

Aquaculture and fisheries for nutrition: towards a nutrition-sensitive approach

by Genschick, S; Phillips, M.J; Thilsted, S.H; Thorne-Lyman, A.L; & Subasinghe, R

This article explains the concept of a “nutrition-sensitive approach” to aquaculture and fisheries and provides insights into the ways in which this approach, if widely applied, could create large impacts on the nutritional status and health of populations, within both resource- poor and better-off populations.

Introduction

The world faces multiple challenges to meet the food and nutritional requirements of a population that is projected to reach over 9 billion people by 2050. Addressing the “double burden” of malnutrition, in which problems of over-nutrition coexist with those of under-nutrition, including micronutrient deficiencies, will require a significant shift in current approaches to food systems.

But to ensure good health of the population, and to find a middle ground that minimises the dual problems of under- and over-nutrition, it's important to consider the quality of foods being consumed. Taking a food-systems approach to this problem that considers the ability of different policy options to deliver combinations of high quality foods, is essential.



Harvesting small fish from a polyculture pond in Barisal, Bangladesh
Md. Zamal Uddin, WorldFish

The challenge of feeding 9 billion people

Traditional notions of food insecurity and hunger evoke visions of empty stomachs

and inadequate calories resulting from insufficient quantities of food. Over the past several decades, notions of food security have been expanded to recognise the importance of nutritional quality of food (dietary diversity), and the advancement of the concept of food and nutrition security. This reflects the reality that good nutritional status is the product not only of access to safe food of high nutritional quality, but also access to health care, clean water, and adequate caring practices, particularly in relation to meeting the special nutritional needs of infants, young children, and pregnant and lactating women.

High quality nutrient-rich foods are particularly important during the first 1 000 days of life beginning at the time a woman becomes pregnant. During this time, key nutrients such as iron, zinc, vitamin A, and essential fatty acids are required in high concentrations for growth, immunity, and proper brain development. Undernutrition, including deficiencies of the nutrients above, underpins nearly half of all deaths of infants and young children, as well as being an important contributor to the two leading causes of maternal mortality, hemorrhage and pre-eclampsia. But it is also important to recognise that globally, and in many low and middle- income countries, deaths due to non-communicable diseases, many of which are attributable to a poor diet, cause three times as many deaths as infections. Food systems have an important role to play in ensuring good health at both ends of the spectrum, and fish is a particularly

compelling food commodity within such systems.

The role of fish for human nutrition and health

Fish and other aquatic animal products (subsequently referred to as “fish”) are a global commodity of key nutritional significance. Fish production contributes directly or indirectly to the income of 10% of the world's population, and this proportion is greater in low and middle income countries. Estimates of the consumption of fish vary, but data derived from food balance sheets suggests at least 1 billion people depend on fish as the main source of animal food, and 3 billion people rely on fish for at least a fifth of their intake of animal source foods. For rural inland poor populations in Asia and Africa, dried fish is a particularly important food; such fish are often small, and consumed whole. As a result, they contain higher levels of nutrients including calcium, zinc, iron, and vitamin A than normally are available in larger fish. Fish is also an important source of vitamin B12, which is only found naturally in animal source foods and plays an important role in the function of the brain and nervous system. It is also rich in essential fatty acids, which are important structural elements of the brain and heart. It also has an enhancing effect, sometimes known as the “meat factor” which enables greater absorption of nutrients from other parts of the diet.

In the public health world, fish is largely recognised for its rich content of omega-3 fatty acids. It has been estimated that a quarter of all disability-adjusted life years lost (DALY's) due to ischemic heart disease and 1% of *all* worldwide DALY's are due to low intake of these nutrients. In fact, a recent systematic analysis revealed that 80% of the world's population had mean intakes less than 250mg/day, with extremely low levels (<100mg/day) prevalent in Sub-Saharan Africa, South America, and Asian mainland nations. These results led the authors of the study to call for "concerted public health and policy initiatives...to increase both supply and consumption" (Micha *et al*, 2014).

Evidence is also accruing in support of the potential benefits of fish consumption during the first 1 000 days and beyond. While not all the evidence is consistent, extensive observational studies have suggested benefits of DHA, a long chain omega-3 fatty acid on multiple aspects of child brain development. There is also evidence from trials that consumption of omega-3 fatty acids in pregnancy is associated with reduced risk of early preterm delivery, an important cause of disability and infant mortality globally. While many types of fish are also rich in their content of micronutrients that are known to be important for health, growth, and development of children, more evidence is needed to understand the contributions that could come from boosting fish consumption (rather than specifically only fatty acids) during the first 1 000 days of life. This represents a promising area of future research.

Nutrition-sensitive aquaculture and fisheries

Within the global nutrition community there has been a strong movement towards "nutrition-sensitive agriculture", or agriculture that seeks specifically to improve nutritional outcomes of populations. The momentum for this movement comes largely from the recognition that: (1) Rising incomes alone do not necessarily translate into improvements in the quality of diet; (2) Health systems alone are poorly equipped to address a problem with deep and wide roots that include social and gender inequality, lack of ability to afford the foods that are richest in essential nutrients, access

to services, and other factors; and (3) That many people globally depend directly on agriculture for their livelihoods. To date, however, relatively little of this momentum has carried over into the aquaculture and fisheries sector, despite the promising nutritional content of fish described above.

It can be argued based on the above that producing more fish through existing models - whether through aquaculture or fisheries management - might be nutrition-sensitive in itself: that greater production would facilitate greater household access to a nutrient-rich commodity and therefore increase the chances of achieving nutritional objectives. However, relying on such an argument would mean lost opportunities to address barriers that currently are hampering the ability to achieve nutrition goals, such as:

- Strong seasonality in production cycles, which result in peaks and troughs in the availability of fish, and access by households to nutrients;
- Focus on production of single species with long production cycles, resulting in peaks in income, rather than round the year income (which poorer households would prefer);
- Lack of market diversity in sizes and species of fish on the market restricts ability of poorer households to purchase fish;
- Lack of knowledge about the nutritional importance of fish, and other nutrient rich foods, during the first 1 000 days of life in which it makes the most difference;
- Food taboos that restrict feeding of fish to young children;
- Unequal distribution of productive resources and therefore household income opportunities through aquaculture and fisheries;
- Lack of empowerment for women to participate in aquaculture and decision-making around what to do with income and foods that are harvested;
- Post-harvest losses limit the amount of available fish for human consumption and consumption of fish that has not been properly preserved exposes people to food-borne illness.

At present, these barriers result in lost opportunities to maximise the chances of achieving nutritional goals through fish. Nutrition-sensitive approaches to aquaculture and fisheries aim to try to overcome such barriers through specific actions, thereby harnessing the potential of fish to make a difference for human health and nutrition. Below we highlight some examples of emerging opportunities.

Opportunity 1: Optimising nutrition through production system innovations

Small modifications can have big impacts on the performance of production systems. The introduction of micronutrient-rich fish ("mola") into homestead pond polyculture systems in Bangladesh for home consumption and sale provides one example. Usually, in polyculture systems a number of different species of similar size and rearing time are cultivated. In Bangladesh, research found that the simultaneous cultivation of small micronutrient-rich fish and large fish, most commonly native carps, is non-detrimental to the performance of either species while the overall output increases, without use of additional inputs.



A Bangladeshi mother feeding her children nutrient-rich small fish (mola) and leafy vegetables

Further, as small fish remain reproductive and harvest periods are shorter than for large fish, multiple harvests in short intervals are possible. This is of benefit in helping households to have access to critical nutrients during seasons of food shortage, and to obtain regular additional income. And, as small fish are often eaten whole, the intake of important micronutrients, iron, and zinc is increased. In homestead models of aquaculture, vegetables and fruits can be cultivated on the pond dikes, resulting in increased availability of foods that provide complementary nutrients to fish, and result in greater dietary diversity around the year.

Opportunity 2: Improving the nutritional content of fish through non-traditional approaches to feeds

There may be opportunities to modify the feeds used in aquaculture to improve the nutritional value of fish and to improve the sustainability of fish production. Perhaps the best example comes from the salmon industry in which a 'finishing feed' or fish oil is fed to fish towards the end of the production cycle to enhance the omega-3 fatty acid content of the fish. While the sustainability of the feed approaches used in the salmon farming industry is questionable given the reliance on marine by-catch, research has also shown that vegetable sources of omega 3's including linseed oil and algae can enhance the fatty acid profile of fish. Research has also indicated that vitamin A and the selenium content of fish can be enhanced by including sources of such micronutrients in the feed, yet more work is needed to explore whether locally available sources of these nutrients (such as orange flesh sweet potato skins) can be used to enhance nutritional values of commonly reared tropical fish species.



Woman feeding fish at a homestead pond in Khulna, Bangladesh

WorldFish

Opportunity 3: Coupling aquaculture and fisheries with behaviour change communication

It is estimated that 800 million people are directly or indirectly involved in the production of fish, many of whom are small pond holders in low and middle income countries, or poor fishers. As such, an interesting opportunity exists to try to improve the consumption of fish by those living in producing households, particularly women and children for whom the benefits would likely be the greatest. For example, in Bangladesh, the USAID-funded 'Feed the Future' project called "Aquaculture for Income and Nutrition" works with small fish pond holders to improve productivity.

However, improved availability and access to fish does not necessarily translate into improved diets. To reach the ultimate goal

of improving the health status of household members, often requires changes in critical diet-related behaviors, particularly with respect to the feeding of infants and young children. Here, the consideration of norms, attitudes, and practices in respect to fish-food purchase, preparation, processing, and allocation among household members represent important prerequisites for the initiation of a transformation process.

Households in Bangladesh are also being encouraged to increase the uptake of micronutrient-rich fish, vegetables and fruits by infants, young children and pregnant as well as lactating women. These recommendations are aligned with the 'First 1 000 days of life' programme initiated by the 'Scaling up Nutrition' programme (SUN), which promotes actions and investment to improve nutrition for mothers, infants and young children during the most critical time of their life for growth and future development. In combination with behaviour change communication and promotion of essential nutrients and hygiene actions, women's decision making and behaviour are assumed to have greater effects on nutrition and health for household members. Fundamental for any kind of decision-making is empowerment. To foster this, nutrition-sensitive aquaculture actions aim to integrate women into income generating or aqua- and agriculture-related tasks. For instance, WorldFish motivates women to engage in vegetables and fruit production in homestead gardens or on pond dykes to diversify diets or to create income.

Opportunity 4: Preservation and food safety to ensure greater access for poor people

Fish for human consumption is often absent from places where it is most needed. To increase the availability and accessibility of fish food, in particular for poor people lacking refrigerators, optimising preservation through processing for improved transport and storage is one of the global recommendations for improving nutrition through food systems. For aquaculture and fisheries, acting on this recommendation is urgent as at least 10 % of the overall production is lost due to spoilage. Preservation, most commonly done by freezing, smoking, drying or salting, can help to increase the availability of fish for human consumption, to retain the nutritional value of fish, and to improve

food safety. However, to uncover the full potential of preservation for improved availability and accessibility will take concerted efforts. In Africa, to date, in many places where food-insecure people live, infrastructure and market access is poorly developed. For example, cold chain coverage is low or simply not existent and remote places are ill-connected to areas of fish production. In rural areas of Northern Zambia, local dried and fresh fish trade is conducted using a bicycle. Cycling for more than ten hours and covering almost 100 km per day, trade under poor infrastructure and logistical conditions reveals potential for improvement.



Sven Genschick, WorldFish

Local fish trade on a bicycle in northern Zambia. By the means of a basket and wet papyrus, fresh fish are transported and sold over distances up to 100 km

Opportunity 5: Capturing lessons, sharing learning and building coalitions

The above opportunities involve testing new approaches and innovations. Many represent a change from conventional approaches to aquaculture and fisheries production, though in some cases building on existing social norms and habits, including a strong preference for fish in many societies. It is essential that any such endeavours are monitored and evaluated closely – both to document success and to build evidence to convince others of the value of approaches found to be successful. This must involve thinking about different audiences, and what type of evidence they find convincing. A number of recent systematic reviews have highlighted the need for strong monitoring and evaluation (M&E) systems that are capable of generating high quality evidence that can be used to convince business, donors and policymakers that investing in fisheries and

aquaculture for nutrition is worthwhile. Building of coalitions within the fisheries and aquaculture sector, and with influential organisations active in nutrition and health is also essential for change.

Summary and conclusion

Fish and other aquatic animals make up a majority of the animal-source food intake for over 1 billion people, and are critically important in developing countries. There is increasing recognition that fish has a special role in human nutrition that goes well beyond traditional considerations as a “commodity” or a source of “animal protein”. Fish is an excellent source of the key nutrients that are often in short supply in the diets of poor populations,

especially young children. Deficiencies of these nutrients, including zinc, iron, vitamin A, vitamin B12, and essential fatty acids have important consequences for health and child development, and therefore for the productivity of nations. Whilst much attention during the past few years has been given to growth of aquaculture, and ensuring sustainability of aquaculture and fisheries, the sector needs new approaches to development, which we refer to as “nutrition-sensitive”. This approach seeks to enhance the role that aquaculture and fisheries play in contributing to the nutrition and health of populations worldwide.

Fish is generally associated as being a relatively healthy food source compared with other animal proteins and one could argue that it would be simpler

to just produce more in order to meet the needs of populations. However, nutrition-sensitive thinking seeks rather to maximise potential impacts by improving quality, availability and access to food. As the examples of nutrition-sensitive approaches in aquaculture have demonstrated, improvements are often possible by innovative and integrative thinking, triggering small changes with big impacts. Therefore, the opportunity to further elevate the significance of aquaculture and fisheries for nutrition and food security is immense, realised by relatively simple means, and for the benefit of all populations regardless of their economic status. 🌐

Reader enquiry number 4

References

1. Thilsted, S.H. (2012). The potential of nutrient-rich small fish species in aquaculture to improve human nutrition and health. In: Subasinghe, R.R.; Arthur, J.R.; Bartley, D.M.; De Silva, S.S.; Halwart, M.; Hishamunda, N.; Mohan, C.V.; Sorgeloos, P. (eds.) *Farming the waters for people and food. Proceedings of the Global Conference on Aquaculture 2010. Phuket, Thailand, 22-25 September 2010*, pp. 57-73. FAO, Rome and NACA, Bangkok
2. Bogard, Jessica R., Shakuntala H. Thilsted, Geoffrey C. Marks, Md. Abdul Wahab, Mostafa A.R. Hossain, Jette Jakobsen, James Stangoulis (2015). Nutrient composition of important fish species in Bangladesh and potential contribution to recommended nutrient intakes. In: *Journal of Food Composition and Analysis*, 42(1), 120-133.
3. Micha, R., Khatibzadeh, S., Shi, P., Fahimi, S., Lim, S., Andrews, K. G., & Mozaffarian, D. (2014). Global, regional, and national consumption levels of dietary fats and oils in 1990 and 2010: a systematic analysis including 266 country-specific nutrition surveys. *Bmj*, 348.
4. Béné, C., Barange, M., Subasinghe, R., Pinstrup-Andersen, P., Merino, G., Hemre, G. I., & Williams, M. (2015). Feeding 9 billion by 2050—Putting fish back on the menu. *Food Security*, 7(2), 261-274.

The Authors



Michael Phillips, Director - Aquaculture and Genetic Improvement, WorldFish



Andrew Thorne-Lyman, Senior Nutrition Specialist, WorldFish



Shakuntala Haraksingh Thilsted, Senior Nutrition Advisor, WorldFish



Sven Genschick, Post-doctoral Fellow - Aquaculture and Genetics Improvement, WorldFish



Rohana Subasinghe, Chief - Aquaculture Branch, Fisheries and Aquaculture Resources Use and Conservation Division, Fisheries and Aquaculture Department of the Food and Agriculture Organization of the United Nations (FAO)

Acknowledgements

The article is based on research supported by various partners and donors; among these the authors would particularly like to recognise the CGIAR Research Program on Aquatic Agricultural Systems (AAS), the USAID Aquaculture for Income and Nutrition project in Bangladesh and the BMZ/GIZ project “Aquaculture and the poor: improving fish production, consumption and nutrition linkages”.