



Photo credit: Felix Clay/Duckrabbit

Strengthening small-scale fisheries for food and nutrition security, human well-being and environmental health in Zambia



In partnership with



Food and Agriculture
Organization of the
United Nations



RESEARCH
PROGRAM ON
Fish

Led by WorldFish

Strengthening small-scale fisheries for food and nutrition security, human well-being and environmental health in Zambia

Authors

Keagan Kakwasha, Fiona Armstrong Simmance, Philippa Cohen, Lizzy Muzungaire, Harris Phiri, Mbamwai Mbewe, Evans Mutanuka, Bonface Nankwenya, Joshua Wesana, Kendra Byrd, Lauren Pincus, Julia de Bruyn, Chan Chin Yee, Davids Mills and Victor Siamudaala

Citation

This brief should be cited as: Kakwasha K, Simmance FA, Cohen PJ, Muzungaire L, Phiri H, Mbewe M, Mutanuka E, Nankwenya B, Wesana J, Byrd K, Pincus L, de Bruyn J, Chan CY, Mills D, and Siamudaala V. 2020. Strengthening small-scale fisheries for food and nutrition security, human well-being and environmental health in Zambia. Penang, Malaysia: WorldFish. Program Brief: 2020-41.

Acknowledgments

This work was undertaken as part of the [CGIAR Research Program on Fish Agri-Food Systems \(FISH\)](#) led by [WorldFish](#). The work was part of the [Illuminating Hidden Harvests](#) initiative led by the Food and Agriculture Organization, in partnership with [Duke University](#) and WorldFish. The program is supported by contributors to the [CGIAR Trust Fund](#).

Contact

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

Creative Commons License



Content in this publication is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License ([CC BY-NC 4.0](#)), which permits non-commercial use, including reproduction, adaptation and distribution of the publication provided the original work is properly cited.

© 2020 WorldFish.

Photo credits

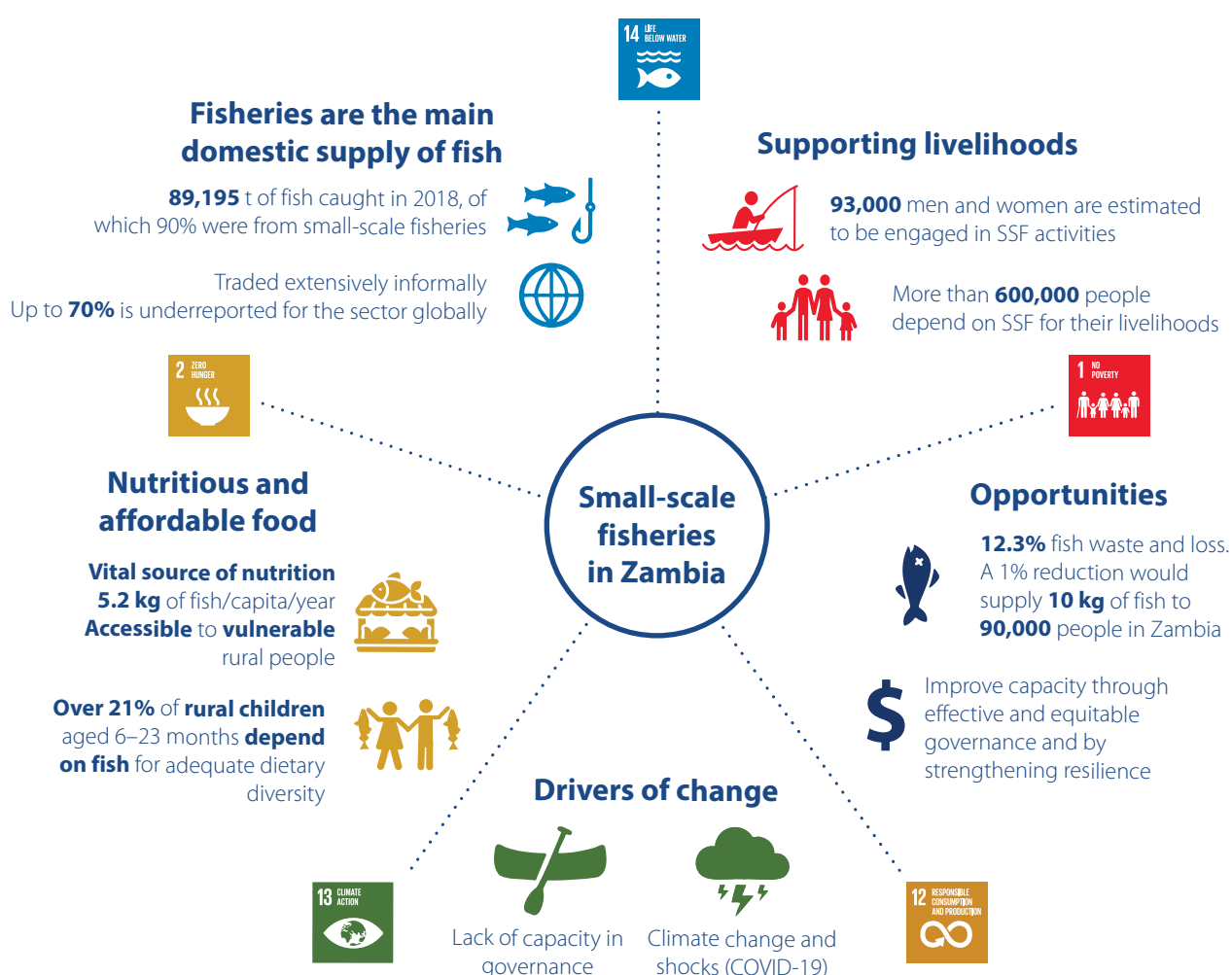
Front cover, Felix Clay/Duckrabbitt; page 2, Kate Longley/WorldFish; page 3, Chosa Mweemba/WorldFish; page 6, Saskia Husken/WorldFish; page 7, Clayton Smith/WorldFish; pages 11, 14, 16, Georgina Smith/WorldFish; page 12, Lizzy Muzungaire/WorldFish

Table of contents

Summary	1
1. Motivation	2
2. Benchmarking the contributions and values of small-scale fisheries in Zambia	4
3. Drivers of change and challenges in small-scale fisheries in Zambia	12
4. The contribution of small-scale fisheries to food systems in Zambia and progress toward the Sustainable Development Goals	15
References	17

Summary

Zambia is rich in aquatic resources with 15 million ha of water in the form of rivers, lakes and swamps. These water bodies support diverse and widespread capture fisheries, particularly small-scale fisheries (SSF) that make significant contributions to human well-being, food and nutrition as well as to local, national and regional economies. The fisheries sector has a critically important role in food systems in Zambia and in addressing complex and evolving nutritional priorities, as well as the environmental and climate change challenges. Fish from SSF are currently the main supply of fish in Zambia and will likely be so in the coming decades. Fish from SSF are often traded extensively informally, such as in dried form, and provide an accessible and nutritious food source for all, including vulnerable rural and urban populations, and during times of climate-induced agricultural lean periods. Despite this, the catches and services of SSF are underreported and persistently undervalued. Future investment priorities need to shift to safeguard and enhance fisheries, such as through effective governance and reductions in waste and loss, to secure the flow of benefits that underpin sustainable development.



There are millions of Zambians who directly depend on small-scale fisheries for household income and food and nutrition security. I am happy with this collaborative research, which shows how this previously overlooked sector supports livelihoods for so many people.

—Hon. Professor Nkandu Luo, MP, Minister of Fisheries and Livestock, Zambia



People here in Luangwa depend on small-scale fisheries for livelihoods, so the investment made by WorldFish through its research is greatly appreciated because it has helped us to reduce postharvest fish losses.

—Grace Ngulube, a female fish trader sharing perspectives from a WorldFish project and its value in improving small-scale fisheries value chains

1. Motivation

The UN Sustainable Development Goals (SDGs) have shone a global spotlight on pathways to an inclusive, food secure and sustainable future for the planet. In this light, SSF are increasingly being recognized for the diversity of their current and potential contributions to SDG targets. This is acknowledged with the explicit commitment within the SDGs to ensure “access of small-scale artisanal fishers to fisheries resources and markets.” Despite the global growth in aquaculture, capture fisheries—particularly small-scale capture fisheries—in the context of low-income countries will continue to be a food and livelihood mainstay for many “poor and marginalized women and men around the world for decades to come, particularly those living in sub-Saharan Africa” (Cohen et al. 2016; Golden et al. 2017) including Zambia (Tran et al. 2018; Chan et al. 2019).

Zambia is rich in aquatic resources, with 15 million ha of water in the form of rivers, lakes and swamps. These water bodies support diverse and widespread SSF that are of considerable national and regional importance. Fish from SSF, particularly dried, are widely traded across borders, providing one of the most accessible micronutrient rich foods in a diet that staple foods otherwise dominate (O’Meara et al. n.d.). Fish from SSF provide an excellent source of bioavailable micronutrients, such as iron, especially when small indigenous species are consumed whole. At the same time, SSF support livelihoods of men and women across value chains, with economic flows into wider agricultural sectors being central to reducing extreme poverty in rural environments.

Despite the importance of the sector, inland SSF are one of the most underreported fisheries sectors. As a result, their contribution to local, national and regional economies for food and nutrition security is persistently undervalued (Funge-Smith 2018; Fluet-Chouinard 2018), with minimal government investment. The SDGs also undervalue inland SSF, where the sector is subsumed into SDG 15 (life on land) and underrepresented in SDG 14 (life below water). The potential of inland SSF has not yet been realized in Zambia. The government, through its 2017–2021 7th National Development Plan (7NDP), has estimated that with a growing population an additional 108,000 t of fish will be needed to nourish future Zambians with an annual target supply of 12 kg of fish per capita (Ministry of National Development Planning 2017).



Photo credit: Kate Longley/WorldFish

Woman fishing with a fishing basket in Matongo fishing camp, Zambia.

Beyond national supply targets, consideration is also needed for the complex geographic, socioeconomic, cultural, gender and age-related factors that influence access to and consumption of fish to support adequate dietary intake for vulnerable populations.

Fish from SSF are the most available and accessible fish for Zambians (Mussa et al. 2017; DOF 2019). They can be a local sustainable, resilient and nutritious food source with untapped potential to nourish a growing Zambian population. Preserving the supply and providing fish from SSF will safeguard an important source of micronutrients in the diets of people who are vulnerable to micronutrient deficiencies, or “hidden hunger,” with profound impacts on individual and societal well-being. In addition, strengthening and enhancing SSF value chains can increase the economic flow of benefits and help reduce extreme poverty in rural environments.

Zambia has an opportunity to be at the global forefront of developing an approach for nutrition-sensitive futures in fisheries. Appropriate and research-guided investments in capture fisheries communities, value chains (across all preharvest, harvest and postharvest activities) and management can improve the provision and distribution of fish and reduce Zambia’s dependency on fish imports. By doing so, Zambia has the potential to become the fish basket for southern Africa, providing fish to enhance the nutritional adequacy of diets and improving economic development through domestic markets and international exports.

In this brief, we outline evidence of current benchmarks and illustrate some promising innovations and areas of investment that will enable Zambia to transition to more sustainable and healthy food systems. In particular, we focus on areas that will help Zambia achieve the SDGs by 2030—namely SDG 1 (reducing poverty), SDG 2 (ending hunger), SDG 14 (life below water) and SDG 15.1 (conserve and restore terrestrial and freshwater ecosystems), as well as achieving the ambitions set out in the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication.

We show that maintaining the integrity of key components and functions of local traditional food systems, including those involving inland waters and SSF, is critical for upholding and improving food security and dietary quality for rural households and children in Zambia (O’Meara et al. n.d.). Investment is needed in the sector to drive effective governance across sectors (such as fisheries-water-agriculture). It is also needed to implement value chain enhancements and climate adaptation with new technology and gender-sensitive approaches in order to safeguard aquatic resources and functioning SSF.



Women pounding fish into powder, Zambia.

2. Benchmarking the contributions and values of small-scale fisheries in Zambia

Small-scale fisheries are the main fish supply for Zambians

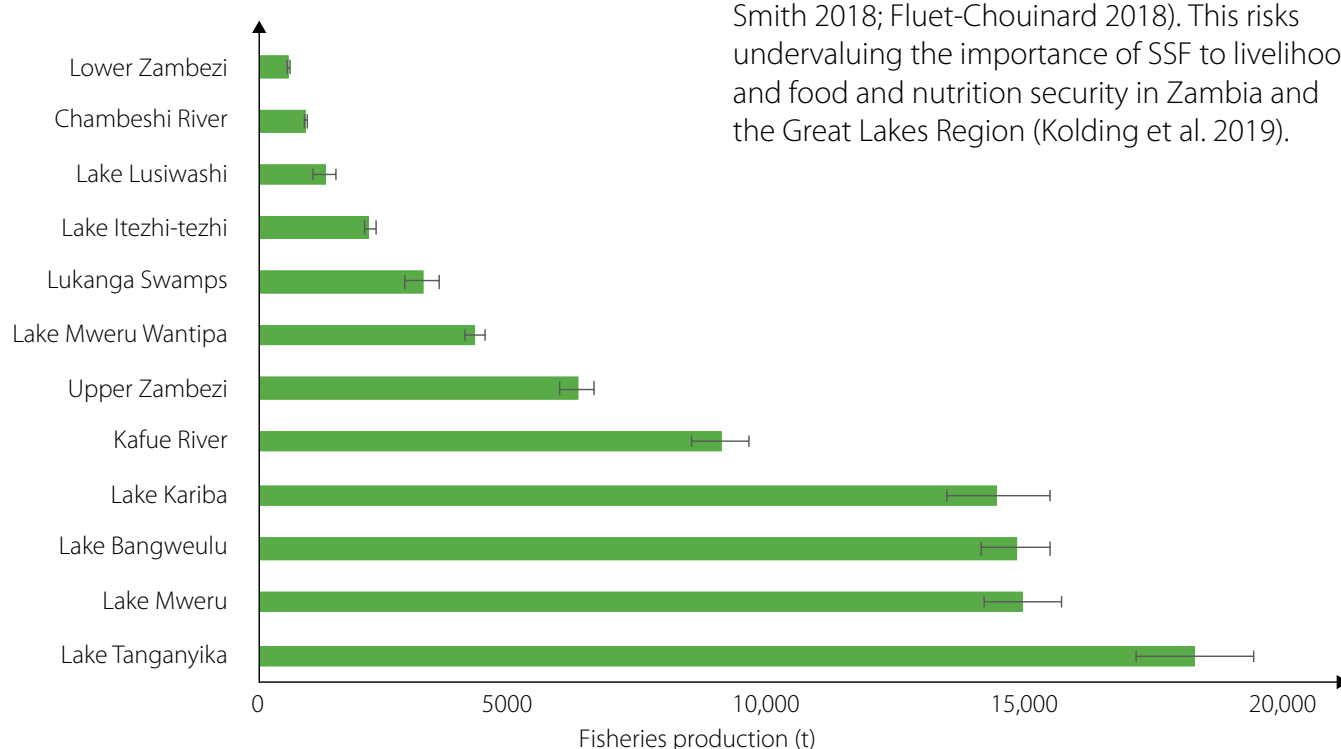
The 15 million ha of rivers, lakes, swamps and wetlands, including over 1 150 small water bodies, support diverse and widespread capture fisheries that predominately operate in rural environments. Fish harvest from the wild is critically important in supporting livelihoods and the food and nutrition security of rural populations, where there can be limited alternative sources of employment and nutritious foods.

In Zambia, wild fish from capture fisheries account for the majority of domestic fish production (71%, 89,000 t) relative to farmed fish (29%, 36,000 t) (DOF 2019). Capture fisheries production has grown steadily from an estimated 64,868 t in the 1990s to approximately 89,195 t in 2018 (DOF 2019). The sector is predominantly small-scale (80%–90%), with 12 main fisheries distributed across the country (Figure 1) (DOF 2019). In Zambia, small and large-scale fisheries are defined as follows:

- Small-scale fisheries: artisanal fishers with small capital investment who use low technology gear and vessels, such as canoes (often nonmotorized), and catch fish for subsistence or local markets (FAO 2020; DOF 2019).
- Large-scale fisheries: industrial fishers with huge capital investments who catch fish for commercial purposes (DOF 2019).

Recent studies have shown that fish from SSF are sold in the export markets (Mussa et al. 2017). Meanwhile, large-scale fisheries dominate only a few water bodies, mainly in Lake Tanganyika, but also in Lake Kariba, Lake Bangweulu and Lake Mweru where they represent 40% of total catch. Overall, however, SSF dominate (DOF 2019).

Although SSF are important in Zambia as the main supply of fish domestically, the dispersive, informal and remote nature of fisheries presents challenges for monitoring and reporting catches (Funge-Smith 2018; Kolding et al. 2019). Some have suggested that SSF catches are underestimated by as much as 70% (Funge-Smith 2018; Fluet-Chouinard 2018). This risks undervaluing the importance of SSF to livelihoods and food and nutrition security in Zambia and the Great Lakes Region (Kolding et al. 2019).



Data source: DOF 2019.

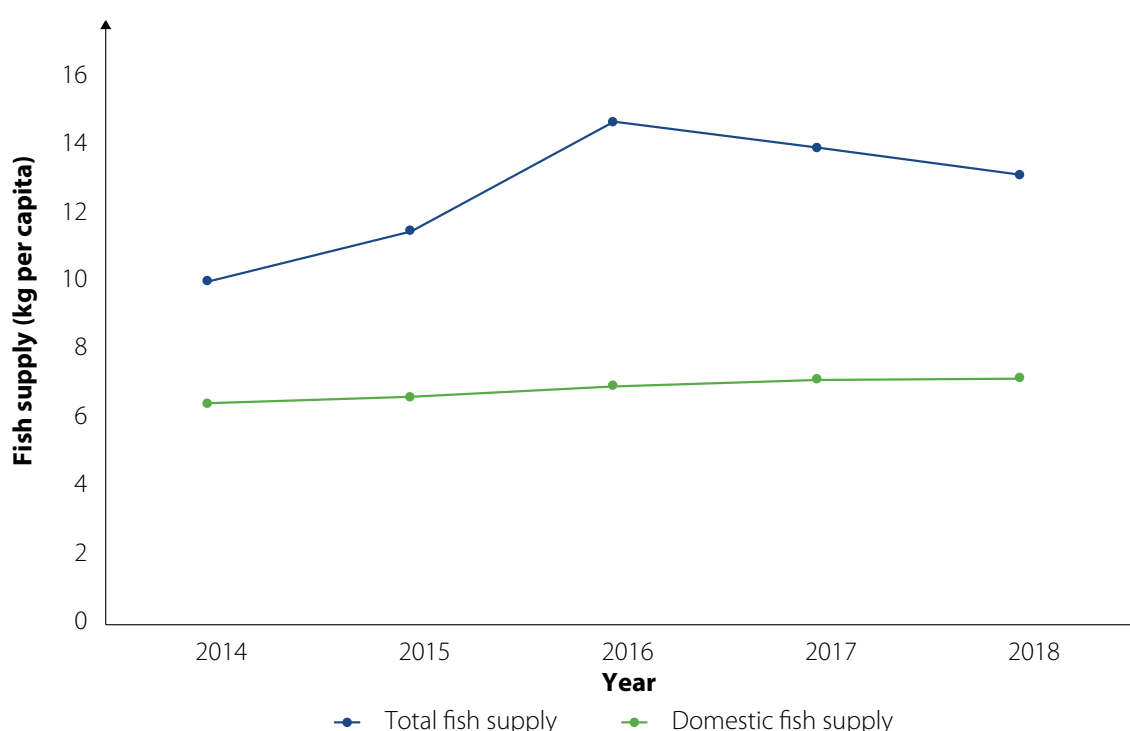
Figure 1. The reported capture fisheries production in Zambia by water body in 2018 (the latest available year of data). Standard error bars indicate variation in production from 2008 to 2018.

Trends in total fish supply in Zambia have changed over time, mainly due to fish imports, with capture fisheries dominating domestic supply (over 70%) (Figure 2) (DOF 2019). In 2018, the total per capita fish supply was estimated at 13.2 kg based on a net supply of 228,000 t of fish comprised of 45% imports (6 kg/capita), and 55% (7.2 kg/capita) domestic supply (DOF 2019). Among the domestic supply, 39% came from capture fisheries (5.2 kg/capita) and 16% from aquaculture (2.0 kg/capita) (DOF 2019). Over the past decade, fish imports have been an increasingly important component of fish supply to a growing population, increasing 14-fold alongside less dramatic increases in domestic capture fisheries and commercial aquaculture production (Tran et al. 2019). However, a recent study suggests that fish imports are largely re-exported to neighboring countries and not consumed in Zambia (DOF 2019). This further highlights the importance of the domestic supply of fish (Figure 2) and fish from capture fisheries (estimated at 5.2 kg/capita in 2018) for local food and nutrition security in Zambia, particularly in rural areas.

Informal fish trade is invisible, but important for providing nutritious and affordable food to vulnerable populations in remote rural areas

Zambia's capture fisheries also serve regional and international markets through formal and

informal fish trade. Formally, the majority of fish imported into Zambia, which are largely marine fish from Namibia and farmed tilapia from China, is re-exported to the Democratic Republic of Congo (DRC) (Mussa et al. 2017; DOF 2019). Fish produced domestically, mainly from SSF, are also traded through formal networks to neighboring countries, particularly the DRC, and to international markets in Asia, such as China. However, a large proportion of catches, particularly small dried fish, is traded informally across borders in the region, is unrecorded and has generally not been quantified. Recent research has suggested that informal trade of small fish from SSF in Zambia is extensive, with estimates of 97,000 t of fish being informally exported to neighboring countries (Funge-Smith 2018; Mussa et al. 2017). National statistics suggest a total annual capture fisheries production of 89,000 t, of which approximately 90% is from SSF. These figures flag the persistent issues with underestimating SSF catches. In addition, this informal and undocumented trade of fish highlights the immense uncaptured value of SSF value chains in supporting local livelihoods, and in providing fish as a nutritious food across the region, serving vulnerable rural populations. Further information is needed regarding the trade flows in the region and how fish imports are used for local food and nutrition security.



Data source: DOF 2019.

Figure 2. Trends in total and domestic reported fish supply (kg per capita) from 2014 to 2018. Total fish supply includes domestic capture and aquaculture production, imports, and accounts for exports.

Employment in small-scale fisheries

Employment in SSF is underreported by at least a factor of five in Africa. In Zambia, 600,000 people are reported to depend on SSF; however, the role of SSF in livelihoods and local rural economies is likely higher, and SSF are critical for the livelihoods of vulnerable rural populations

New evidence illuminates the role of SSF for livelihoods in Africa. It shows that employment across value chains can be five times higher than official records (FAO et al. 2021). In Africa, over 10 million people are estimated to be employed in SSF value chains, including preharvest, harvest, processing and trading, with many more dependent as fish-reliant households (FAO et al. 2021). In Zambia, approximately 93,000 people are estimated to be involved in SSF harvesting (FAO et al. 2021). This is higher than official reports (80,000), and it is estimated that an additional 32,500 people are involved in preharvest or postharvest SSF (FAO et al. 2021; DOF 2015). However, the role of women in the sector and their dependency on SSF are not fully known. Official reports show that 2163 women are engaged in SSF with more than 600,000 people living in fishing villages (DOF 2015). However,

employment and dependency data is not collected formally across value chains by gender. As a result, SSF employment of women and dependency in Zambia is likely higher and plays a critical role in rural economies where limited opportunities exist.

Reporting on small-scale fisheries

Improved data would illustrate that fisheries contribute substantially more to local and national economies in Zambia

The contribution of fisheries to the country's gross domestic product (GDP) can be viewed as small. Yet it is one sector that affects millions of Zambians who directly depend on it for household income and food and nutrition security. In 2017, for instance, over USD 171 million worth of fish was sold in informal markets, with 80% exported to the DRC (Kakwasha 2017). SSF are also vastly underreported, and their contribution to local and national economies undervalued (FAO et al. 2021). In Malawi, for example, once underreporting of SSF was accounted for, estimates of GDP contribution from the sector increased by a factor of 2.5, with SSF value chains valued at USD 454 million (Torell et al. 2020).



A woman drying fish at the Nyimba Fishing Camp, Zambia.

Small-scale fisheries are important for reducing malnutrition

Increasing fish consumption in Zambia could address undernutrition, including micronutrient deficiencies and the resultant costs to individuals and societies

People living in geographically remote, rural areas remain reliant on traditional food systems where food is sourced directly from natural resources (capture fisheries) and primary production (small-scale agriculture) (O'Meara et al. n.d.; Luckett et al. 2015; HLPE 2020). In Zambia, poverty and food insecurity are high, particularly among rural populations, with 42% of people living in extreme poverty and more than half (54%) experiencing hunger where they do not have enough food to eat (Ministry of National Development Planning 2017; Lincoln 2018). At the same time, malnutrition is high among children under 5 years old, as 54% have vitamin A deficiency while 58% have anemia, and 35% are stunted. The persistence of iron deficiency anemia, for instance, can be associated with an observed decade-long decline (from 63% to 54%) in consumption of iron-rich foods,

including fish, among children under 5 years old in Zambia, as well as wider health challenges that affect intake (Zambia Statistics Agency, Ministry of Health Zambia 2020).

Fish is one of the most affordable and nutrient-dense animal-source foods in many contexts. It is rich in key micronutrients (iron, iodine, vitamin A and zinc) and contains high quality protein and fatty acids that can improve nutrition, health, physical and cognitive development, and growth (O'Meara et al. n.d.). A recent nutritional analysis of different fish types consumed in Zambia confirmed that both large and small fish species contain high amounts of protein, vitamin B12, calcium, iron and zinc as well as omega-3 fatty acids. If consumed in adequate quantities, fish could possibly fill the recommended daily intake gaps among vulnerable populations, particularly women and children (Nölle et al. 2020). Therefore, fish has great potential to address diverse nutritional challenges among women, children and other vulnerable groups (such as those affected by HIV/AIDS), particularly in rural areas in Zambia (Banda 2009).



Dried fish, Lake Kariba, Zambia.

At less than half of global averages, the national average fish supply in Zambia in 2017 was relatively low (FAOSTAT 2020). However, fish is the largest animal-source food contributing to the protein supply. It has increased since 1980 (Figure 3) and is a critical source of minerals and micronutrients (FAOSTAT 2020). National fish supply statistics often underestimate fish and SSF, because they take the average supply across the population and do not account for informal trade and under-reporting of SSF which can be reflected in actual consumption surveys. As a result, statistics fail to acknowledge the variation that exists in dietary patterns, according to geographic, socioeconomic, cultural, gender and age-related characteristics. For example, in Mkushi District of central Zambia, two studies have reported the proportion of children consuming small fish is higher than those consuming large fish, showing the importance of small fish from SSF (Chileshe et al. 2020; Caswell et al. 2015). Other studies have found that in low-income areas of Lusaka, pregnant women consumed fish two to three times per week, most commonly kapenta, which comprise two small fish from SSF (Chunda-Liyoka 2020).

Subnational fish consumption patterns allow identification of high and low consumption patterns for targeted nutrition-sensitive fish interventions. Current evidence in Zambia linking fish consumption to improved nutrition and growth is limited, and there is a need for

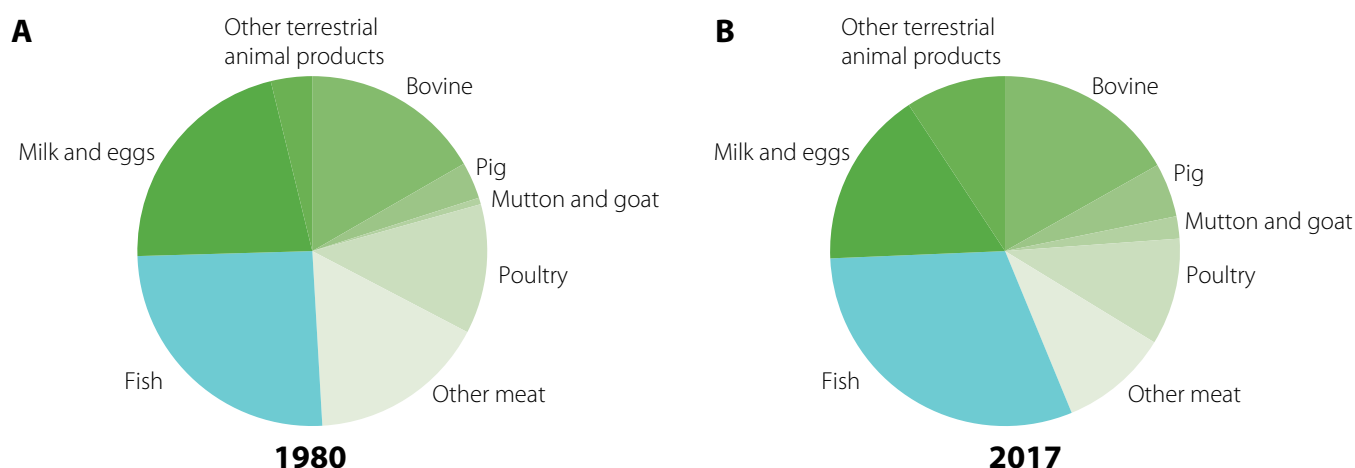
further investment to enable research in this area. One study in Lusaka has shown that greater fish intake was associated with a lower risk of stunting for children 6–23 months of age, but this same effect was not shown for older children (Marinda et al. 2018).

As shown in Figure 3, fish in Zambia’s animal protein supply shows a trend toward dominance and an increased share of total animal-source protein supply.

Consumption of fish from small-scale fisheries

Infants and young children living near small-scale fisheries are more likely to consume fish

In Zambia, children who live within 5 km of inland water bodies where capture fisheries operate are significantly more likely to have eaten fish (up to a seven-fold increase) in the previous 24 hours compared to those living more than 5 km away (Figure 4) (O’Meara et al. n.d.). The share of children who consumed fish was highest in Western (38%) and Luapula (34%) districts, which are rich in fish from the Zambezi River in the west and Lakes Mweru and Bengweulu in the northeast. Lake Mweru fisheries, in particular, provide nutrient-rich small indigenous pelagic fish called Chisense (*Microthrissa moeruensis*) (Funge-Smith 2018). In comparison, fewer children were reported to consume fish in Eastern District (6%), where there are few to no inland waters or fisheries.



Data source: FAOSTAT 2020.

Figure 3. Fish and animal protein supply per gram per capita per day in Zambia in 1980 (left) and 2017 (right). Other terrestrial animal products include offal and other edible animal product. Other meat includes game, birds, snails, etc. Fish includes only finfish, as no shellfish was reported for the years.

Figure 4 shows fish consumption among rural children under 2 years of age. The darker green shading represents a higher percentage of children consuming fish in the previous 24 hours. Yellow dots represent children living in close proximity to a waterbody where fisheries, predominantly small-scale, are known to operate. Yellow dots can obscure smaller waterbodies due to the scale of the image.

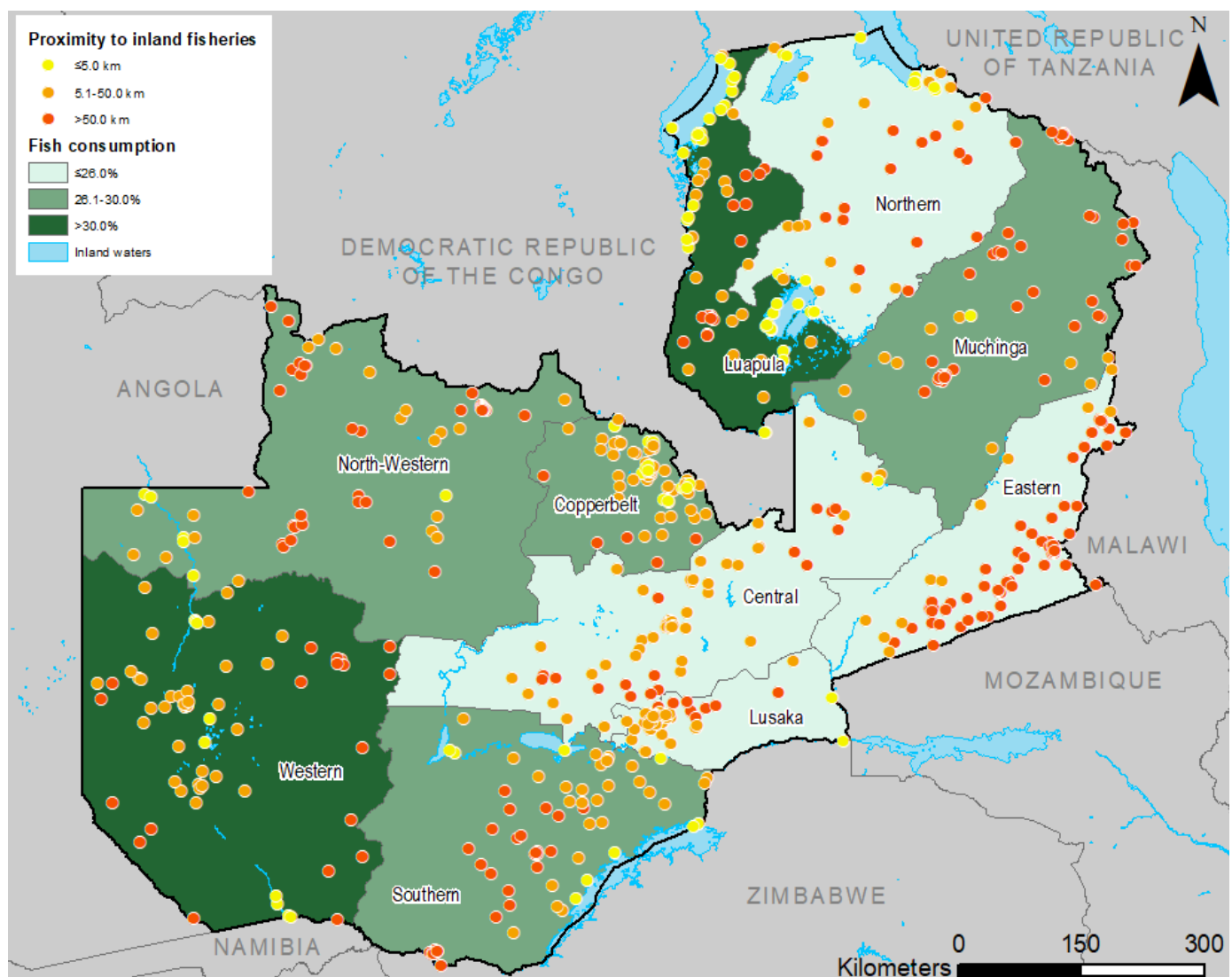
Small-scale fisheries contribution to dietary diversity

Living close to formal markets does not ensure sufficient availability and consumption of fish

Recent analysis has found that infants and young children in rural areas living closer to formal markets were less likely to consume fish than those living nearer to water bodies, where capture fisheries were

likely to be active (O'Meara et al. n.d.). This highlights the importance of involvement in fisheries and informal trade systems in ensuring fish availability and affordability. It also suggests that fish value chains could be improved to increase access to fish for those children that live farther away from SSF.

Variation has also been shown in both the frequency of fish consumption and the particular fish species consumed by those relying on market purchases. Among low-income households in Lusaka, prices can hinder access to fish through formal markets. Wealthier households are more likely to consume tilapia, while poorer households commonly consume kapenta, a small nutrient-dense fish from SSF, because of its affordability. This reflects high availability and access to fish from capture fisheries, and small fish can be readily divided among household members (Genschick et al. 2018).



Source: (O'Meara et al. n.d.)

Figure 4. Prevalence of fish consumption of rural children aged 6–23 months by district.

Contribution of small-scale fisheries to dietary diversity

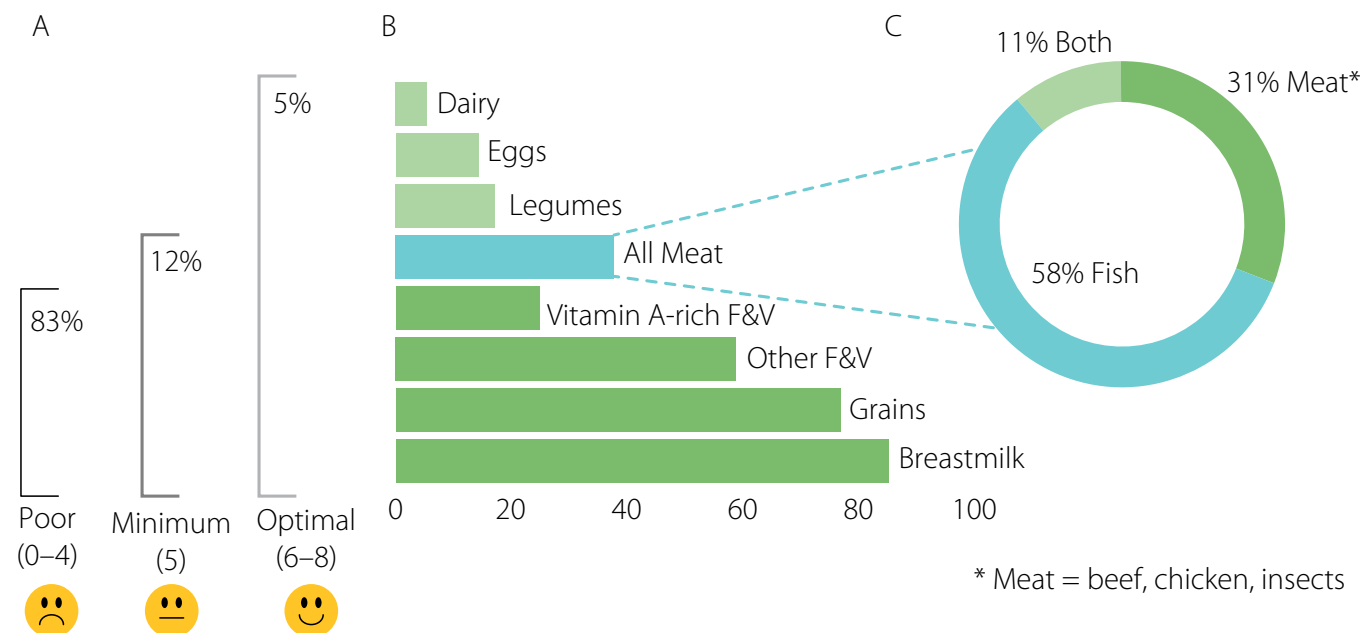
Children living close to SSF are more likely to have higher dietary diversity

Fish was the most commonly eaten animal-source food among young children in rural Zambia (O'Meara et al. n.d.). Due to fish consumption, children living close to inland water bodies where SSF operate were also more likely to have better dietary diversity, regardless of other animal-source food intake (O'Meara et al. n.d.). Measures of dietary diversity describe the number of different food groups an individual consumes, and they are used to represent the likely nutritional adequacy of diets. For children under 2 years old, the World Health Organization (WHO) recommends that five of eight different food groups should be consumed on a given day.

As shown in Figure 5, 83% of rural children consumed fewer than five of eight food groups, while 12% met the minimum cut-off

for an adequately diverse diet (based on WHO guidelines) and just 5% had an optimally diverse diet of more than five food groups per day. Still, fish is the biggest source of flesh food among children, contributing to the overall dietary diversity score (O'Meara et al. n.d.).

Over 21% of rural Zambian children (182,280 aged 0–2 years of age (CSO 2012)) relied on eating fish to achieve a higher dietary diversity score (Figure 5) (O'Meara et al. n.d.). The association between fisheries (particularly SSF) and increased fish consumption and food security is also found in Malawi and the wider African Great Lakes region. This shows the important role of SSF for sustainable development of vulnerable rural populations and in providing quality and nutritious food across rural and urban environments (Simmanee et al. n.d.). Recent innovative research also illuminates the importance of fisheries to food security in other regions of the world, such as West Africa (Nigeria) (Lo et al. 2019), the Caribbean (Haiti) (Temsah et al. 2018) and Southeast Asia



Source: (O'Meara et al. n.d.)

Figure 5. The dietary diversity of rural children ages 6–23 months in Zambia based on 24-hour dietary assessments. A) 83% of rural children consumed fewer than five of eight food groups, 12% met the minimum cut-off for an adequately diverse diet and 5% had an optimally diverse diet of more than five food groups per day, B) the percentage of children consuming each food group, and C) the relative contribution of different flesh foods, demonstrating fish as the major source within this category, contributing to the overall dietary diversity score (O'Meara et al. n.d.).

(Philippines) (Alva et al. 2016), particularly in low- and middle-income countries and rural environments where natural environments are critical for access to food. The role of fish from SSF for improved dietary diversity in children in Zambia therefore has potential to contribute toward improved nutrition and health (O'Meara et al. n.d.). Fish from SSF have great potential to tackle micronutrient deficiencies. Wider research is warranted to understand how to safeguard and enhance its potential and also to address wider dimensions of malnutrition that could prohibit the use of its nutrient benefits.

Food safety of fish

Fish products that fish vendors trade and sell present substantial food safety hazards, but proper cooking can protect consumers from most illnesses associated with unclean foods. Antimicrobial resistant *E. coli* and *Salmonella* spp. have been documented in fish from markets in Zambia (Songe et al. 2016), but little is known

about the full extent of food safety contaminants in the Zambian fish sector. Traditional methods of preservation, such as smoking and sun drying, can expose fish to environmental contaminants, molds and pathogenic bacteria. This is especially true if fish are dried in heavily polluted areas like roadsides, where fish are potentially exposed to heavy metals and particles from passing cars. Smoke-cured fish can contain polycyclic aromatic hydrocarbons, which are well-known carcinogens, if fish are exposed to high levels of smoke during traditional curing processes (Esumang et al. 2014). Using cold chain technologies, where feasible, and hygienic preservation techniques, such as elevating fish off the ground when sun drying or using an improved kiln with a charcoal filter for smoking, can mitigate food safety risks. Supply chain improvements are needed to improve the quantity and quality of fish to contribute to human diets and avoid potential health risks, in Zambian contexts.



Photo credit: Georgina Smith/WildFish

Catch of the day, Zambia.

3. Drivers of change and challenges in small-scale fisheries in Zambia

Capture fishers and SSF in Zambia experience multiple social, economic and environmental drivers of change and challenges (Barange et al. 2018; Funge-Smith 2018; Kolding et al. 2019).

Vulnerability to environmental, economic and social shocks

Fisheries, fishing communities and fish supply chains are vulnerable to environmental, economic and social shocks

Waterflows are a main driver of inland fisheries productivity. However, increasing climate change and variability in rainfall are affecting the

stability of supply (Barange et al. 2018; Kolding et al. 2019). Climate change is increasingly affecting water levels at critical points in the life cycle of fish, and perennial and sporadic outbreaks of infections with *Aphanomyces infadans* (epizootic ulcerative syndrome) have affected the productivity and sustainability of fisheries in Zambia. Macro-level shocks, such as the current global COVID-19 pandemic, are likely to be disrupting the production, provision, distribution and consumption of fish, with large economic and food and nutrition security implications (FAO 2020). The scale and nature of effects of the COVID-19 pandemic on the



Photo credit: Lizzy MwanangweWorldFish

Extensive trade of dried fish, Luangwa Zambia.

fisheries in Zambia are not yet known. It remains speculative that the disruption of the global fisheries supply chains will put undue pressure on the country's major capture fisheries to meet the national supply gap that is ordinarily met by fish imports. The sector remains vulnerable to shocks. To protect against them, improvements in technology, access to social, human and financial capital, and gender-sensitive approaches are needed for improved resilience and adaptation (Barange et al. 2018; Cole et al. 2018).

Increasing pressure on resources and environments

Fisheries management investments are still necessary to address increasing pressure on resources and environments

Fishing pressure has risen leading to a reduction in catch per unit effort, with challenges of poor fisheries governance and regulation of destructive fishing methods. At the same time, surging population growth not only increases the demand for fish, but also aggravates the pressure on the natural environment and functioning of fisheries via increased environmental degradation relating to water resource use, habitat loss, pollution and aquatic fish disease (Funge-Smith 2018; Barange et al. 2018). Pollution of water bodies as industries discharge effluents into lakes and rivers affects the quality of water for fish, which causes declines in fish abundance. In addition, land use changes and environmental degradation driven mainly by unsustainable farming practices and mining have resulted in the loss of critical habitats and increased sedimentation. Integrated management and policies across the fish-forest-water nexus is needed to protect and strengthen ecosystem functions.

Value chain inequities and inefficiencies

Addressing value chain inequities and inefficiencies has potential for high impact with a 1% reduction in fish loss, providing 90,000 Zambians with 10 kg fish per year

SSF value chains exhibit high levels of fish waste and loss, which include physical loss but also quality losses, with major nutrition and economic impacts (Funge-Smith 2018; Torell et al. 2020). Studies in Zambia have shown that physical fish losses occur throughout the value chain, with total losses translating to about USD 6 million in 2017

(Kefi et al. 2017). Cumulative postharvest losses were estimated at 12.3%, with processors incurring the highest percentage loss of 7.4% (Kefi et al. 2017). In addition, women processors have been found to experience three times more fish losses compared to men in Zambia, due to lack of processing technologies and gendered norms and beliefs (Kaminski et al. 2020). Value chain improvements focused on quality of fish are needed not only to increase fish supply and consumption but also to improve the nutritional value and safety of fish for healthy diets and improved nutrition in Zambia. Based on current capture fisheries production, a 1% reduction in fish loss in Zambia would provide 10 kg/capita annually for 90,000 people. As the production of SSF is underestimated, with substantial "hidden harvests," the benefits in reducing fish loss in value chains in terms of national supply would be considerably higher.

Several areas across SSF value chains require improvements:

- fish handling and storage, such as using crates during harvesting
- processing techniques, such as raised drying racks, solar dryers or icing
- extension services to improve knowledge
- harmonizing food safety standards at national and regional levels
- marketing connections via use of technology and networks in rural areas.

These can enhance the nutritional and economic benefits of the sector and improve the provision and access to nutritious and affordable fish products from higher value markets.

Additional challenges exist in value chains where large inequalities reduce the flow of benefits to vulnerable groups. For example, increasing gender disparities are causing women and youths to be significantly marginalized and exploited in value chain activities, with little benefits compared to men (Cole et al. 2018). Fishing communities also experience wider dimensions of poverty relating to poor access to basic services. These include health, education, water quality and sanitation, where communities often experience high morbidity and disease burden from waterborne diseases. In addition, fishing communities often lack social and financial services, such as access to credit and social protection. These build adaptive capacity during times of shock and crises, such as

during poor rainfall in communities also reliant on agricultural production.

Governance capacity for sustainable small-scale fisheries

The capacity to strengthen the resilience of the sector and reduce pressures on fisheries is currently limited. The Department of Fisheries (DOF), which is mandated to ensure the sustainable development of the country's capture fisheries, faces challenges of inadequate financing and low staffing. Inadequate financing and staffing compromises the capacity of the DOF to support and stimulate the growth of the sector to strengthen livelihoods and enhance food and nutrition security, the economy and planetary health. Low institutional

capacity has resulted in inadequate research and extension services to generate and disseminate gender-sensitive and climate-smart innovations and technologies to improve and modernize the fisheries. This partly accounts for the failure of the sector to thrive, its low and undervalued contribution to GDP, and the high levels of waste and losses experienced across value chains. Limited institutional capacity has also resulted in weak and inadequate monitoring and surveillance and control of productivity and use of the fisheries. Inadequate incentives for community-based fisheries, unclear property rights and weak governance structures compound the situation. This is a result of the open-access regime, as water bodies and fisheries are considered common property.



Small-scale fisheries, Zambia.

4. The contribution of small-scale fisheries to food systems in Zambia and progress toward the Sustainable Development Goals

Mixed food systems (traditional and modern) dominate Zambia, where population growth, urbanization and a rise in income are driving a transformation toward modern systems in some contexts, while traditional food systems continue in others. Modern food systems dominate in urban areas, with growing international supply chains, technology, diversity in markets and access to food that is more processed, packaged and reliant on cold storage. Traditional food systems continue to characterize many rural parts of the country. In these areas, food is mainly produced by smallholders with basic processing and storage methods, and access to food is driven by the natural environment (such as wild fish from fisheries and crops from cultivation) and informal markets. Despite economic development in Zambia, with increases in income and urbanization, just over half of population live in rural environments, and more than 70% depend on natural resources, such as agriculture, for their livelihoods (FAOSTAT 2020). Zambian populations, including young children, have some of the poorest diets and highest rates of undernourishment in the world (FAOSTAT 2020). Wild fish and capture fisheries play a critical role in improving physical and economic access to food for vulnerable rural populations (O'Meara et al. n.d.; Simmance et al. n.d.).

The majority of Zambia's population depends on rain-fed agriculture. As a result of increasing climate variability, crop and livestock disease and poor quality soil, low agricultural production has been common in recent years. This has pushed rural populations into more extreme poverty and food insecurity. At the same time, urban poor are also vulnerable to macro-level drivers of food price shocks that are affected by instability in supply. Recent assessments on determinants of food insecurity in Zambia often omit fish and fisheries (Nkomoki et al. 2019). Climate variability and flooding can have serious impacts on agriculture production and dependent livelihoods. In recent years, maize yields have declined in Zambia due to climate variability of drought and floods, with maize prices above average, impacting livelihoods and food security (FEWS NET 2018). However, flooding can present advantages where fisheries are often enhanced—"fish comes with the rains" (Kolding et al. 2016). Fisheries can act as a short-term safety net for livelihoods and food security during climate-induced agricultural lean periods, but waterflows also need to be safeguarded to ensure sustainable long-term production (Kolding et al. 2016).



The fisheries sector has a critically important role in transforming food systems in Zambia and addressing complex and evolving nutritional priorities, as well as the environmental and climate change challenges. Fish from small-scale fisheries is currently the main supply of fish in Zambia, and will likely be so in the coming decades, providing an accessible and nutritious food source for all, including those vulnerable. Future investment priorities need to shift to safeguard and enhance fisheries, such as through effective governance and reductions in waste and loss, to secure the flow of benefits that underpin sustainable development.



The fisheries sector has a critically important role in transforming food systems in Zambia and addressing complex and evolving nutritional priorities, as well as the environmental and climate change challenges. Fish can provide one of the most sustainable, nutritious and resilient food sources that the poorest and most vulnerable populations in Zambia can access, including at times of climate-induced agricultural lean periods (Béné et al. 2016). By illuminating the hidden

value of capture fisheries and fish for nutrition and livelihoods, fish can be integrated into cross-sector policies and management approaches to strengthen food systems in Zambia. The contribution of fish within food systems is integral to achieving the SDGs in Zambia—particularly to leave no one behind in the fight to end hunger and poverty, and to drive sustainability for delivering healthy diets and protecting the environment for generations to come.



Photo credit: Georgia Smith/WildAid

Barotse Floodplain, Zambia.

References

- Alva S, Johnson K, Jacob A, D'Agnes H, Mantovani R and Evans T. 2016. Marine protected areas and children's dietary diversity in the Philippines. *Population and Environment* 37(3):341–61.
<https://doi.org/10.1007/s11111-015-0240-9>
- Banda ND, Hüsken SMC and Kaunda W. 2009. The impact of nutrition and fish supplementation on the response to anti retroviral therapy, Zambia: A literature review. Regional Programme Fisheries and HIV/AIDS in Africa. *In* WorldFish. 1–25. Penang: WorldFish, Project Report 1985.
http://pubs.iclarm.net/resource_centre/WF_2512.pdf
- Barange M, Bahri T, Beveridge MCM, Cochrane KL, Funge-Smith S and Poulain F. 2018. Impacts of climate change on fisheries and aquaculture: Synthesis of current knowledge, adaptation and mitigation options. *In* FAO Fisheries and Aquaculture Technical Paper (Vol. 627). Rome: FAO
<http://www.fao.org/documents/card/ru/c/I9705EN/>
- Béné C, Arthur R, Norbury H, Allison EH, Beveridge M, Bush S, Campling L, Leschen W, Little D, Squires D et al. 2016. Contribution of fisheries and aquaculture to food security and poverty reduction: Assessing the current evidence. *World Development* 79:177–96. <https://doi.org/10.1016/J.WORLDDEV.2015.11.007>
- Caswell BL, Talegawkar SA, Dyer B, Siamusantu W, Klemm RDW and Palmer AC. 2015. Assessing child nutrient intakes using a tablet-based 24-hour recall tool in rural Zambia. *Food and Nutrition Bulletin* 36(4):467–80.
<https://doi.org/10.1177/0379572115612631>
- [CSO] Central Statistical Office. Zambia. 2012. 2010 Census of population and housing: National analytical report. [https://www.zamstats.gov.zm/phocadownload/2010_Census/2010 Census of Population National Analytical Report.pdf](https://www.zamstats.gov.zm/phocadownload/2010_Census/2010%20Census%20of%20Population%20National%20Analytical%20Report.pdf)
- Chan CY, Tran N, Pethiyagoda S, Crissman CC, Sulser TB and Phillips MJ. 2019. Prospects and challenges of fish for food security in Africa. *Global Food Security* 20(December 2018):17–25.
<https://doi.org/10.1016/j.gfs.2018.12.002>
- Chileshe J, Talsma EF, Schoustra SE, Borgonjen-van den Berg KJ, Handema R, Zwaan BJ and Brouwer ID. 2020. Potential contribution of cereal and milk based fermented foods to dietary nutrient intake of 1-5 years old children in Central province in Zambia. *PLOS ONE* 15(5):e0232824.
<https://doi.org/10.1371/journal.pone.0232824>
- Chunda-Liyoka C, Lubeya MK, Imakando M, Kisling S, Majid S, Willis MS, Wood C, Kankasa C and DiRusso CC. 2020. Healthy pregnancies and essential fats: Focus group discussions with Zambian women on dietary need and acceptability of a novel RUSF containing fish oil DHA. *BMC Pregnancy and Childbirth* 20(1):93.
<https://doi.org/10.1186/s12884-020-2783-8>

Cohen PJ, Lawless S, Dyer M, Morgan M, Saeni E, Teioli H and Kantor P. 2016. Understanding adaptive capacity and capacity to innovate in social–ecological systems: Applying a gender lens. *Ambio* 45(3):309–21. <https://doi.org/10.1007/s13280-016-0831-4>

Cole SM, McDougall C, Kaminski AM, Kefi AS, Chilala A and Chisule G. 2018. Postharvest fish losses and unequal gender relations: Drivers of the social-ecological trap in the Barotse Floodplain fishery, Zambia. *Ecology and Society* 23(2). <https://doi.org/10.5751/ES-09950-230218>

[DOF] Department of Fisheries. 2015. Fisheries statistics annual survey. Ministry of Fisheries and Livestock: Lusaka, Department of Fisheries Head Quarters, Chilanga.

[DOF] Department of Fisheries. 2019. Annual Report, 2019. Lusaka: Ministry of Fisheries and Livestock, Department of Fisheries, Chilanga.

Essumang DK, Dodoo DK and Adjei JK. 2014. Effective reduction of PAH contamination in smoke cured fish products using charcoal filters in a modified traditional kiln. *Food Control* 35(1):85–93. <https://doi.org/10.1016/j.foodcont.2013.06.045>

[FEWS NET] Famine Early Warning Systems Network. 2018. Southern Africa regional supply and market outlook. Lusaka: Indiba Agriculture Policy Research Institute (IAPRI). https://reliefweb.int/sites/reliefweb.int/files/resources/SA_Regional_Supply_and_Market_Outlook_August_2019_to_March_2020.pdf

Fluet-Chouinard E, Funge-Smith S and McIntyre PB. 2018. Global hidden harvest of freshwater fish revealed by household surveys. *Proceedings of the National Academy of Sciences of the United States of America* 115(29):7623–28. <https://doi.org/10.1073/pnas.1721097115>

[FAOSTAT] Food and Agriculture Organization Corporate Statistical Database. 2020. Database for fish and animal protein supply quantity. FAOSTAT New Food Balances. Rome: FAO. <http://www.fao.org/faostat/en/#data/FBS>

[FAO] Food and Agriculture Organization. 2020. The state of world fisheries and aquaculture 2020: Sustainability in action. *In* Nature and Resources (Vol. 35, Issue 3). Rome: FAO. <https://doi.org/10.4060/ca9229en>

Food and Agriculture Organization, Duke University and WorldFish. 2021. Illuminating Hidden Harvests: The contribution of small-scale fisheries to sustainable development. Rome: FAO.

Funge-Smith SJ. 2018. Review of the state of world fishery resources: Inland fisheries. FAO Fisheries and Aquaculture Circular No. C942 Rev.3. Rome: FAO. 397 pp. <https://doi.org/10.1098/rspb.2006.3735>

Genschick S, Marinda P, Tembo G, Kaminski AM and Thilsted SH. 2018. Fish consumption in urban Lusaka: The need for aquaculture to improve targeting of the poor. *Aquaculture* 492:280–89. <https://doi.org/10.1016/j.aquaculture.2018.03.052>

Golden CD, Seto KL, Dey MM, Chen OL, Gephart JA, Myers SS, Smith M, Vaitla B and Allison EH. 2017. Does aquaculture support the needs of nutritionally vulnerable nations? *Frontiers in Marine Science* 4(MAY):1–7. <https://doi.org/10.3389/fmars.2017.00159>

[HLPE] High Level Panel of Experts on Food Security and Nutrition. 2020. Food security and nutrition: Building a global narrative towards 2030. Rome: HLPE.

Kakwasha K. 2017. Analysis of the informal trade as a source of household income: A case of cross-border fish traders in Zambia. Penang: WorldFish.

Kaminski AM, Cole SM, Al Haddad RE, Kefi AS, Chilala AD, Chisule G, Mukuka KN, Longley C, Teoh SJ and Ward AR. 2020. Fish losses for whom? A gendered assessment of post-harvest losses in the Barotse Floodplain fishery, Zambia. *Sustainability* 12:10091.

Kefi AS, Cole SM, Kaminski AM, Ward A and Mkandawire NL. 2017. Physical losses of fish along the value chain in Zambia: A case study of Barotse Floodplain. *International Journal of Fisheries and Aquaculture* 9(10):98–107. <https://doi.org/10.5897/ijfa2017.0638>

Kolding J, van Zwieten P, Marttin F and Poulain F. 2016 Fisheries in the drylands of sub-Saharan Africa: “Fish come with the rains.” FAO Fisheries and Aquaculture Circular No. 1118. Rome: FAO.

Kolding J, Zwieten P van, Marttin F, Funge-Smith S and Poulain F. 2019. Freshwater small pelagic fish and their fisheries in the major African lakes and reservoirs in relation to food security and nutrition. FAO Fisheries and Aquaculture Technical Paper, 642, 124. <https://doi.org/10.4060/ca0843en>

Lincoln F. 2018. The scope of hidden hunger in Zambia. *Food Science and Nutrition Technology* 3:10.23880/FSNT-16000151.

Lo M, Narulita S and Ickowitz, A. 2019. The relationship between forests and freshwater fish consumption in rural Nigeria. *PLoS ONE* 14(6):1–15. <https://doi.org/10.1371/journal.pone.0218038>

Luckett BG, DeClerck FAJ, Fanzo J, Mundorf AR and Rose D. 2015. Application of the Nutrition Functional Diversity indicator to assess food system contributions to dietary diversity and sustainable diets of Malawian households. *Public Health Nutrition* 18(13):2479–87. <https://doi.org/10.1017/S136898001500169X>

Marinda PA, Genschick S, Khayeka-Wandabwa C, Kiwanuka-Lubinda R and Thilsted SH. 2018. Dietary diversity determinants and contribution of fish to maternal and under-five nutritional status in Zambia. *PLoS ONE* 13(9):1–18. <https://doi.org/10.1371/journal.pone.0204009>

Ministry of National Development Planning. 2017. 7th National Development Plan 2017–2021: Accelerating development efforts towards Vision 2030 without leaving anyone behind. Lusaka: Ministry of Finance. <https://doi.org/10.1192/bjp.111.479.1009-a>

- Mussa H, Kaunda E, Chimatiro S, Kakwasha K, Banda L, Nankwenya B and Nyengere J. 2017. Assessment of informal cross-border fish trade in the Southern Africa region: A case of Malawi and Zambia. *Journal of Agricultural Science and Technology B* 7(5):358–66. <https://doi.org/10.17265/2161-6264/2017.05.009>
- Nkomoki W, Bavorová M and Banout J. 2019. Factors associated with household food security in Zambia. *Sustainability* 11(9):1–18. <https://doi.org/10.3390/su11092715>
- Nölle N, Genschick S, Schwadorf K, Hrenn H, Brandner S and Biesalski HK. 2020. Fish as a source of (micro) nutrients to combat hidden hunger in Zambia. *Food Security* 1–22.
- Songe MM, Hang'ombe BM, Knight-Jones TJD and Grace D. 2016. Antimicrobial resistant enteropathogenic *Escherichia coli* and *Salmonella* spp. in houseflies infesting fish in food markets in Zambia. *International Journal of Environmental Research and Public Health* 14(1):21. <https://doi.org/10.3390/ijerph14010021>
- Temsah G, Johnson K, Evans T and Adams DK. 2018. Benefits of biodiverse marine resources to child nutrition in differing developmental contexts in Hispaniola. *PLoS ONE* 13(5):1–23. <https://doi.org/10.1371/journal.pone.0197155>
- Torell EC, Jamu DM, Kanyerere GZ, Chiwaula L, Nagoli J, Kambewa P, Brooks A and Freeman P. 2020. Assessing the economic impacts of post-harvest fisheries losses in Malawi. *World Development Perspectives*:100224. <https://doi.org/10.1016/j.wdp.2020.100224>
- Tran N, Chu L, Chan CY, Genschick S, Phillips MJ and Kefi AS. 2019. Fish supply and demand for food security in sub-Saharan Africa: An analysis of the Zambian fish sector. *Marine Policy* 99:343–50. <https://doi.org/https://doi.org/10.1016/j.marpol.2018.11.009>
- Zambia Statistics Agency, Ministry of Health Zambia and the Inner City Fund. 2019. Zambia demographic and health survey 2018. Lusaka, Zambia: Zambia Statistics Agency and the Ministry of Health; Rockville, US: ICF.

About WorldFish

WorldFish is a nonprofit research and innovation institution that creates, advances and translates scientific research on aquatic food systems into scalable solutions with transformational impact on human well-being and the environment. Our research data, evidence and insights shape better practices, policies and investment decisions for sustainable development in low- and middle-income countries.

We have a global presence across 20 countries in Asia, Africa and the Pacific with 460 staff of 30 nationalities deployed where the greatest sustainable development challenges can be addressed through holistic aquatic food systems solutions.

Our research and innovation work spans climate change, food security and nutrition, sustainable fisheries and aquaculture, the blue economy and ocean governance, One Health, genetics and AgriTech, and it integrates evidence and perspectives on gender, youth and social inclusion. Our approach empowers people for change over the long term: research excellence and engagement with national and international partners are at the heart of our efforts to set new agendas, build capacities and support better decision-making on the critical issues of our times.

WorldFish is part of One CGIAR, the world's largest agricultural innovation network.