

Solar powered technologies changing face of aquaculture

In Uganda, and globally, about 90 percent of aquaculture farmers operate in ponds or cages located in remote areas without access to electricity. Solar energy is sustainable, cost-effective, and suitable for rural settings.

BY HEDWIG ARINAITWE

Solar-powered systems offer significant benefits. They reduce dependence on fossil-fuel-based or unreliable grid electricity, lower operational emissions, and ensure continuity of operations even when project funding ends or electricity supply is disrupted. For research institutions and smallholder farmers, solar energy supports sustainable, low-carbon food production systems that are better suited to climate variability and long-term environmental pressures. Below are some of the smart technologies in aquaculture that use solar to operate.

Automating fish feeders

William Katumwa is the director of Twave Limited, a technology company founded in 2023 that majorly specialises in solar-tech aquaculture solutions.

According to Mr Katumwa, his passion in aquaculture started from childhood growing up close to the landing site in Katosi, Mukono District, where he witnessed systematic brookness and through his education focused to change the story.

When he went to university for a Bachelor's degree in Software Engineering, his final-year project focused on aquaculture. He specialised in automating water quality management.

"When I advanced to a Master's degree in Technology Innovation and Industrial Development at Meru University, my research continued in the same direction. I focused on automating water quality because it is the biggest challenge faced by aquaculture farmers," he says.

Through his research, he found that the major issue in aquaculture is water quality, which is often caused by overfeeding. Water quality, he says, is not just about colour. It includes dissolved oxygen levels, ammonium levels, and humidity. If water quality is poor, fish will not feed. Farmers may continue feeding without realising the fish are stressed, causing feed to dissolve in the water and go to waste.

"As young people, when we tried fishing in swamps, we often found dead fish. That experience sparked my interest in controlled fish farming, that is, aquaculture in ponds, cages, or tanks, rather than relying on wild fishing.

Together with his colleague, Charles

Kalungi, they invented a solar-powered automated fish feeder. The goal is to reduce feed wastage and promote sustainable aquaculture.

Traditionally, he says farmers feed fish by manually throwing feed into ponds or cages, which leads to significant wastage.

"Our system ensures fish are fed only when they are ready to feed, and in the right quantities. The system uses artificial intelligence to analyse fish behaviour, particularly swimming patterns, which indicate appetite or stress," he says, adding that it also considers several parameters; number of fish stocked, growth stage, water quality conditions, and they also have water quality sensors that monitor conditions in real time.

When all parameters are favourable, the system calculates the precise amount of feed needed. A shutter mechanism releases and evenly distributes the feed across the pond, preventing fish from crowding in one area. Feeding is done at optimal times to ensure healthy growth.

Farmers monitor everything through a mobile application, meaning they do not have to be physically present on the farm. The app provides real-time statistics and insights. The system also calculates Feed Conversion Ratio (FCR), which tells the farmer whether the feeds being used are producing the expected growth. If not, AI helps pin point whether the issue is feed quality, water quality, or another factor.

Sustainable lifeline for fisheries

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"It reduces operational costs and supports environmentally responsible aquaculture. We have developed a Minimum Viable Product (MVP), which is about 75 percent complete. We are currently testing it at the Kajansi National Fisheries Research and Development Institute. We also conducted a successful pilot in Kawanda, which led us to scale the testing to more demanding environments, exposing the system to rain, heat, and other real-world conditions before market launch," he says.

Uganda is facing a decline of about 13.3 percent in freshwater fish species,



creating a deficit of more than 580,000 tonnes of fish on the market. This affects nutrition, considering the fact that more than 5.3 million Ugandans consume fish.

By standardising aquaculture through technology, there is reduced reliance on wild fishing, protecting lakes, and creating investment opportunities, especially for youth and women.

Cost effect

Technically, importing water quality sensors from China is expensive due to high taxes.

"We are negotiating bulk purchasing and engaging the Ministry of Agriculture and Fisheries to seek tax relief. Funding is also a major challenge. As a startup, we rely on personal savings and grants, often pausing development to raise funds before continuing. That is why we are open to partnerships, collaborations, and investors," he says.

Scaling, Inspiration

Katumwa believes they will be in at least two East African countries, particularly Uganda and Kenya, fully commercialised product.

"The commitment from fish farmers who are already interested in adopting the technology motivates us to keep going. I am inspired more by quote: individuals. My co-founder, Ka also inspires me. He dreams of technology, which makes our here feel achievable," he says.

The aquaponics system - tech

As climate change brings long spells, rising temperatures, and drying water sources, traditional fishing methods become harder to sustain. Aquaponics offers a dipath where fish and crops grow together, supported by recycling, solar, and a smart design. An aquaponic system integrates fish and vegetable production. Water coming from fish contains high levels of nutrients like nitrogen and phosphorus, which are used by the plants. This reduces the need for fertilizers and prevents nutrient waste from uneaten fish feed.

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