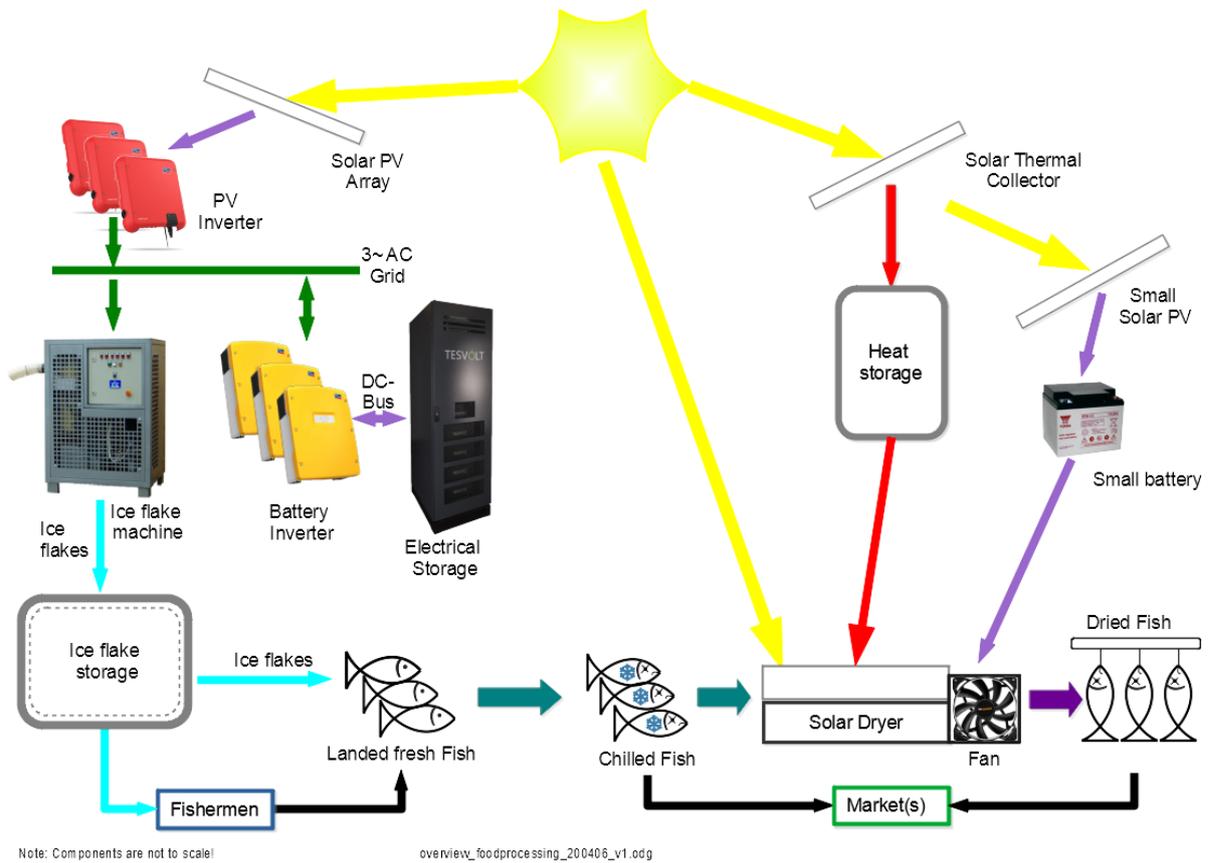


Fig. 2: System concept (simplified version)

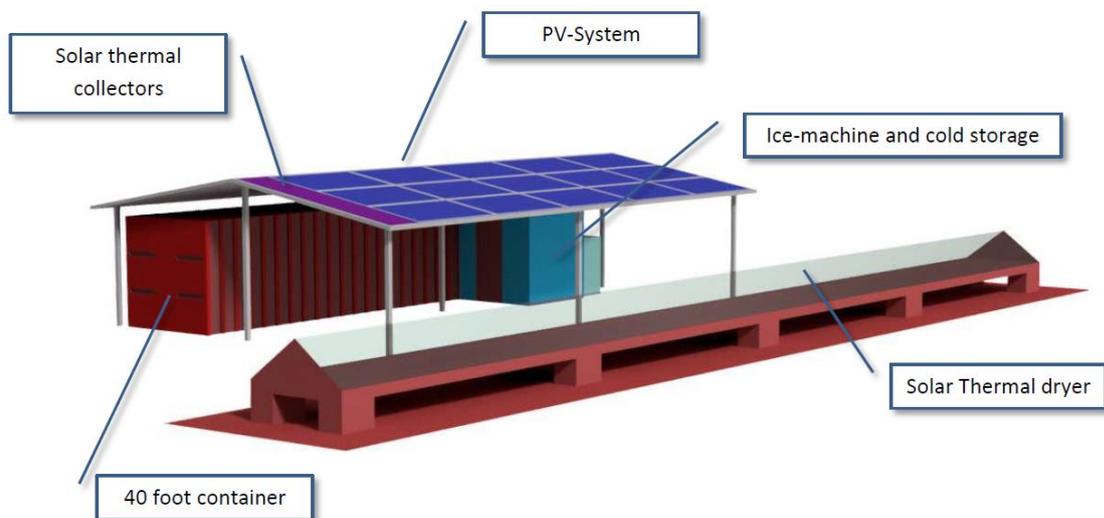


Fig. 3: Installation planning with photovoltaic system, solar collectors, 40-foot container, ice machine and small cold storage room for the flake ice as well as solar thermal dryer

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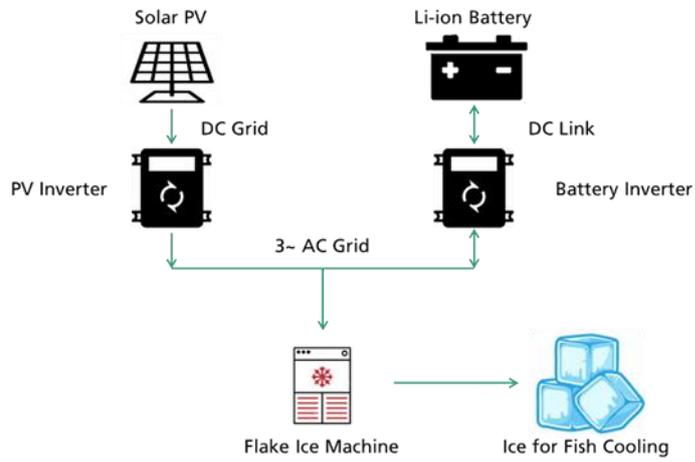


Fig. 4: System structure of the photovoltaic system for ice production