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Sustaining and improving the contribution small-scale fisheries make to healthy and sustainable food systems in Malawi

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Sustaining and improving the contribution small-scale fisheries make to healthy and sustainable food systems in Malawi

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1. Summary

In Malawi, small-scale inland fisheries[1] are the main source of fish and other aquatic foods. They contribute more than 90% of national fish supplies, provide nutrition for over 11.9 million people and employment for over 200,000 women and men (Figure 1). Fish and other aquatic foods are the most consumed animal-source food (a critical food group), particularly among rural populations and households that are close to waterbodies. Although aquaculture is expanding in Malawi, it currently supports just 6% of fish supply, and projections suggest capture fisheries will remain the most important source of fish in Malawi for decades to come (Chan et al. 2019). In this paper, we present the latest understanding and data on values and challenges that exist within Malawi's small-scale capture fisheries, and distill the opportunities to sustain and improve multiple development outcomes with small-scale fisheries as an entry point.

Fish provide a rich source of micronutrients, fatty acids and quality protein. Small fish species commonly consumed whole and dried in Malawi, such as usipa (*Engraulicypris sardella*) and matemba (*Enteromius paludinosus*), are particularly rich in calcium, zinc and omega-3 fatty acids. A 100 g portion of small fish caught by small-scale fisheries provides, on average, 38% of the recommended daily intake for calcium and 51% for zinc among adult women. The diversity of nutrients in small fish make them a nutritional standout among animal-source foods. Dried small fish are instrumental in broadcasting the nutrition benefits of small-scale fisheries along informal supply chains to households and communities distant from the water bodies where fisheries operate.

Figure 1. Working through and with small-scale fisheries provides opportunities for Malawi to progress at least six of the SDGs.

Safeguarding the supply and accessibility of fish from small-scale fisheries is critical to support diet quality, particularly among women, infants and children, who can be otherwise vulnerable to undernutrition. While there are natural (though variable) production limits to capture fisheries, improved livelihood and well-being contributions from capture fisheries can be achieved if investments are made into managing resources, reducing waste and loss, and improving access to fish-based products and their distribution through informal networks, formal markets and/or emergency food programs.

Small-scale fisheries receive little policy, investment and management attention relative to the opportunities that exist to sustain and improve the contributions they make to many of the UN Sustainable Development Goals (SDGs). The Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (FAO 2015) outlines principles and approaches that can improve social, economic and environmental outcomes from working with, and through, small-scale fisheries. By working with small-scale fisheries, there are multiple opportunities to avoid and reduce poverty (SDG 1) and reduce all forms of hunger, particularly micronutrient deficiencies (SDG 2). This will lead to improved health outcomes (SDG 3), address gender inequities and improve gender equality (SDG 8), improve sustainable management and efficient use of natural (aquatic) resources and reduce post-harvest losses (SDG 12), and sustain life below water (SDG 14), including through protecting tenure, access and stewardship rights of fishers (SDG 14b). Conversely, the loss of the benefits small-scale fisheries provide would be devastating to Malawi and lead to failure and deterioration against multiple SDGs. Effective and equitable fisheries governance, value-chain technology improvements, effective market links, building adaptive capacity to climate change, and integrating governance across water-agriculture-fisheries systems all represent opportunities to safeguard and enhance the diverse benefits that small-scale fisheries provide to Malawi.

Packing fish for transportation at Mposa Beach Lake Chilwa, Machinga, Malawi.

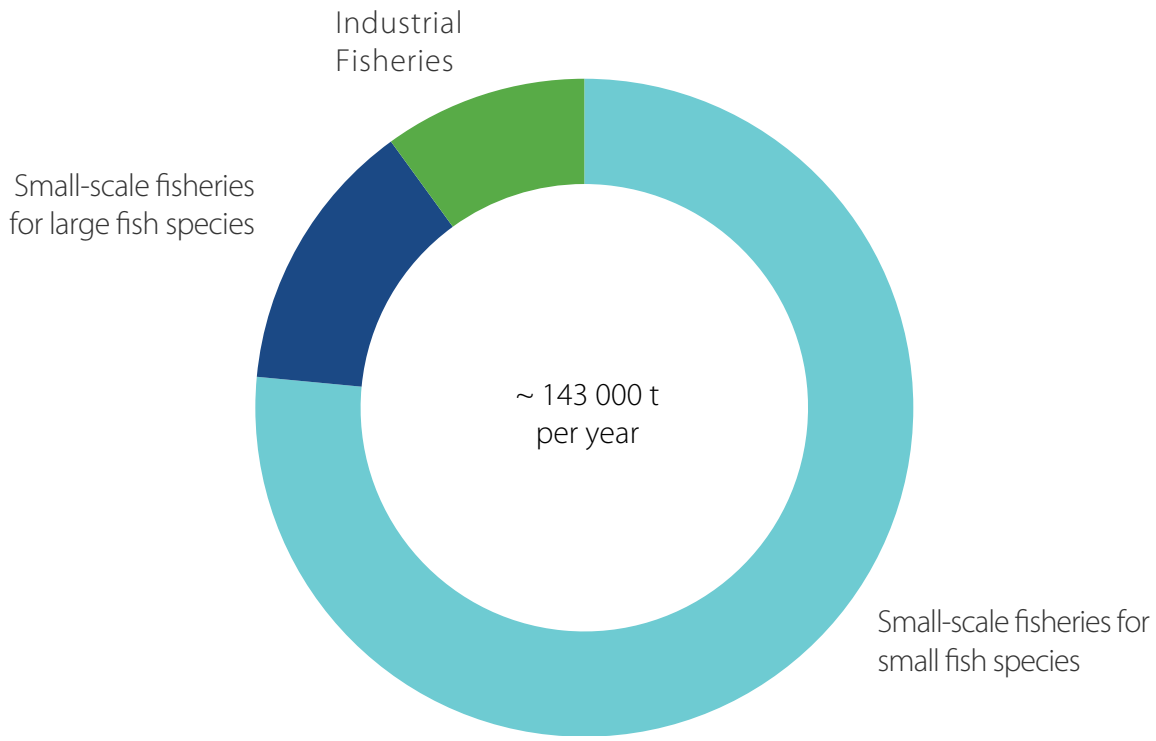
2. Benchmarking the contributions and values of small-scale fisheries in Malawi

2.1. Production and trade of small-scale fisheries in Malawi

Small-scale fisheries supply 90% of Malawi's fish and other aquatic foods

Malawi has a rich diversity of aquatic habitats with rivers, swamps, wetlands, floodplains, small waterbodies and a large lake that comprise part of the Great Rift Valley and African Great Lakes region. Malawi's largest waterbodies are protected under international biodiversity treaties: Lake Malawi is designated a UNESCO World Heritage Site and Lake Chilwa a Wetland of International Importance (Ramsar Site). Lake Malawi covers nearly 20% of the country, is the third-largest lake in Africa and is one of the world's deepest and most biodiverse lakes, supporting over 1000 fish species. Lake Chilwa is a shallow, climate-sensitive lake that experiences periodic drying and supports a rich biodiversity across its wetlands, including endemic bird life.

These vast inland waterbodies support productive freshwater fisheries, which are the main domestic source of fish in Malawi, with 94% of domestic fish production from capture fisheries and 6% from aquaculture (FAO 2021). Lake Malawi supplies the largest volume of fish in the country, followed by Lake Chilwa, which supports one of the most productive inland fisheries (in terms of catch per area) in Africa (Jul-Larsen et al. 2003). Over 90% of capture fisheries are small-scale (Fluet-Chouinard et al. 2018; Funge-Smith 2018) (Figure 2), with industrial (large-scale) fisheries comprising a small fleet of commercial trawl vessels in southern Lake Malawi. Total reported fish landings average 143,000 t of catch each year, and approximately 128,700 t of this are from small-scale fisheries (GOM 2020). Reported small-scale fisheries landings are sufficient to supply 6.7 kg of fish to each person in Malawi annually, based on the 2020 population estimate. Actual landings are likely higher due to underreporting of small-scale catches (Fluet-Chouinard et al. 2018; Funge-Smith 2018).



Note: Landings from industrial fisheries (green) and small-scale fisheries (blue) for small (<25 cm at maximum length) and large (>25cm) fish species.

Source: GOM 2018; FAO et al. forthcoming.

Figure 2. Capture fisheries landings in Malawi (average 2013–2017).

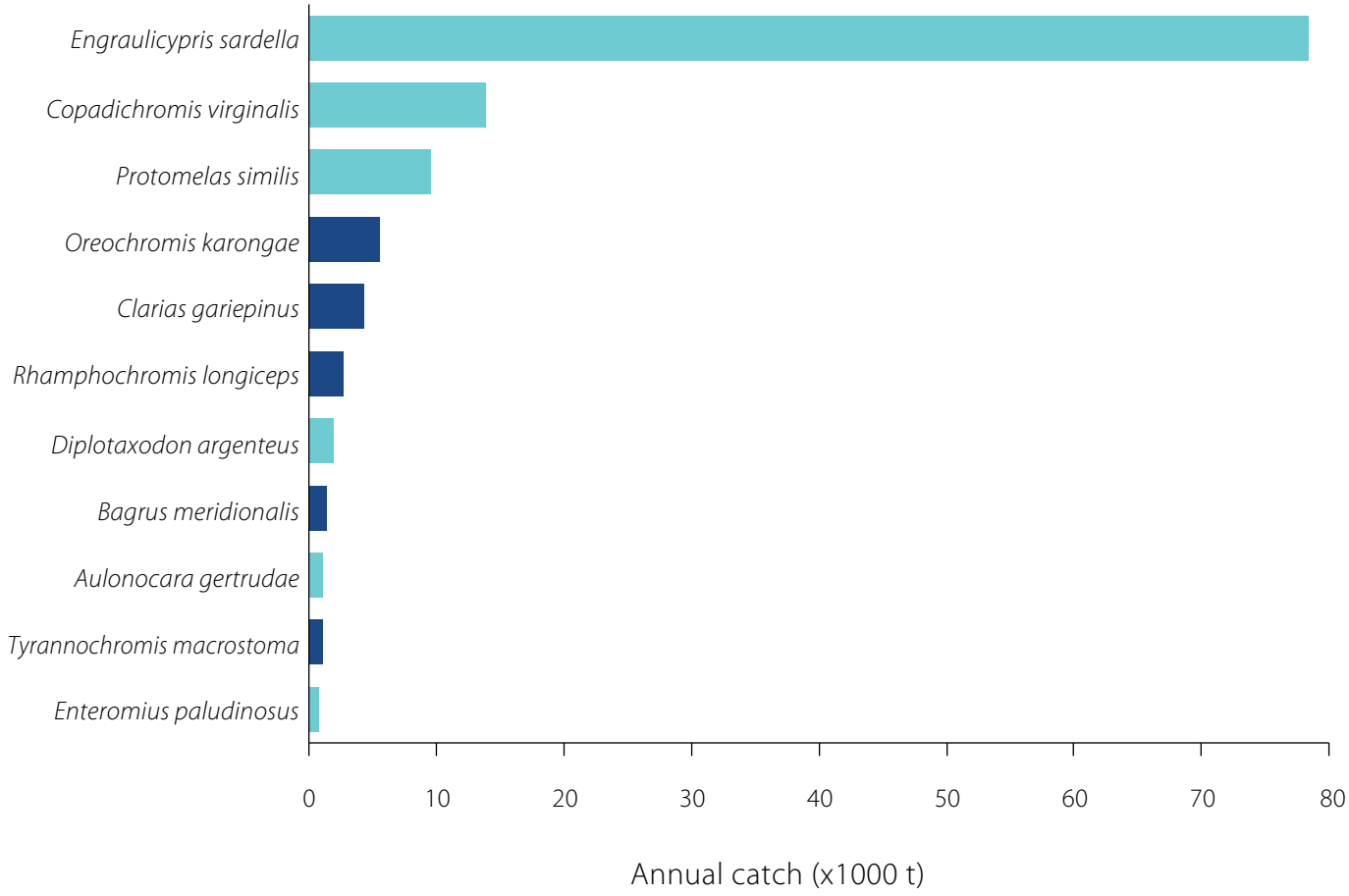
Fish production fluctuates with climate variability and is linked to lake level fluctuations (Jul-Larsen et al. 2003), whereby periods of higher variability in water levels increase fish production due to increased nutrient loads (Kolding et al. 2019). However, during periods of extremely low water levels, catches can collapse, as seen in Lake Chilwa, where periodic drought is becoming increasingly frequent (Chiotha et al. 2018; Simmance et al. 2021). In areas such as Lake Malombe, overfishing, habitat destruction and siltation have played a dominant role in recent declines in catches (Jul-Larsen et al. 2003; Zwieten et al. 2011; Makwinja et al. 2021).

Ten species account for 99% of the reported small-scale fisheries catch (Figure 3). Among these 10 species, fish with a maximum length less than 25 cm (small fish) comprise almost 90% of landings. Small pelagic fish species such as the endemic usipa (*E. sardella*) dominate catches (Government of Malawi 2020), while the proportion of catches comprising some larger fish species, such as chambo (*Oreochromis* spp.), has declined over recent decades. A rich diversity of fishing methods contribute to this catch, ranging from traditional gear and craft, such as fish traps and handlines operated from dugout canoes, to relatively modern methods including seine nets operated from motored planked boats with several crew members (Kolding et al. 2019).

Fish from small-scale fisheries is traded extensively

Extensive informal supply chains mean dried small fish from small-scale fisheries reach 76% of rural poor households that live far from fisheries

Fish from small-scale fisheries is traded within Malawi, flows into Malawi from neighboring countries and is exported from Malawi to the region. Small-scale fishery exports are traded almost entirely through informal, intraregional trade corridors to neighboring Tanzania, Zambia, Mozambique and other countries within the Southern African Development Community region. Formal fish exports are limited to aquarium fish with major markets in Europe, Asia and North America (Msukwa et al. forthcoming).



Note: Dark blue bars represent large fish species (maximum length >25cm) and bright blue depict small fish species (maximum length <25cm).

Source: GOM 2018; FAO et al. forthcoming.

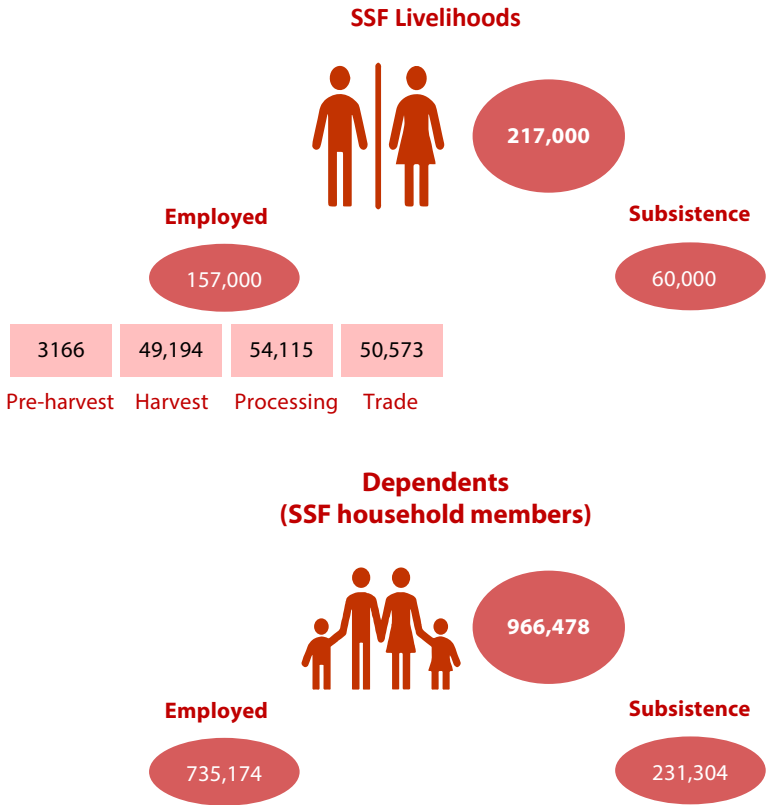
Figure 3. The 10 fish species most landed (by weight) from small-scale fisheries in Malawi (average 2013–2017).

Volumes and values of fish moving across borders via informal trade are substantial, and Malawi is not an exception. A recent study (Mussa et al. 2017) reported that over 1 year (between 2015 and 2016) an estimated 24,115 t of fish, valued at USD 41.6 million, was exported from Malawi to neighboring countries. This volume accounts for 19% of average annual small-scale fisheries landings (128,700 t) reported for this period. Dried small pelagic species, such as usipa (*E. sardella*) comprise the bulk of exports (Mussa et al. 2017). Women, men, youths and the elderly all take part in small-scale fisheries trade in Malawi, though women dominate, comprising 66% of traders (Mussa et al. 2017). In Malawi, informal trade associated with small-scale fisheries contributes to the livelihoods of over 50,000 people (FAO et al. forthcoming). These livelihoods create vital trade corridors that ensure fish reach regions farther away from waterbodies (Funge-Smith 2018). In Malawi, these corridors ensure highly nutritious dried small fish are accessible to 76% of rural poor households living far from fisheries (Simmance et al. forthcoming).

2.2. Economic benefits across small-scale fisheries supply chains

Employment in small-scale fisheries

In 2020 approximately 70,000 people, of which 314 were women, were reported to be directly employed in the harvesting aspect of small-scale fisheries. Data collected on harvesting engagements include gear owners, skippers and crewmembers. Employment in pre-harvest (e.g. boat and gear making, provisioning) and post-harvest (e.g. processing, trading, marketing) activities is not monitored in this survey. The Integrated Household Survey (2016) administered by the National Statistics Office includes a series of questions dedicated to fisheries (Béné et al. 2012) and provides a more complete picture of small-scale fisheries employment. Analysis of this dataset as a component of the Illuminating Hidden Harvests (IHH) initiative (FAO et al. forthcoming) reported that 217,000 people were engaged in small-scale fisheries livelihoods in Malawi. Of these, 157,000 were employed directly in fishing and pre- and post-harvest activities, while a further 60,000 were considered subsistence fishers, meaning those who only fish for food (Figure 4). This data suggests that



Note: Subsistent fishers are defined as those who engage in small-scale fisheries livelihoods for fish as food only, compared to those fishing for sale. Dependents are the total number of small-scale fisheries household members.

Source: IHS 2017 (FAO et al. forthcoming).

Figure 4. Estimated number of people engaged in small-scale fisheries livelihoods in Malawi.

3.3% of all households, or nearly 1 million people (household members, dependents), are deriving support from small-scale fisheries livelihoods.

The role of women in Malawi's small-scale fisheries

In Malawi, the roles of women and men in small-scale fisheries are shaped by gender norms, traditions and cultures, as well as intra-household dynamics and power relations (Funge-Smith 2018; Simmance et al. 2021). Women are primarily engaged in processing and trading, but data on women's employment in fisheries is sparse. A single study (Muss et al. 2017) found that 66% of fish traders are women. Women largely process and trade dried small fish, as smoked and fresh fish are more perishable and have higher costs in processing and handling, meaning that it is ultimately harder to secure good prices (Kambewa et al. 2009). Fish harvesting is often deemed too dangerous and physically demanding for women, and the travel involved in trading in distant markets is viewed as too risky for young women (Simmance 2017). In Lake Chilwa, women gear owners accompany the crew for fishing operations (Manyungwa et al. 2019). In the fisheries of the Songwe River, women of the Nyakyusa tribe fish using mosquito nets, cast nets, open baskets locally known as kiyasha, and poisonous plants (mkondo) (Funge-Smith 2018). They fish mainly in small pools along the river when water levels have receded from October to December. These fishers target small fish, such as cichlids and cyprinids (locally called *magheghe*), barbus and catfish. In other instances where women fish, their fishing tends to be close to home and to the shores in shallow waters and floodplains, where they fish with baskets, fish traps and small seine nets. Women consider fishing in the floodplains convenient since they can combine fishing and working in the rice fields or gather wild plants.

Small-scale fisheries livelihoods

Small-scale fisheries provide livelihoods for over 200,000 women and men, and engagement in small-scale fisheries is associated with lower income poverty in rural areas of Malawi

Analysis of household income and expenditure survey data revealed that households engaging in small-scale fisheries livelihood activities (harvesting, processing and trade) are frequently less income poor than those focused on agricultural livelihoods, and even many with non-agricultural incomes, particularly in rural settings (Simmance et al. forthcoming). Households of all wealth groups engage in fisheries, including those headed by a single female, but fishing households overall have contextually relatively high financial capital (Simmance 2017; Simmance et al. 2021). In addition, small-scale fisheries in some contexts remain accessible year-round, including during climate-induced agricultural lean periods (Simmance et al. 2021). For example, one study (Simmance 2017) found that fishing households experienced food insecurity for 3 months of the year compared to 10 months experienced in non-fishing households. Other studies in the country have also shown that fishing communities often have higher asset wealth than non-fishers (Aberman et al. 2018; O'Meara et al. 2021). Simmance et al. (2021) captured voices and lived experiences of small-scale fishers which highlighted the benefits and challenges of the sector. As an example, one female fisher stated: "In fishing we have challenges but the benefits surpass the challenges ... without fishing I would not have been able to buy clothes for my family and food to support them." Small-scale fisheries thus can be an important driver of household, village and rural economies, underpinning sustainable development. The benefits from small-scale fisheries are highly context specific and shaped by several factors, including local ecosystem health and productivity, type of fish-related activities, gender relations, and socioeconomic and cultural contexts (Fiorella et al. 2014; Simmance 2017).

Small-scale fisheries communities can be marginalized from access to basic services

Although small-scale fisheries communities are not always income poor, they can experience increasing vulnerability to shocks (e.g. climate disturbances) and wider dimensions of poverty. In Malawi, the remote and rural contexts of small-scale fisheries communities mean they are often marginalized from basic services (e.g. credit and health care), exposed to increased health risks (e.g. HIV/AIDS and water-borne diseases) and multiple shocks (Béné and Friend 2011; Parker et al. 2012; Simmance et al. 2021). Incidences of HIV and AIDS in fishing communities can be five to 10 times higher than in the general population (Nagoli et

al. 2010) due to risky sex-for-fish transactions, and where vulnerable populations are often attracted to fisheries as a last resort (Jul-Larsen et al. 2003; Allison and Seeley 2004). HIV and AIDS related deaths result in loss of experienced labor among fishing communities, loss of livelihoods of fishing families and loss of living standards. As a result, this reduces a community's overall capacity and willingness to participate in natural resource management (Nagoli et al. 2010).

2.3. The contribution of small-scale fisheries to food and nutrition security

The nutrient contributions of Malawi's small-scale fisheries

Key fact: Fish are rich in micronutrients, fatty acids and quality protein and have a nutrient profile that addresses many of the nutrient deficiencies experienced by the people of Malawi.

In Malawi, almost one in five people experience hunger, and 81% of the population experience moderate to severe food insecurity at some time in the year, with rates highest in rural settings (FAOSTAT 2021). Malawi also has among the highest levels of childhood stunting (37% in children under 5 years old) (FAOSTAT 2021).

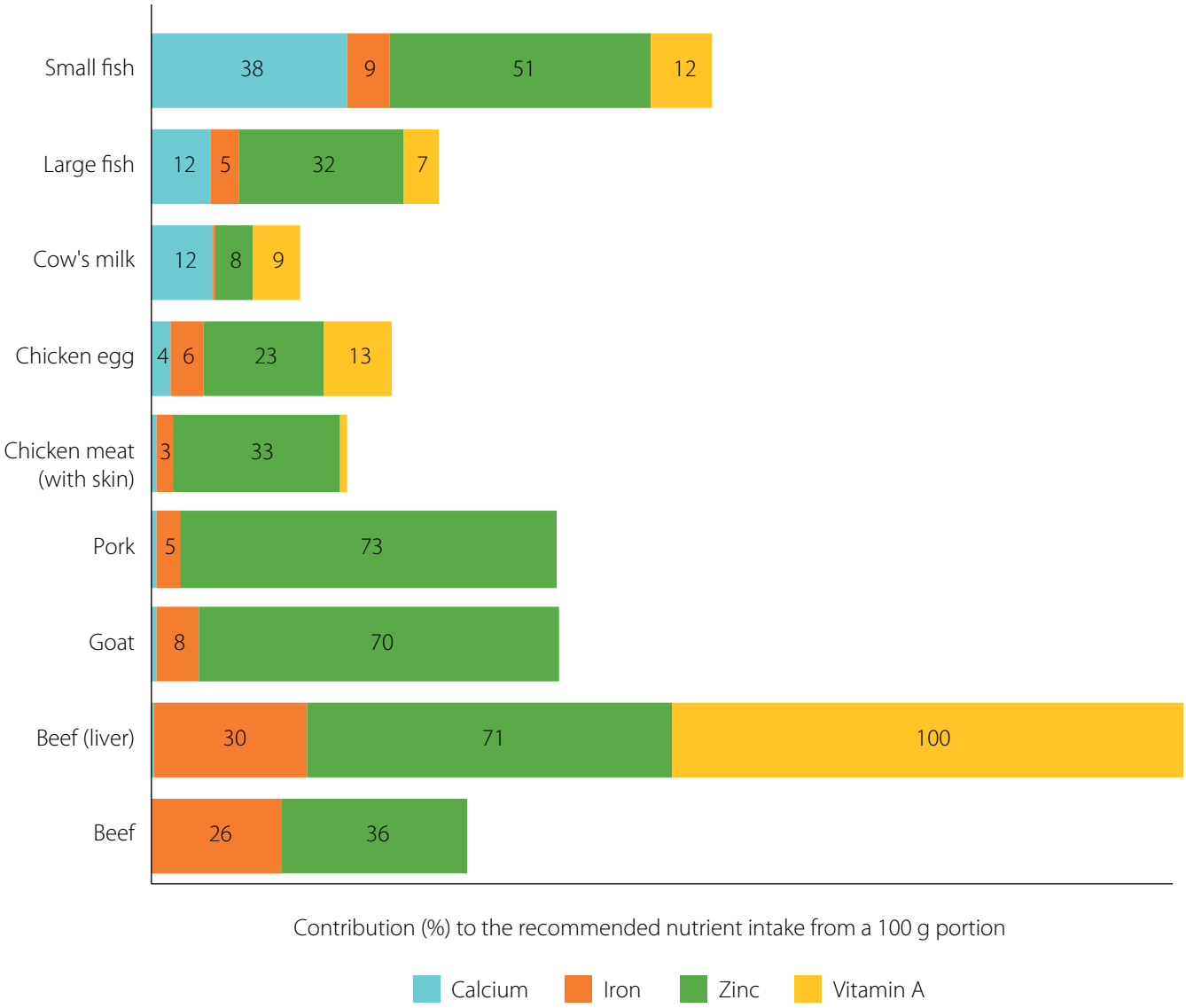
In southern Malawi, fish was found to be the most commonly consumed animal protein and its consumption led to a decrease in stunting levels among children aged 12–36 months (Kaimila et al. 2019) (Box 1). Fish in general are nutrient-rich; however, there are variations in nutrient qualities between different fish species (Hicks et al. 2019). Assessing nutrient composition from fish samples is prohibitively expensive, and as a result there is limited nutrient data from freshwater species globally, but particularly from the inland fisheries of low and middle income countries (Byrd et al. 2020). New modeling approaches (Hicks et al. 2019) have been applied for the first time to species from inland fisheries, producing new estimates for species and for Malawi's small-scale fisheries as a whole (Figure 5 and Table 1) (FAO et al. forthcoming).

Fish from small-scale fisheries in Malawi are rich in multiple nutrients relative to other animal-source foods (Figure 5), with different species having different nutrient compositions (Table 1). One

Using a net to catch chambo in Lake Malawi.

Box 1. Nutrition and health benefits of fish.

Fish are now widely recognized as a nutrient-rich food with high concentrations of multiple micronutrients (such as vitamin B12, vitamin A, calcium, zinc and iron), omega-3 fatty acids (Byrd et al. 2021) and high quality protein (Michaelsen et al. 2009; HLPE 2014). Consumption of fish alongside other healthy foods can also increase bio absorption, for example increasing absorption of iron found in plant sources (HLPE 2014). Consumption of fish is associated with a range of nutrition and health benefits even when consumed in small amounts and/or seasonally (Bogard et al. 2017). Consumption of fish has been associated with reduced risk of anaemia (Nguyen et al. 2018), cardiovascular and Alzheimer's diseases (Swanson et al. 2012), type 2 diabetes and some cancers (HLPE 2014). Fish consumption is also potentially associated with reduced stunting in children 6–23 months old, though more evidence is needed (Headey et al. 2018; Marinda et al. 2018b).



Note: Bars represent the contribution a 100 g portion of an animal-source food provides of four key nutrients relative to the recommended nutrient intake (RNI) for an adult women (age 19–50 years). For each nutrient, the value within the bar represents the percentage contribution to RNI, while total bar length provides a measure of nutrient richness. Estimates are based on the nutrient profiles of Malawi fish species and other animal-source foods.

Source: MAFOODS 2019; FishBase 2021; FAO et al. forthcoming.

Figure 5. Contribution of animal-source foods to the recommended daily intake of nutrients.

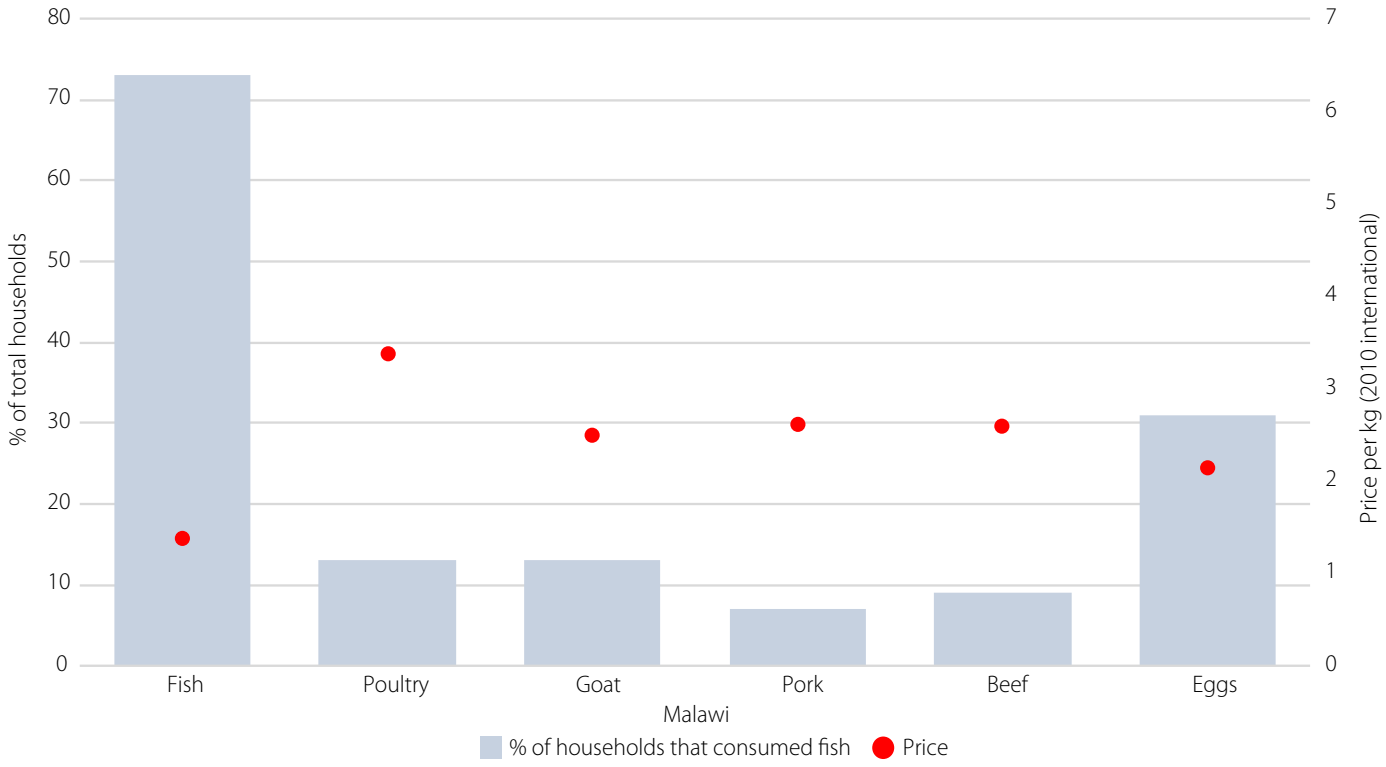
example is if fish are dried and eaten whole, which is common for usipa (*E. sardella*) (Kawarazuka and Béné 2011). Although sun drying reduces vitamin A concentrations in fish, it can increase nutrient concentration four times by removing water (HLPE 2014; FAO et al. forthcoming). Fresh and dried fish are rich in key micronutrients relative to other animal-source foods. In Malawi, beneficial omega-3 fatty acids are found in higher concentrations in breastmilk relative to global averages, which is attributed to high rates of fish consumption (Jimenez et al. 2015). Furthermore, the mean levels of arachidonic acid (omega-6 fatty acid) and docosahexaenoic acid (omega-3 fatty acid) were twice the national average among women of Mangochi District close to Lake Malawi, likely because they regularly consumed usipa (Brenna et al. 2007; Jimenez et al. 2015). Furthermore, children in Malawi consuming relative high proportions of animal-source foods (mainly fish) had a reduced prevalence of stunted growth (Kaimila et al. 2019), which is a symptom of malnutrition and poor health.

Food environments: Physical and economic access to fish from small-scale fisheries

Fish from small-scale fisheries are the most available and affordable animal-source food in Malawi

Fish in Malawi, particularly small fish from small-scale fisheries, are often more available and affordable than other animal-source foods. Fish, particularly dried small fish, is cheaper than poultry, goat, pork and beef, though more expensive than eggs (Simmance et al. forthcoming) (Figure 6). However, relative affordability and access can vary sub-nationally (Kodish et al. 2015; Simmance et al. forthcoming).

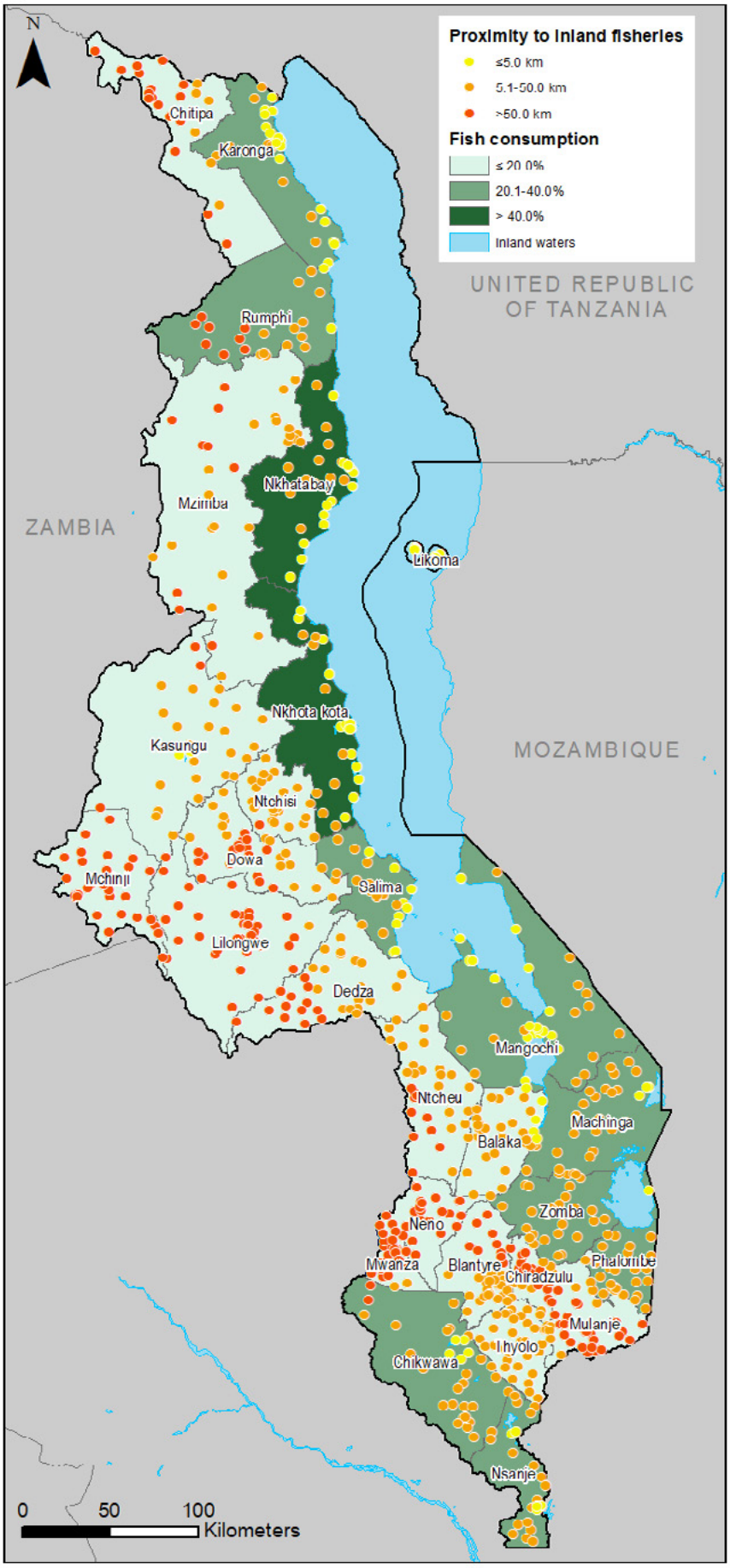
Small fish, such as usipa, play a key role in low-cost diets, particularly in rural areas of Malawi (Yan et al. 2021) and can be accessible throughout the year (Schneider et al. 2021). In urban areas in Malawi, fish consumption is price-sensitive. In one study (Chikowi et al. 2021), increases in fish prices reduced fish consumption by 22%–51%, while in another increased dried fish consumption was triggered by decreasing prices (Aberman et



Note: Percentage of total households (n=12,447) that consumed some portion of animal-source foods in the 7-day recall period. Price of foods are based on surveyed household purchases (average price per kilogram in international USD).

Source: IHS 2017; Simmance et al. forthcoming.

Figure 6. Household consumption of animal-source foods and prices of foods purchased in Malawi.



Note: Green shading represents the percentage of children who consumed fish in the previous 24 hours. Yellow dots represent children living in close proximity to a waterbody where fisheries are known to operate. Yellow dots may obscure smaller water bodies due to scale of image.

Source: O'Meara et al. 2021.

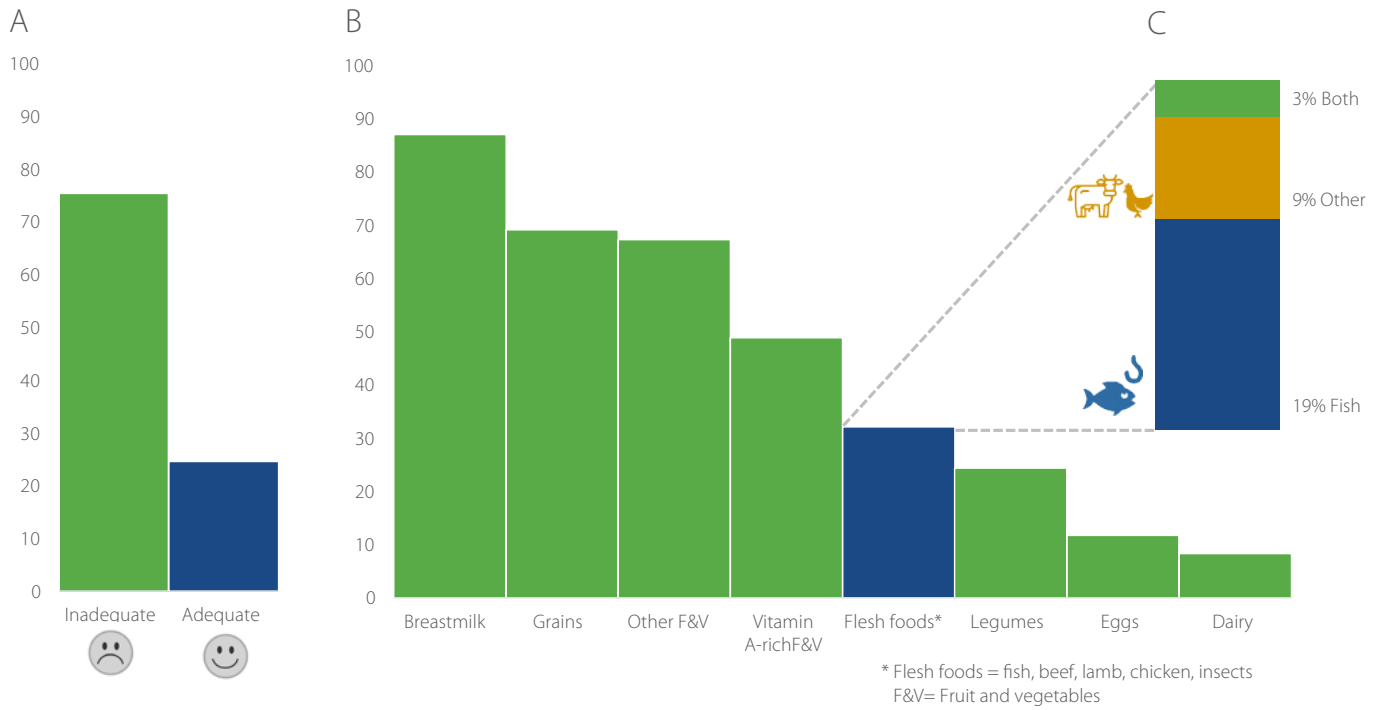
Figure 7. Map showing prevalence of fish consumption of children aged 6 months to 2 years by district.

al. 2018). In addition, proximity to urban markets can increase access to fish for mothers and children (Thakwalakwa et al. 2020), while in rural areas proximity to small-scale fisheries is a major factor driving access (O'Meara et al. 2021). Data comparing prices between fish species, form (e.g. dried, smoked, fresh) and size is limited, partly due to non-standardization of measurements between studies (e.g. "heaps" of fish). Dried small fish species, such as usipa (*E. sardella*), can be 2–3 times cheaper than larger fish species such as mlamba (*Clarias gariepinus*) and chambo (*O. karongae*) by dry weight (Hocart 2017). In Lake Chilwa, small fish, such as matemba (*E. paludinosus*), are one of the cheapest fish to purchase and are highly productive throughout the year (Simmance 2017), with no seasonality in prices (Bai et al. 2021). As such, small fish are among the most nutritious foods available and accessible to people in Malawi, and its dried form extends seasonal availability and underpins distribution to remote populations.

Fish is the main animal-source food consumed within households in rural and in urban environments

People in Malawi consume, on average, 11 kg of fish a year (Simmance et al. forthcoming). This meets the EAT Lancet universal recommendation of fish consumption for a sustainable and healthy diet (28 g per day or 10.2 kg each year) (Willett et al. 2019). To meet this level of annual fish consumption for Malawi's entire population equates to about 178,000 t of fish, which is 25% higher than the government's reported average landings of 143,000 t (GOM 2020). This discrepancy suggests small-scale fisheries catches substantially exceed current estimates of catch because imports of fish are relatively small compared to exports from small-scale fisheries (Mussa et al. 2017).

Diets in Malawi have shifted over time. Between 2010 and 2017, meat consumption declined,



Note: Data is from recall surveys of food consumed in the previous 24 hours, which provides a standard measure of dietary diversity (the number of food groups consumed out of eight groups in total): (A) children's dietary diversity scores demonstrating that majority of children (i.e. 75%) had inadequate (poor) dietary diversity as defined by the World Health Organization's cut-off of consuming five (adequate) of the eight food groups (B); and (C) of the children who consumed flesh foods, the largest share ate fish (19%).

Source: Demographic and Health Surveys for Malawi in O'Meara et al. 2021.

Figure 8. The dietary diversity of Malawi's rural children (n=3995) aged 6 months to 2 years.

while fish consumption increased (Gilbert et al. 2019). In 2017, 73% of households, or 12 million people, across rural and urban settings reported consuming fish over the previous 7 days, whereas 31% had consumed eggs and less than 13% had consumed any other type of animal-source food, such as beef, poultry, goat and pork (IHS 2017; Simmance et al. forthcoming) (Figure 6).

Although fish is widely consumed across households, O'Meara et al. (2021) found that only 22% of rural children (aged 6–23 months) in Malawi had consumed fish in the previous 24 hours. When the meal is divided among household members in Malawi, household members individually may not receive adequate nutrients, with young children and women of reproductive age being particularly vulnerable (Schneider et al. 2021). Infant nutrition can be increased with awareness programming and other interventions. Following a 6-month nutrition education intervention in Blantyre, the prevalence of fish consumption among malnourished children increased from 22% to 47% (Buonomo et al. 2012). Other studies found wide variation in access to, and consumption of, fish among children and adults (Kaimila et al. 2019; Stewart et al. 2019).

Living close to small-scale fisheries increases physical access to fish as food and reduces inequalities in access to fish for the poor

Inequalities exist in access to fish. Two studies investigating geographic variation in fish consumption found that households (Simmance et al. forthcoming) and children (O'Meara et al. 2021) living near small-scale fisheries were 10–13 times more likely to consume fish than those living distant from fisheries. However, consumption drops rapidly with distance from a fishery. For every 1 km a Malawian child lived farther from a small-scale fishery, the likelihood of them eating fish dropped 20% (O'Meara et al. 2021). Children living near shorelines of major lakes and rivers were more likely to eat fish than those living farther away (Figure 7). For example, among children aged 6 months to 2 years living around Lake Malawi, over 82% in Likoma District, 47% in Nhotakota District and 43% in Nkhata Bay District ate fish prior to a 24-hour dietary recall (O'Meara et al. 2021). This represents 7-13 fold greater fish consumption in children from the districts close to lakes and rivers compared with Ntchisi District, which is far from a fishery, where only 6% of children had consumed fish the day before (O'Meara et al. 2021). At the household level, inequalities in fish consumption between households in the upper and lower income quintiles dropped 50% among those living within 5 km of water bodies (Simmance et al. forthcoming). Several studies in the region also found that households engaged in small-scale fisheries have higher fish consumption through increased physical access to fish (Darling 2014; Simmance 2017; Moreau and Garaway 2018).

Extensive trade of dried fish is important for improving access to nutritious food in remote rural areas

Across Malawi, 96% of fish consumed is purchased, but for fishing households this share is smaller and 41% of fish consumed is either self-caught or produced (Simmance et al. forthcoming). A higher share of households in Malawi consume dried small fish (71%) than fresh (28%) or smoked (28%) fish (Simmance et al. forthcoming). Living in proximity to water bodies supporting small-scale fisheries influences the form of fish consumed. Fresh fish consumption in rural areas was over four times higher close to small-scale fisheries, whereas dried fish consumption was 1.5 times higher farther from small-scale fisheries. Informal trade of dried fish from small-scale fisheries is substantial in the region (Kakwasha 2017; Mussa et al. 2017; Kakwasha et al. 2020) and is critical for providing access to nutritious food to remote rural and urban populations (Genschick et al. 2018).

Consumer behavior and fish consumption

Fish consumption is shaped by consumer choices and preferences, where dried small fish are often preferred because they are more affordable, easier to prepare and taste better (de Bruyn et al. 2021). In Malawi, the majority of consumers, particularly in rural communities, purchase fish from markets and through supply chains that operate without refrigeration (Hocart 2017). Taste is a key factor in fish choice for Malawi consumers (de Bruyn et al. 2021). In studies of fish choice, taste was an important predictor of higher fish consumption in Blantyre and Lilongwe (Chikowi et al. 2021), Lilongwe and Kasungu (Thakwalakwa et al. 2020) and on the shores of Lake Chilwa in Zomba where small fish are often ranked tastiest (Simmance 2017). Perceptions on nutritional value, quality and

ease of preparation (including using less fuel for cooking) also influence choices to consume certain fish species (Simmance 2017). Also, consumers hold cultural and religious beliefs around certain fish species, with chambo (*Oreochromis spp.*) being preferred for celebrations and special events, and mlamba (catfish), a taboo in certain religions, is believed to cause ill health in children due to infestation of parasites (Simmance 2017).

The contribution of small-scale fisheries to dietary diversity

Children and households are more likely to have higher dietary diversity if they live within 5 km of fishing grounds, where 19% of Malawian children rely on eating fish as their main flesh food

Fish from inland small-scale fisheries contribute to dietary diversity and are a nutrient-rich form of animal-source food. Dietary diversity refers to the number of a total of eight different food groups (as defined by the Food and Agricultural Organization) a child consumes. A higher dietary diversity score means that a child's diet is more likely to be adequate in the nutrients required for optimal growth and health. The contribution of fish to dietary diversity, and the relative importance it plays to nutrition differs among age groups, urban and rural settings, proximity to fishers, wealth, gender and age.

In rural parts of Malawi, 75% of children had poor dietary diversity (O'Meara et al. 2021). Overall, animal-source food consumption is low, like other low-income contexts. However, 19% of Malawian children had a higher dietary diversity score because they ate fish (Figure 8). The average number of food groups consumed was three out of eight. This means that if fish became unavailable in the diets of the children who rely on fish for higher dietary diversity, more than 100,000 rural Malawian children aged 0–2 years could be at risk of a 30% decline in dietary quality (O'Meara et al. 2021). This would increase the risk of micronutrient deficiencies (Byrd et al. 2021) and stunting (Headey et al. 2018).

Children living less than 5 km from inland water bodies where small-scale fisheries operate, such as Lake Malawi, were more likely to eat fish and have better dietary diversity, irrespective of other animal-source food intake (O'Meara et al. 2021). The link between proximity to water bodies and higher rates of fish consumption has also been found in other parts of Malawi: in Machinga (by Shire River and Lake Chiuta) and Nsanje (by Lake Chilwa) as well as among communities living close to Lake Malawi (de Bruyn et al. 2021). In urban settings, wealthier households tend to have higher fish consumption (Marinda et al. 2018). In Blantyre and Lilongwe, households with higher incomes tend to choose fresh fish over smoked or dried tilapia (Chikowi et al. 2021).

Food safety of fish from small-scale fisheries

Food safety and quality concerns relate to all types of food. The implications for human health and potential losses of nutritious foods and nutritional value are of major concern globally. Small-scale fisheries face particular challenges linked to land-based contaminants affecting inland and nearshore fishstocks, and limited access to quality processing and market chain infrastructure, services and information. Antimicrobial resistant *E. coli* and *Salmonella* spp. have been documented in fish appearing in markets, but little is known about the full extent of food safety contaminants in the Malawian fish industry. In nearby Uganda, however, aflatoxin, a contaminant associated with child stunting, has been detected on dried cyprinid fish (Kigozi et al. 2020). Traditional methods of preserving fish, 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 (Essumang et al. 2014; Hasselberg et al. 2020).

Food safety risks can be mitigated by improving cold chain technologies, storage 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 (FAO 2011). Given that fish is essential for nutrition and health in Malawi, supply chain improvements that lead to both higher quantity and quality of available fish can be expected to contribute directly to nutrition security. Furthermore, because of the long shelf life of dried fish from small-scale fisheries, research is needed on the impact of extended storage periods on the safety and nutritional value of the fish.

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

3.1. Technology and infrastructure drivers: Waste and loss in small-scale fisheries value chains

In the past 10–15 years, the species composition of fisheries catches in Malawi has shifted from being dominated by large cichlids, catfish and cyprinids to instead comprising mostly small pelagic fish species, mainly usipa (*E. sardella*), utaka (*Copadichromis* spp.) and kambuzi (*Haplochromines* spp.) (Kolding et al. 2019; Torell et al. 2020). These small fish species, however, are often most perishable and are subject to high post-harvest losses due to spoilage. Small-scale fisheries face particular challenges linked to land-based contaminants affecting inland and nearshore fishstocks, and limited access to quality processing and market chain infrastructure, services and information. Substantial physical and quality losses of small fish have been reported in Malawi at the beach (43%), processing (54% and marketing nodes (69%) (Troell et al. 2020). These losses are due to inadequate techniques and infrastructure for handling, processing, packaging and preservation that often fall short of minimum hygiene standards and result in microbial contamination, poor taste and nutrient losses.

There are substantial gains to be made from investing in improved post-harvest processes. A 1% increase in fish supply in Malawi, such as via reducing waste and loss across supply chains, could supply approximately an additional 180,000 people with the recommended intake of 10 kg

Open sun drying of fish in Lake Chilwa, Malawi.

of fish a year for a healthy diet (Willett et al. 2019; Simmance et al. forthcoming). Scaling existing technologies that improve fish processing and distribution, such as cold chains and cold storage, improved solar drying facilities and improved handing techniques, can improve fish quality and ultimately nutrition outcomes from fish. For them to work, however, they must do so while increasing consumer awareness and addressing social barriers and constraints, including those that contribute to unequal time and labor burdens. Nonetheless, some bottlenecks to scaling remain and need further attention, such as improving the economic viability of solar drying technologies for small-scale fisheries.

3.2. Economic and market drivers: Fish supply and trade

Fish from domestic small-scale fisheries leave Malawi through extensive intraregional informal trade (Kolding et al. 2019). Malawi is described as the fish basket for Southern and Eastern Africa (Funge-Smith 2018). Small pelagic fish such as usipa from Lake Malawi is the most traded fish commodity exported informally to neighboring countries Mozambique, Zambia and Tanzania (Mussa et al. 2017). Not all fish exported is used for human consumption, as volumes of small fish are used as fishmeal and fish oil ingredients in the aquaculture industry. Evidence from the African Great Lakes indicates that small fish are becoming increasingly inaccessible to the most vulnerable, caused by high demand from the aquaculture feed industry (Wesana et al. forthcoming). In addition, there are concerns about the environmental and human health impacts associated with processing small fish to produce fish-based feeds (Cowx and Ogutu-Owhayo 2019; Kolding et al. 2019; Thiao and Bunting forthcoming). Directing small fish away from human consumption for use as animal feed clearly reduces the potential of these fish to contribute to local nutrition security. In addition, comparative studies of the nutritional value of fish imports and their accessibility to vulnerable populations, such as the rural poor, would shed light on the outcomes of the import-export trade-off in the country. Support for fish traders and improved trade policies that do not undermine local food and nutrition security are required to optimize the nutritional benefits from small-scale fisheries.

3.3. Environmental drivers: Climate change, disease vectors and natural resource degradation

Inland fisheries face many environmental challenges, from altered water flows, land-use change, habitat destruction, overfishing and pollution (Barange et al. 2018; Kao et al. 2020; Simmance et al. 2021; WWF 2021). Strengthened integrated policies across the fisheries, forest, agriculture and water sectors and inclusive governance are needed to protect aquatic resources and ensure productive and resilient fisheries. Climate variability is a key driver of many inland fisheries where fish production follows the rains (Kolding et al. 2016) or links closely with water level fluctuation. Periodic shocks, such as drought and extremely low water levels, are characteristic of these systems and have altered the ecology of lakes over time, whereby small highly productive species and adaptable resilient species come to dominate fishery landings (Simmance 2017; Kolding et al. 2019). Climate change will likely bring more variability in rainfall and extreme events, such as flooding, drought and changes in wind patterns (Kolding et al. 2016; Simmance 2017).

Climate variability can bring opportunities for inland fisheries. One example is flood pulses of nutrient inputs, which can increase production. However, declines in catches are also a likely outcome because of drought and low water levels causing biodiversity and productivity losses (Jul-Larsen et al. 2003; Chiotha et al. 2018). A study examining the lived experiences and perceptions of fishers in climate-sensitive Lake Chilwa found that fishers perceived climate variability (drought, floods and seasonal wind) as the main livelihood challenge experienced (Simmance et al. 2021). Land-use change relating to conversion of wetlands for agriculture and deforestation causing sedimentation in lakes has been driving fisheries degradation in the country, but may also increase production through eutrophication and ecological shifts as observed in Lake Victoria (Kolding et al. 2008). One study found that in Lake Chilwa, 80% of the wetland area has been lost over the past few decades due to agricultural expansion with irreplaceable loss of nutrients and income from aquatic resources (Pullanikkatil et al. 2020).

3.4. Political and institutional drivers: Governance of small-scale fisheries

The management of fisheries in Malawi is based on three systems of traditional fisheries management, centralized and participatory co-management (Donda and Njaya 2007). The National Fisheries and Aquaculture Policy of 2016 guides the management of the fisheries in Malawi. The policy recognizes governance as one of the priority areas, and participatory fisheries management as the preferred system (GOM 2012).

Fisheries in Malawi are governed by co-management arrangements in which fishing communities have an equal role in management alongside the government. However, challenges exist in implementing and enforcing co-management rules and regulations, and there are tensions between government and fishing communities (Simmance et al. 2021). For example, the government has implemented closed fishing seasons for parts of the year that coincide with the hunger season for fishing communities (Simmance et al. 2021). In addition, restrictions on certain fishing gear can be challenging for fishers in remote regions who cannot access legal gear (Simmance 2017). The implementation of co-management is constrained by unclear benefits and roles of the communities (Kolding et al. 2019), limited capacity of key stakeholders participating in fisheries, financial constraints and weak cooperation among stakeholders (Njaya 2009). Further on, the implementation of co-management is affected by the limited support to the local management committees, which are central to the concept of participatory fisheries management. Local management committees in lakes Malawi, Malombe and Chilwa face several challenges. There are power struggles among powerful village headmen struggling to control fisheries benefits. There is also legal ambiguity as to whether the local management committee members should be elected or appointed. In addition, the local management committee composition often reflects the village headmen's interests and not the population as a whole (Hara 2008; Donda et al. 2014).

Fisheries management and supplies of fish for food and nutrition must account for the dynamic nature of Malawi's fisheries systems. For example, Lake Chilwa in southern Malawi is a shallow climate-sensitive lake that is one of the most productive lakes in Africa in terms of area, but it is also one of the most unpredictable (Jul-larsen et al. 2003). Fish production follows the rains and inflows, where lake level fluctuations drive good and bad years of fisheries (Kolding and van Zwieten 2011; Simmance 2017). Periodic drought throughout Lake Chilwa's history has caused regime shifts in species composition. The African catfish (*Clarius gariepinus*), which is resilient to low-water levels, as well as two small fish species (*Enteromius paludinosus* and *Oreochromis shiranus chilwa*), dominate catches (Simmance 2017). Although the catfish is most resilient to climate fluctuation and available throughout the year, it has relatively low nutritional value compared with small fish species (Table 1) and is least preferred by local consumers. It is also regarded as taboo in certain cultures and religions and believed to cause illness in children (Simmance 2017). Fisheries management and governance need to conserve refuges of small fish species, particularly at vulnerable times of drought (Njaya et al. 2011).

3.5. Sociocultural drivers: Rights of women in small-scale fisheries

Women are generally poorly represented in fisheries governance in Malawi (Manyungwa et al. 2019). For instance, at the technical level, there is only one female serving in a senior management role (deputy director) within the Department of Fisheries among four male staff. At the community level, representation of women in governance structures is nominally stronger, at 43%. However, there are no woman chairs (heads) of local fisheries committees, and the majority of women are engaged as rank-and-file members of the committees. With regards to empowerment benefits from small-scale fisheries, women and men at the household level engage in joint decision-making on the use of money that accrues from participating in the fisheries supply chain activities (Manyungwa et al. 2019). Despite these benefits, women living in the lakeshore communities continue to face challenges such as limited access to and control over capital, land, agricultural inputs, technologies, and leadership opportunities (FISH 2015). The participation of women in small-scale fisheries is thus mostly constrained to fish processing and trading, two activities associated with high post-harvest losses and vulnerability to price fluctuations (Torell et al. 2020).

In terms of policy, the National Fisheries and Aquaculture Policy mentions gender and women within policy priority 4 (on principles of governance, inclusiveness, accountability and equity) and policy priority 5. It does so in regards to social development and decent employment, which seeks to enhance and increase attention on small-scale fisheries and promote gender equality as a prerequisite for the improvement and socioeconomic sustainability of the sector and the empowerment of fishing communities (GOM 2012). While this policy provide provisions recognizing women, gender inclusivity and gender sensitivity, there is often limited social inclusion to accommodate economic fairness since women do not command and control large and more productive assets, such as boats, engines and their fishing gear. Women face unequal inheritance and legal rights even on assets owned by their male relatives (Nagoli et al. 2019).

3.6. Demographic drivers: Urbanization and food environments

Economic development, urbanization and population growth are shifting diets and broader food systems. Malawi is characterized as mainly rural, with 83% of its approximately 19 million population living in rural areas, and 17% in urban (FAOSTAT 2021). In urban areas, fresh fish can be more expensive and so less accessible to poorer households (Chikowi et al. 2021), whereas small fish, particularly in dried form, are often still the main accessible animal-source food for the urban poor (Marinda et al. 2018). Strategies, however, are needed to leverage the nutritional, low cost and preservation benefits of dried small fish for people who reside in rural areas that are far from small-scale fisheries (O'Meara et al. 2021).

Photo credit: Patrick Dugan/WorldFish

Checking line, Lake Malawi, Malawi.

4. Conclusion: Safeguarding and enhancing the contribution of small-scale fisheries to Malawi's food system and the Sustainable Development Goals

Small-scale fisheries provide diverse values that underpin the SDGs in Malawi. They are also a foundation of sustainable food systems for a healthy people and environment. Small-scale fisheries supply 90% of the fish (or 143,000 t each year) flowing through Malawi's food system and provide livelihoods for over 217,000 women and men, which in turn support household income and the food and nutrition security of over one million people (GOM 2020; FAO et al. forthcoming). Dried small fish from small-scale fisheries nourish over 11.9 million people in Malawi and are the most accessible animal-source food for the urban and rural poor (Simmance et al. forthcoming). Small-scale fisheries also act as one of the most sustainable food sectors with the lowest environmental footprint compared with other animal-source food systems (Ainsworth et al. n.d.; Hilborn et al. 2018).

The loss of these benefits would be devastating to Malawi. They would lead to failure and deterioration against (at least) SDG 1 (ending poverty), SDG 2 (ending all forms of hunger), SDG 3 (improved health), SDG 12 (sustainable and efficient use of natural resources) and SDG 14 (sustaining life below water). Despite the modest existence and growth of aquaculture, quantitative projections demonstrate that capture fisheries will remain the most important source of fish for Malawi for decades to come (Chan et al. 2019). As such, it is critical that opportunities to sustain and optimize the values of the small-scale fisheries sector are fully explored and used. There are many opportunities in Malawi to make better use of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication. Strengthening commitment and implementation of these guidelines can safeguard the SSF benefits for Malawi's societies, local economies and natural environments.

Four opportunities in particular could safeguard and enhance the contribution small-scale fisheries make to Malawi's food system and the SGDs:

4.1. Improve management and sustainable production

Inclusive governance and effective management of small-scale capture fisheries can be achieved through collaborative forms of management, specifically co-management of resources and resource use. This would involve fishers and supply chains actors who work in collaboration with government agencies. Effective management of supplies will also rely on integrated policies that address drivers and change at the food-water nexus. Improving data and representation of small-scale fisheries values in reporting and statistics provides greater opportunities for adaptive management and ensures proportionate investment and governance attention.

4.2. Reduce loss and waste

Addressing inequities, inefficiencies and losses in small-scale fisheries supply chains provides substantial and relatively untapped potential to increase supplies and improve elements of human well-being and economic development. Innovations that have been tested and found to be effective include bundling social (e.g. gender-transformative approaches) and technical innovations (e.g. solar drying tents and new fish-based products). Both address waste and loss and enhance supply of fish to vulnerable populations.

4.3. Optimize nutritional benefits of fish and other aquatic foods

Using fish from small-scale fisheries to improve nutrient intakes in children in the first 1000 days of life provides substantial opportunities to address malnutrition and avoid the knock-on costs to individuals and societies. These opportunities are available by governing fish trade in ways that improve and secure the use of small fish for local nutrition, as well as integrating fish-based products (e.g. powdered small fish) into school feeding and nutrition programs (Ahern et al. 2021; Byrd et al. 2021).

4.4. Support actors and reduce inequalities within small-scale fisheries

Fishing communities can experience wider dimensions of poverty, such as lack of access to financial and health services. They also face inequalities. For example, fisheries and agricultural smallholders, women in particular, experience greater degrees of marginalization from resource access, markets and decision-making processes. These inequities undermine and reduce the availability of small-scale fisheries and the provision of benefits to society, and prevent fishers from engaging effectively in resource management.

Mrs. Bitinesi drying her fish in a solar tent dryer in Lake Malawi.

Note

[1] Small-scale fisheries are traditional, subsistence and small or medium fishing enterprises involving individuals, households or small groups (as opposed to commercial companies) engaged in fishing with small capital inputs and lower capacity gears and vessels, such as canoes (often non-motorized), or no vessel at all, which catch fish and other aquatic foods for subsistence or local markets. Small-scale fisheries can be used to describe and include pre- and post-harvest labor, in addition to harvesting labor (adapted from FAO 2020).

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Food name / Fish species (with local name)	Calcium (mg)	Iron (mg)	Selenium (mcg)	Zinc (mg)	Vitamin A (mcg, RAE)	Omega_3 (DHA+EPA) (g)	Protein (g)
Large* freshwater fish							
Bagrus meridionalis (catfish, kampango)	59.0	0.9	96.7	0.9	42.7	0.1	16.4
Clarias gariepinus (catfish, mlamba)	20.1	1.6	73.3	0.5	32.3	0.2	17.3
Clarias ngamensis (catfish, mlamba)	87.9	1.0	143.1	0.7	29.7	0.3	16.7
Labeo mesops (nchila)	201.8	0.8	234.9	1.5	11.8	0.2	16.1
Opsaridium microcephalum (sanjika)	238.5	1.9	60.0	1.5	66.9	0.3	17.4
Opsaridium microlepis (mpasa)	184.1	1.6	64.3	1.4	62.4	0.3	17.4
Oreochromis karongae (chambo)	19.9	1.7	59.5	2.3	12.2	0.2	17.5
Oreochromis Shiranus (chambo)	30.9	1.8	64.5	2.1	5.8	0.4	17.2
Oreochromis squamipinnis (chambo, kasawala)	22.4	1.8	57.5	2.4	13.8	0.2	17.5
Rhamphochromis longiceps (mcheni)	195.3	2.3	45.5	2.0	50.5	0.3	19.1
Tyrannochromis macrostoma (chisawasawa)	207.6	1.5	65.5	1.6	53.4	0.2	18.1
Average for large freshwater fish	115.2	1.5	87.7	1.5	34.7	0.3	17.3
Small* freshwater fish							
Aulonocara gertrudae (chingong'u)	327.7	2.0	44.5	3.2	42.3	0.3	17.7
Copadichromis virginalis (utaka)	246.0	1.6	45.6	2.5	59.2	0.3	17.9
Diplotaxodon argenteus (ndunduma)	202.7	1.6	46.2	1.9	110.4	0.4	18.2
Engraulicypris sardella (usipa)	735.8	7.0	59.2	2.2	49.1	0.3	17.1
Enteromius paludinosus (matemba)	637.8	2.4	51.3	2.5	47.4	0.4	17.5
Opsaridium tweddleorum (dwarf sanjika)	542.2	2.6	44.5	2.1	107.2	0.4	17.2
Protomelas kirkii (mbaba)	256.8	1.7	49.7	2.5	46.0	0.3	18.1
Protomelas similis (kmbuzi)	226.1	2.0	52.2	3.0	24.3	0.3	17.6
Synodontis njassae (nkolokolo)	253.6	1.6	54.7	2.3	43.4	0.3	16.4
Average for small freshwater fish	381.0	2.5	49.8	2.5	58.8	0.3	17.5
Other animal-source foods							
Beef	1	7.5	-	1.77	-	-	20.5
Beef (liver)	7	8.8	-	3.5	4970	-	19.4
Goat	11	2.4	-	3.4	0	-	17.5
Pork	10	1.4	-	3.6	0	-	16.8
Chicken meat (with skin)	8	1	-	1.6	7	-	21.1
Chicken egg	39	1.8	-	1.1	67	-	12.6
Cow's milk	120	0.1	-	0.3	44	-	2.9

Note: This data can also be found on FishBase here. Blue highlights the food items that contain the top three values for each nutrient. Green highlights the food items most nutrient dense, contributing to 25% of recommended nutrient intake for adult women for at least three nutrients. Orange highlights where blue and green overlap. Other animal-source foods and their nutrient values are derived from Malawi's Food Composition Table (MAFOODS 2019).

**Freshwater fish species (small and large) are those most commonly caught from small-scale fisheries in Malawi and are defined as small (maximum length <25cm) and large (maximum length >25cm). Their nutrient values are derived from FishBase and nutrient modeling as part of the Illuminating Hidden Harvests Initiative (FishBase 2021; FAO et al. forthcoming).*

Source: MAFOODS 2019; FishBase 2021; FAO et al. forthcoming.

Table 1. Nutrient content of fish species from small-scale fisheries in Malawi and other animal-source foods (per 100 g of edible fish).

WorldFish

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.

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