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View Point

# Sustaining healthy diets: The role of capture fisheries and aquaculture for improving nutrition in the post-2015 era

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ABSTRACT

The Sustainable Development Goals (SDGs) agenda makes achieving food security and ending malnutrition a global priority. Within this framework, the importance of fisheries in local and global food systems and its contribution to nutrition and health, particularly for the poor are overlooked and undervalued. This paper reviews current fish production and consumption from capture fisheries and aquaculture, highlights opportunities for enhancing healthy diets and outlines key multi-sectoral policy solutions. Mirroring the call for a diversification of agricultural research and investment beyond a few staple grains, it is anticipated that productivity gains for a few farmed aquatic species will not suffice. Capture fisheries and aquaculture have a complementary role to play in increasing fish availability and access, and must be promoted in ways that support measurable nutrition and health gains. This paper argues that the lack of a nutrition-sensitive policy focus on capture fisheries and aquaculture represents an untapped opportunity that must be realised for ensuring sustainable healthy diets for all.


## Introduction

A core vision of the post-2015 development agenda is a "healthy life for all" in a world where everyone consumes food that is "affordable and nutritious" (United Nations, 2015). Several of the Sustainable Development Goals (SDGs) (No. 2 and No. 14 in particular) speak to the importance of supporting consumer choice and enhanced nutrition by promoting agricultural productivity among small-scale producers and supporting links between local and global markets. Those goals focus on the importance of sustaining food production, on the one hand, and on securing year-round access to diverse foods, on the other.

Fish[1] production and trade contribute significantly to global agricultural output. Fish production in 2012 exceeded 158 million metric tons, while the value of international fish trade amounted to USD129 billion (HLPE, 2014). An increasingly large share of fish entering global markets derives from aquaculture (the farming of aquatic animals and plants); the world's fastest growing food production sector for more than four decades (Tveterås et al., 2012). Much of fish produced and traded within low-income countries derives from capture fisheries (non-fed fish harvested from undomesticated ecosystems). These two production systems have important complementary roles in meeting rising demand for fish and other products (such as animal feed and fish oil), and enhancing incomes and nutrition among smallholder producers, fishers and poor consumers. However, fisheries policies are increasingly articulated around value-creation through export to urban and

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[1] The term 'fish' is used in the broadest sense to include all aquatic animals, including fish (both fed and non-fed), crustaceans (e.g. shrimp, prawns, crabs), molluscs (e.g. oysters, mussels, snails) and other aquatic invertebrates.

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international markets. Capture fisheries institutions concentrate ownership and use of fishing assets to maximize economic output which may bring benefits to resource conservation and trade, but decreases the quantity of fish available on local markets (Béné et al., 2010). Aquaculture policies tend to focus on maximizing productivity and economic efficiency (Hishamunda et al., 2009). These policies leave little room for promoting diversity of systems and species, or accessibility of fish among poor consumers whose diets typically lack nutrient-rich foods.

Acknowledging the need for public health policymakers to actively engage with agricultural sub-sectors, the Second International Conference on Nutrition (ICN2) stated that "fisheries and aquaculture need to be addressed comprehensively through coordinated public policies" (FAO and WHO, 2014). The call for improved policy coordination, environmental protection, enhanced fish production and reduced loss and waste represents a major opportunity to promote capture fisheries and aquaculture as key nutrition-sensitive agricultural sub-sectors.

The term 'nutrition-sensitive agriculture' was described by Ruel and colleagues as agriculture policies and interventions that support improved nutrition outcomes as distinct from 'nutrition-specific' public health interventions (such as vitamin A supplementation or promotion of exclusive breastfeeding) (Ruel et al., 2013). While there is much debate regarding the impact of agriculture on nutrition, fish systems are rarely mentioned. Indeed, the role of the fisheries sector in improving diets continues to be overlooked in discussions of sustainable food systems. The benefits of fish for health are well demonstrated. Can fisheries play a greater role in healthy diets in coming years? In answering in the affirmative, this paper argues that the lack of a nutrition-sensitive policy focus on capture fisheries and aquaculture represents an untapped opportunity.

This paper has three parts: the first describes the current state of production and consumption of fish in selected countries and evidence on the value of fish to nutrition and health. Section 'Capture fisheries and aquaculture in healthy diets' explores opportunities for enhancing future diets and challenges to production and trade, with a focus on low-income countries where the highest burden of undernutrition and micronutrient deficiencies are found. Section 'Policies for nutrition-sensitive capture fisheries and aquaculture' proposes a policy agenda to enhance and sustain the capture fisheries and aquaculture sub-sectors as a core part of the SDGs development agenda to 2030.

## Capture fisheries and aquaculture in healthy diets

Estimated global consumption of fish continues to increase, reaching an all-time high of 19 kg/capita/year in 2011 (Table 1), up from 9 kg/capita/year in 1961 (FAOSTAT, 2015). Fish production continues to grow at an average annual rate of 3.2%, largely due to increases in aquaculture with relatively stable supply from capture fisheries (FAO, 2014). Aquaculture is projected to contribute 63% of global fish consumption by 2030, and in some Asian countries, particularly China, fish production from aquaculture already now exceeds that from capture fisheries. Fish is one of the most traded food commodities, with consumption in mid- and high-income countries increasingly derived from imports, while low-income countries are more heavily reliant on local supply (FAO, 2014). However, trade is bidirectional, with a trend for low-income countries to export high-market value fish products and import low-market value products for domestic consumption (Asche et al., 2015). This trade pattern is demonstrated in Table 1, with total per capita fish production being much higher than consumption in some countries (e.g. Norway, Peru and Chile), whereas, per capita consumption is greater than production in others (e.g. Nigeria, Japan and Republic of Korea). Consumption patterns vary widely, with fish as the most important animal-source food in Bangladesh and Indonesia, and India with the lowest per capita consumption.

The benefits of fish to nutrition and health are well-documented. Rimm and Mozaffarian found that fish intake is associated with a 36% reduced mortality risk from heart disease (2006), while a meta-analysis by Zhao et al. showed that consumption of 60 g fish/day is associated with a 12% reduction in mortality (2015). Focusing on global mortality, Lim et al. found that diets low in seafood omega-3 fatty acids accounted for 1.4 million deaths in 2010 (2012). Building on the same data, Ezzati and Riboli calculated that diets low in fish and seafood are responsible for roughly 1% of the world's total burden of disease-related disability-adjusted life years (DALYs) (2013). In addition, fish consumption in United States of America is significantly associated with long-term weight loss (Smith et al., 2015). As a result, an increasing number of countries (mostly high-income) are recommending minimum levels of regular fish consumption in their national dietary guidelines (National Health and Medical Research Council, 2013; The Danish Veterinary and Food Administration; U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010).

The benefits of fish are associated in part with high concentrations of bioavailable minerals and vitamins, essential fatty acids and animal protein (Bogard et al., 2015b; Wheal et al., 2016). Fig. 1a–f shows the contribution to recommended nutrient intakes from selected fish species for pregnant and lactating women, infants and young children (FAO and WHO, 2004). Fig. 1b shows that fish are a rich source of vitamin B12, only found in animal-source foods, which is essential for multiple functions, including growth, brain function and nervous system maintenance. As a source of highly bioavailable calcium, small fish are particularly important in the diets of the poor which are often low in milk and milk products (Hansen et al., 1998). The same applies to zinc and iron which are considered 'problem nutrients' globally. Fish are also a unique source of long chain omega-3 fatty acids. It has been shown that intake of omega-3 fatty acids in pregnancy is associated with reduced risk of early preterm delivery (and a modest increase in birth weight) (Imhoff-Kunsch et al., 2012), whereas, low seafood consumption during pregnancy increases the risk of suboptimal neurodevelopmental outcomes, including cognition and fine motor skills (Hibbeln et al., 2007). In addition, fish enhances the uptake of micronutrients from plant-source foods in the meal (Michaelsen et al., 2009; Sandström et al., 1989). The high levels of nutrients in fish underpin the potential value of fish to healthy diets. Small indigenous fish species which are eaten whole (with bones, head and viscera; very little cleaning loss and no plate waste) have large potential to contribute to micronutrient intakes (Bogard et al., 2015b). Similarly, ground dried small fish provide a dense source of nutrients which is valuable for young children who eat small meals due to limited stomach capacity (Bogard et al., 2015a).

Estimated global fish consumption (19 kg/capita/year in 2011) is expected to increase to 22 kg/capita/year in 2024, with increases in all regions (OECD and FAO, 2015). However, this projected increase masks widening global inequities in fish consumption, with the poor in all regions continuing to have low intakes. To address this issue, policymakers globally must consider how to make more fish accessible to the poor, while increasing supply sustainably.

### *Opportunities for enhancing current and future diets*

As recommended by ICN2 (FAO and WHO, 2014), sustainable food systems that promote healthy diets must build on 'nutrition-sensitive agriculture'. To be nutrition-sensitive, agriculture policies and interventions should leverage production and

**Table 1**
Fish production and consumption in selected countries.

| | Production | | | | Apparent consumption | |
|---|---|---|---|---|---|---|
| | Total fish (million t/yr) | Capture fisheries (million t/yr) | Aquaculture fish (million t/yr) | Total fish (kg/capita/yr) | Fish (kg/capita/yr) | Fish protein (% total animal protein) |
| *Selected low- and mid-income countries* | | | | | | |
| Bangladesh | 3.41 | 1.55 | 1.86 | 21.1 | 19.7 | 56.2 |
| China | 59.82 | 16.27 | 43.55 | 43.2 | 33.5 | 22.4 |
| India | 9.20 | 4.65 | 4.55 | 7.3 | 5.2 | 13.0 |
| Indonesia | 9.92 | 6.10 | 3.82 | 39.70 | 28.9 | 54.8 |
| Malawi | 0.11 | 0.11 | 0 | 7.1 | 5.7 | 27.7 |
| Nigeria | 1.02 | 0.72 | 0.30 | 5.8 | 17.1 | 43.1 |
| Peru | 5.98 | 5.85 | 0.13 | 196.9 | 22.7 | 22.5 |
| Viet Nam | 6.01 | 2.80 | 3.21 | 65.7 | 33.6 | 27.3 |
| *Selected high-income countries* | | | | | | |
| Chile | 2.80 | 1.77 | 1.03 | 159.1 | 14.6 | 8.3 |
| Japan | 4.27 | 3.66 | 0.61 | 33.5 | 51.7 | 37.3 |
| Norway | 3.32 | 2.07 | 1.25 | 658.8 | 53.4 | 23.4 |
| Republic of Korea | 2.00 | 1.60 | 0.40 | 40.6 | 60.4 | 38.7 |
| United States of America | 5.67 | 5.23 | 0.44 | 17.7 | 21.7 | 7.4 |
| Global total | 162.76 | 92.57 | 70.19 | 22.5 | 18.9 | 16.5 |

Note: Data for fish production and consumption are sourced from 2013 (Fisheries and aquaculture software, 2015), and 2011 (FAOSTAT, 2015), respectively. Quantities are expressed in live weight equivalent. Apparent consumption refers to the quantity of fish available for consumption (production plus imports less exports and non-food uses).

value chain investments to achieve measurable impacts on nutrition (Ruel et al., 2013). This requires integration of capture fisheries and aquaculture into local and national food systems to improve future diets. There are three interlinked opportunities for this: (a) improving the quality and quantity of fish supply (which can improve diets of both producers and consumers); (b) facilitating women's empowerment; and (c) promoting equitable trade and enhanced markets.

Globally, fish production from both capture fisheries and aquaculture depends heavily on small-scale fishers and farmers, many of whom are poor. An estimated 30.6 million people derive their livelihoods from small-scale fisheries, and consume a proportion of their catch – thereby, direct consumption provides an opportunity to improve dietary quality (HLPE, 2014). Capture fisheries are typically diverse, however, aquaculture globally focuses on a few select species. Nutrient composition of fish varies widely (Fig. 1a–f), and so diversity of species in aquaculture (e.g. polyculture systems) requires much greater emphasis than currently exists, for this opportunity to be fully realized. Nutritional quality can also be improved by development of value chains that reduce loss and improve processing methods (e.g. fish drying and smoking) which preserve and concentrate nutrients and increase seasonality of availability. Investments in local and regional market chains are an effective way of making nutritious food available to the poor. Improving quality and quantity of fish supply requires complementary investments in both improved capture fisheries management to maintain diversity and ensure that fish are not over-harvested; and growth in aquaculture of diverse species.

Increasingly, reduction in food loss and waste is seen as essential for achieving food and nutrition security. Fish loss and waste amount to 39% of fish landed globally (HLPE, 2014), with large discards (portion of catch returned to the sea) from marine capture fisheries, prior to landing. Post-harvest loss is high in low-income countries, due to poor infrastructure, cold chain, processing and storage facilities, whereas, large waste (at retail and consumer level) occurs in rich countries. Recommendations to reduce fish loss and waste include improving conditions for workers (many of whom are women) and processing technologies (e.g. solar drying) in low-income countries to deal with peak capture periods, extend seasonality of consumption, and increase reach to people without access to fresh fish, as well as the use of safe, nutrient-rich loss and waste from processing for suitable fish products, in all countries.

In capture fisheries, men are predominantly engaged in catching and women in processing, trading and selling, particularly in sub-Saharan Africa (Weeratunge et al., 2014). Yet, the estimated 56 million women involved in this sub-sector (HLPE, 2014), are constrained by deplorable working conditions, poor market and transportation infrastructure, limited financial and business services, competition for limited catches, and variable supply. Investments that strengthen women's empowerment are known to lead to improvements in nutrition and health of women and their families (World Bank, 2011). Development of aquaculture systems in which women are engaged offers opportunities to increase fish consumption by all household members. Homestead aquaculture provides women who spend considerable time on household activities and child care, opportunities to participate more actively, primarily in fish feeding. In Bangladesh, where there are concerted efforts to engage women in pond polyculture, there are reports of increased control of income and greater decision-making by women (Farnworth et al., 2015). However, data on time use, the balance between work time and, for example, child care and leisure are needed.

Fish is one of the most globally traded foods, with a net flow from low- to high-income countries (Smith et al., 2010). That said, vibrant markets for fish, including dried small fish exist across the developing world, which are particularly accessible to poor consumers, as they are sold in small portions for relatively low prices. Increased aquaculture production, especially in Asia has helped to stabilise fish prices, keeping fish within the reach of the poor. Aquaculture also has beneficial effects for reducing price volatility due to increased control over production and resulting stability in supply (Tveterås et al., 2012). In Bangladesh, aquaculture production more than doubled over the past decade, reducing the price of farmed fish (few large species) which became more accessible to poor consumers as a result. However, the price of indigenous small fish from capture systems, which are more nutrient-rich and more likely to be consumed by the poor, has risen sharply (Belton et al., 2014; Toufique and Belton, 2014). The net effect on nutrition and health of these relative price effects and product substitution among poor consumers is not known.

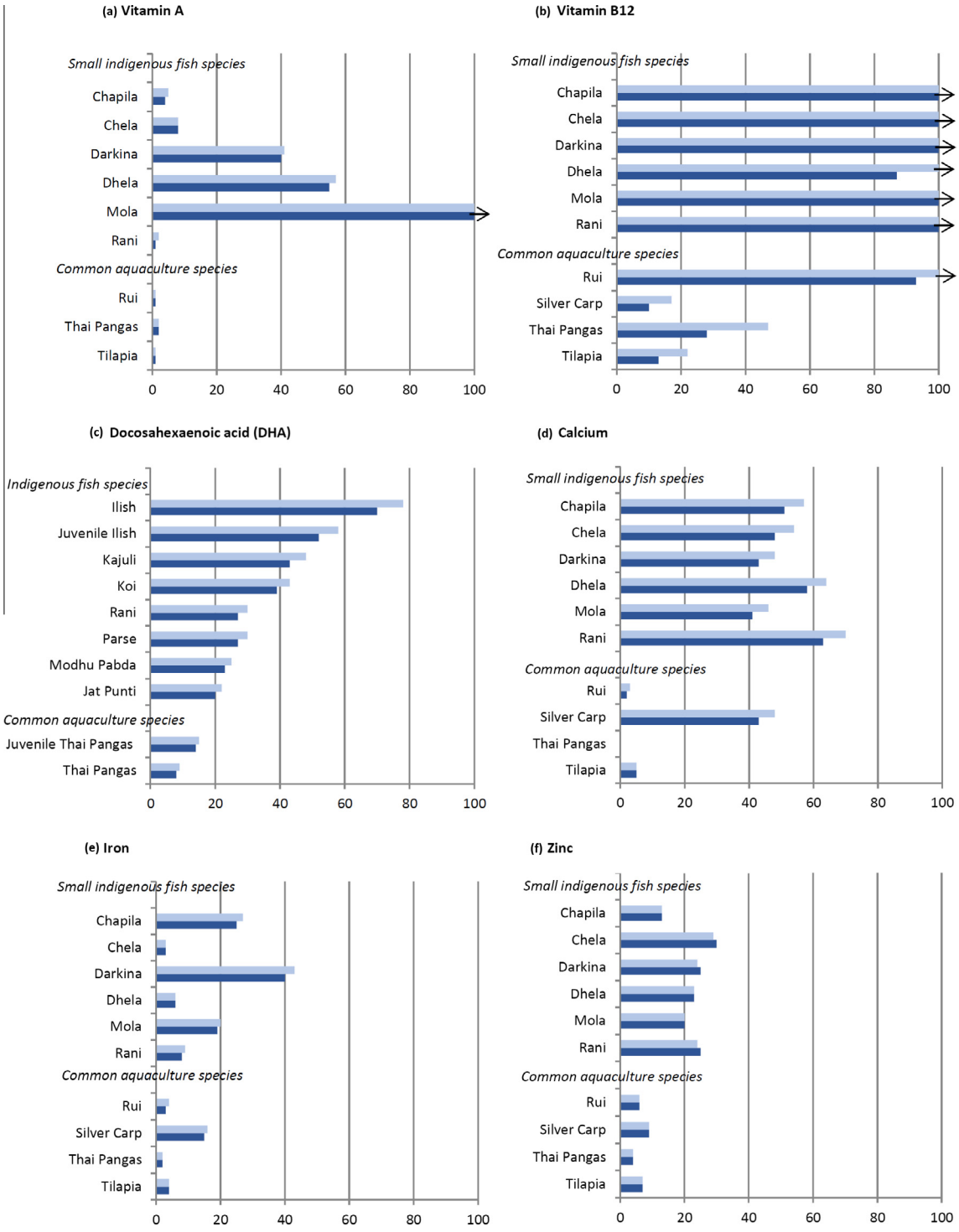


**Fig. 1.** Contribution (%) of selected fish species to recommended nutrient intakes for pregnant and lactating women and infants and young children in Bangladesh. Note: Light blue and dark blue bars represent contributions to recommended nutrient intakes (RNIs) for pregnant and lactating women (PLW), and infants and young children (6–23 months), respectively. Arrows represent contributions that exceed 100% of RNI. Contributions were calculated by assigning an average RNI target for each nutrient, accounting for variations in requirements throughout the three trimesters of pregnancy and first 12 months of lactation, and for infants, throughout the period from age 7 to 23 months; then by calculating the contribution from a standard portion (50 g/day for PLW and 25 g/day for infants) of each species (Bogard et al., 2015b). The RNIs for iron are based on 10% bioavailability and for zinc, moderate bioavailability (FAO and WHO, 2004). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

## Policies for nutrition-sensitive capture fisheries and aquaculture

Current policies and public and private sector investments are typically framed around their potential to reduce poverty and food insecurity but rarely with a nutrition-sensitive lens. By narrowly focusing on maximizing productivity and income-generating potential, the goals of fisheries policies remain largely sectoral and include little explicit consideration of the sector's potential contribution to broader societal goals such as diets, nutrition,

health and sustainability (Ahmed and Lorica, 2002). Multi-sectoral policy solutions lie in: (a) diversification of production systems; (b) efficient management and protection of all systems; (c) improved value chain and markets; and (d) consideration of context-specific consumer preferences and nutritional needs.

*Diversification of production systems*

To achieve improved access to diverse and healthy diets that include nutrient-rich foods, policymakers must broaden the scope of their agricultural support to embrace species diversity and nutritional quality. In capture fisheries, ecosystem-based fisheries management and habitat conservation can increase both fish stocks and biodiversity, thereby enhancing the quantity and nutritional quality of fish available for consumption. Improvements in the management of rice-fish systems hold great potential for increasing productivity and species diversity (Dey et al., 2013). Within aquaculture, pond polyculture systems are a way of realising these objectives – a mix of nutrient-rich small fish species and 'cash-crop' species for household consumption and markets can be grown together to maximize the use of input resources – similar to the principle of intercropping (Thilsted, 2012). The production of the small fish, mola (*Amblypharyngodon mola*) in pond polyculture has been shown to be cost-effective approach to reduce micronutrient malnutrition in Bangladesh, by estimating DALYs saved (Fiedler et al., 2016).

*Efficient management and protection of all systems*

Nutrition-sensitive fisheries management can be best-served by ensuring that small-scale fishers and processors have equitable access to common resources of coastal and inland waters (Toufique and Gregory, 2008). This is already mandated by a series of international codes of conduct and voluntary standards adopted (though not necessarily implemented) by member states of the UN Food and Agriculture Organization (FAO, 1995, 2015). Policy must be mindful that food production is not the only use made of aquatic and marine space. Damming of rivers and lakes for irrigation and hydropower, draining of fish-rich floodplains and wetlands for cropping or industrial development, coastal urbanisation and industrialisation, tourist development, offshore renewable energy, mining and oil and gas exploration, as well as protected-area conservation all compete with fish production (Sale et al., 2014). Thus, as promoted by SDG 14, nutrition-sensitive water resource, coastal and ocean policies must consider the nutritional consequences of non-fisheries activities. The future of fisheries is closely tied to the impacts of climate change such as rising seawater levels and temperatures, water scarcity, and food price volatility. In this respect, climate change is requiring a drastic re-think of food production policies – and this offers a good opportunity to apply a nutrition lens going forward. A major policy concern lies in the use of wild small fish for fish feed which, on the one hand enhances the nutritional quality of farmed fish, but on the other, directs low-cost, nutritious fish away from direct human consumption. Globally, there are calls to make a greater proportion of these fish (e.g. sardines, anchovies) available for human consumption. Depleting wild fish stocks and associated increasing costs are prompting efforts to use alternative ingredients such as nutrient-rich algae for fish feed. Strong multi-sectoral policy coordination and action are required in this regard for fisheries to contribute to healthy diets and realisation of the SDGs.

*Improved value chain and markets*

Current fisheries policy is focused on international trade and markets to ensure large quantities of safe fish and fish products for consumption in high-income countries. For these markets, there is large investment in food inspection systems and improved traceability, with importing countries often insisting on chain-of-custody certification. In contrast, the vast local and regional trade of nutrient-rich fish products (particularly dried and smoked small fish) on which the poor depend is largely neglected in global and national analyses. Policies should be re-oriented to prioritise access and ensure affordability of fish and fish products for the poor, which contribute to their nutritional needs. This requires comprehensive multi-sector policy coordination involving, for example, labour rights, transport and infrastructure, and social welfare. Lack of data presents a serious problem in understanding this complex system. Attention must be paid to prioritising the supply of diverse, nutrient-rich fish species, infrastructure to maintain quality and year-round access of fish, and the protection of both actors – many of whom are poor women, and consumers in local and domestic values chains. With no policy support, this sector is vulnerable to negative impacts of an increasingly globalised market in which fish trade to high-income countries is projected to increase.

*Consideration of context-specific consumer preferences and nutritional needs*

Fisheries policies must be positioned within a food systems approach to healthy diets. This includes consideration of the cultural preferences, food habits and nutritional needs of consumers, particularly of vulnerable groups such as women and young children. Integrated production systems, in the context of local diets, for example, fish – rice systems, and homestead pond polyculture with vegetables grown on the dykes, as practised in Bangladesh, can extend the overall benefits of the fisheries sector to healthy diets. In addition, the importance of consumer preferences in shaping food demand should not be underestimated. This has important implications for analysing trends in demand and predicting future fish supply (Kobayashi et al., 2015).

In general, lack of suitable data makes it difficult to provide evidence for the positive or negative outcomes of different policy options for the development of nutrition-sensitive capture fisheries and aquaculture. A shift in policy orientation must therefore be accompanied by a shift in the priorities for research and monitoring. Knowledge gaps include: fish consumption patterns, disaggregated by season, income group, within household, and geographic location (beyond national aggregate estimates from food balance sheets and population size); the contribution of fish in diets, both nutritionally and culturally, as distinct from other animal-source foods; nutrient composition at species level, particularly of indigenous fish; studies linking interventions in capture fisheries and aquaculture to impacts on nutritional status and health outcomes; and women's workload within the fisheries sector.

## Conclusions

Fish are beneficial to nutrition and health and will play an essential role in sustaining healthy diets (where culturally appropriate) in the future. If the vision of the SDGs is to be attained, the fisheries sector, in the context of growing demand will require policy frameworks that are nutrition-sensitive. To make this happen, coordinated policy actions and investments across relevant sectors are essential. Fisheries must be seen as a core component of the agriculture sector, as well as an entry point for multi-sectoral interventions aimed at improving nutrition and health outcomes. The present narrow focus on productivity gains and economic outputs will not suffice. A more balanced approach to sustaining capture fisheries and growth in diverse aquaculture

systems is required. Complementarities between the capture fisheries and aquaculture sub-sectors must be clearly articulated and capitalised on in order for countries to sustainably increase the quantity and quality of fish supply while promoting nutrition and health gains, particularly for poor consumers, between now and 2030.

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