Environmentally friendly cold storage for fish – an example from Kenya

Off-grid, high-efficiency cold storage can help secure the livelihood of fishermen

green cooling initiative

The Fish Cold Chain is vital for food preservation and safety

Fish is a staple in many regions of the world. But it's a delicate food that spoils easily and can become unsafe. Therefore, it must be refrigerated from the time it is caught until it reaches a consumer's stove. Otherwise, producers lose their wares and consumers face health risks.

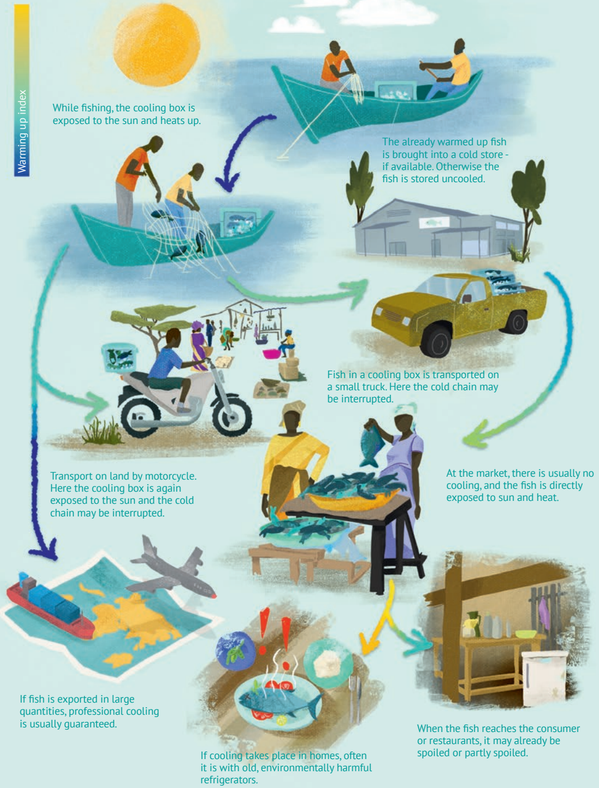
In Kenya's growing Lake Victoria region, fish is an important source of protein. After it is caught, fish is either eaten locally or transported overland to the capital, Nairobi. Along this route, producers do not have sufficient facilities for cold storage of the fish.

If the fish cannot properly be cooled directly after catching it spoils on the shores of the lake. With the right cooling infrastructure, more fish would make it to the market and fishermen would earn more for their catches. The International Institute of Refrigeration estimates that improving access to refrigeration in developing countries could prevent 23 percent of perishable foods from spoiling.

Through a partnership with the private sector, GCI has designed and build a Fish Cold Store in Kenya on the shores of Lake Victoria as a best-practice example to promote sustainable development, particularly in rural areas.

The Fish Cold Store is solar-powered and based on natural refrigerants to make it not only climate friendly, but also energy-efficient and cost-effective. Transport crates filled with ice flakes produced on site additionally enhance the quality of transport and maintenance of the cold chain.

Keeping Fish Cool



A climate-friendly sustainable cooling solution

The refrigeration and air conditioning industry is responsible for a significant share of global greenhouse gas emissions, because many appliances use fluorinated gases as refrigerants, which deplete the ozone layer.

In addition, in poorly insulated cold stores, much of the cold air gets lost, which increases energy consumption and contributes to global warming. Smart designs start with rooms that have insulation that is thicker than 150 millimeters. This enables cold store operators to keep energy consumption low and secure food safety during prolonged power shortages.

The Fish Cold Store on Lake Victoria keeps fish fresh with technology that protects the environment, while helping the operator save energy. A cold store is not simply a room used to keep food cold. It is a room specifically designed to meet the conditions for safe storage of perishable goods.

Typically, cold stores are built to maintain the temperature of a particular product, not make it colder. When planning a cold store, its designers need to consider the cooling temperature, the design of the rooms and the thermodynamic aspects of the particular goods that are to be cooled.

Building designers must also take into account the location and external conditions, such as average temperatures, terrain characteristics and accessibility. When constructing the building, it is also important to consider insulation, additional rooms, the power supply and water access. Since Lake Victoria has a lot of sun and water, the building designers chose a solar powered cooling system with an ice machine that takes its water directly from the lake. The ice is needed to cool down the fish so that when it is taken inside the cold store, it already has the desired temperature. The cold store refrigeration unit can then keep the fish at the desired temperature. The cold store room uses an air conditioning system that works with natural refrigerants and insulation that are made from climate-friendly material.

Fresh fish for a warming world

From snow-capped mountains to wide-open plains and endless beaches at the Indian Ocean – East Africa sounds like a dream in many ways. But the "Hakuna Matata"-way of life is endangered as it is getting hotter every year. The global warming target of 1.5 degrees Celsius has already been exceeded in some parts of the region. Adaption will become increasingly challenging. The world will suffer more negative impacts on intensity and frequency of extreme events, on resources, ecosystems, biodiversity and food security.

The East African region is trying to tackle those problems by focusing on afforestation, clean energy, energy efficiency and climate-friendly agriculture. Fish production, for example, is one of the fastest growing markets.

As fish is a vital source of essential macro- and micronutrients, it could also play an important role in reducing the high prevalence of undernutrition. However, food security has still much room to improve: up to 60% of the fish spoils due to interrupted cold chains.

The Green Cooling Initiative starts right here by supporting the development of environmental-friendly and energy-efficient cold stores.

green cooling initiative

The Green Cooling Initiative and GIZ Proklima

GIZ Proklima is a program of the *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) *GmbH*, which provides technical support to developing countries to implement the provisions of the *Montreal Protocol* and the *Kigali Amendment* on substances that deplete the ozone layer and affect the global climate.

As part of *GIZ Proklima*, the *Green Cooling Initiative* (GCI) is working on behalf of the German *Federal Ministry for the Environment, Nature Conservation and Nuclear Safety* (BMU) under its *International Climate Initiative* (IKI) to promote ozone- and climate-friendly technologies.

The overall objective of GCI is to minimize the environmental and climate impact of cooling systems used in the private and public sectors.

Three key objectives include:

- Promoting natural refrigerants and energy-efficiency
- Establishing advanced training institutions and certification schemes
- Encouraging public and private financing of projects

One way of minimizing the impact of the cooling industry on the environment is by helping it move to green cooling technologies by leapfrogging from ozone depleting refrigerants to natural refrigerants and maximized energy-efficiency.

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Market sale

Thanks to the cooling in the Cold Store, fresh chilled fish is sold at the market and remains longer fresh.

The Fish Cold Store has changed the lives of fishermen

Before the Cold Store was built, local fishermen often had to throw away 40 to 60% of their catch because they had no way to keep the fish cool. Now, 5 tons of fish can be stored and kept fresh for two to three days in the Fish Cold Store. It is climate- friendly, cost effective and sustainable because it's powered by solar energy, and ice to cool the fish is made from lake water.

To operate the Fish Cold Store so that little energy is lost, fishermen must be trained about how it can and should be used.

Some of the aspects to be considered include:

- The amount of food planned to be stored in the cold store, since this impacts the temperature. On the basis of that calculation an optimisation of cooling unit and ice makers can be made.
- How often the doors will be opened and the lights be switched on, since that increases the temperature inside the cold store?
- And how often people will go inside the cold store, since body heat impacts temperatures as well?

When covering fish with ice, fishermen need to:

- Make sure that the fish is gutted, scales removed and properly washed
- Make sure the ice directly covers the fish
- Keep fish from drying out
- Allow the fish placed inside a crate to cool down uniformly.

These steps keep the temperature of the fish constant and ensure quality.

Cooling Unit II

A completely integrated refrigeration unit with build in compressor and evaporator allows a compact and easily to be maintained cooling system.

Washroom

Hygiene plays an important role: before placing the fish on ice (for storage), the fish is gutted, scales removed and properly washed.

Storage system

The fish is covered with ice and placed in crates inside the cold store.

Solar power

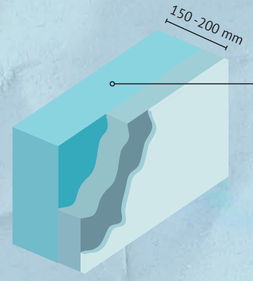
The electricity needed to run the Cold Store is generated by solar cells on the roof of the building.

Cooling Unit I

The cooling unit sets and controls the temperature and keeps the fish chilled.

Doors

The Cold Store has a sliding door to keep out the heat. It also switches on / off the light and places the cooling unit on hold



Insulation

Climate-friendly polyurethane cold store panels were used, 150 to 200 mm thick.

The cold store is preceded by a pre-room to reduce heat entering the cold store when the door is opened.

Ice machine

The lake water is purified by filtering and reverse osmosis before the ice machine produces chipped ice. Workers place the cleaning fish in crates and cover it with ice to cool it down to 2°C, just around the freezing point.

Fish farming

In fish ponds native Tilapia are bred and raised.

Lake Victoria, Kenya

Due to the tropical climate, Kenya needs an uninterrupted cold chain to keep fish fresh and safe.

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