

## INCREASED SUSTAINABILITY AND RESEARCH CAPACITY FOR TILAPIA AQUACULTURE IN ZAMBIA

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Aquaculture is currently the main consumer of global fishmeal production. Sustainability concerns inherent to fishmeal production for aquaculture include the overexploitation of some fish stocks and the use of small pelagic fish that are important human food to produce food for fish, as is the case in the African Great Lakes region and West Coast, for instance. Therefore, we must find alternative protein sources, which will substitute fishmeal, to support the sustainable growth of aquaculture in Africa and globally.

Several ingredients are currently considered alternatives to fishmeal in fish diets, including plant-based proteins (e.g., soybean meals, sunflower meal), animal-based protein sources (e.g., blood meal, poultry meals, insect meals), microbial biomass (bacteria) meals, and yeast (fungi) products. Dry yeast proteins are also called single-cell proteins. However, choosing the best alternative ingredients in the African context is difficult due to limited facilities for conducting rigorous scientific research to demonstrate the relevance of targeted ingredients.

To address these challenges, the Feed the Future Innovation Lab for Fish (Fish Innovation Lab) funded a study in Zambia focusing on using a single-cell protein as an alternative to fishmeal in tilapia farming. The objective of this project was to upgrade the aquaculture research facility of the Natural Resource Development College (NRDC) in Lusaka, Zambia, and use it to study the effect of replacing fishmeal with the dry yeast product (DY-Pro) in the Nile tilapia (*Oreochromis niloticus*) diet. The novel ingredient, DY-Pro, is produced by the U.S. company Meridian Biotech from *Saccharomyces cerevisiae*, a yeast species commonly used in brewing, winemaking, and bread baking and commonly known as “brewer’s yeast.”

“Prior to the start of this project, the facility had a lot of limitations in terms of conducting research. For instance, there was neither running water nor reservoirs for storing and setting of water before use in the lab, and the students spent a lot of time carrying water in buckets for cleaning and managing the aquariums,” said Masautso E. Sakala, a training officer at the NRDC and a co-PI on this project.

Sakala further explained that the NRDC research facility lacked adequate storage for and a limited number of aquaria, which meant the lab could not meet the demand of students conducting aquaculture research.

“The lab could only accommodate about five to six students at a time of a class of 30 students; therefore, we had to reduce experimental duration to about five to six weeks in order to accommodate all the students. An upgrade to the facility was absolutely needed to increase the research capacity and to allow a better quality of research in the lab,” said Sakala.

Through the Fish Innovation Lab, managed by Mississippi State University and funded by USAID, aquaculture experts of WorldFish (Malaysia and Zambia Offices), Texas A&M University (USA), Mississippi State University (USA), Meridian Biotech (USA), NRDC (Zambia), Aller Aqua (Zambia), and Yalelo Ltd. (Zambia) collaborated on this project. Upgrades to the NRDC facility included designing and building a flow-through aquaculture system of 30 aquaria, a steel structure with three layers (levels), a 2000-L tank, a 1000-L tank, an air blower, a water pump, and piping.



Masautso Sakala conducting research at NRDC.  
Tabitha Mulilo/WorldFish

“The new facility has made supervision of student’s research projects efficient, as I can now supervise research without limitations that forced me to make compromises on the duration of research and we can now collect enough data to make reliable conclusions. The aquaria are also helping me and other faculty members to hold live fish for practical lessons in fish processing, fish biology, and aquaculture,” said Sakala.

Upon completion of the new research facility, the project experiment took place. The specific objective of this experiment was to investigate whether the DY-Pro single-cell protein could be used as an alternative protein source to substitute fishmeal and therefore support the sustainable growth of tilapia farming globally. The fish species used in this experiment was the Nile tilapia, which is the most widely farmed fish group geographically and the second most farmed fish group by volume globally. To achieve the project’s objective, tilapia were fed diets in which graded levels of DY-Pro were used to replace 0, 2, 5, 25, 50, 75 and 100% of fishmeal.

At the end of the experiment, the research team found that the use of DY-Pro in tilapia diets can effectively help reduce the pressure on the fisheries stocks, by replacing 100% of fishmeal in tilapia diets without any significant effects on fish growth and fish body shape. Therefore, the use of products like DY-Pro can reduce sustainability concerns of fishmeal production, thereby allowing more fish to be used for human consumption rather than being converted to fishmeal.

“NRDC is the first training institution to have such a facility in the country, many thanks to the project and research team. It is not only a pride of the college but also a pride of the fisheries and aquaculture students. Many keep asking for permission to bring over friends from other departments to admire the facility. Moreover, the college can now boast a reliable research facility and can welcome collaborative research with partners that approach the institution with research ideas,” said Sakala.

The achievement of this project has built the capacity of the local vocational institution (NRDC) and proposed a solution to tilapia aquaculture in Zambia and Southern Africa, where tilapia plays a crucial role in animal protein supply of the urban and rural populations. Findings from this study will thus have direct application in the aquaculture industry of Zambia and human nutrition and can be scaled up in the Southern African Development Community region, which Sakala said is already happening.

“Upon completion of this project, we have conducted sedation projects of both African catfish and tilapia species using different sedatives, such as basil and clove. Right now, we are conducting a species comparison experiment with various species of tilapia available in the country. We also plan to conduct a number of research projects in the aquaria, such as investigating locally grown feed ingredients, better and effective ways of sex reversal, feeding rates, stocking rates, among others,” Sakala said. “Through the achievement of these upcoming research activities, we hope to find many other local alternative feed ingredients that will reduce the cost of feed, and ultimately reduce the production cost of fish, and therefore contribute to ensuring food security and the growth of the aquaculture sector in Zambia.”



New aquaria installed at NRDC for aquaculture research.  
Tabitha Mulilo/WorldFish

## ABOUT THE FISH INNOVATION LAB

The Fish Innovation Lab supports the United States Agency for International Development’s agricultural research and capacity building work under Feed the Future, the U.S. Government’s global hunger and food security initiative. Mississippi State University is the program’s management entity. The University of Rhode Island, Texas State University, Washington University in St. Louis, and RTI International serve as management partners.

[www.fishinnovationlab.msstate.edu](http://www.fishinnovationlab.msstate.edu)

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