# PROFISHBLUE Project Report– Capacity building of participating institutions, support National Hatchery equipment and Support to national research activities on regional germplasm (Zambia, Malawi, Mozambique and SA)

**July 2024**

**Implemnting Partner:**

**Authors**

Victor Siamudala, Mathew Hamilton, Tom Malambo and Yvonne Mwanza.

**Citation**

This publication should be cited as: Siamudaala V., Hamilton, M., Malambo, T., and Mwanza, Y. (2023). Capacity Building of Participating Institutions, Support National Hatchery Equipment and Support to National Research Activities on Regional Germplasm (Zambia, Malawi, Mozambique and SA). Penang, Malaysia: WorldFish.

**About WorldFish**

Worldfish is an international, not-for-profit research organization that works to reduce hunger and poverty by improving fisheries and aquaculture. It collaborates with numerous international, regional and national partners to deliver transformational impacts to millions of people who depend on fish for food, nutrition and income in the developing world. Headquartered in Penang, Malaysia and with regional offices across Africa, Asia and the Pacific, WorldFish is a member of the CGIAR, the world's largest global partnership on agriculture research and innovation for a food secure future.

**Photo Credits**

Yvonne Mwanza and Patience Chungu, WorldFish

**Acknowledgements**

The Program for Improving Fisheries Governance and Blue Economy Trade Corridors in SADC Region (PROFISHBLUE) Project in Zambia is implemented by WorldFish, who lead the CGIAR Initiative on Aquatic Foods. WorldFish was contracted by the Southern African Development Commission (SADC) Secretariat to co-implement the Project, with generous funding support from the African Development Bank (AfDB).

**Contact**

WorldFish Communications and Marketing Department, Jalan Batu Maung, Batu Maung, 11960 Bayan Lepas, Penang, Malaysia. Email: worldfishcenter@cgiar.org

## Executive Summary

WorldFish, in line with the Project Financing Agreement, for the Programme for Improving Fisheries Governance and Blue Economy Trade Corridors in SADC Region (PROFISHBLUE) Project, conducted the following as part of capacity building of participating institutions, support National Hatchery equipment and Support to national research activities on regional germplasm with a focus on the following members states - Malawi, Mozambique, South Africa and Zambia.

1. A regional genetics training workshop as part of knowledge and skills transfer to the different stakeholders ranging from governments, private sector, academia, to research organizations,
2. Supported national hatcheries through purchase of equipment the Genetic Improvements Programs (GIPS) for the Governments of the Republics of Malawi and Zambia and;
3. Provided additional support to one experiment/study for one generation of target species in the region which is undergoing genetic improvement *O. andersonii* in Zambia, building on earlier work by WorldFish and partners in the SADC region.

The report is divided into three chapters. Chapter 1 provides information on the Regional Genetics Training that took place from 8th - 11th April 2024 in Kitwe, Zambia. The training covered critical aspects of managing a genetics breeding nucleus program. The training was designed to strengthen the capacity of participating institutions to implement the regional framework for genetic improvement for priority species. The training also helped the SADC members with ongoing genetic improvement programs (GIP) and those about to commission GIPs to understand how best to improve their GIPs in line with critical resources required for a viable GIP. In Chapter 2 we report on the progress we have achieved in the procurement and support of hatchery equipment to the Governments of the Republics of Malawi and Zambia. Various equipment worth US$ 7102.22 have been purchased to support the GIP at the National Aquaculture Centre (NAC) in Zomba in Malawi. The equipment is meant to improve heat conservation and recirculation and,

subsequently reduce the current long incubation period experienced under the GIP in Malawi. Equipment worth US$ 9231.54 has been purchased for the GIP at the National Aquaculture Research and Development Centre (NARDC) in Kitwe, Zambia. The equipment will improve aeration in ponds and heating in the hatchery for improved mating and grow out of families produced at NARDC in Kitwe, Zambia. Preparations are underway to handover the equipment to the Government of the Republic of Malawi on 22$^{nd}$ July 2024. The dates for the handover of the equipment to the Government of the Republic of Zambia was initially planned for 19$^{th}$ July 2024 but has since been rescheduled to a date to be later communicated by the Ministry of Fisheries and Livestock of Zambia. In Chapter 3 we have reported progress achieved under the "Support to national research activities." The report focuses on the research support to NARDC in Kitwe, Zambia where we have supported the Government of the Republic of Zambia with the tagging of fingerlings and stocking of Generation 2 of the *Oreochromis andersonii.*

## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AfDB | African Development Bank |
| AQGR | Aquatic Genetic Resources |
| FIS | Fisheries Information System |
| GIP | Genetic Improvement Program |
| NAC | National Aquaculture Centre |
| NARDC | National Aquaculture Research and Development Centre |
| NBC | National Breeding Centre |
| PIT | Passive Integrated Transponder |
| PROFISHBLUE | Programme for Enhancing Fisheries Governance and Blue Economy Trade Corridors |
| SADC | Southern Africa Development Community |
| UK | United Kingdom |

## Chapter 1

## Capacity Building Report

### 1. Introduction

The Program for Improving Fisheries Governance and Blue Economy Trade Corridors in the Southern Africa Development Community (SADC) Region (PROFISHBLUE) project is being implemented by the SADC secretariat while WorldFish is one of its implementing partners. The African Development Bank (AfDB) is funding the PROFISHBLUE project, which aims to promote sustainable management and utilization of fisheries resources in SADC within the framework of the blue economy idea. The SADC Secretariat has enlisted WorldFish to assist with the implementation of the Programme for Improving Fisheries Governance and Blue Economy Trade Corridors in the SADC Region (PROFISHBLUE Project). The project's overarching goal is to support the sustainable management of fisheries resources within the context of the blue economy in order to enhance the security of food and nutrition, generate jobs through value chain activities, ease intraregional trade, and strengthen the region's adaptive capacity against climate change and other external shocks. WorldFish has been tasked to implement the following components:

Component 1: improving collaborative governance of transboundary resources

Component 1.5: Digital fisheries information systems (FIS) for value chain actors and knowledge sharing platform

Component 2: Policy harmonization and trade facilitation towards intra- regional trade

Under component 1 WorldFish is expected to among others support capacity building of participating institutions, support National Hatchery equipment and Support to national research activities on regional germplasm with a focus on the following member states - Malawi, Mozambique, South Africa and Zambia.

The SADC member states have determined that building local aquatic genetic resources (AQGR) is a top priority in order to boost the aquaculture industry by providing access to genetically improved germplasm for important fish species that are farmed in the SADC region. The primary species under consideration include *Oreochromis andersonii*, *Oreochromis shiranus* and *Oreochromis mossabicus*.

It is against this background that WorldFish conducted a regional genetics training to cover key aspects of genetics management for a genetics breeding nucleus. This training is one way of building the participating institutions' capacity to implement the regional framework for genetic improvement for priority species. The training also helped SADC member states that either have a genetic improvement program (GIP) in place or are about to start one to partially meet some of their genetic improvement needs. The training was residential and it ran from 8th -11th April, 2024 and it was held in Kitwe, Zambia.

## Objectives of the Training

Building capacity of participating institutions on implementation of the regional framework for genetic improvement for priority fish species.

## Methodology

The training programs were designed by WorldFish experts to respond to the key gaps identified during the implementation of some of its GIPs in different regions of the world taking into account the target beneficiaries i.e. participants to the training workshops and, methods of delivery of training materials. The training modules were co-developed with the key trainers engaged to provide training on specific topics of the modules.

WorldFish used a mix of techniques to deliver the training comprising inter alia:

a) **Lecture discussions** - the resource persons delivered the training module in form of interactive lectures;

b) **Group exercises and assignments** - the participants formed groups to undertake group assignments (exercises) to help them discuss the thematic area allocated to them and put into practice the knowledge from the lecture discussions;

c) **Plenary Sessions** - the groups presented their completed assignment to all the workshop participants which provided for interaction in form of Question and Answer Sessions;

d) Practical sessions - In some instances the workshop participants were given specific exercises to undertake or participate in for them to have a hands-on approach to the training and;

e) **Field Excursions** - WorldFish arranged for a "study visit" to NARDC for participants to see the application of the knowledge and skills in a real life situation. The field excursion was interactive as participants engaged management of the GIP facility on different aspects of the production or experiment.

## Training Participants

A total of 21 particpants were trained comprising 13 men and 8 women from 4 member states as shown in Table 1.

**Table 1: Number of Participants for the Promote genetic improvement and aquaculture programs| regional hatchery support and training.**

| Country | Number of Participants | | Total | Participating Agencies |
|---|---|---|---|---|
| | Male | Female | | |
| **Workshop Participants** | | | | |
| Malawi | 4 | 1 | 5 | Government<br>Academia<br>Research Organizations<br>Others |
| Mozambique | 1 | 1 | 2 | Government<br>Academia<br>Research Organizations<br>Others |
| South Africa | 1 | 2 | 3 | Government<br>Academia<br>Research Organizations<br>Others |
| Zambia | 7 | 4 | 11 | Government<br>Academia<br>Research Organizations<br>Others |
| **Workshop Trainers & Facilitators** | | | | |
| | Name | Institution | Role during training | Area covered |
| | Dr. Rose Basiita | WorldFish | Trainer | Overview of genetic improvement<br>Factors to consider for a successful breeding program |

| | | | | |
|---|---|---|---|---|
| | Dr Robert Mukiibi | Rosling University in Edenburg, UK. | Trainer | Fundamentals and basic statistics relevant to genetics and breeding<br>Preparation of data files and installation of relevant genetics data analysis.<br>Estimation of breeding value and selecting breeding candidates |
| | Dr. Mathew Hamilton | WorldFish | Trainer | Quantifying genetic gains |

**List of Training Materials Provided to the Workshop Participants** - several training materials were given to the workshop participants depending on the training module/curriculum. These included:

- Power Point Presentations;
- Group exercises and assignments and;
- Handout materials, mostly simplified versions of the lecture notes

Please find link to all training materials: Regional Genetics training

**Training Outcomes** - the outcomes for the training were to equip participants with skills useful for a genetic improvement program *inter alia*:

a) Data Collection, Data Archiving, and Management,

b) Fish Tagging,

c) Data Analysis and,

d) Identification of estimated breeding values and estimation of genetic gain

**Lessons Learnt & Recommendations**

- Installation of software and packages for the data analysis took time and some laptops of the participants were too slow in processing information and this slowed the pace of the training. For future trainings the participants should be sent links to software and asked to install them prior to the training.
- Limited time for the training. The training which was initially planned for 5 days to allow participants enough time to assimilate the lessons from the trainings was instead conducted in 4.days due to limited budget.
- Field excursion should have been done first so that the participants understand how the data they were asked to analyze was created especially for participants coming from countries where the GIP are yet to start.

**Post Training** - this phase involved the preparation of the workshop training reports and revision of the training modules to incorporate new knowledge and information gained from the interactive training workshops. The training report is attached as Annex 1

Chapter 2

# Hatchery Equipment Report

## 1. Introduction

The Southern African Development Community (SADC) Genetic Improvement Program aims to enhance the productivity and sustainability of fish farming in the region through selective breeding and genetic improvement. Efficient fish hatcheries are crucial for the program's success, necessitating the acquisition of specialized equipment for participating institutions from SADC member states.

WorldFish is among others promoting the genetic improvement and aquaculture programs under this project subcomponent, by rendering support to participating institutions through the procurement of hatchery equipment as one way of building the participating institutions' capacity to implement the regional framework for genetic improvement for priority species. This hatchery support helps the governments of the SADC countries that either a running genetic improvement program (GIP) in place to partially meet some of their genetic improvement needs.

This report outlines the guidance that was given to participating institutions on the purchase of priority equipment for the GIP hatcheries, justifies its necessity, and provides guidelines for the procurement.

### Objectives

The primary objectives of the purchase of the equipment are to:

- Upgrade the hatchery for Malawi to improve heat conservation and recirculation to reduce the current long incubation period experienced at the GIP Facility in Malawi and;

- Improve aeration in ponds and heat conservation in hatchery for improved mating and growth out of families produced at the GIP facility in Zambia.

## 2. Equipment Priority List and Justification

Each participating institution conducted a thorough needs assessment to determine the specific equipment requirements based on the capacity and objectives of their respective hatchery facility. Participating country's Department of Fisheries and/ Aquaculture in liaison with the focal persons were asked to conduct this needs assessment for their hatcheries after which WorldFish held consultation meetings to confirm the equipment to prioritize for the genetic Improvement Program (GIP) for Malawi and Zambia. The final equipment list for Malawi's GIP includes hatchery heat conservation and water recirculation equipment to reduce the current long incubation period being experienced. The final priority equipment list for the GIP for Zambia includes equipment that will bring about improved heat conservation in the hatchery and improved aeration in both the hatchery and the grow out ponds.

The following equipment has been purchased for Malawi:

1. **Heat conservation gadgets** (includes water tank heaters)
    - **Justification**: The water tank heaters which are able to heat up to 800l of water, this will improve heat conservation in the hatchery thereby reducing the current long incubation period for Malawi.
2. **Water reticulation Systems (Includes 5,000 liters overhead water tank,210l plastic drum, 2" PVC pipe, PVC gate valve, submersible drainage pumps, hose pipe, submersible pumps**)
    - **Justification**: The purchased items are essential for maintaining consistent water quality, enhances fish health, and promotes better growth and survival rates. It also supports resource and environmental efficiency, operational effectiveness and economic benefits. They allow for the

continuous use and recycling of water, reducing water consumption and environmental impact. The procured items will resolve the current the poor water reticulation system challenges that are being faced by the hatchery.

3. **Industrial pressure cleaner for happas**
    - **Justification**: Using high-pressure washers for cleaning happas on a fish farm offers significant advantages in terms of efficiency, thoroughness, fish health, equipment durability, cost-effectiveness, environmental benefits, worker safety, operational consistency, and versatility. These benefits contribute to the overall productivity and sustainability of the breeding nucleus' operations.

The following equipment has been purchased for Zambia:

1. **Heat conservation gadgets** (includes water tank heaters)

- **Justification**: The water tank heaters which are able to heat upto 800 litres of water. This will shorten the hatchery's existing lengthy incubation period by improving heat conservation.

2. **Aeration equipment** (Electric fountain aerator, Air compressor, flexible clear air tube, aeration hose)
    - **Justification**: improved aeration in a fish hatchery is essential for maintaining a healthy, productive, and sustainable aquaculture environment. It enhances fish health and growth, improves water quality, prevents disease, and increases overall efficiency.
3. **Water Quality Monitoring gadgets (includes pH probe and dissolved oxygen probe)**
    - **Justification**: These items are vital for continuously monitoring parameters such as temperature, pH and dissolved oxygen. Maintaining optimal water conditions is critical for the health and growth of fish.
4. **Trovan scale**

- **Justification**: A trovan scale enhances precision in weight measurement, improves record-keeping and management practices, supports health monitoring and provides significant economic and operational benefits.

5. **Industrial pressure cleaner for happas**
    - **Justification**: Using high-pressure washers for cleaning happas on a fish farm offers significant advantages in terms of efficiency, thoroughness, fish health, equipment durability, cost-effectiveness, environmental benefits, worker safety, operational consistency, and versatility. These benefits contribute to the overall productivity and sustainability of the breeding nucleus' operations.

## Installation and Commissioning

WorldFish has ensured that the procured equipment has been properly installed and commissioned by qualified technicians and has since verified that all systems are functioning correctly before final handover.

***Plate1 Installed water tank heaters for improved heat conservation NAC in Domasi, Malawi.***

*Plate 2 Electric fountain aerators installed to improve pond aeration at the GIP nucleus breeding center for O. andersonii in Kitwe, Zambia*

## Training Programs

WorldFish is conducting training sessions for staff at participating institutions to ensure they are proficient in using and maintaining the new equipment.

## Expected Outcomes

1. **Strengthened Institutional Capacity**: Empowered institutions with the necessary tools, knowledge, and infrastructure to conduct advanced genetic research and breeding programs.

## Conclusions

The Genetics Component of the SADC PROFISH Blue Project is pivotal in transforming the aquaculture sector in Southern Africa. By focusing on genetic improvement and sustainable practices, this initiative will significantly enhance fish production, support economic growth, and ensure food security for the region. The acquisition of modern fish hatchery equipment is a critical step in advancing the SADC Genetic Improvement Program. By equipping participating institutions with state-of-the-art tools, we can significantly enhance the genetic quality and productivity of fish stocks in the region. This investment will support sustainable aquaculture development, and create downstream benefits of improved food and nutrition security, job creation and economic growth for the SADC member states. The list of equipment for Malawi and Zambia are listed as Annexes II and III respectively.

**Chapter 3**

# Fingerling tagging and stocking of Generation Two(G2) *Oreochromis andersonii* Report

## 1. Introduction

WorldFish is supporting the tagging and stocking of *O. andersonii* fingerlings at the National Aquaculture Research and Development Center (NARDC) Nucleus Breeding Center (NBC) under the PRO FISH BLUE Project.

After producing the second selected generation (G2) of *O.andersonii* families in January 2024, families were nursed in separate hapas (one family per hapa). Once of sufficient size, fingerlings were then tagged with passive integrated transponder (PIT) tags and stocked into earthen ponds to be grown out in a common environment. Fingerling tagging is paramount in aquaculture genetics as this allows identification of individual fish and the family to which they belong. Fish tagging with PIT tags is a technique that was first used around mid-1980s to gather information about fish movement and ecology (Larsen et al. 2013).

## 2. Objectives

To support the fingerling tagging and stocking of G2 for *O.andersonii* under the genetic component of the PRO FISH BLUE project.

## 3. Materials and Methods

The materials that were used during tagging and stocking of fingerlings included:

| No | Equipment and consumables |
|---|---|
| 1 | Fish measuring device |
| 2 | Clove powder |
| 3 | Gloves |
| 4 | Dissecting boards |
| 5 | Analytical Grade Ethanol |
| 6 | Iodine |
| 7 | Spray bottle |
| 8 | Veiner caliper |
| 9 | Buckets |
| 10 | Permanent makers |
| 11 | Camera |
| 12 | Aeration |
| 13 | Cotton buds |
| 14 | Beakers1 |
| 15 | Grade 11  surgical blades |
| 16 | Tags |
| 17 | Cryo vials |
| 18 | Storage boxes |
| 19 | Barcodes |
| 20 | Data entry sheets |
|  | Plain papers |

## 4. Research Site and Species

Tagging and stocking was undertaken at the national breeding centre (NBC) at National Aquaculture Research and Development Center (NARDC). The NBC is owned by the Department of Fisheries and is located in Mwekera, Copperbelt Province, Zambia. *O. andersonii* is an indigenous species in Zambia and the Zambezi river basin.

### Fingerling Production

After selecting the parents, the fish were placed in mating hapas measuring 2x1m. These hapas were positioned in the pond two days prior to mating. It is crucial to pair the fish in the hapas quickly but carefully. The mating ratio that was used was one male to three females (1:3). After mating, the eggs were checked after seven days. Any female fish found with eggs were carefully relieved of their eggs, which were then taken to the hatchery for incubation. Once the eggs hatched and the fry had absorbed their yolk sacs, they were transferred to nursery hapas where they were grown until they reached the size of 5g. Only fry at 5g or more were tagged.

### Tagging Procedure

Morphometric measurements were taken on each fish during tagging. Traits assessed were:

- Weight (g)
- Standard Length(cm)
- Total Length (cm)
- Head Length(mm)
- Body depth(mm)

After capturing the morphometric measurements, the fish were tagged. Tagging involved the insertion of a passive integrated transponder (PIT).

***Plate 1 Passive integrated transponders in a petri-dish***

Fingerlings were tagged when they reached a weight of 5g or more. The fish were anesthetized in clove solution. Two to three fish were placed in the clove-oil solution at a given time, and the first fish to become anesthetized was tagged first. This approach reduced stress on the fish.

The fish was tagged by making a small slit just above the starting point of the anal fin. After the slit was made, a tag, was read in the system and inserted into the muscle. Afterward, iodine was applied to the tagged area to minimize the risk of bacterial infection and to expedite the healing process. Following the tagging process, the fish then was carefully placed in a recovery bucket with aeration, gently positioning the head into the water first.  Fish were then returned to a recovery hapa, containing fish from the same family.

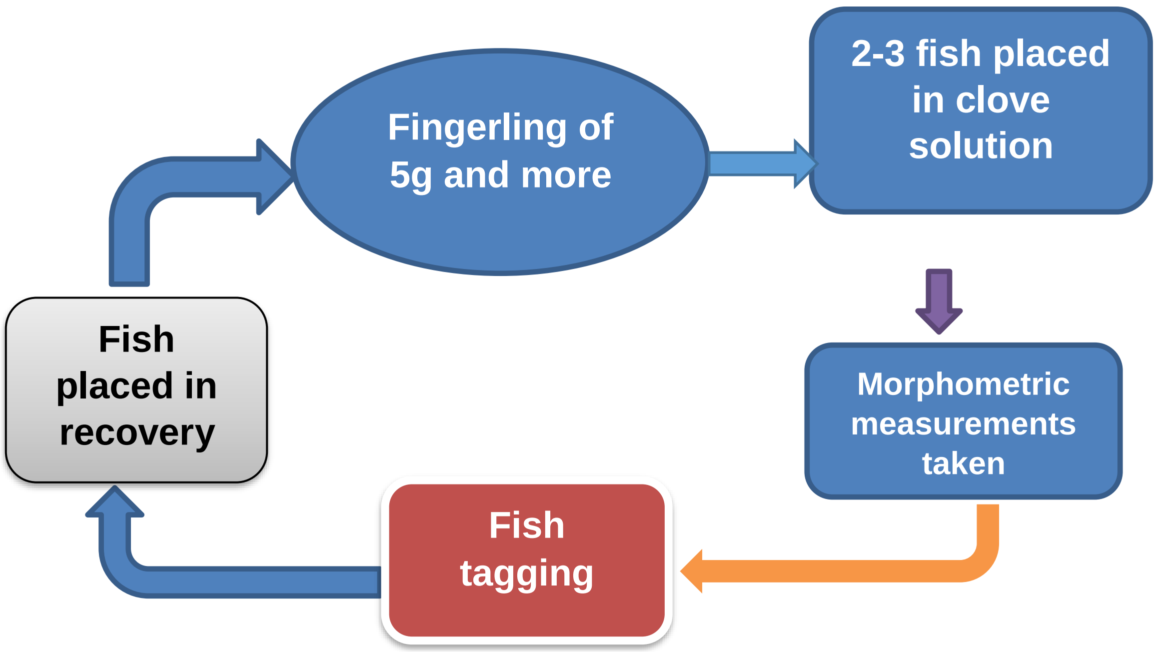


*Plate 2 Summary of fingerling tagging*

**Stocking Procedure -** fish that had retained tags and healed completely were anesthetized in clove solution before reading their tag and were assigned a photo ID, photographed, and fin clipped. The finclip was then taken from the caudal fin of each individual fish using a finclip punch.

***Plate 3 Fin clip punch***

| TROVAN_ID | Serial | Stocking_Photo_ID | Barcode | Family_ID | POND_ORIGIN | DESTINATION_ID | Hapa_ID |
|---|---|---|---|---|---|---|---|
| 0006D49A10 | 3448 | 1442 | ZFB9354 | 66 | E22 | E24 | 429 |
| 0008076E36 | 3449 | 1449 | ZFB9361 | 66 | E22 | E24 | 429 |
| 0008075663 | 3452 | 1447 | ZFB9359 | 66 | E22 | E24 | 429 |
| 0006D04712 | 3453 | 1427 | ZFB9339 | 66 | E22 | E24 | 429 |
| 00075FA591 | 3458 | 1443 | ZFB9355 | 66 | E22 | E24 | 429 |
| 0006A20C33 | 3459 | 1375 | ZFB9287 | 37 | E22 | E24 | 431 |
| 00071F5537 | 3460 | 1380 | ZFB9292 | 37 | E22 | E24 | 431 |
| 00075B1936 | 3461 | 1411 | ZFB9323 | 37 | E22 | E24 | 431 |
| 0007CEE957 | 3462 | 1376 | ZFB9288 | 37 | E22 | E24 | 431 |
| 0008078BFB | 3463 | 1422 | ZFB9334 | 37 | E22 | E24 | 431 |
| 0007F44E6B | 3465 | 1384 | ZFB9296 | 37 | E22 | E24 | 431 |

***Plate 4 Example of data set recorded during stocking***

Fin clips were placed in a cryo-vial pre-filled with analytical-grade ethanol and a unique barcode was assigned to each sample.

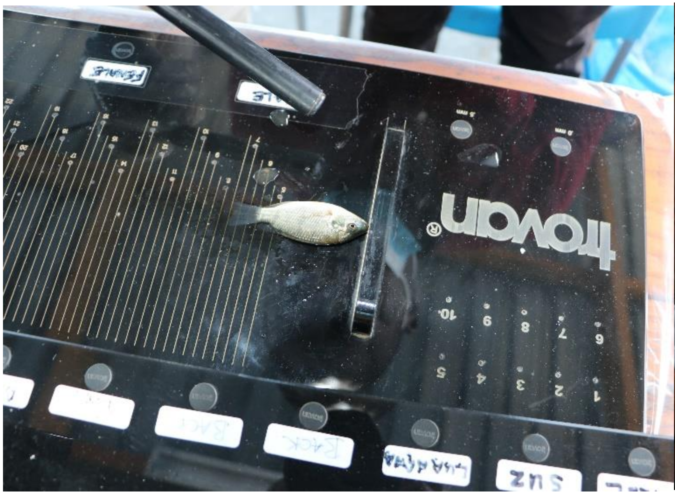


*Plate 5 Morphometric measurements and fin clip collection*

The fish was then put in a recovery bucket. After recovery, the fish were stocked in a grow out pond for progeny testing by letting them swim out of the bucket. Four progeny testing ponds were used at the NBC. All the four ponds were semi-earthen ponds and 750m$^2$ in size.

| G2 BATCH 1 | |
|---|---|
| **STOCKED POND** | **TOTAL STOCKED** |
| E5 | 245 |
| E6 | 248 |
| **Grand Total** | **493** |

| G2 BATCH 2 | |
|---|---|
| **STOCKED POND** | **TOTAL STOCKED** |
| E17 | 1031 |
| E18 | 1017 |
| E19 | 1026 |
| E20 | 1016 |
| **Grand Total** | **4090** |

***Plate 6 Number of fish stocked in each pond for the two batches***

From each family, we aimed to stock 70 individuals. The fish from each family were randomly stocked across the six progeny testing ponds.

Two batches of fish were tagged and stocked in experimental ponds. The final stocking date for the first batch was 07/04/2024 while the final stocking date for the second batch was 17/06/2024. Batch 1 was stocked in two progeny testing ponds and 493 individuals were stocked. Batch 2 was stocked with 4090 individuals in 4 progeny ponds. 103 unique families have been stocked out of a targeted 100 families. Furthermore, we have two families that we haven't tagged and stocked due to small sizes. The status of the two families are below:

- 424 1x1 spawned on 16$^{nd}$ April,2024 and were transferred on 22$^{nd}$ April,2024.

- 477 1x3 spawned on 9th April,2024 and were transferred on 20th April,2024.

## Challenges:

- Some families were too small to tag, which caused delays in completing the stocking exercise.
- Mortalities were both recorded at tagging and stocking
- Due to weather changes from hot to cold, some fish developed fungal infections

## Expected Outcomes

Experimental units stocked with tagged fish, fish grown to table size and harvested.

## Conclusion

Fish tagging is essential for breeding and genetic studies. In our research, we physically tagged the fish by inserting a PIT tag into their muscle. This allowed identification of individual fish and their relatives within each population throughout their life cycle. By identifying and tracking the pedigree of individual fish, family-based breeding programs account for relationships between individual animals to (i) accurately estimate the additive genetic worth of individuals (i.e. estimated breeding values), ii) select parents from multiple families (i.e. maintain genetic variation) and iii) avoid mating related individuals – thus enhancing genetic gains in desirable traits such as growth rate.

## About WorldFish

WorldFish is an international, not-for-profit research organization that works to reduce hunger and poverty by improving fisheries and aquaculture. It collaborates with numerous international, regional and national partners to deliver transformational impacts to millions of people who depend on fish for food, nutrition and income in the developing world. Headquartered in Penang, Malaysia and with regional offices across Africa, Asia and the Pacific, WorldFish is a member of CGIAR, the world's largest global partnership on agriculture research and innovation for a food secure future.