Making the case for fish!

Food and nutrition security through smallholder aquaculture

Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

Content

In the ongoing struggle for food and nutrition security worldwide, the importance of fish as a key component of human nutrition should not be underestimated. Commissioned by the German Federal Ministry for Economic Cooperation and Development, GIZ's *Global Programme Sustainable Fisheries and Aquaculture* (GP Fish) aims, through this paper, to provide evidence on the role of fish in addressing malnutrition and supporting healthy diets, particularly for food-insecure households. It is directed to professionals working in the field of food and nutrition security as well as rural development and investigates questions like "Does fish feed the poor, or is it too expensive?" By combining scientific insights with hands-on data from years of field experience, supplemented by practical examples, it aims to provide a broad overview of the current state in selected countries and a path forward.

Key words: *Food and nutrition security, Fish, Healthy diet, Aquaculture*

The nutritional value of fish

Malnutrition is the most important aspect of food and nutrition insecurity and comes in many forms: undernutrition, overnutrition, and micronutrient deficiencies, often referred to as "hidden hunger" [1], [2], [3]. The latter represents a major public health concern and results from inadequate intake of nutrients, such as iron, zinc, calcium, iodine, folate, and different vitamins [1], [4], [5].

Strategies to combat micronutrient deficiencies include supplementation, (agronomic) biofortification, and most importantly diet diversification, which is the focus of contemporary policy discourses concerning the improvement of human nutrition [1], [4], [6], [7]. Diversifying diets by consuming animal proteins can significantly prevent micronutrient deficiencies, especially in low-income food-deficit countries, where diets are predominantly carbohydrate-based [2], [4].

Fish is a highly nutritious food that provides proteins, essential fatty acids, and micronutrients, as shown in **Figure 1**, to the point that it is sometimes referred to as a "superfood" [5], [8]. Due to its nutritional properties, even small quantities of fish can make important contributions to food and nutrition security [2], [9]. This is particularly true for small fish species that are consumed whole – including bones, heads, and guts – in regions where nutritional deficiencies and reliance on blue foods are high [2], [4], [10].

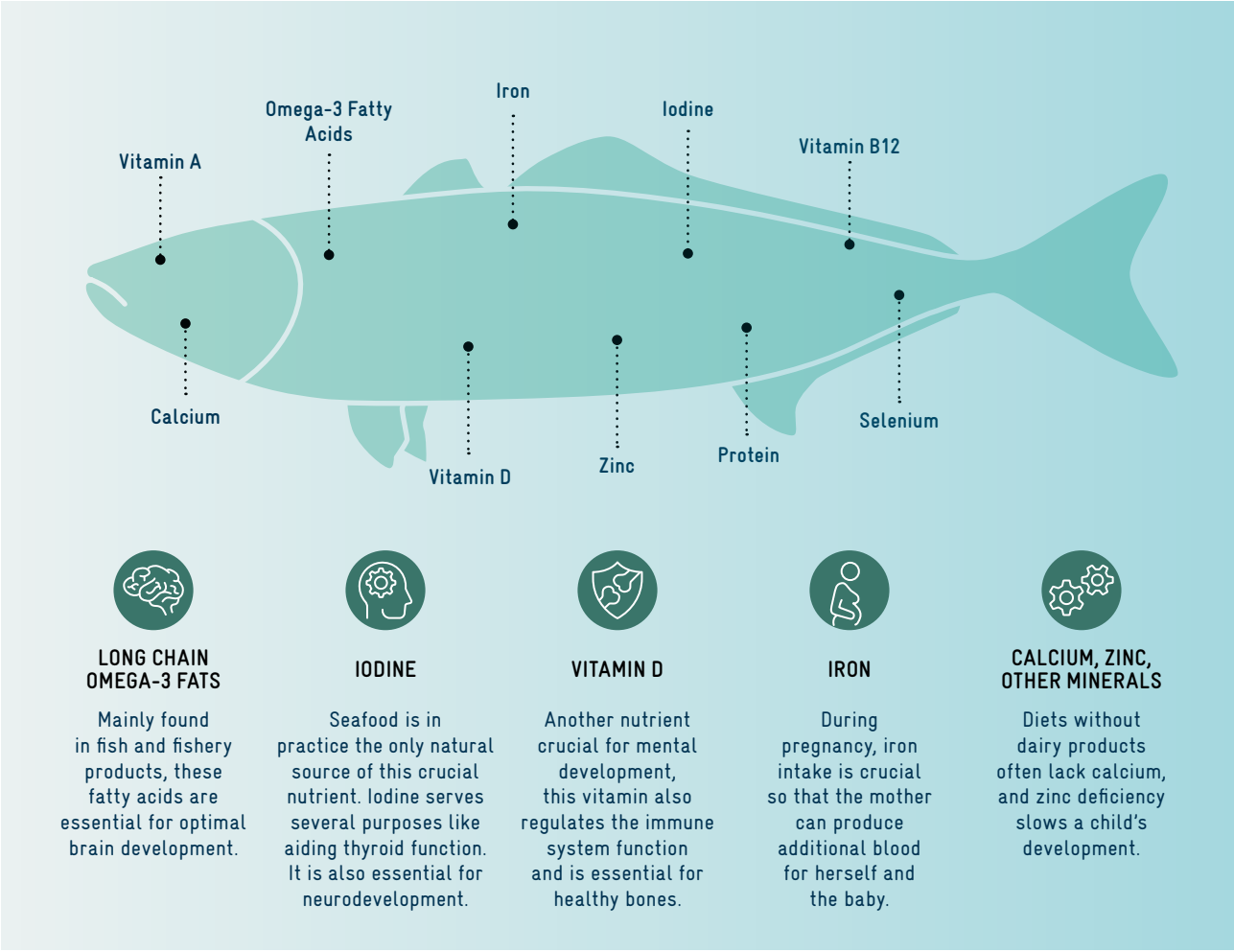

Figure 1: Fish as a source of micronutrients. [5]

Figure 2 shows the share of recommended nutrient intake when consuming aquatic vs. terrestrial foods. Food sources are arranged from highest (top) to lowest (bottom) nutrient density [4]. Visibly, aquatic "blue" foods like fish and mussels, are richer in nutrients compared to terrestrial sources. They are specifically good sources for Omega-3 fatty acids and Vitamin B12. Therefore, "blue foods" not only offer a remarkable opportunity for transforming our food systems but also contribute to tackling malnutrition [4], [11].

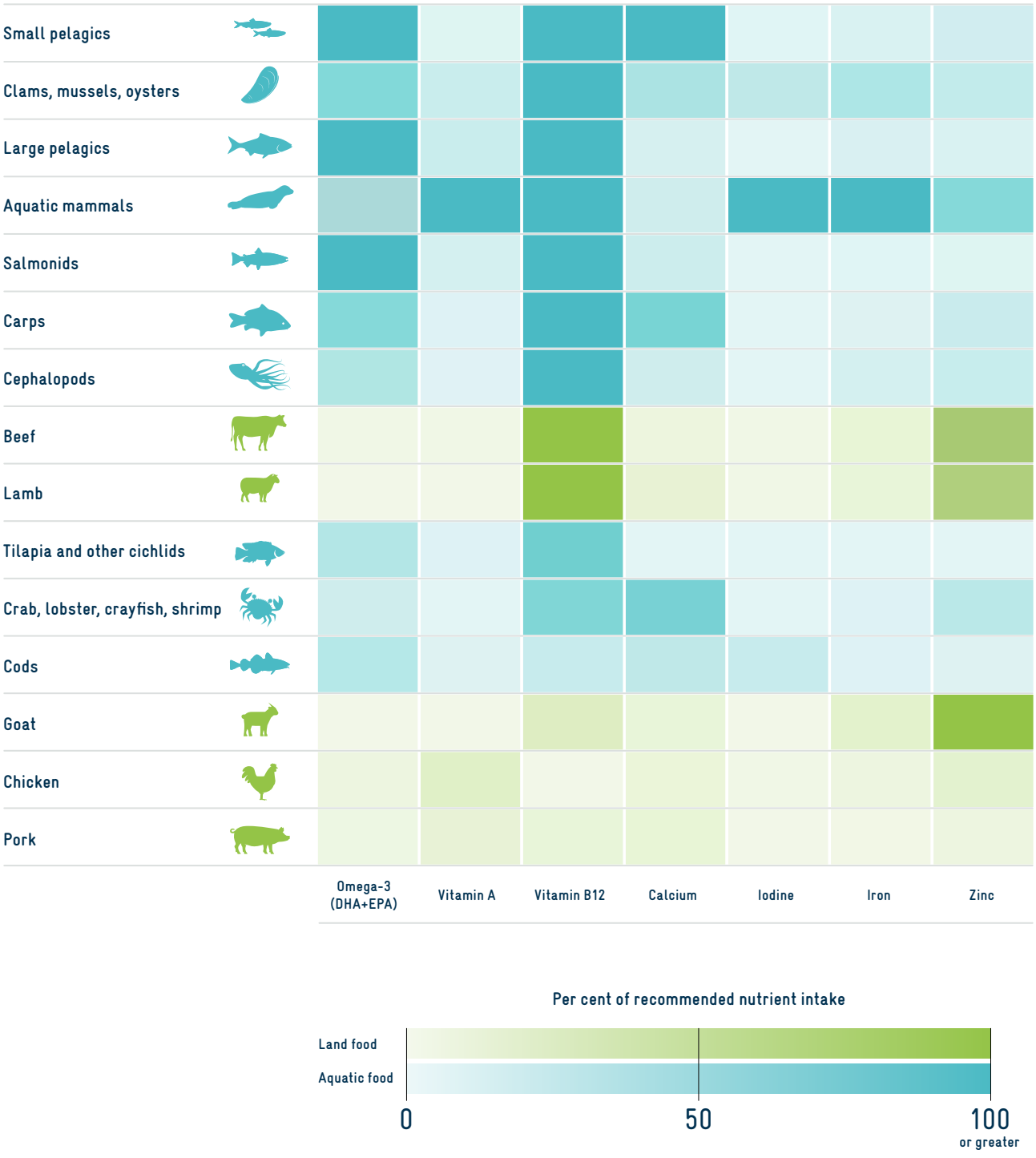

Figure 2: Aquatic vs terrestrial foods' contribution to recommended nutrient intake when consuming 100g of the respective food source. [4]

Evidence: The current role of fish

Globally, fish consumption shows strong regional differences. For instance, in 2009 the average yearly fish consumption per capita in Africa was 9 kg, while in Asia it reached almost 21 kg per person [9]. On every continent, small island developing states or coastal countries have higher consumption rates than their landlocked counterparts. In addition to these differences, the FAO State of World Fisheries and Aquaculture report of 2022 predicts these regional imbalances to increase in the future while fish consumption in Africa is expected to further decline [12].

These observations are consistent with the findings of the baseline studies conducted by the GP Fish, which found that the median annual fish consumption per capita was 0.9 kg in Malawi (2018), 1.1 kg in Madagascar (2018), 1.8 kg in Zambia (2021), but 24.4 kg in Cambodia (2022). It must be noted that these consumption patterns reflect the situation of the rural population, who typically have lower incomes compared to the national average. Considering the recommended average yearly fish consumption of 10 kg per person [13], these findings are worrying.

Considering the importance of fish as a protein and nutrient source for rural households it is important is to better understand fish consumption patterns and their impact on food and nutrition security. In Malawi, Madagascar, Zambia and Cambodia the GP Fish and the *Global Programme Food and Nutrition Security, Enhanced Resilience* (GP Food and Nutrition Security hereafter) are working together to improve food and nutrition security. While the data from the GP Fish are focused on fish production and consumption of close by consumers, data from the GP Food and Nutrition Security provide information about the consumption of different protein sources by the Individual Dietary Diversity Score (IDDS). The GP Food and Nutrition Security collected data from women of reproductive age living in rural, low-income households, not focusing on people involved in the fisheries and aquaculture sector and the surveys included questions to determine a household food security status. Using the extensive dataset allowed an assessment of the current role of fish in comparison to other animal and plant protein sources, without the bias of an increased fish consumption among households involved in fish production. Given that data collection was based on 24-hour recalls, the table in the **Annex** contextualizes the date of the survey with seasonal implications on fish availability (fishing ban, harvesting seasons), indicating that results can be considered representative.

The frequency of the consumption of various protein sources over the last 24 hours, disaggregated by food security status, is shown in **Figure 3**. The food protein sources include fish and seafood, pulses (beans, peas, lentils), meat and poultry, eggs, and milk and dairy products[1]. The percentages indicate how many of the respondents consumed a particular protein source (e.g., 19 % of the food insecure women in Madagascar have consumed fish and seafood in the last 24 hours)[2]. The overall height of the column indicates the aggregated frequency of protein consumption by respondents for each country. Lowest frequency of protein consumption within the last 24 hours for food insecure respondents was found in Madagascar and the highest in Cambodia.

Aquaculture farmers in Haute Matsiatra, Madagascar are prepareing the brood stock for a new rice-fish production.
© GIZ/Sabina Wolf

1 Insects and organ meat were also considered for the analyses but were excluded in the figure, given their low consumption rates of less than 7 % in all cases.

2 Please note, that the total percentages for each column do not add up to 100 % because the IDDS questionnaire allows for multiple and no answers.

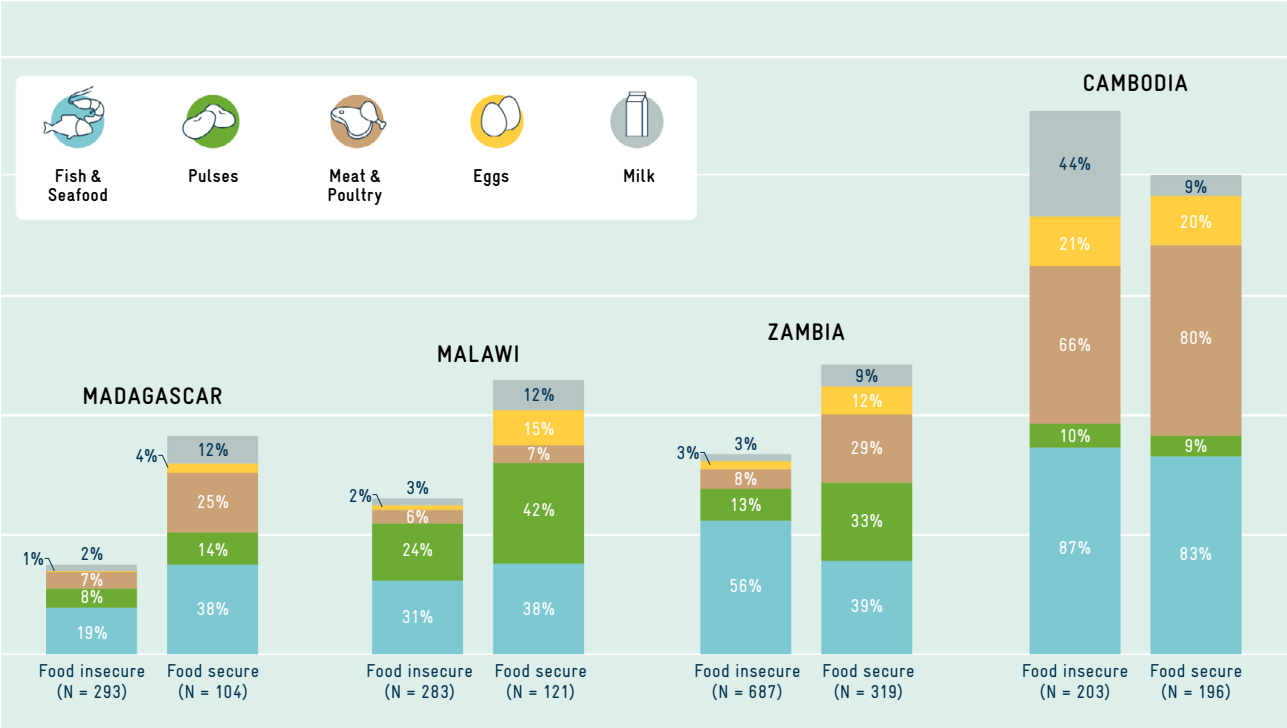

Figure 3: Distribution of protein sources consumed in the last 24 hours disaggregated by food security level and country.

Figure 3 reveals several interesting trends:

1. In general, **fish is currently the most frequently consumed protein source** in nearly all countries. The importance of fish as a protein source can be explained by the fact that fish is often more affordable, more accessible, and culturally preferred compared to other animal- or plant-based protein sources [3], [9], [14], [15].

2. **Food secure respondents do not in general consume fish more frequently compared to food insecure respondents**. This indicates that fish is a source of protein and nutrients that is accessible also to the most vulnerable, namely the food insecure population [4], [10], [15].

3. The results show **regional differences in the frequency of protein consumption between African countries and Cambodia**: in Madagascar, Malawi, and Zambia, between 19–56 % of food insecure respondents and 38–39 % of food secure respondents have consumed fish during the last 24 hours, while in Cambodia more than 80 % of the respondents consumed fish during the last 24 hours, independent of the food security status. These results are consistent with the abundance of fish in Cambodia, while access to fish in African countries is often limited by seasonality and distance from water bodies.

In addition to the differences between countries, Figure 4 illustrates high differences in consumption patterns within one country. In Zambia, the GP Food and Nutrition Security found fish to be a consumed by 68.3 % (food insecure) and 88.5 % (food secure) of the interviewed women in the last 24 hours, while in the Eastern Province, it was only 16.5 % and 23.2 % respectively. This is consistent with the results from the GP Fish survey, which found that the median annual fish consumption in Luapula Province was 2.2 kg and 5.2 kg per capita, while fish consumption in Eastern Province amounts to only 0.9 kg for food insecure and 2 kg per year for the food secure respondents. These results suggest that the Chambeshi / Luapula river system and connected wetlands in Luapula Province make fish more accessible than in the rather dry Eastern Province. For the success of new interventions in the field of food and nutrition security related to fish production and consumption, the local conditions and cultural context are important factors to consider during the planning process.

How to make more fish available in the local market

What strategies need to be pursued to make more fish available to consumers in local markets? Because wild fish stocks are generally overfished and the oceans' ecosystems experience severe degradation [9], [16] the logical strategy is to increase fish supply through aquaculture. When increasing fish availability, especially for the food insecure population, the approach chosen must be environmentally sustainable, provide fish at an affordable price for this group (e.g., by avoiding additional costs such as for transportation) and should still offer the opportunity for producers to earn a living income.

The approach should therefore be centered around sustainable, decentralized aquaculture adapted to the limited financial and technical capacities of smallholders. Small-scale aquaculture in low-income countries plays already a crucial role in food and nutrition security as well as poverty reduction but still has significant potential to grow. On the one hand, vertically integrated aquaculture farms (companies that expand production to up- or downstream supply-chain activities) make important contributions to a country's economic growth by increasing export earnings, but they usually have only little impact on the local fish supply and food security [17], [18]. On the other hand,

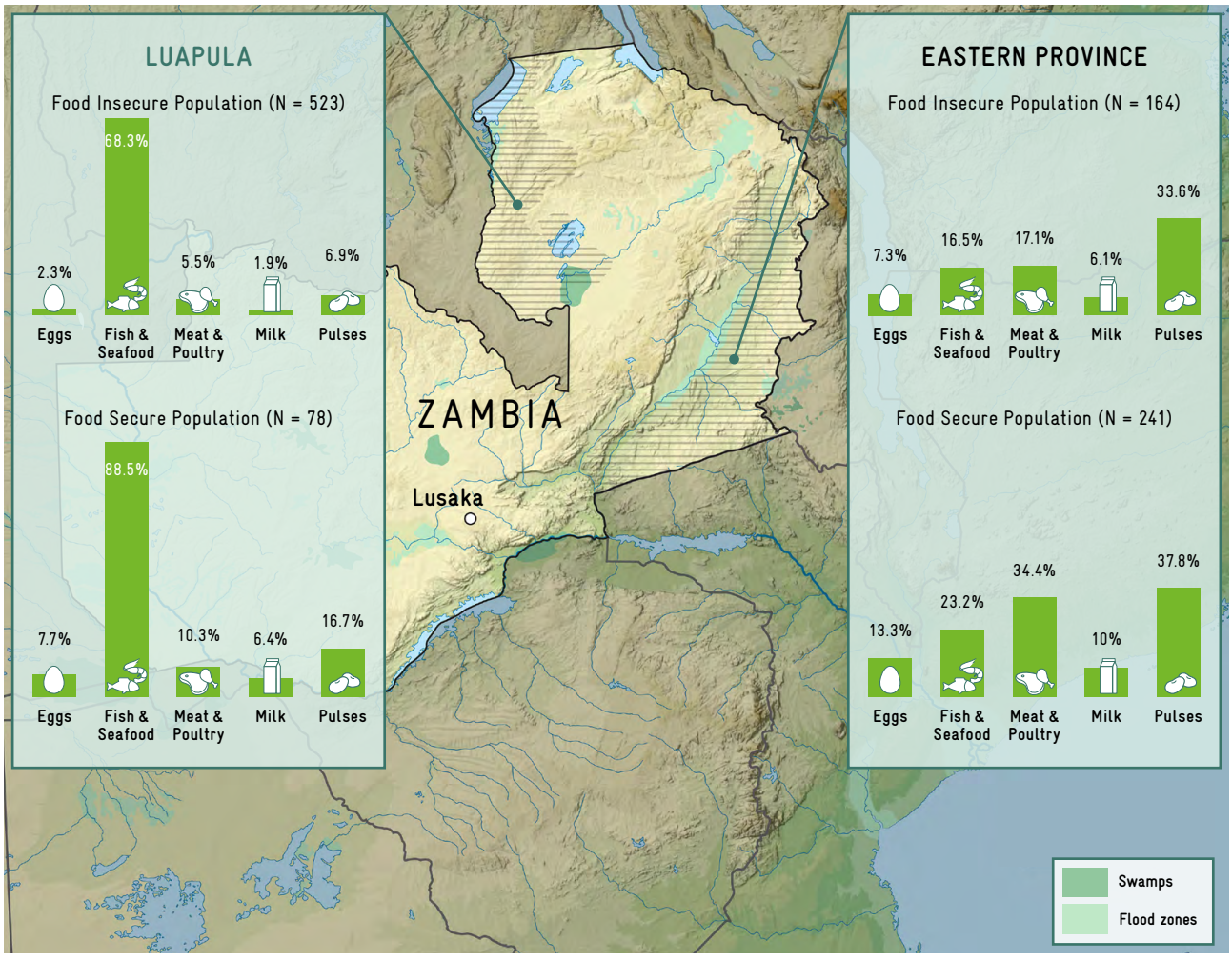

Figure 4: Distribution of proteins consumed in the last 24 hours in Zambia disaggregated by food security level and region.
Map (edited): © Eric Gaba – Wikimedia Commons user: Sting

small-scale aquaculture directly contributes to a higher fish consumption by the producers, depending on cultural preference for fish as a source of animal protein [2], [16], [19] and to higher incomes that allow producers to purchase other foods [2], [4], [9], [16].

When evaluating aquaculture as a source of income, it is important to consider that most small-scale farmers have little technical knowledge and financial capacities. These constraints prevent them from making larger investments for infrastructure and inputs, which are required when operating an intensive aquaculture production system. Formulated feeds, veterinarian products and machinery can significantly increase aquaculture production but are in most cases financially prohibitive for smallholders in remote rural areas. The required investments exceed their financial capacities by far and credits would put the household economies at risk [14], [16], [20], [21]. For this reason, technical and financial capacity development is so important. Optimizing the productivity of earthen ponds with low investments for fertilizer and supplementary feeds generating high profits per kg fish produced seems a workable way forward. As an example, for a technique increasing production and being adapted to smallholders' capacities, the GP Fish has introduced intermittent harvesting of Tilapia in Malawi. This practice is applied in mixed-sex cultures of Tilapia, based on natural feed supplemented with agricultural by-products. Excess Tilapias, that hatched during the production cycle, are harvested by size-selective traps before reaching reproductive age. These frequently harvested fish are an easy-accessible protein source and nutrient-rich food component for a diversified diet and surplus production is generating additional income. Intermittent harvesting also reduces the economic risk of losing the entire production due to predators, theft, diseases, or natural disasters.

In addition to its economic viability, small-scale aquaculture is usually more environmentally friendly compared to industrial production systems based on industrialized feeds. Fish feed usually includes a certain ratio of fishmeal and fish oil and these ingredients are produced mainly from small pelagic fish from capture fisheries, which put an additional burden on the marine environment [9]. It also affects the food insecure population because small pelagic fish are highly nutritious and help to combat food and nutrition insecurity directly (see Figure 2). Fish feed also includes agricultural products like corn and soya, thus competing with food production for human consumption. Despite the negative externalities on ocean biodiversity, research has also shown that intensive aquaculture systems contribute more to global warming through automated processes and high demand for production inputs. Additionally, these systems cause habitat destruction and introduce alien species, which further affect the indigenous biodiversity [14], [20], [21]. In contrast, extensive and semi-intensive small-scale aquacultures requires little external inputs and have less environmental impact [22]. For this reason, GP Fish supports small-scale aquaculture farming of omnivorous fish species such as Carp and Tilapia. The aim is to empower producers technically and economically by optimizing pond productivity and integrating fish production into agriculture activities. This approach uses the natural environment sustainably to promote fish production.

To ensure that fish production supported by the GP Fish is a accessible protein source also for the most vulnerable, GP Fish regularly tracks fish prices and the share of total production accessible to the food insecure population.

To ensure that fish production supported by the GP Fish is a accessible protein source also for the most vulnerable, GP Fish regularly tracks fish prices and the share of total production accessible to the food insecure population. According to the conducted surveys 90 %, 58 %, 84 %, and 99 % of farmed fish is accessible for the food insecure population in Madagascar, Malawi, Zambia, and Cambodia respectively (status 2023). These numbers again highlight the potential of extensive and semi-intensive aquaculture techniques to supply affordable protein and nutrients in areas with a high share of vulnerable people.

Conclusion

Blue foods, like fish from aquaculture, represent a promising source of proteins and nutrients for the future. Smallholder fish production provide nutritional, economic and environmental advantages against the backdrop of high malnutrition rates, especially in low-income and food-deficit countries. Aquatic food is a very broad category encompassing different species and production systems, with very diverse nutritional properties and ecological footprints [13]. The evidence presented shows that fish is already an important component of the diets of the most vulnerable communities, underlining the need to increase the supply of fish in the local markets. Fish from extensive and semi-intensive small-scale aquaculture is not only a successful strategy to tackle nutrition insecurity and poverty but also contributes to the sustainable transformation of our food systems. With those targets in mind, further support of the sector is of utmost importance.

Farmer harvesting at the right time to ensure good quality and price at the local markets. © GIZ/Marvin Kaulembe

References

[1] **Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)** (2020). Handout: Food and Nutrition Security Glossary, Internal Document.

[2] **Kawarazuka, N. & C. Béné** (2010). Linking Small-Scale Fisheries and Aquaculture to Household Nutritional Security: An Overview, Food Security, vol. 2, no. 4, pp. 343–357.

[3] **Tacon, A. G. & M. Metian** (2018). Food Matters: Fish, Income, and Food Supply – a Comparative Analysis, Reviews in Fisheries Science & Aquaculture, vol. 26, no. 1, pp. 15–28.

[4] **Golden, C. D., J. Z. Koehn, A. Shepon, S. Passarelli, C. M. Free, D. F. Viana, H. Matthey, J. G. Eurich, J. A. Gephart, E. Fluet-Chouinard, E. A. Nyboer, A. J. Lynch, M. Kjellevold, S. Bromage, P. Charlebois, M. Barange, S. Vannuccini, L. Cao, K. M. Kleisner, E. B. Rimm, G. Danaei, C. DeSisto, H. Kelahan, K. J. Fiorella, D. C. Little, E. H. Allison, J. Fanzo & H. Thilsted** (2021). Aquatic foods to nourish nations, Nature, vol. 598, pp. 315–320.

[5] **Food and Agriculture Organization (FAO)** (2018). Role of fish in food security in selected Pacific Island Countries, Policy Brief No. 2, Available online: www.fao.org.

[6] **Food and Agriculture Organization (FAO)** (2006). Food Security, Policy Brief, Available online: www.fao.org.

[7] **Food and Agriculture Organization (FAO) & World Health Organization (WHO)** (2013). Maximizing the contribution of fish to human nutrition, ICN2 Second International Conference on Nutrition, Better nutrition better lives, Available online: www.fao.org.

[8] **Yousaf, S. & M. Jha** (2021). Your gourmet dinner is eating up the superfood of the poor, scroll.in, Available online: scroll.in/article/1008534.

[9] **Béné, C., M. Barange, R. Subasinghe, P. Pinstrup-Andersen, G. Merino, G. I. Hemre & M. Williams** (2015). Feeding 9 billion by 2050 – Putting gish back on the menu, Food Security, vol. 7, pp. 261–274.

[10] **Cojocaru, A. L., Y. Liu, M. D. Smith, W. Akpalu, C. Chávez, M. M. Dey, J. Dresdner, V. Kahui, R. B. Pincinato & N. Tran** (2022). The "Seafood" System: Aquatic Foods, Food Security, and the Global South, Review of Environmental Economics and Policy, vol. 16, no. 2, pp. 306–326.

[11] **Crona, B. I., E. Wassénius, M. Jonell, J. Z. Koehn, R. Short, M. Tigchelaar, T. M Daw, C. D. Golden, J. A. Gephart, E. H. Allison, S. R. Bush, L. Cao, W. W. L. Cheung, F. DeClerck, J. Fanzo, S. Gelcich, A. Kishore, B. S. Halpern, C. C. Hicks, J. P. Leape, D. C. Little, F. Micheli, R. L. Naylor, M. Phillips, E. R. Selig, M. Springmann, U. R. Sumaila, M. Troell, S. H. Thilsted & C. C. C. Wabnitz** (2023). Four ways blue foods can help achieve food system ambitions across nations, Nature, vol. 616, pp. 104–112.

[12] **Food and Agriculture Organization (FAO)** (2023). The State of World Fisheries and Aquaculture 2022, Part 1 World Review, Available online: www.fao.org.

[13] **Troell, M., M. Jonell & B. Crona** (2019). The role of seafood in sustainable and healthy diets: The EAT-Lancet Commission report through a blue lens, Available online: gizonline.sharepoint.com/sites/GVNachhaltigeFischereiundAquakultur.

[14] **Finegold, C.** (2009). The Importance of Fisheries and Aquaculture to Development, The Royal Swedish Academy of Agriculture and Forestry, Available online: digitalarchive.worldfishcenter.org.

[15] **Kawarazuka, N. & C. Béné** (2011). The potential role of small fish species in improving micronutrient deficiencies in developing countries: building evidence, Public Health Nutrition, vol. 14, no. 11, pp. 1927–1938.

[16] **Belton, B., S. R. Bush & D. C. Little** (2017) Not just for the wealthy: Rethinking farmed fish consumption in the Global South, Global Food Security, pp. 1–8.

[17] **Gonzalez Parrao, C., S. Shisler, M. Moratti, C. Yavuz, A. Acharya, J. Eyers & B. Snilstveit** (2021). Aquaculture for Improving Productivity, Income, Nutrition and Women's Empowerment in Low- and Middle-income Countries: A Systematic Review and Meta-analysis, Campbell Systematic Reviews, vol. 17, no. 4, pp. 1–95.

[18] **Stevenson, J. R. & X. Irz** (2009). Is Aquaculture Development an Effective Tool for Poverty Alleviation? A Review of Theory and Evidence, Cahiers Agricultures, vol. 18, no. 2–3, pp. 292–299.

[19] **Béné, C., R. Arthur, H. Norbury, E. H. Allison, M. Beveridge, S. Bush, L. Campling, W. Leschen, D. Little & D. Squires** (2016). Contribution of Fisheries and Aquaculture to Food Security and Poverty Reduction: Assessing the Current Evidence, World Development, vol. 79, pp. 177–196.

[20] **Ahmed, N. & G. M. Turchini** (2021). The Evolution of the Blue-Green Revolution of Rice-Fish Cultivation for Sustainable Food Production, Sustainability Science, vol. 16, no. 4, pp. 1375–1390.

[21] **Johnson, R.** (2007). The Ecosystem Approach to Aquaculture: An analysis of adaptive governance and management of small-scale coastal shrimp aquaculture in Thailand, Centre for Transdisciplinary Environmental Research, Stockholm University.

[22] **Brugère, C., J. Aguilar-Manjarrez, M. C. Beveridge & D. Soto** (2019). The Ecosystem Approach to Aquaculture: 10 Years on – A Critical Review and Consideration of Its Future Role in Blue Growth, Reviews in Aquaculture, vol. 11, no. 3, pp. 493–514.

Annex

Country	Data collection GP Food Security (3 months after main harvest)	Fish market status during data collection	Rainy season & related fishing bans	Fish harvest season
Zambia 	**September 2020** Eastern Province & Luapula Province	**September: good availability of fish** The majority of traded fish is dry (smoke-dried and sun-dried), and from freshwater sources. Fish from aquaculture is rather small compared to fish from wild sources, especially in rural villages and small towns. In the cities, where shops and cold chains are better, and where incomes are higher, more aquaculture fish is available.	**Rainy season: November to May** There is a fishing ban from the Department of Fisheries between 1st of December and 1st of March: fish in general remains on the menu but there is a preference towards small dried pelagic that are exempted from the fish ban.	In general, the fishing season is in the dry season (April to November). The fish farming season is from **December to March**, making the share of aquaculture fish in the market larger, as the rain makes it difficult to fish and to process, transport, and store dried fish.
Malawi 	**August 2021** Dedza & Salima	**August: good availability of fish** In the month of August, supply of fresh fish for Salima is high because there are no restrictions on catches from Lake Malawi and it is also the fish harvesting period for pond farmers. However, Dedza is highly dependent on processed fish (smoked and sundried) with little or no availability of fresh fish.	**Rainy season: November to April** The closed season for small-scale fishers runs from **early November to December end**. For commercial fishers the closed season runs from **early December to the end of February**. In this period Tilapia supply is very low and the local market is dominated by Usipa which is also on high demand. Moreover, the districts far from the Lake like Dedza face a shortage in fish supply.	The harvesting time for the farmed fish starts from **June** runs up to **September**. However, the Dedza district is one of the districts that has very few fish farmers that are only found in one Extension Planning Area (EPA) of Mayani.
Madagascar 	**February 2020** Atsimo Atsinanana	**February: normal availability of fish** In Atsimo Atsinanana particularly dried sea fish is usually available to the population.	**Rainy season: November to March** (but in the South – where Atsimo Atsinanana is located – there is almost no rain all year round and climate change makes it even drier). There is an official closure of freshwater fishing between 15th October and 15th November. There is no information about closure period for marine fisheries.	In the Highlands and the East Coast the fish harvesting season is between **May and September**. In Atsimo Atsinanana aquaculture is not very developed. There are some occasional villagers fishing in rivers, rice fields, etc. There is also not really a season for harvesting, as the climate is very flexible.
Cambodia 	**March 2021** Kampong Thom & Kampot	**March: good availability of fish in the markets** Fish from aquaculture is available throughout the year, but when the supply of wild fish is high, the market of aquaculture fish is small.	**Rainy season: June to October** There is a fishing ban between 1st of June and 30th of September (only for commercial fishing, artisanal fishing is still allowed). In this period, wild fish supply decreases a lot and most fish in the market comes from Vietnamese aquaculture production.	**Between March and July** is the main time for aquaculture harvests.

As a federally owned enterprise, GIZ supports the German Government in achieving its objectives in the field of international cooperation for sustainable development.

Published by:
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Global Programme Sustainable Fisheries and Aquaculture
Division G500 – Rural Development, Agribusiness and Food Security
Friedrich-Ebert-Allee 32 + 36
53113 Bonn, Germany
T +49 228 44 60-0
F +49 228 44 60-17 66
E GVFisch@giz.de
I www.giz.de/en/worldwide/122386.html

Authors:
Gianna Angermayr, Dr. Jens Kahle

Contributions by:
Daniel Pfaff, Josephine Figiel, Sven Genschick, Lukas Novaes Tump

Design, layout & illustrations:
Katrin Straßburger, Sandra Winter/
W4 Büro für Gestaltung, Frankfurt, Germany

Maps:
The maps in this publication are intended only for information purposes and in no way constitute recognition under international law of boundaries and territories. GIZ accepts no responsibility for these maps being entirely up to date, correct or complete. All liability for any damage, direct or indirect, resulting from their use is excluded.

Bonn, July 2024