WorldFish

June 2022

Final Technical Report

The Aquaculture Technical, Vocational, and Entrepreneurship Training for Improved Private Sector and Smallholder Skills Project in Zambia

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Norad BluePlanet MUSIKA Making Agricultural Markets Work for Zambia CGIAR Research Program on Fish

Citation
This publication should be cited as: Mudege, N.N. (2022). Final Technical Report, 2022: The Aquaculture Technical, Vocational, and Entrepreneurship Training for Improved Private Sector and Smallholder Skills Project in Zambia Dissemination and planning meeting. Penang, Malaysia: WorldFish. <Publication No>.

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.*

Acknowledgements

Funding support for this work was provided by the **Norwegian Agency for Development Cooperation (Norad)** in the framework of the Aquaculture Technical, Vocational, and Entrepreneurship Training for Improved Private Sector and Smallholder Skills Project in Zambia. We acknowledge Dr Siamudaala for reviewing the report and providing comments to the project team.

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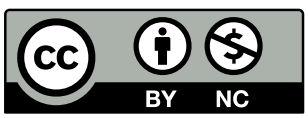

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EXECUTIVE SUMMARY

This section provides an overview of the project (project information), objectives and a summary of what has been achieved and lessons learnt.

Project information

Title	ZAM-18/0002 Aquaculture Technical, Vocational, and Entrepreneurship Training for Improved Private Sector and Smallholder Skills Project in Zambia
Recipient	International Center for Living Aquatic Resources Management (ICLARM), also known as WorldFish
Partners	BluePlanet Academy [BluePlanet], Natural Resources Development College [NRDC] and Musika Development Initiatives [Musika])
Project period	1st July 2018 to 30 April 2022
Geographic location (Country, countries, province of implementation)	Zambia (Lusaka, Northern and Luapula Provinces)
Total budget	NOK20,000,000
Grant received from MFA/ Norad/ Embassy in 2020	Norad

The Aquaculture Technical, Vocational, and Entrepreneurship Training for Improved Private Sector and Smallholder Skills Project in Zambia (AQ TEVET July 2018 to April 2022) is funded by the Norwegian Agency for Development Cooperation (Norad). The project is implemented in Zambia's Northern, Luapula and Lusaka provinces to exploit aquaculture's high potential and address challenges affecting fish farmers in the northern region.

The project's overall objective is to develop the aquaculture knowledge and practical skills of students and smallholder commercial fish farmers (particularly women and youth) to find gainful employment in the private sector. It comprises two components: i. Upgrading the fisheries science curriculum (long- and short-term courses) and training tools and developing an online training platform and internship program at the NRDC, but with links to other TEVET institutions to scale the upgraded curriculum over the project life span and beyond and, ii. Enhancing the technical education, vocational and entrepreneurship skills of rural women, men and youth smallholder commercial fish farmers and increasing their linkages to input/output markets and entrepreneurship opportunities via private sector extension support and services delivery

MAIN ACHIEVEMENTS

We achieved most of the project outcomes for both components. Regarding component one, 169 students (44% female) against a target of 135 (50% female) are

using the upgraded curriculum and tools developed, the online training platform and the internship program reflecting an achievement rate of 125%. Of 169 students, 41 from the 2019 cohort (30% of whom are females) completed the training using the new curriculum. They graduated in January 2022 (See figure 1). The project launched the NRDC Aquaculture Skills Training Centre (ASTC) in December 2020 in a high-level event attended by Hon. Prof. Nkandu Luo (MP), the then Zambia's Minister of Fisheries and Livestock. The 169 fisheries students have used the center for their practicals. An additional 691 students from the following programs at NRDC Fisheries and Aquaculture, Animal Science, Crop Science, Agriculture Business Management, Agricultural Education, Horticulture and Food and Nutrition have also used the ASTC for practical sessions. Ten courses are using the centre for practical sessions for the students. All 169 fisheries science students have used the online training platform.

The model developed at NRDC was also scaled out to Kasaka Fisheries Training Institute, which upgraded its curriculum and rolled it out. The Chinhoyi University of Technology (CUT) in Zimbabwe has expressed interest in rolling out a similar model to upgrade its fisheries and aquaculture curricula. WorldFish, CUT, and others collaborated to develop a proposal that has been submitted in response to a call for funding. The second institution to adopt the project innovations is a private commercial fish farm –Lake Harvest of Zimbabwe. Blue Planet is also scaling the online training platform to Skretting –a feed supplier in Zambia, Uganda, Kenya, Rwanda, Ivory Coast, and Tanzania (through Food Tech Africa). Mulungushi University in Zambia also expressed interest in developing an aquaculture curriculum. An MOU has been signed between WorldFish and Mulungushi University to mobilise resources to develop the curriculum. The project also developed a short-courses curriculum with NRDC that has since been finalised. NRDC implemented a beginners course for those interested in aquaculture towards the end of 2021..

Regarding the project's second component, the project was able to bring three large private sector companies on board. These companies include Aller Aqua Zambia Limited, Novatek Animal Feed Limited and Zhongkhai International. The first two are feed millers, and the third is an ethanol plant involved in experiments on feeding fish with by-products from cassava processing. In addition to the large private sector companies, the project managed to recruit an additional six SMEs to invest in the sector. The project has reached close to 1700 farmers in Northern and Luapula provinces with training and extension services. The midterm evaluation findings revealed that smallholder farm profit margins increased by 32.6% from ZMW1,263 in 2018 to ZMW1,675 in 2020 per growing cycle. Smallholder farmers are increasingly adopting Better Management Practices (BMPs) for Aquaculture. The end of the project's independent evaluation shows that an average of 80% of trained farmers adopted components of BMPs for aquaculture that they have been introduced. The project is therefore confident that fish farmers' productivity will increase. The current minister of Fisheries and Livestock, Honourable Makozo Chikote and other government dignitaries toured the project implementation sites in Northern and Luapula provinces in 2022 and were impressed by the progress the farmers have made.

Sustainability: The project has built-in elements to promote the sustainability of project impacts. NRDC developed a sustainability plan for the Aquaculture Skills Training Center (ASTC). The plan outlines how the training center will contribute to

achieving the goals and objectives of the fisheries department while also running a business unit to fund and sustain itself beyond the project. According to the NRDC's principal Dr Alice Tembo, their parent ministry (the Ministry of Agriculture) is also committed to supporting the ASTC to ensure its sustainability. NRDC and KFTI lecturers were involved in developing the upgraded curriculum to ensure ownership of the project interventions around TEVET training. These lectures were also trained on curriculum upgrading and module development to ensure they have the skills for future use at their institutions. Under component 2, the project relies on building profitable business linkages between private sector players and smallholder farmers. The project has created a symbiotic relationship between smallholders (depending on private sector extension services, input and output markets) and the private sector, depending on a well-performing smallholder sector to sell inputs and be a fish supplier for the market. As part of their business strategy, actors, including SMEs will continue to offer aquaculture extension services in remote areas that the government may not reach. Because of this interdependence, it is expected that the project outcomes and impacts will be sustainable after the project. The first feed shop to be set up by Aller Aqua in Kasama resulted from the project's efforts. Other feed companies such as Novatek have followed suit upon realising the immense business potential in the region. These developments give confidence that the project's gains are sustainable. The high adoption rate of BMPs by farmers is encouraging since farmers will continue to practice these even after the end of the project since they have been linked to markets for their end products. Some of the involved SMEs collaborated to submit a competitive proposal to the Accelerating Impacts of CGIAR Climate Change Research for Africa (AICCRA). They won a grant of 50,000USD for two years, which they are now using to continue offering extension services and training to farmers using some of the materials developed by the AQTEVET project.

Capacity building: NRDC lecturers were trained to develop a curriculum. To date, they have developed the curriculum for the regular courses, the curriculum for the short duration courses, and the modules to administer these courses. They also independently administer regular online courses, including enrolling students and administering examinations. The courses and curriculum were also developed in collaboration with the private sector, smallholder farmers and the department of fisheries. These actors attended several meetings to validate the courses, review and comment to ensure that the developed courses responded to industry's needs and built relevant capacity and skills for graduates. The project developed an internship program guide to be used by NRDC and the companies that would host student interns to ensure that the students benefited from internships and gained practical skills. Close to twenty-nine companies were willing to host students for internships. The AQTEVET project also engaged four student interns from NRDC. The interns were attached to Triple Blessings, Hopeways, Zhongkai and Kasakalabwe. These interns have also been trained in various aquaculture activities, including managing a catfish hatchery (for interns attached to Kasakalabwe). Staff at Kasakalabwe have been trained on running a catfish hatchery. Farmer's capacities for better management practices for aquaculture have been strengthened, as evidenced by the improvement in their aquaculture practices. Additionally, the project developed training materials in iciBemba (local language), used by the private sector companies during extension service delivery and distributed to farmers who want training materials in Bemba (in their local language). The materials are also available in English and thus accessible to a broader audience.

Lessons Learnt: Involving women in aquaculture needs to include other gender equality issues and norms, such as women's lack of access to land. Women's lack of access to and control over land hampered the project's ability to reach at least 40% women among smallholder fish farmers. The project increased the number of women by targeting cooperatives with many female members. In addition, some SMEs such as Hopeways and Triple Blessings actively engage with traditional authorities to provide land to women's cooperatives to promote women's access to land and foster change in attitudes and behaviour. Secondly, although the feed is now as close as it has ever been to farmers, distance and cost are still barriers for smallholder fish farmers to access the commercial feed. The need to invest in more last-mile distributors can hardly be overemphasized. The provision of motorbikes by the project has helped increase SMEs' ability to reach farmers in remote places. Some hatchery operators have noted that pond water temperature in their area is slightly cooler at certain times of the year, reducing fingerlings' productivity during those times. The low productivity of fingerlings in winter prevents SMEs from satisfying the demand for fingerlings at the beginning of the fish farming season. Tilapia do not breed well in low temperatures—the project invested in greenhouses for two SMEs to boost future production of fingerlings.

Additional lessons learnt include the following:

- De-risking investments is necessary to stimulate private sector investment into smallholder aquaculture
- To promote the smallholder aquaculture sector, we need private sector financial investments
    - to finance technology adoption
- Small to Medium-scale Enterprises (SMEs) play a critical link between smallholders and the large private sector
- . Working with local SMEs who already have investments in the area is cost-effective.Working with SMEs was advantageous during COVID-19 since farmers continued to get the extension services and the technical support they needed.

1. INTRODUCTION AND BACKGROUND

The Aquaculture Technical, Vocational, and Entrepreneurship Training for Improved Private Sector and Smallholder Skills (AQ TEVET) project was a 3-years, 10-month project implemented in Zambia's Northern, Luapula and Lusaka provinces. It began in July 2018 and was expected to end in December 2021; however, in November 2021, the project was granted a four-month no-cost extension to finalize activities delayed due to the COVID-19 pandemic.

The project sought to:

1. Create opportunities for youth employment.
2. Ensure a fit between curricula of the technical education, vocational and entrepreneurship training (TEVET) system and skillset required by the private sector.
3. Strengthen links between smallholder farmers and the private sector to improve input supply, aggregation and sale of fish produced.
4. Increase the production and productivity of smallholder farmers.

The AQ TEVET project had a budget of NOK 20 million (USD 2.4 million) and was funded by the Norwegian Agency for Development Cooperation (Norad).

The goal of AQ TEVET was "to increase the number of human resources working for the private sector, and the number of smallholder commercial fish farmers with enhanced aquaculture knowledge and up-to-date practical skills to help sustainably grow the sector and make it more inclusive." The project's objective was to develop the aquaculture knowledge and practical skills of students and smallholder commercial fish farmers, especially women and female youths, participating in TEVET to find gainful employment in the private sector. The project was led by WorldFish and implemented in partnership with Musika, the BluePlanet Academy (BluePlanet) and the Natural Resources Development College (NRDC).

The project had two components:

Component 1: Upgrade the fisheries science curriculum (long- and short-term courses) and training tools at the NRDC, and develop an online training platform and internship program, but with links to other TEVET institutions to scale the upgraded training "package".

Component 2: Enhance the TEVET skills of rural women, men and youth smallholder commercial fish farmers and increase their links to input/output markets and entrepreneurship opportunities via private sector extension support and services delivery.

This report presents the key achievements and the lessons learned. See Annex 1 for the results framework

2. KEY ACHIEVEMENTS

Component 1: Upgrading the curriculum, developing training tools at the NRDC and developing an online platform and internship program

The key achievements under Component 1 are presented under each of the three key result areas.

Enhanced knowledge-base of students trained at the NRDC

The AQ TEVET project upgraded the curriculum for the NRDC's aquaculture diploma program in 2019, and implementation began in January 2020. The NRDC reviewed 16 courses and added five new ones to address the bias toward capture fisheries. The upgraded curriculum introduced the following five courses to respond to the identified human resource needs of private and public sector employers: (i) Introduction to Aquaculture and Fisheries in Zambia, (ii) Aquaculture Systems and Facilities, (iii) Fish Hatchery Management, (iv) Fish Production Management and (v) Fisheries and Aquaculture Statistics. The AQ TEVET project developed a learning toolkit for the long-term curriculum.

The project enhanced the knowledge-base of 169 students (44% female) against a target of 135 (50% female) using the upgraded curriculum and tools developed, the online training platform and internship program reflecting an achievement rate of 125% (see figure 1). Of 169 students, 41 (30% females) from the 2019 cohort completed the training using the new curriculum and graduated in January 2022. The other three cohorts (2020, 2021 and 2022) are still pursuing their diploma programme and will graduate at the end of 2022 and 2023, respectively.

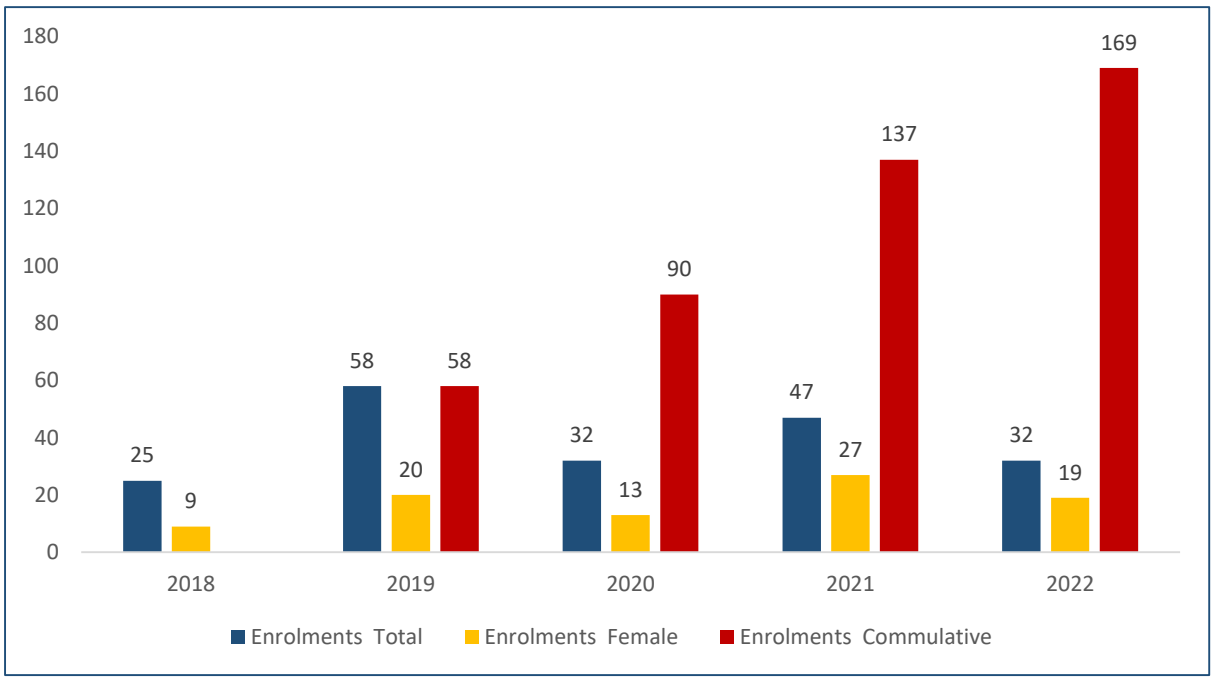

Figure 1: Fisheries science enrolment statistics from 2018 to 2022

The project established a fully equipped aquaculture skills training center at the

NRDC.

The training center has a four-roomed building, housing an indoor hatchery and separate rooms for feed formulation and storage, a small office, and ablution facilities. The indoor hatchery with an all-year-round water supply has a production capacity of 1,000,000 fingerlings per year. The center also has four broodstock ponds, six nursery ponds, four production ponds and a feed storage room. The training center provides facilities for hands-on experience and supports student research. The facility also provides an opportunity for students to practice what they have learned, and for prospective aquaculture farmers and business people participating in short courses in aquaculture to practice what they learn. The center is used by students and those doing short courses for practicals as illustrated below:

Figure 2: Hatchery at the Aquaculture and Fisheries Training Center (AFTC) (Photo credit: Tabitha Mulilo

Figure 3: Students at NRDC learning about hatchery management at the ASTC

The center is now generating some revenue from the short courses as well as the fingerlings and table-size fish grown in the production ponds (see report from NRDC ANNEX 2 Progress report of the ASTC). With support from the project, the NRDC finalized and validated the short-term curriculum in 2020. The first short-term training course, "Introduction to Fish Farming," was hosted in October 2021 with 19 participants, eight of whom were female (see figures 4,5 and 6).

Figure 4: Participants in the first short-term course learning about pond siting at the ASTC

Figure 5: Participants at the short term course learning about how to peg a pond at the ASTC

Figure 6: Participants of the short term course on their graduation day at the ASTC

Online platform

In collaboration with WorldFish and NRDC, BluePlanet developed a digital knowledge platform for aquaculture. The platform complements the main aquaculture courses of the fisheries and aquaculture science diploma at the NRDC. It allows students to gain extra knowledge through short videos, followed by assignments. An estimated 100 videos have been developed and are available in the video library. Students access the platform using a computer laboratory set up by WorldFish at the NRDC equipped with 18 desktop computers (See figure 7 of some students using the ASTC). Because these computers are not enough, some students use their smartphones to access the platform.

Figure 7: NRDC students accessing the online training platform

During project evaluation, almost all the students (93%) said that they were happy with the e-learning platform. They particularly liked the videos, making it easier to understand what was taught in class. The students stressed that the e-learning platform came at a right time when the COVID 19 pandemic was hitting the country as it enabled them to continue learning from the comfort of their homes. NRDC has further scaled up access to the online training platform to students in seven of the nine programmes currently offered at the college by introducing, for example, an introductory aquaculture course for all students and making it compulsory. All the students who take this course from other study programmes are given access to the online training platform. This upscaling has contributed to the project's goal of enhancing aquaculture knowledge. It also shows that the college is using the training lab to its fullest capacity, which can attract proper attention in maintaining its functionality.

Business and entrepreneurship training

The project offered entrepreneurship training to Thirteen participants (six female) (See Annex 3 training workshop report). The training workshop aimed to:

1. Inculcate an entrepreneurial spirit in the students, so they are ready for the market.
2. Learn business management skills and the skills needed to pitch a business idea to potential funders.
3. Train students on how to develop a business plan and help them use it for a business idea they have.

The training, which comprised online workshops, face-to-face workshops and field visits, also included motivational talks from young entrepreneurs, coaching and mentorship from private business and finance institutions (see figures 8, 9 and 10 for some of the activities related to the training). The AQ TEVET project established links to financial institutions such as Agora Microfinance Zambia, National Savings and Credit Bank (NATSAVE) and others who talked to trainees about fundable

businesses and financial issues to consider when setting up a business and insurance options. Agbit trained students on how to pitch business ideas successfully.

Figure 8: Entrepreneurship training participants at Agbit where they were trained to pitch their business ideas to potential funders

Figure 9: Entrepreneurship training participants meeting with private sector players engaged in cage fish farming to learn more about business management

Figure 10: A trainee discussing her business plan with her mentor and coach

Impact of the curriculum upgrading on the NRDC's fisheries science faculty

At the end-of-project workshop, NRDC in Kasama NRDC's representative, Mr Masauso Sakala, credited the program with strengthening the college's fisheries training and making the faculty of fisheries and aquaculture more attractive to students.

> "*The fisheries program was almost collapsing due to insufficient student enrolment numbers. The faculty of fisheries was far less attractive to potential students compared to other faculties at the college. But with the review of the curriculum and construction of an aquaculture skills training centre, we have seen enrollment figures increase by 100%. With this and other facilities like the e-learning platform introduced by the project, honorable minister we have been able to make NRDC a center of excellence for fisheries and aquaculture training*".

The number of students asking to change their course to other faculties per year has reduced from 8 students per cohort of first-years to 1 student.

Enhanced practical skills of students gained from student attachments/internships

The activity was designed to prepare students with sufficient practical skills for potential employment in the private sector. The project developed an internship program outlining the guidelines such as when the internship is undertaken, where, preparation before placement, what happens during placement, student conduct, and assessment tools.

Twenty-eight companies (12 fish producers, eight companies working in capture fisheries and five feed companies) expressed interest in hosting students on industrial internships/attachments to help students strengthen their practical skills in aquaculture. The companies were willing to provide accommodation for students on attachment. Previously, students were required to make their accommodation arrangements. However, this excluded those who could not afford housing from internships and made it hard for female students if they could not find suitable accommodation because of the area's remoteness and other factors.

Before the AQ TEVET project, students went on internship only once at the end of year 2. The project developed an internship guide rationalizing the frequency of attachments, improving the mode of assessments and varying activities carried out each time to enhance learning. Initial discussions anticipated having five industrial attachment sessions (one at the end of every semester). However, the industrial attachment/internship guide promotes two eight-week attachment sessions (at the end of Years 1 and 2) and an optional internship session in Year 3. The final decision on the number of internships resulted from input from parents, students, and industry hosts who mentioned that more attachments would take a heavy toll on them. A total of 137 students have undertaken internships under the improved internship programme introduced by the project, representing a 101% achievement against the number of students (135) targeted.

The project established links between the entrepreneurship skills trainees and finance institutions, such as NATSAVE, for possible access to business start-up finance if their proposed idea was good. Students gained practical skills at the aquaculture skills training center by using the facility to apply the theoretical knowledge they had learned (see figures, 11, 12 and 13).

Figure 11: Students engaged in a practical lesson at the Aquaculture Skills Training Center and NRDC

Figure 12: Students learning about pond stocking at the NRDC's Aquaculture Skills Training Center

Figure 13: Students learning more about fish biology at the Aquaculture Skills Training Center

The Accelerating Impacts of CGIAR Climate Change Research in Africa project (AICCRA), funded by the WorldBank and implemented in Zambia, is building upon the internship program started by the WorldFish and NRDC to expand it and provide more internship opportunities for students beyond the aquaculture and fisheries department.

Activity 3- Students from the NRDC find gainful employment with companies operating in the aquaculture value chain or set up their aquaculture-related businesses, and and prospective students are encouraged to apply to the fisheries science department at the NRDC

This activity aimed to increase opportunities for students, especially women and female youths, to find gainful employment in the aquaculture sector and equip students with entrepreneurial skills to set up aquaculture-related businesses. This activity's results have not been fully assessed because only one cohort (2019) of students introduced to the new curriculum have completed their diploma programme as of December 2021 and graduated in 2022. Thus the timing for expecting results from this activity is too short or has not yet matured for the project to see the effects on the number of students who have been able to find gainful employment or set up their businesses. However, the project has addressed most of the human resource deficiencies that hindered graduates' employment in the private sector in addition to the results presented in the previous discussions. For example, the gender and youth responsive marketing strategy was finalized and approved by NRDC's top management and implemented to encourage more female students to join the faculty.

Other activities have been implemented to market NRDC graduates to potential employers:

1. Social media posts on Twitter and Facebook highlight the updated curriculum at NRDC and updates on progress. We also published a blog highlighting the online learning at NRDC titled 'A Tilapia-based E-learning platform created to improve aquaculture TEVET training in Zambia' (http://blog.worldfishcenter.org/2020/06/a-tilapia-based-e-learning-platform-created-to-improve-aquaculture-tevet-trainings-in-zambia/
2. Billboards advertising the fisheries and aquaculture course included female students in the pictures to encourage women to apply.
3. Radio advertisements: The program ran radio advertisements in December 2020 advertising the course and encouraging women to apply
4. The project managers invited national television and media houses to the ASTC centre's launch, highlighting other project achievements. The launch was featured on local news on radio and television. Representatives of the private sector were also invited and attended the launch.

The then Minister of Fisheries and Livestock, Hon. Prof. Nkandu Luo (MP), launched the center in a high-level media event attended by several media houses and broadcast on national television.

Figure 14: Prof Nkandu Luo, the Minister of Fisheries and Livestock, cutting the ribbon, Dr Alice Tembo the principal of NRDC (in yellow) and other delegates looking on at the official launch of the ASTC (Photo credit: Netsayi N Mudege)

Activity 4- TEVET institutes in Zambia adopt/modify the curriculum, training tools, online training platform and internship program

This activity aimed to scale the innovative curriculum package to two other TEVET institutions offering Zambia fisheries and aquaculture training. There were delays with the service provider contracted to upgrade the curriculum, so the project engaged the University of Zambia, the NRDC and the Curriculum Development Centre in Zambia to do the upgrade. The excellent partnership between WorldFish and the NRDC helped fast-track the steps that the design team had overlooked, such as the duration of curriculum updating, approvals and validation by the various committees and certifications. The NRDC has modified and implemented the upgraded curriculum, training tools, online training platform, industrial attachment, and internship program. Scaling up the innovative curriculum package has fully been completed and delivered exciting, innovative results that have attracted higher-level institutions of learning, particularly national universities in Zambia and other southern African Countries such as Malawi and Zimbabwe.

In Zambia, the new curriculum review was scaled to Kasaka Fisheries Training Institution (KFTI). KFTI offers a fisheries and aquaculture certificate programme. After collaboration with the KFTI, KFTI also upgraded its curriculum. Partly due to encouragement from the AQ TEVET project, KFTI is now using its upgraded curriculum to seek accreditation from TEVETA.

Mulungushi University expressed interest in adopting and modifying the upgraded package for short courses and collaborating with the NRDC to run the courses and scale them out. Additionally, an MOU has been signed between WorldFish and Mulungushi University to mobilize resources for carrying out the curriculum upgrading exercise, including online courses. Mulungushi University is also raising resources to set up an aquaculture and fisheries center of excellence.

The project also hosted a project dissemination meeting with partners and stakeholders from Zambia and the southern African region (see Annex 4, Annual meeting report). As a result of that meeting, several universities expressed interest in adopting the NRDC model of upgrading their fisheries science training to respond to the current needs of the aquaculture industry. The Chinhoyi University of Technology

(CUT) in Zimbabwe has expressed interest in upgrading its fisheries and aquaculture curriculum. In collaboration with CUT, NRDC and Blue Planet, WorldFish led the development of a scaling-up proposal. Unfortunately, although the proposal was selected among those considered in the final stage by the donor funding selection committee, the committee did not choose it for funding.

The AQ TEVET also developed a scaling strategy for the upgraded fisheries science curriculum, training tools, online training platform and internship program for Zambia and the larger Southern Africa Development Community region.The online training platform developed by BluePlanet has more than 100 videos uploaded. The first institution to adopt the online learning platform is a private commercial fish farm –Lake Harvest of Zimbabwe. This enterprise specializes in tilapia fish production and has funded the development of other movies. One hundred and forty-four staff from Lake Harvest are enrolled on the platform. BluePlanet also scaled the platform to Skretting and FoodTech in Uganda, Rwanda, Tanzania, Kenya and FoodTech in Tanzania and Côte d'Ivoire. The platform is also used in Egypt, Morocco, Algeria, Libya, Ethiopia, the Democratic Republic of Congo, Namibia, South Africa, Cameroun, Nigeria and Ghana.

Component 2: Enhancing the TEVET skills of rural women, men and youth smallholder commercial fish farmers and increasing their links to input/output markets and entrepreneurship opportunities via private sector extension support and services delivery

The key achievements under Component 2 are presented under indicators on result area 5.

Activity 5: Private sector Linkages and TEVET Provided to Smallholder Commercial Fish Farmers.

The objective of this project activity was to develop the capacity of 10 commercial private sector companies operating along the aquaculture value chain to deliver sustainable and profitable inputs and outputs services, including training and technology transfer to 1,000 smallholder farmers. The project managed to recruit six companies that invested in the smallholder aquaculture value chain in the northern region of Zambia. Partnering with 6 out of the targeted 10 companies reflects 60% achievement (see figure 15). The six private sector companies that were reached include Novatek Animal Feed Limited, Aller Aqua Zambia Limited, Zhongkai-international Zambia Limited, Hopeways Enterprise Limited, Kasakalabwe Multipurpose Cooperative and Triple Blessings.

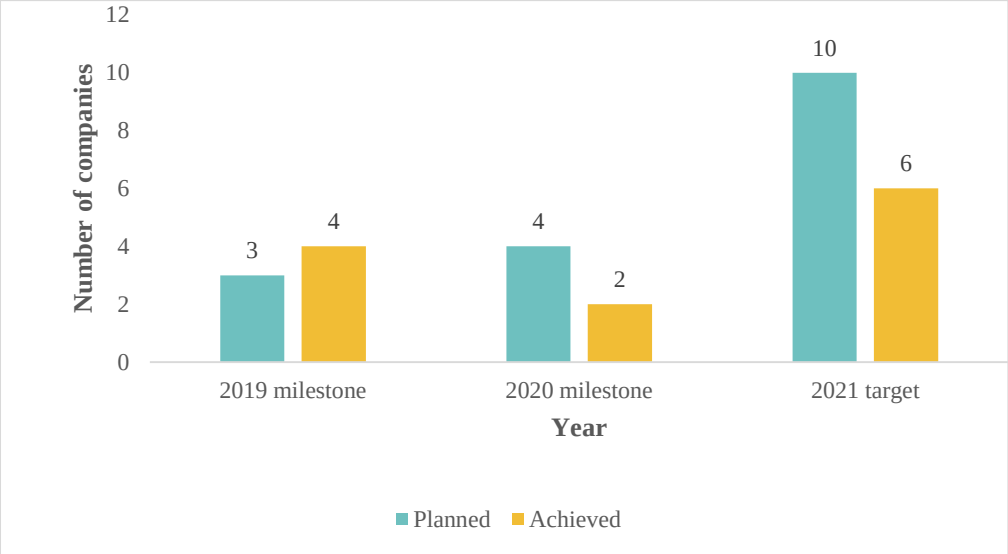

Figure 15: Number of private sector companies that have invested in smallholder aquaculuture in northern Zambia

At the end of 2020, the project decided not to pursue the remaining four private sectors. It takes a long time to build the smallholder-private-sector relationship; hence signing new agreements would not have yielded fruitful results considering that the project was expected to end in December 2021. Instead, the project team focused on strengthening the linkages between the six private sector companies and SMEs that are last-mile distributors. Last-mile distributors are critical because they bring inputs even closer to farmers, particularly in remote, hard-to-reach areas and help the project reach its intended target.

The project strengthened the capacity of the six private sector companies to provide support and extension services to smallholders. Two of these (Novatek Animal Feed Limited and Aller Aqua Zambia Limited) are big feed millers specialized in commercial fish feed production and distribution. The big feed millers received some interns from the project to help at their feed shops and provide information and

training to smallholder farmers purchasing feed. Two of the private sector companies, Hopeways Enterprise Limited and Kasakalabwe Multipurpose Cooperative, specialize in fingerlings production. The third private sector company Triple Blessings was an off-taker specialized in buying farmed fish. These three companies received support which included Training of Trainers, motorbikes to provide extension services. Kasakalabwe also benefited from the construction of a catfish hatchery and a greenhouse for fingerlings production. In addition, to the interns that all private sector players received from the project, Hopeways also benefited from a greenhouse that was installed towards the end of 2021. The 6th company is Zhongkai-international Zambia Limited. It invested in testing cassava by-products as an alternative source of fish feed. However, the experiment was unsuccessful, and the project cannot recommend using cassava by-products to feed fish.

In addition, these companies invested in training farmers who buy their products, mainly feed and fingerlings.

Figure 16: Drone photos of the Hopeways Fish farms which provides training to farmers and also produces fingerlings for sale Photo credit Dr Kwaku

The training offered by the private sector equipped smallholders with knowledge on better management practices for aquaculture, including using quality inputs such as fingerlings and feed purchased from private sector players. Over 2,300 farmers were

identified; of these, 1,717 (22% women) received various aquaculture training provided by private companies. Farmers reached are above the target of 1000 farmers trained by the end of the project (See figure 17).

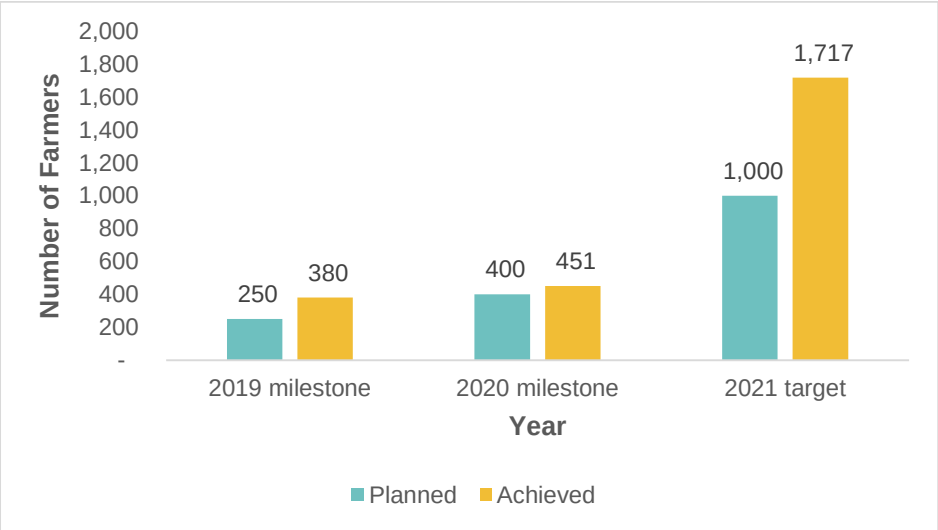

Figure 17: Number of farmers trained and linked to aquaculture markets

Out of trained farmers, 1,419 (83,7%) adopted better management practices such as improved construction and rehabilitation of ponds, feeding, and stocking single-sex fingerlings. Although women's adoption rate is not reported, WorldFish has been awarded a grant by the CGIAR Gender Platform to conduct a gendered impact assessment of the project. A key important thing about these results is that the private sector has established permanent structures and will continue providing training to farmers even after the project has closed. The private sector approach has effectively improved training and extension services to smallholder fish farmers.

The project specifically targeted women with training by working with cooperatives with a majority of members being women. See figure 18 showing women cooperatives members being trained:

Figure 18: Training through cooperatives to reach more women.

For example Kasakalabwe has reached and trained 12 cooperatives and offered extension services in order to reach more women.

Enhanced knowledge on aquaculture farming practices, access to input and output market among smallholder fish farmers

The private sector delivered extension services and provided access to inputs and outputs. The profit margins of smallholder fish farmers increased by 32.6%.
AQ TEVET also established 16 demonstration ponds for training smallholder fish farmers. Four field days were held in which 361 (30.2% female) participants attended to facilitate technology transfer.

The private sector companies availed quality seed to farmers. From there being no investments in quality seed by the end of February 2021, the two private sector companies produced a total of 1,005,944 fingerlings.

Table 1: Achievement interms of seed production

Private Actor	Period	Quantity produced	Species	Quantity sold	Remarks
Kasakalabwe	2021-2022	78,000	Catfish	12,000	62,000 in nursery tanks

Kasakalabwe	2020-2022	746, 064	Tilapia	736,094	9,970 stocked in own ponds
Hopeways	2021-2022	181,880	Tilapia	129,080	52,800 stocked in own ponds
Total		1,005,944		877, 174	

The fingerlings produced and sold are a big improvement considering that there were no sources of high-quality fingerlings in the region prior to project implementation. The seed companies were also taught how to develop and maintain their own broodstock to reduce reliance on wild stock, thus also stocked their own ponds to develop broodstock and also produce growout fish.

In 2020, one of the SMEs, the Kasakalabwe Multipurpose Cooperative, started breeding catfish, and by 2021 had produce a total of 78,000 catfish fingerlings and sold 16,000 catfish fingerlings to smallholder farmers. The work of Kasakalabwe introduced first-time farmers to catfish farming, providing farmers with a choice of either catfish or tilapia or both, aligning with available resources and climate variability. The demand for catfish fingerlings is very high. However, there was a challenge of getting mature male catfish to continue production since catfish farming is relatively new in Zambia, and parent stock was not readily available. However, Kasakalabwe is raising catfish parent stock from its first production.

Hopeways Enterprise Limited also produced and sold same-sex/ sex-reversed fingerlings to smallholders, provided extension services and offered training to smallholder fish farmers.

However fingerlings production has been plagued by low temperature during winter months. To mitigate against cold temperatures, AQ TEVET provided greenhouses (an innovation by the project team that was not in the project design) to Hopeways and Kasakalabwe to improve tilapia fingerlings production and meet the high demand for quality seed and the start of the fish farming season (See figure 19).

Figure 19: Greenhouse facility at Hopeways

One of the interns developed a hatchery for Kasakalabwe using local materials to boost Tilapia fingerlings production to meet demand (see figure 20):

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Figure 20: Francis Bwalya (intern) working in a hatchery, which he developed using primarily local materials to boost seed production at Kasakalabwe cooperative

Kasakalabwe Multipurpose Cooperative managed to meet seed standards and received the stadards certification from the Zambia's Burea of Standards (ZBS) (see figure 21). Hopeways Enterprise Limited recently initiated the certification process.

Figure 21: Francis explaining the fingerling production procedures whilst the Standards Officer from Zambia Burea of Standards listens.

Feed

The project had successfully brought on board feed milling companies Novatek Animal Feed Limited and Aller Aqua Zambia Limited to invest in smallholder aquaculture in northern Zambia. With this result, the project achieved its objective of getting private sector value chain actors to the two regions. The first feed shop to be set up by Aller Aqua in Kasama resulted from the project's efforts. Other feed companies such as Novatek have followed suit upon realizing the immense business potential in the region. These developments give confidence that the project's gains are sustainable.

Figure 22: Farmers loading their feed from Novatek retail shoponto bicycles for transportation in Kasama

While the Novatek and Aller Aqua established shops and branches in the two provinces, they also invested in training farmers who buy feed. These innovative linkages by the project are worth commending because is effectively improved extension services to smallholder fish farmers. Extension services in aquaculture remain very low, especially in the two-targeted regions. Hence, for the project to intervene in this aspect of the industry is a considerable achievement.

About 19 additional networks of SMEs have been brought on board by the two private companies and are delivering inputs and output services, including training of farmers(See Annex 5, Insights from the field). For example, in 2020, Novatek established partnerships with SMEs, including Kasama Food Basket, EvaMuta, Kasakalabwe, Adsek and Hopeways, as last-mile distributors of Novatek feeds in the two provinces. Such linkages enable farmers in remote parts of the provinces to access feed and be part of the aquaculture value chain.

However, the challenge is that despite acquiring the knowledge and having access to input, many farmers (72%) are yet to put the acquired knowledge into practice. Many farmers (predominantly female farmers) do not have access to financial inputs (loans) to buy feed and other inputs. The evaluation results indicated many farmers complained that commercial fish feed and pond construction are expensive. Without linkages to access finance, many farmers, although they have been undertaking aquaculture training, cannot put the training into practice. For example, many farmers mentioned going back to the traditional way of feeding fish because they could not afford commercial feeds.

The 2018/2019 drought in Zambia had several effects on the country, including inconsistencies in power supply – low power shedding. The drought affected feed producers because they rely on electricity for production. Maize production decreased across the country, affecting low feed production for private companies. The outbreak of the covid-19 pandemic delayed the project significantly. First, trade restrictions affected the aquaculture industry (feed production), making it difficult for the project to convince private actors to expand and invest in new provinces. The pandemic also restricted mobility, made monitoring visits challenging, and delayed project activities like farmer training. It took time and effort, and in the end, only two companies agreed to the project.

AQ TEVET piloted the integration of distillers' grain and cassava aggregation in the smallholder fish farming sector as an alternative fish feed with six farmers in the districts of Mbala, Mungwi and Kasama. Results showed poor growth of fish fed on the feed, so it was not recommended.

Output markets

Triple Blessings, an off-taker, bought fish from farmers at competitive prices. Tripple Blessings also provided training, commercial feeds and extension support to smallholder fish farmers.

Figure 23: Tripple Blessings purchasing fish from farmers after a complete harvest

The independent end of project evaluation found that Fifty-five (55) per cent of the farmers asserted having access to readily available markets for their harvests. Others (6%) also mentioned that the price of selling fish had improved. Smallholders also indicated that it was more profitable to sell fish to off-takers than to sell to individuals in the communities (See Annex 6, End of Project Evaluation report).

According to Tripple Blessing, the fish demand still outstrips the province's supply. There is still room to improve productivity to meet market demand.
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Enhanced knowledge and farming practices

Of the 1,717 smallholders trained, the project evaluation revealed that most of them have adopted aquaculture better management practices. For example,

- 83% said that they now know that pond size determines the number of fish to stock and harvest.
- 90% of the farmer respondents mentioned that they should not buy fingerlings from their fellow farmers;
- 96% were able to keep and track records of their businesses, including biosecurity, fish behaviour, feeding practices and many other better management practices.

The project developed a better management practices manual that private companies use when providing extension services to farmers. During project

evaluation, smallholder farmers testified that the private sector market linkages had improved their farming practices.

> *"We used to overstock our fishponds, but now we understand stocking density and its effects."* –the farmer explains some of the better management practices she had received.

> *"It's been five months since I stalked my last fish, and I must say I have not had even single mortality. I believe this is a result of my proper application of the knowledge I gained about fingerling management." (Farmers' survey respondent).*

These results of the project also excited the government of Zambia (Annex 7 end of project workshop report). At the end-of-project workshop, Mr Lewis Mwape, Deputy Permanent Secretary for Northern Province, mentioned that the AQTEVET project was well targeted as it addressed the high poverty levels prevalent in the two provinces using the available water resources. Mr Mwape observed that the implementation approach of linking smallholders to aquaculture markets such as seed, feed, and private sector-led extension services and off-takers was very sustainable.

> *"In terms of poverty profile of this country, we have western province at 82.1%, Luapula at 81.1% and Northern province at 79%. Honourable minister, if you look at the three provinces I have talked about, two of these provinces are part of this project. Our partners have focused on the resources available in the two provinces - water resources. Luapula province owns two-thirds of the water bodies in this country, which means that this is a well-targeted project. This project has changed the face of aquaculture, and we must make this [aquaculture] a heritage for the two provinces, in terms of empowering our people, honourable minister".* –Deputy permanent secretary, Northern Province, Mr Lewis Mwape, addressing the Hon. Minister of Fisheries and Livestock, Mr Makozo Chikote, MP.

Before July 2018, smallholder aquaculture farmers had little knowledge about farming practices to improve their yield. However, after WorldFish and partners implemented the AQ TEVET project, farmers adopted better management practices like improved pond construction and rehabilitation, buying and using same-sex fingerlings, and commercial fish feeds.

Figure 24: Below Mr George Mwila explaining to the Honourable Minister of Fisheries and Livestock Mr Makozo Chikote, MP about fish farming during a tour of his farm in Mbala during the end of project meeting.

3. LESSONS LEARNED AND BEST PRACTICES OF THE AQ TEVET PROJECT

Please see Annex 8 for details on lessons learnt

Component 1 was not able to measure the impact of the curriculum upgrading exercise because of the limited duration of project implementation. Where possible, project designs of curriculum upgrading and scaling should have a minimum of 5 years of implementation to allow for time to track results and ensure the project's goal and objectives are attained. Project implementation should begin after the curriculum is upgraded and validated. In addition, working with the right partners on the project helped generate the desired results. As a partner, the NRDC helped ease the process of getting government approval by providing a precise gap analysis for the fisheries and aquaculture science curriculum.

Involving women in aquaculture needs to include other gender equality issues and norms, such as women's lack of access to land. Women's lack of access to and control over land hampered the project's ability to reach at least 40% women among smallholder fish farmers. The project increased the number of women by targeting

cooperatives with many female members. In addition, some SMEs such as Hopeways and Triple Blessings actively engage with traditional authorities to provide land to women's cooperatives to promote women's access to land and foster change in attitudes and behaviour. A major lesson is that projects that seek to increase the participation of women and youths in activities along the aquaculture value chain, should challenge social and cultural norms that constrain women, bridge the gender gaps in investments and increase opportunities in marketing and processing.

Secondly, although the feed is now as close as it has ever been to farmers, distance and cost are still barriers for smallholder fish farmers to access the commercial feed. The need to invest in more last-mile distributors can hardly be overemphasized. The provision of motorbikes by the project has helped increase SMEs' ability to reach farmers in remote places. A lesson learnt is that when looking for aquaculture investors of inputs and markets in remote rural areas, it is effective to engage with SMEs already on the ground and understand the local situation. Local SMEs have good networks and knowledge of the region, which encouraged them to invest in fish farming in the northern region. Understanding the local context of local SMEs helps to appreciate the needs, challenges and opportunities for investment. Understanding the local context also helped defray the perceived risks large companies had of associating with smallholder fish farmers in a rural set-up, such as not being able to move large volumes of commercial fish feed because smallholder farmers do not have money. Also working with SMEs was advantageous during COVID-19 since farmers continued to get the extension services and the technical support they needed.

Producing several size packages of commercial fish feed based on the needs of smallholder fish farmers and their behaviour translates to more fish feed sales and promotes the use of quality fish feeds by smallholder farmers

De-risking investments is necessary to stimulate private sector investment into smallholder aquaculture. Furthermore, to promote the smallholder aquaculture sector, we need private sector financial investments to finance technology adoption. For instance, some hatchery operators have noted that pond water temperature in their area is slightly cooler at certain times of the year, reducing fingerlings' productivity during those times. The low productivity of fingerlings in winter prevents SMEs from satisfying the demand for fingerlings at the beginning of the fish farming season. Tilapia do not breed well in low temperatures. They need access to finance to invest in technologies such as greenhouses.

LIST OF ANNEXES

ANNEX 1 Results Framework

ANNEX 2 Progress report of the ASTC

ANNEX 3 Entrepreneurship training report

ANNEX 4 Annual project meeting report 2021

ANNEX 5 Insights from the field

ANNEX 6 End of Project Evaluation report

ANNEX 7 End of project workshop report

ANNEX 8 Lessons Learnt Document

ANNEX 9 List of Publications

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.

For more information, please visit www.worldfishcenter.org