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Toward more inclusive and sustainable development of Zambian aquaculture

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Purpose

This policy brief presents an overview of the aquaculture sector in Zambia. It describes opportunities and approaches for sustainable aquaculture development and exemplifies the importance of aquaculture in meeting development challenges, including the contribution to economic growth, alleviating poverty, and addressing food and nutrition security for improved public health outcomes.

Key messages

1. Improve financing mechanisms such as microfinance and loans in aquaculture.
2. Promote entrepreneurship and the development of small- and medium-sized enterprises (SMEs) through inclusive business models that strengthen vertical and horizontal relations between actors in the aquaculture value chain. For example, out-grower schemes and private-public partnerships can increase small- and medium-scale farmers' access to inputs, services, knowledge and markets in order to improve production and productivity while enabling large-scale producers to increase their market share.
3. Promote integrated aquaculture-agriculture approaches to increase the efficiency of on-farm resources utilization to better close existing nutrient-cycles.
4. Encourage private and government investments in seed production technologies for improving tilapia strains (*Oreochromis spp.*) and identifying nutritious and better-performing species in addition to tilapia.
5. Promote the use of alternative, environmentally sustainable aquaculture production technologies with indigenous fish species in pond polyculture or fingerponds in wetlands or seasonal floodplains to enhance the sustainable production of nutrient-rich fish species for household consumption and retail, and to diversify livelihoods and relieve pressure from capture fisheries.

Large-scale cage-culture, Yalelo, Lake Kariba, Siavonga.

Introduction

The aquaculture sector in Zambia has recently experienced significant growth. From 2004 to 2014, aquaculture production in the country nearly quadrupled from 5125 t to 19,281 (DoF 2015) and now contributes approximately 20% of the total fish production (100,107 t) and 12% of the total fish supply in Zambia (155,155 t) (DoF 2015). The main fish supply source is still the fisheries sector (80,826 t in 2014), followed by fish imports (55,048 t in 2014). However, supplies from fisheries have become relatively stagnant. Between 2004 and 2007, outputs marginally increased from 67,724 t to 73,543 t. They have since fluctuated around 80,000 t and are likely to decrease in the near future because of overexploitation (DoF 2015; Tweddle et al. 2015; Kolding and van Zwieten 2014). Zambia currently imports over 55,000 t of fish and the importation of fish increased 14-fold between the years 2004 and 2014 (Kaminski et al. under review). Due to changes in the overall growth in fish supply, the per capita fish supply steadily grew from 6.8 kg per person per year in 2011 to 11 kg per person per year in 2014. Results from the supply-demand modeling[1] of the Zambian fish sector conducted by WorldFish and partners showed that fish demand would continue growing to 2030. This expected progression in demand is mainly ascribed to ongoing population and income growth, with the latter expected to accompany changing diets toward higher intakes of animal source foods.

Along with the increase in demand for fish, there is growing recognition of its dietary benefits for the Zambian population. Fish is important for food and nutrition security as well as for addressing hidden hunger[2] and providing essential nutrients for pregnant and lactating women and children during the critical first 1000 days of life (Longley et al. 2014). Together, these two factors represent significant opportunities to further develop and invest in aquaculture. An enabling environment is emerging to support the development of the sector, exemplified by the recent growth in commercial aquaculture, a solid base of established small-scale farms, new government policies, investment interest by international donors and development banks[3], and the growing number of aquaculture research and development projects implemented around the country.[4]

Developing the sector holds additional potential to reduce poverty in Zambia. Over 60% of the population is living below the national poverty line, and more than 50% of the population is younger than 15 years of age (CSO 2014). Recently, very little growth by small-scale, rural-based farms was achieved due to a number of interrelated factors, including poor infrastructure, little to no availability of and accessibility to microfinance, and limited access to seed and commercial feeds as well as extension services to develop best management practices. Overcoming such shortages is expected to have a positive effect on productivity and income generation for existing small-scale farmers and is likely to encourage other households, as well as women and youth, to venture into aquaculture production or employment. Much of the growth in aquaculture production in recent years has been due to large-scale farms operating on Lake Kariba and in or around Southern Province and Lusaka Province. Improving linkages between small- and large-scale sectors could improve learning, technology dissemination and the establishment of business relationships. Better merging of these separated value chain nodes could improve aquaculture production and increase profitability in both small- and large-scale farming. This would ultimately increase fish availability to tackle malnutrition through increased consumption of fish, particularly by women and children.

To date, thousands of children and women suffer from one or more forms of malnutrition, including low birth weight, wasting, stunting, being underweight and multiple deficiencies in micronutrients such as vitamin A, iron, zinc and iodine (CSO 2014). Hence, development efforts in aquaculture should explicitly address food and nutrition security for improved health and poverty reduction, such as through the promotion of inclusive growth models to improve the capacity of women and youth. Based on findings from WorldFish-led and/or -supported research projects, this policy brief highlights approaches and makes recommendations to seize opportunities that could help ensure that growth in the aquaculture sector is more socially and economically inclusive and environmentally sustainable.

Emphasize inclusive growth in aquaculture through private and public partnerships

Research findings from an assessment of the Zambian aquaculture value chain, conducted by WorldFish and partners and funded by the German Cooperation for International Collaboration (GIZ), showed that recent growth in the country's aquaculture sector was largely triggered through private sector investments and upgrades in the commercial value chain (Kaminski et al. under review). These upgrades have, for example, led to the increased supply of higher quality seed and feed and the development of retail infrastructure and logistics (including cold chains and depots). Further findings suggest that the small-scale aquaculture sector, characterized by rural homestead production with low productivity and limited access to input and output markets, is not yet benefiting from recent developments in larger-scale, commercial aquaculture and has been mostly subsidized and perpetuated over the years by interventions from development organizations and the government.

Enabling small-scale farmers to access improved inputs from upgrades in commercial aquaculture represents a significant opportunity to intensify their production systems and thus increase their productivity, income from fish sales and/or household fish consumption. To take advantage of these opportunities, three innovative approaches of policy relevance can be considered "good practice" to achieve impact at scale.

Pro-poor microfinance mechanisms (with a specific focus on youth and women)

Although quality inputs and new production technologies in aquaculture are becoming increasingly available, they are mainly utilized by large-scale farms with the financial capacity to benefit from these innovations. Hence, adoption rates of new technologies are low in small-scale

Photo credit: Alexander Kaminski/WorldFish

Two women farmers participate in feed trials conducted by WorldFish and partners, Nsombo, Luwingu District.

aquaculture, and this exclusion is mainly due to the high costs of inputs. Increasing the access of small-scale farmers to microfinance is considered critical to help them invest in technologies, which is likely to help increase their productivity and profitability in aquaculture. To date, microfinance options are largely unavailable and not specifically designed for poorer small-scale fish farmers. Developing microfinance models for small-scale farmers in aquaculture hence would represent an innovation in itself and should apprehend circumstances such as long production cycles in aquaculture and low financial collateral of small-scale farmers. Some exceptions are the government-supported Citizens Economic Empowerment Commission (CEEC) loans and a youth-focused aquaculture project funded by the Swedish International Development Cooperation Agency (SIDA) called "Yapasa" (which means *"the plan worked out"*), whereby farmers access finance to purchase high-quality seed and commercial feed and receive regular training and extension support through a private aquaculture service provider. Youth fish farmers gain sufficient capacities and generate enough savings to continue aquaculture on their own, and loans get "recycled" by new borrowers entering the credit scheme. This model represents a win-win situation for youth (including female farmers), who gain both management and business skills, and for the private sector, which creates demand for their products and services and increases their market-share.

Decentralized seed distribution model

Access to quality inputs in small-scale aquaculture is often constrained by the distance to suppliers, a lack of infrastructure or by the cost of inputs. Research conducted by WorldFIsh and partners in Northern Province has found that the farmer-to-farm supply of fingerlings represents the most common form of seed distribution in small-scale aquaculture (Nsonga and Simbotwe 2014: Kaminski et al. under review). To maintain or even grow small-scale aquaculture, access to high-quality broodstock and seed are of significant importance. Under the Irish Aid-funded Local Development Programme, WorldFish and partners have undertaken research to develop and test a decentralized seed distribution model (Figure 1).

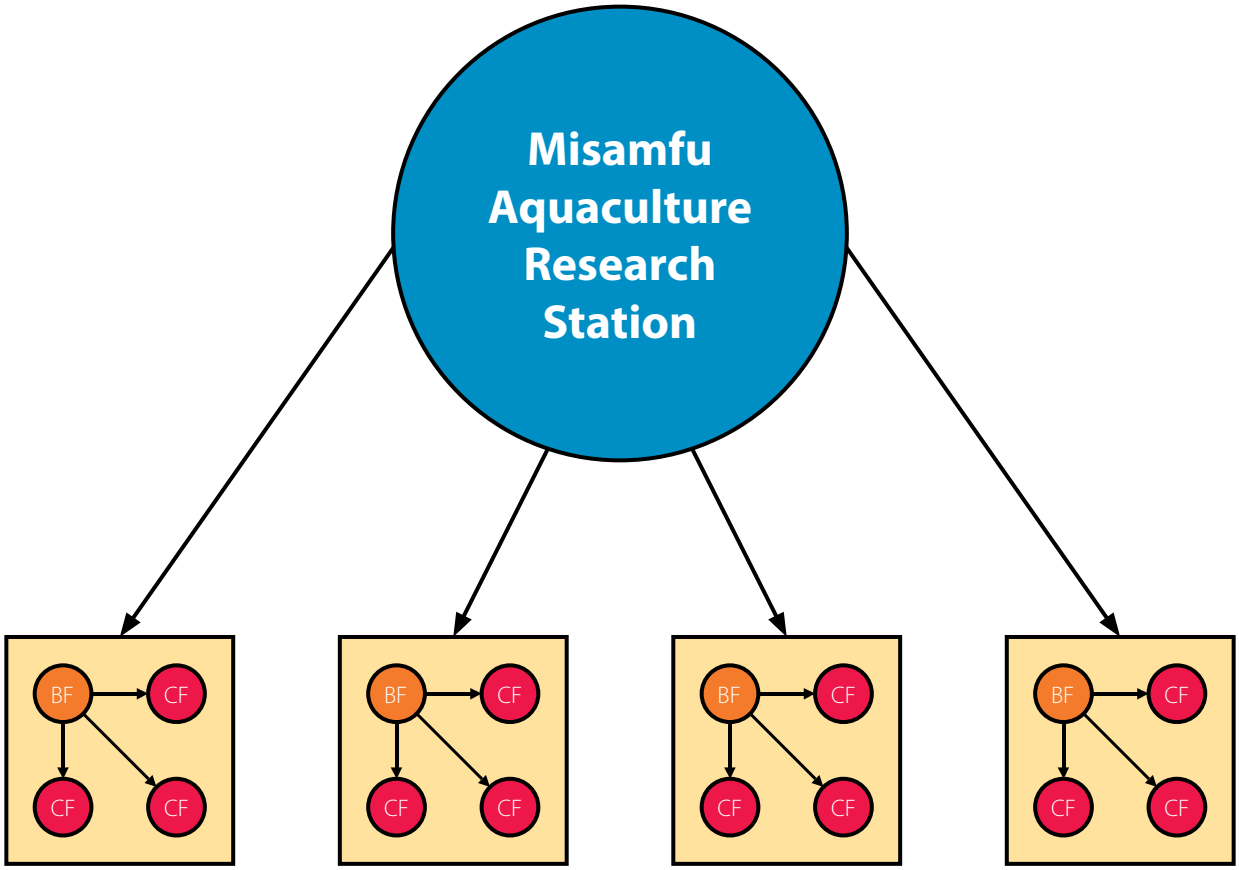

Figure 1. Schematic illustration of the decentralized distribution of seed from a National Aquaculture Research Station (NARS) to small-scale "cluster farmers" (CF) via "breeder farmers" (BF).

In this model, hatchery facilities at a government research station have been upgraded to create the best possible environment for broodstock management. The broodstock is then sold to selected, trained small-scale breeder farmers, who keep broodstock for local fingerling production. Fingerlings produced by "breeder farmers" are then distributed to so-called "cluster farmers" for grow-out. In regular intervals, the broodstock of breeder farmers will be renewed to maintain the production of good quality seed. The improved availability of locally produced, good quality fingerlings is expected to trigger a more consistent demand and supply of fingerlings as well as to improve productivity in small-scale aquaculture. If microfinance is accessed by these small-scale cluster farmers, consistent and increased supply of better quality fingerlings would stimulate demand in other products such as commercial feed.

Inclusive business models (contract farming) and out-grower schemes

WorldFish and partners are currently testing inclusive business models involving small-scale fish farmers and the private sector. In the decentralized seed distribution model described above, breeder farmers produce and supply fingerlings to cluster farmers for grow-out, which enables better coordination and cooperation between farmers and creates local "production zones" that attract both input and output markets. Another potential model is testing the feasibility of a private sector fish farm and hatchery to contract small-scale fish farmers to help them increase production through the provisioning of seed and feed on a loan basis, which can be recovered when the private sector company purchases fish after harvesting (Figure 2).

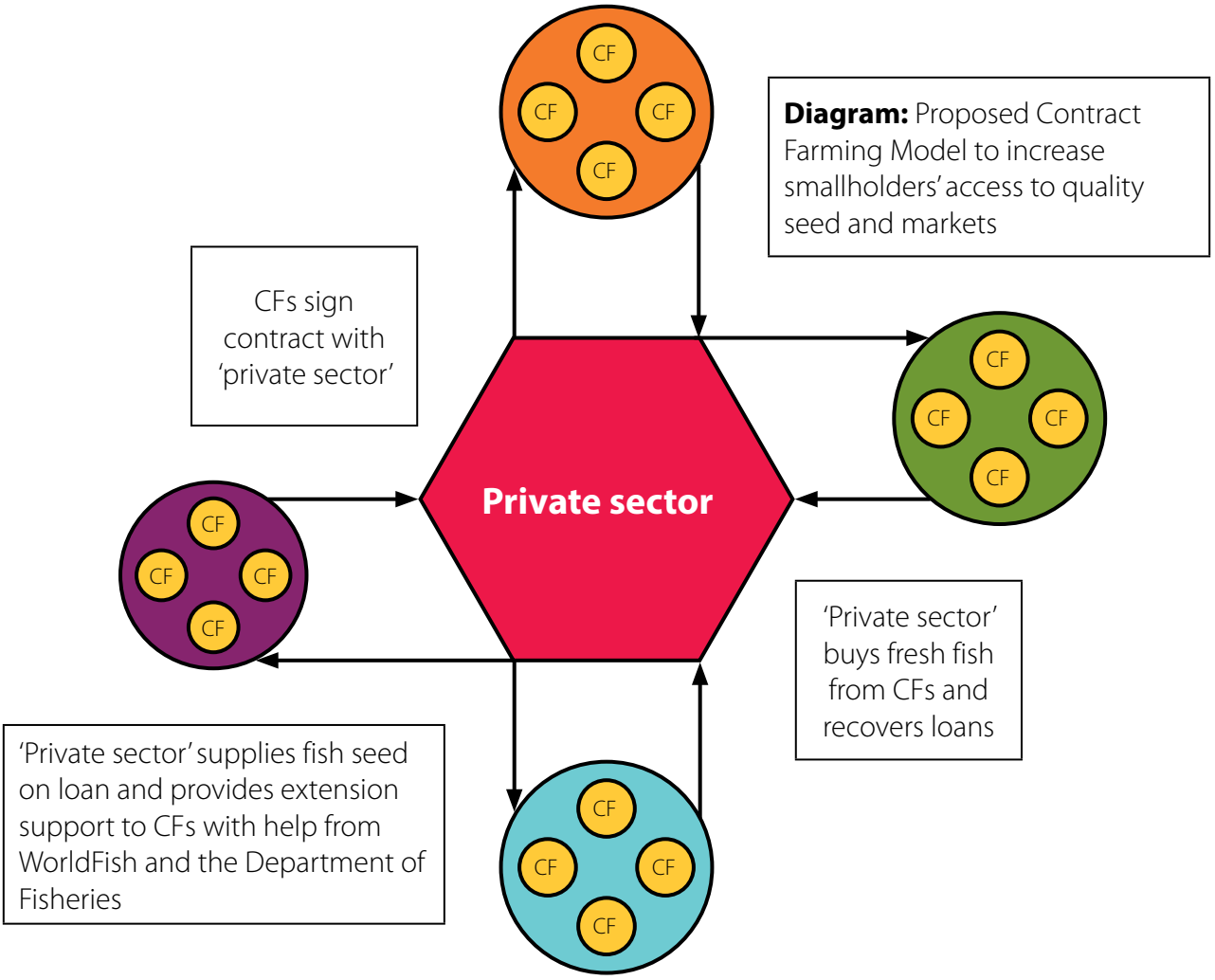

Figure 2. Schematic illustration of an out-grower scheme with binding arrangements regarding the supply of inputs and purchasing of outputs.

Promote integrated approaches in aquaculture

Limited access of small-scale farmers to quality inputs as well as to extension services, and the fact that their livelihoods depend on crop rather than fish farming, often results in farmers abandoning aquaculture when their efforts result in poor economic returns. Approaches are needed to ease success in aquaculture and allow farmers to sustain or increase productivity in aquaculture at the lowest possible costs. Aquaculture production costs can be minimized when resources are used that are easily available and accessible at the household, farm or community level. The integration of aquaculture activities with other livelihood activities represents a proven approach (Brummett and Noble 2005; Pant et al. 2005) and has been tested by WorldFish and partners in Zambia through the local homestead production of feeds and fertilization. In this approach, small-scale aquaculture farmers were trained and their capacities strengthened to recognize the potential of available on-farm products for integration with pond aquaculture. Local feed production and fertilization are only two examples of realizing and utilizing the potential on-farm synergy effects of integrated crop and fish production by closing existing nutrient cycles for improving productivity and profitability. Capacity building in small-scale aquaculture is expected to allow farmers to realize the benefits of integrated approaches (Nsonga and Imelda 2016).

Women farmers participate in netting and weighing of fish from experimental ponds testing feeds and fertilisation, Kawala, Mbala District.

Better address poor consumer needs through species and product selection in aquaculture

A cross-sectional study on fish consumption in urban Lusaka conducted by WorldFish and partners has shown that the consumption of fish per se is not dependent on wealth, but rather the selection of fish species and products. While relatively poorer households largely rely on inexpensive fish or fish products, such as smaller-sized and often dried fish from capture fisheries, wealthier households tend to diversify their diets with fish products such as larger-sized and fresh tilapia from aquaculture (Genschick et al. under review). The latter are either imported or produced and retailed in urban areas by the large-scale commercial sector in Zambia. As farmed tilapia is often out of reach for the poorest households, fish from capture fisheries remains the single and most important supply source of fish for this population group. Future population growth will result in a decline in per capita fish supply from capture fisheries. As poor households lack alternative means to maintain or even increase consumption of larger farmed fish, further declines in capture fisheries are expected to cause negative consequences on food and nutrition security among the poor.

To avoid this scenario, aquaculture development should be strengthened so that farmed fish becomes more affordable and better targets the needs of poor urban and also rural consumers. Price competive fish imports are likely to reach relatively poor households, but aquaculture development policies need to foster a sustainable expansion of the domestic sector and dissemination of improved technologies among small- and large-scale farmers for increasing production, lowering fish prices and improving the accessibility of fish for poor households while supporting small-scale producers to engage in the fish farming business. Although the aquaculture sector is growing, new production niches, such as the breeding and subsequent cultivation of small fish, which are currently sourced from captured fisheries only, should be explored to better address the dietary needs and preferences of poor and other consumers. The production of such species could be reinforced through alternative production technologies, including polyculture with small indigenous species. Fingerponds, whereby a high diversity of fish species are seasonally trapped in floodplains or wetland ponds, is a promising technology to achieve such production. They can be incorproated into broader fisheries co-management plans to reduce pressure on fisheries by providing alternative sources for fish (for instance during the period of the annual fishing ban in capture fisheries) in order to improve food, nutrition and economic security.

Photo credit: Alexander Kaminski/WorldFish

Children investigate a small pond in a *dambo* (wetland), Chungu, Luwingu District.

Ease and promote the intake of fish during the first 1000 days of life

Further findings of the cross-sectional study on fish consumption among poor households in urban Lusaka and results from a case-study on fish consumption in Northern Province have shown that age is a critical factor for the consumption of fish. In rural as well as urban areas, infants (6–23 months of age) as well as young children (24–59 months of age) often do not consume fish even though fish is prepared within the households and consumed by other household members. Under IFAD- and Irish-Aid funded projects, WorldFish and research partners are developing and promoting innovative technologies to produce fish-based powders and fish-based recipes. Both approaches aim to overcome barriers regarding an early intake or the feeding of fish to infants and young children. Impediments are commonly due to health concerns (e.g. the swallowing of bones) or a dislike of fish scent and taste. Incorporating fish powders in existing or newly developed dishes covers the distinct scent and taste of fish and ensures that bony parts are grinded up and incorporated in the powder. The results of sensory and acceptability evaluations for fish-based powders and recipes indicate a high acceptance among women, children and infants.

Strengthen fish breeding capacities

While upgrades in commercial value chains, such as vertically integrating hatcheries and importing improved, non-native *O.niloticus* broodstock, have triggered an increase in productivity, many small-scale farmers have no access to advanced and improved technologies. Country wide dissemination of improved breeds is limited due to the location and concentration of private hatcheries with improved breeds to few sites only, and it is banned from production (by government decree) outside areas where it has been introduced prior to the government decree.

Investments in private and governmental seed production technologies for promising species, in addition to tilapia (*Oreochromis spp.*), are expected to increase availability and country wide access to well-performing breeds in aquaculture and hence to improve species diversity and productivity in aquaculture.

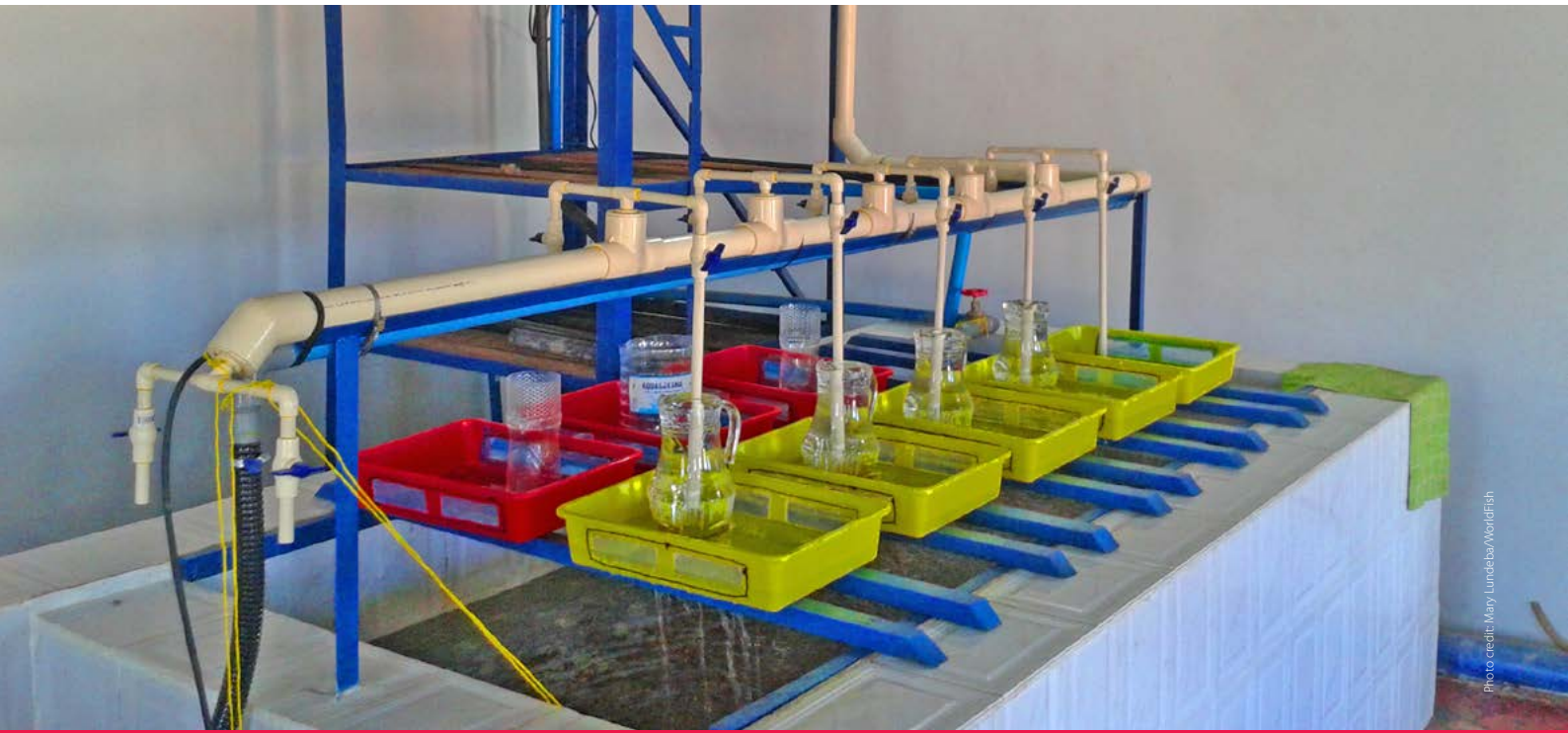

Photo credit: Mary Lundeba/WorldFish

A hatchery for indigenous *O. tanganicae* developed in partnership with Great Lake Products Ltd and WorldFish on the shores of Lake Tanganyika, Mpulungu, Mpulungu District.

Notes

[1] Tran N, Long C, Chan CY, Phillips MJ, Kefi AS, Kaminski AM and Genschick S. Future fish supply and demand scenarios in Zambia: Development options to sustain fish supply for improving fish food and nutrition security. Manuscript prepared for *Marine Policy*.

[2] Hidden hunger occurs when the quality of food people eat does not meet their nutrient requirements, so the food is deficient in micronutrients such as the vitamins and minerals that they need for their growth and development (WHO 2014).

[3] See for instance the Zambia - Aquaculture Enterprise Development Project by the African Development Bank (AfDB) (https://www.afdb.org/en/documents/document/zambia-aquaculture-enterprise-development-project-93700/)

[4] See for instance the (1) Irish Aid-funded Local Development Project led by Self Help Africa (https://selfhelpafrica.org/ie/zambia/); the (2) Rural Aquaculture Promotion (RAP) project by Peace Corps (https://www.peacecorps.gov/zambia/projects/); and the (3) GIZ-funded project on Aquaculture and the poor: improving fish production, consumption and nutrition linkages (https://www.worldfishcenter.org/content/improving-fish-production-consumption-and-nutrition-linkages-poor);

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