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COMMITTEE ON FISHERIES

SUB-COMMITTEE ON AQUACULTURE

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NUTRITION, FOOD SECURITY AND AQUACULTURE: ADDITIONAL ANNOTATIONS

Executive Summary

This information paper provides additional information in support of working document COFI:AQ/X/2019/6: “Aquaculture’s contribution to ending hunger, securing food supplies and promoting good health and dietary practices”.



INTRODUCTION AND CONTEXT

1. The Rome Declaration on World Food Security and subsequent Plan of Action, adopted at the 1996 World Food Summit, lay the foundations of a common objective - food security, at the individual, household, national, regional and global levels.¹ Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Ten years ago, the World Summit on Food Security developed the Rome Principles for Sustainable Global Food Security² (Box 1).

Box 1: The 2009 Rome Principles for Sustainable Global Food Security

The 2009 World Summit on Food Security developed the following Rome Principles¹ for Sustainable Global Food Security, as basis for commitments and actions:

- Principle 1: Invest in country-owned plans, aimed at channeling resources to well-designed and results-based programmes and partnerships.
- Principle 2: Foster strategic coordination at national, regional and global level to improve governance, promote better allocation of resources, avoid duplication of efforts and identify response-gaps.
- Principle 3: Strive for a comprehensive twin-track approach to food security that consists of: 1) direct action to immediately tackle hunger for the most vulnerable and 2) medium and long-term sustainable agricultural, food security, nutrition and rural development programmes to eliminate the root causes of hunger and poverty, including through the progressive realization of the right to adequate food.
- Principle 4: Ensure a strong role for the multilateral system by sustained improvements in efficiency, responsiveness, coordination and effectiveness of multilateral institutions.
- Principle 5: Ensure sustained and substantial commitment by all partners to investment in agriculture and food security and nutrition, with provision of necessary resources in a timely and reliable fashion, aimed at multi-year plans and programmes.

2. The importance of the contribution of fisheries and aquaculture to food security and nutrition has long been recognized in the diets of local communities worldwide, as well as at high level and international platforms, notably the 1995 Kyoto Conference,³ and the FAO Ministerial Conferences on Fisheries in 1995⁴ and 1999.⁵

3. More recently, and more specifically to aquaculture development, the 2015 COFI Sub-Committee on Aquaculture (COFI:AQ), included food security and nutrition issues in its 8th Session in Brazil, on the occasion of a special event on the “Contribution of aquaculture to food and nutrition

¹ <http://www.fao.org/WFS/> ; <http://www.fao.org/3/w3613e/w3613e00.htm>

² WSFS. 2009. Declaration of the World Summit on Food Security - Rome Principles for Sustainable Global Food Security . WSFS 2009/2. <https://www.mofa.go.jp/policy/economy/fishery/wsfs0911-2.pdf>

³ FAO/Japan. 1995. Kyoto Conference Outcome & Papers Presented. Kyoto Declaration and Plan of Action <http://www.fao.org/3/ac442e/ac442e00.htm>

⁴ FAO. 1995. The Rome Consensus on World Fisheries, adopted by the FAO Ministerial Conference on Fisheries, Rome, 14-15 March 1995. <http://www.fao.org/3/AC441E/AC441E00.htm>

⁵ FAO. 1999. The Rome Declaration on the Implementation of the Code of Conduct for Responsible Fisheries, adopted by the FAO Ministerial Meeting on Fisheries , Rome, 10-11 March 1999. <http://www.fao.org/3/X2220E/X2220E00.htm>

security, poverty alleviation and national economies: evidence-based experiences".⁶ The COFI:AQ⁷ recognized school lunch programmes and national advertising campaigns, and emphasized the opportunity of using aquaculture development in the promotion of fish consumption. Here it was also noted that promotion of fish⁸ consumption and the subsequent nutritional benefits are often absent from national strategies. The COFI:AQ recommended that FAO report on good farming practices, assessing aquaculture's contribution to food security and nutrition, and its impact on policy development.

4. The following COFI:AQ Session in 2017⁹ underlined the important contribution of aquaculture to food security and nutrition and its great potential, and emphasized the need to support small-scale producers.

5. Concurrent to COFI:AQ, the 2016 Session of the FAO Committee on Fisheries (COFI, 2016)¹⁰ emphasized the role of fisheries and aquaculture in food security and nutrition and welcomed the efforts of FAO to better integrate fisheries and aquaculture in food security and nutrition strategies and programmes. Just last year, COFI 2018¹¹ reiterated the importance of aquaculture for food security and nutrition, particularly for small-scale producers. Furthermore, last year COFI noted that sustainable aquaculture has the potential to meet growing demand and to fill the gap in global fish supply, and noted the interest of many Member Countries to develop aquaculture to meet their food demands.

6. The debate about aquaculture development and its crucial present and future contributions to food security and nutrition, can benefit from consideration of how to better align commitments, policies, and prioritize funding for supporting nutrition efforts through the aquaculture sector. The following recent international instruments, initiatives and policy developments form the basis of aquaculture development's present and future nutrition contributions, most prominently:

- Second International Conference on Nutrition and the Rome Declaration on Nutrition (2014);
- 2030 Agenda for Sustainable Development¹², including the Sustainable Development Goals (2015) and the United Nations Decade of Action on Nutrition (2016-2025);
- FAO's Common Vision for Sustainable Food and Agriculture (2014)¹³ and the 20 Actions on Transforming Food and Agriculture to achieve the SDGs (2018);¹⁴
- Right to Food Guidelines (FAO, 2005).¹⁵

⁶ FAO. 2015. Special Event on "Contribution of Aquaculture to Food and Nutrition Security, Poverty Alleviation and National Economies: Evidence-Based Experiences". COFI:AQ/VIII/2015/11. http://www.fao.org/fi/static-media/MeetingDocuments/COFI_AQ/2015/11e.pdf

⁷FAO Committee on Fisheries. 2015. Report of the eighth session of the Sub-Committee on Aquaculture. Brasilia, Brazil, 5–9 October 2015. FAO Fisheries and Aquaculture Report. No. 1131. Rome <http://www.fao.org/3/a-i5191t.pdf>

⁸ "Fish" is used here to represent farmed fish and seafood, including finfish, crustaceans, molluscs, miscellaneous aquatic animals and aquatic plants.

⁹ FAO Committee on Fisheries. 2018. Report of the ninth session of the Sub-Committee on Aquaculture. Rome, Italy, 24–27 October 2017. FAO Fisheries and Aquaculture Report. No. 1188. Rome. <http://www.fao.org/3/i8886t/18886T.pdf>

¹⁰ FAO. 2017. Report of the Thirty-second Session of the Committee on Fisheries. Rome, 11–15 July 2016. FAO Fisheries and Aquaculture Report No. 1167. Rome. <http://www.fao.org/3/a-i6882e.pdf>

¹¹FAO. 2018. Report of the Thirty-third Session of the Committee on Fisheries. Rome, 9–13 July 2018. Forty-first Session of the FAO Conference. C 2019/23. Rome.

http://www.fao.org/fileadmin/user_upload/bodies/Conference_2019/MX970_23/MX970_C_2019_23_en.pdf

¹² United Nations. 2015. Transforming our world: the 2030 Agenda for Sustainable Development. New York. <https://sustainabledevelopment.un.org/post2015/transformingourworld/publication>

¹³ FAO. 2014. Building a common vision for sustainable food and agriculture – principles and approaches. Rome. . www.fao.org/3/a-i3940e.pdf

¹⁴ FAO. 2018. Transforming Food and Agriculture to Achieve the SDGs: 20 interconnected actions to guide decision-makers. Rome, 71 pp. <http://www.fao.org/3/I9900EN/i9900en.pdf>

FAO. 2018. Transforming Food and Agriculture to Achieve the SDGs: 20 interconnected actions to guide decision-makers. Technical Reference Document. Rome. 132 pp; <http://www.fao.org/3/CA1647EN/ca1647en.pdf>

¹⁵ FAO. 2005. Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security. <http://www.fao.org/3/a-y7937e.pdf>

STATE OF HUNGER AND MALNUTRITION

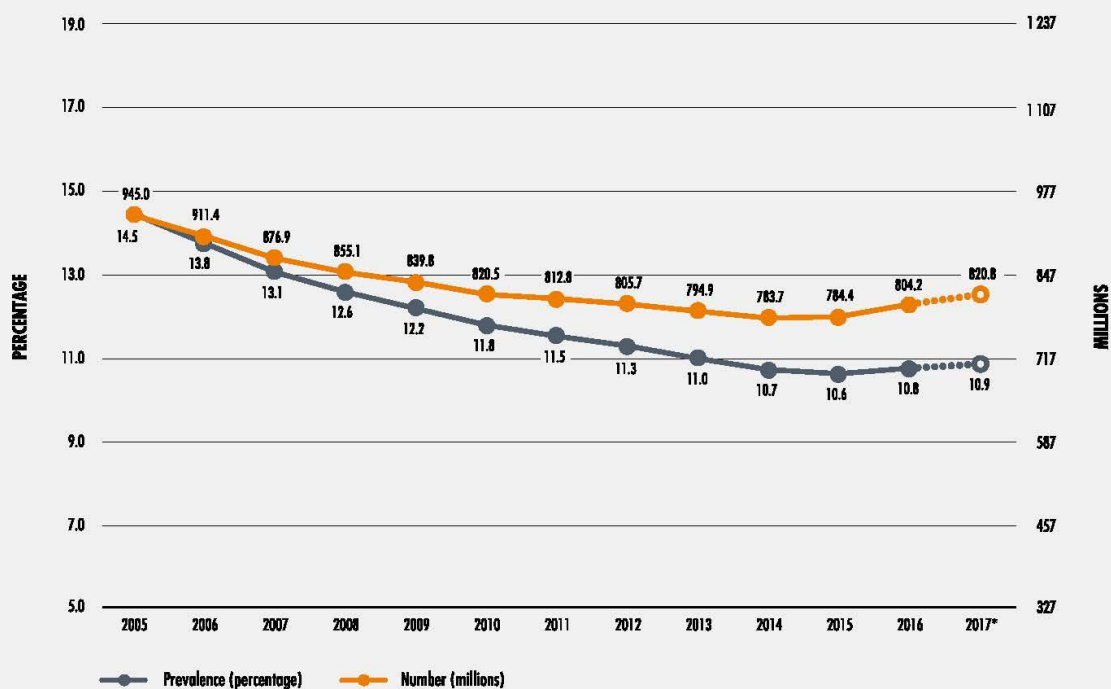
7. The number of people who suffer from hunger has been growing over the past three years, returning to levels from almost a decade ago.¹⁶ New evidence continues to point to a rise in world hunger in recent years after a prolonged decline (Figure 1). This is largely attributed to persistent instability in conflict ridden regions, adverse climate events and economic slowdowns. An estimated 821 million people, approximately one out of every nine people in the world, are undernourished.¹⁷ In 2017, close to 10 percent of the world population was exposed to severe food insecurity, corresponding to about 770 million people.¹⁸ In almost all regions of Africa, as well as in South America, undernourishment and severe food insecurity appear to be increasing, whereas the undernourishment situation is not further deteriorating, in most regions of Asia. The signs of increasing hunger and food insecurity are a warning that there is considerable work to be done to make sure we “leave no one behind” on the road towards a world with zero hunger.

¹⁶ FAO, IFAD, UNICEF, WFP and WHO. 2018. The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition. Rome, FAO. Licence: CC BY-NC-SA 3.0 IGO. <http://www.fao.org/3/I9553EN/i9553en.pdf>

¹⁷ IFPRI. 2019. Accelerating the end of hunger and malnutrition: A global event: Synopsis. Proceedings of IFPRI-FAO Bangkok Conference. 28-30 November 2018. Bangkok, Thailand. Washington, DC: Food and Agriculture Organization (FAO) and International Food Policy Research Institute (IFPRI). <https://doi.org/10.2499/9780896293533> <http://ebrary.ifpri.org/utills/getfile/collection/p15738coll2/id/133063/filename/133275.pdf> <https://www.ifpri-faobangkokconference.org/files/2018/12/Bangkok-at-a-Glance.pdf>

¹⁸ FAO, IFAD, UNICEF, WFP and WHO. 2018. The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition. Rome, FAO. Licence: CC BY-NC-SA 3.0 IGO.

FIGURE 1
THE NUMBER OF UNDERNOURISHED PEOPLE IN THE WORLD HAS BEEN ON THE RISE
SINCE 2014, REACHING AN ESTIMATED 821 MILLION IN 2017



* Projected values, illustrated by dotted lines and empty circles.
 SOURCE: FAO.

8. Food insecurity leads to hunger and undernutrition affecting many societies. Widespread malnutrition exists in the forms of undernutrition such as stunting and wasting, micronutrient deficiencies, as well as overweight and obesity. High rates of these forms of malnutrition coexist in many countries¹¹, with multiple forms of malnutrition existing in the same communities and even households. Over 50 million children under five in the world are affected by wasting, approximately half of whom live in Southern Asia, and one-quarter in sub-Saharan Africa. Nearly 151 million children under five in the world (22 percent) were still stunted in 2017, whereas over 38 million children under five are overweight. More than one in eight adults in the world is obese and one in three women of reproductive age is anaemic.¹⁹

9. Rapid social and economic changes in many low- and middle-income countries have led to increased urbanization and unforeseen changes in food systems, lifestyles and eating habits. The higher cost of nutritious foods, the experience of living with food insecurity, and physiological adaptations to food restriction help explain the higher risk of overweight and obesity for food-insecure families. Poor access to healthy diverse food increases the risk of low birthweight and stunting in children, which are associated with higher risk of overweight and obesity later in life. As a consequence of global food

¹⁹ FAO, IFAD, UNICEF, WFP and WHO. 2018. The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition. Rome, FAO.

systems and subsequent policies, dietary patterns have shifted toward increased consumption of processed foods that are often energy-dense, high in saturated fats, sugars and salt, and low in fibre.

10. The 2030 Agenda, in particular SDG 2, calls for an end to hunger, food insecurity and multiple forms of malnutrition:

- 1) By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.
- 2) By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under five years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons.

11. FAO hosted the Second International Conference on Nutrition (ICN2) in 2014, a high-level intergovernmental meeting that focused global attention on addressing malnutrition in all its forms, resulting in a clear action agenda.²⁰ The two main outcome documents—the Rome Declaration on Nutrition and the Framework for Action, were endorsed by participating governments at the conference, committing world leaders to establishing national policies aimed at eradicating malnutrition and transforming food systems to make nutritious diets available to all. Within the Rome Declaration, it was acknowledged that malnutrition, in all its forms (undernutrition, micronutrient deficiencies, overweight and obesity), not only affects people's health, but also poses a high burden in the form of negative social and economic consequences to individuals, families, communities and States and their governments.²¹ As a follow-up to ICN2, the UN Decade of Action on Nutrition 2016-2025 has become an umbrella framework for countries to share experiences, promote improved coordination and build political momentum to scale up action²² (Box 2).

²⁰ FAO, IFAD, UNICEF, WFP and WHO. 2018. The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition. Rome, FAO.

<http://www.fao.org/3/I9553EN/i9553en.pdf>

²¹ ICN2. 2014. Rome Declaration on Nutrition . <http://www.fao.org/3/a-ml542e.pdf>

²² Committee on Fisheries. 2018. United Nations Decade of Action on Nutrition 2016-2025: opportunities for fisheries and aquaculture to contribute to healthy diets and improved nutrition. <http://www.fao.org/3/MX097EN/mx097en.pdf>

Box 2: the UN Decade of Action on Nutrition 2016–2025

As a commitment by United Nations Member States, the Decade aims to undertake 10 years of sustained and coherent implementation of policies, programs and increased investments to eliminate malnutrition in all its forms, in all countries and for all age groups. The UN General Assembly mandated FAO and WHO to co-lead its implementation, in collaboration with WFP, IFAD, UNICEF and other relevant stakeholders.

The Work Programme of the Decade embraces six inter-connected and cross-cutting thematic action areas, based on the ICN2 recommendations and in line with the SDGs, namely:

- (i) Sustainable, resilient food systems for healthy diets;
- (ii) Aligned health systems providing universal coverage of essential nutrition actions;
- (iii) Social protection and nutrition education;
- (iv) Trade and investment for improved nutrition;
- (v) Safe and supportive environments for nutrition at all ages;
- (vi) Strengthened governance and accountability for nutrition.

Committing to a global Action Network related to fishery and aquaculture under the umbrella of the Decade, Norway was the first country to establish and lead the *Global Action Network on Sustainable Food from the Oceans and Inland Waters for Food Security and Nutrition*, with the aim of increasing the nutritional impacts the fisheries and aquaculture sector can make. Sustainable fish production contributes to food security and nutrition, high quality protein, micronutrients and fatty acids as well as income and livelihoods for local communities.

Source: Committee on Fisheries. 2018. United Nations Decade of Action on Nutrition 2016-2025: opportunities for fisheries and aquaculture to contribute to healthy diets and improved nutrition. <http://www.fao.org/3/MX097EN/mx097en.pdf>

TURNING TO FISH

12. Coinciding with increasing hunger, people have never consumed as much fish as they do today, with per capita global fish consumption having doubled since the 1960s.²³ Trade in fish products is also rising, particularly from and among developing countries,²⁴ and the demand is likely to continue to grow. Total fish production in 2016 reached an all-time high of 171 million tonnes, of which 88 percent (151.2 million tonnes) were utilized for direct human consumption, thanks to relatively stable capture fisheries production, reduced wastage and aquaculture growth. Since 1961, the annual global growth in fish consumption has been twice as high as population growth, demonstrating that the fisheries sector, and,

²³ FAO. 2018. The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals. Rome. <http://www.fao.org/3/I9540EN/i9540en.pdf>

²⁴ Thompson, B. and L. Amoroso. 2014. Improving diets and nutrition: food-based approaches. Rome, FAO. <http://www.fao.org/3/a-i3030e.pdf>

in particular, the aquaculture sector, are crucial in meeting our globally shared goal of “a world without hunger and malnutrition”^{25,26}.

13. One of the concerns of recommending an increased consumption of fish is the sustainability of marine and inland stocks and the potential over-fishing of this important source of high quality nutritious food. Added to this is the fact that a significant albeit decreasing proportion (22 percent) of the world fish catch is used for non-food purposes (about 20 million tonnes), of which 15 million tonnes are reduced to fish meal and fish oil and used as animal feed in industrial livestock and aquaculture production, while the rest (5 million tonnes) was largely utilized as material for direct feeding in aquaculture and raising of livestock and fur animals, in culture (e.g. fry, fingerlings or small adults for on-growing), as bait, in pharmaceutical uses and for ornamental purposes, instead of direct human consumption.²⁷

14. Since the 1980s, virtually all of the increase in the amount of fish consumed has come from aquaculture (in live weight equivalent). Since 2014, aquaculture has provided more fish for human consumption than capture fisheries and by 2030, it is expected to provide 60 percent of the fish available for human consumption.²⁸

PRODUCTION - THE CONTRIBUTION OF GLOBAL AQUACULTURE

15. In recent decades, aquaculture has been responsible for the continuing impressive growth in the supply of fish for human consumption. Global aquaculture production (including aquatic plants) in 2016 was 110.2 million tonnes, with the first-sale value estimated at USD 243.5 billion. The first-sale value, re-estimated with newly available information for some major producing countries, is considerably higher than previous estimates. The total production included 80.0 million tonnes of food fish (USD 231.6 billion) and 30.1 million tonnes of aquatic plants (USD 11.7 billion) as well as 37 900 tonnes of non-food products (USD 214.6 million).

16. The contribution of aquaculture to the global production of fish from capture fisheries and aquaculture combined has risen continuously, reaching some 47 percent in 2016 (up from 26 percent in 2000) and 53 percent if non-food uses (including reduction to fishmeal and fish oil) are excluded.

17. Notably, inland aquaculture contributed significantly to aquaculture’s contribution to fish production as it increased significantly from 38.6 million tonnes in 2011 to about 51.4 million tonnes in 2016.²⁹ Inland aquaculture is a key source of food for many communities in Africa and Asia. Fish plays a crucial role in dietary contributions in these continents, and in some cases accounts for 50 percent or

²⁵ Thilsted, S.H. 2012. The potential of nutrient-rich small fish species in aquaculture to improve human nutrition and health. In R.P. Subasinghe, J.R. Arthur, D.M. Bartley, S.S. De Silva, M. Halwart, N. Hishamunda, C.V. Mohan & P. Sorgeloos, 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. http://pubs.iclarm.net/resource_centre/WF_3140.pdf; <https://www.worldfishcenter.org/content/potential-nutrient-rich-small-fish-species-aquaculture-improve-human-nutrition-and-health>

²⁶ Tacon, A.G.J. 2001. Increasing the contribution of aquaculture for food security and poverty alleviation. In R.P. Subasinghe, P. Bueno, M.J. Phillips, C. Hough, S.E. McGladdery & J.R. Arthur, eds. *Aquaculture in the Third Millennium. Technical Proceedings of the Conference on Aquaculture in the Third Millennium*, Bangkok, Thailand, 20-25 February 2000. pp.63-72. NACA, Bangkok and FAO, Rome. <http://www.fao.org/3/AB412E/ab412e30.htm>

²⁷ FAO. 2018. *The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals*. Rome. <http://www.fao.org/3/I9540EN/i9540en.pdf>

²⁸ FAO. 2018. In Brief. *The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals*. <http://www.fao.org/3/ca0191en/ca0191en.pdf>

²⁹ FAO. 2018. *The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals*. Rome. <http://www.fao.org/3/I9540EN/i9540en.pdf>; <http://www.fao.org/news/story/en/item/1144274/icode/>

more of the total protein intake (case in Bangladesh, Cambodia, Gambia, Ghana, Indonesia, Sierra Leone, Sri Lanka, and some small island developing states).²⁰

18. With 5.8 percent annual growth rate during the period 2001-2016, aquaculture continues to grow fast, but it no longer enjoys the high annual growth rates experienced in the 1980s and 1990s. Still, the level of sectoral development and production distribution continue to be very different among the countries within regions and across the world. FAO projections³⁰ of fish production to 2030 indicate significant increases in regional and global contributions from aquaculture.

19. The growth of farming of fed aquatic animal species has outpaced the farming of unfed species in world aquaculture. The share of unfed species in total aquatic animal production decreased gradually from 2000 to 2016, shrinking by 10 percentage points to 30.5 percent. In 2016, aquaculture was the source of 96.5 percent by volume of the total 31.2 million tonnes of wild-collected and cultivated aquatic plants combined. Global production of farmed aquatic plants, overwhelmingly dominated by seaweeds, grew in output volume from 13.5 million tonnes in 1995 to just over 30 million tonnes in 2016.

20. Overall, FAO projections of fish production to 2030 indicate significant increases in regional and global contributions from aquaculture (Table 1, FAO. 2018).

Table 1: Projected fish production, 2030 (live weight equivalent; Source: adapted from FAO, 2018)³¹

Region	Fisheries and aquaculture			Aquaculture		
	Production (1000 tonnes)		Growth 2016 to 2030	Production (1000 tonnes)		Growth 2016 to 2030
	2016	2030	%	2016	2030	%
Asia	121 776	144 666	18.8	71 546	97 165	35.8
Africa	11 260	13 556	20.4	1 982	3 195	61.2
Europe	16 644	17 954	7.9	2 945	3 953	34.2
North America	6 703	6 470	-3.5	645	744	15.4
Latin America and Caribbean	12 911	16 035	24.2	2 703	4 033	49.2
Oceania	1 640	1 973	20.3	210	299	42.1
World	170 941	200 955	17.6	80 031	109 391	36.7

21. A recent FAO study³² indicates that given steady capture fisheries production, the global aquaculture would need to grow nearly 10 percent a year from the mid-2010s to the early 2020s in order to cover the fish demand growth driven by population and income growth, and aquaculture would need to grow faster than its current trend in 170 countries/territories in order to generate enough fish to satisfy the increase in its fish demand driven by its population and income growth.

³⁰ FAO. 2018. The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals. Rome. <http://www.fao.org/3/I9540EN/i9540en.pdf>

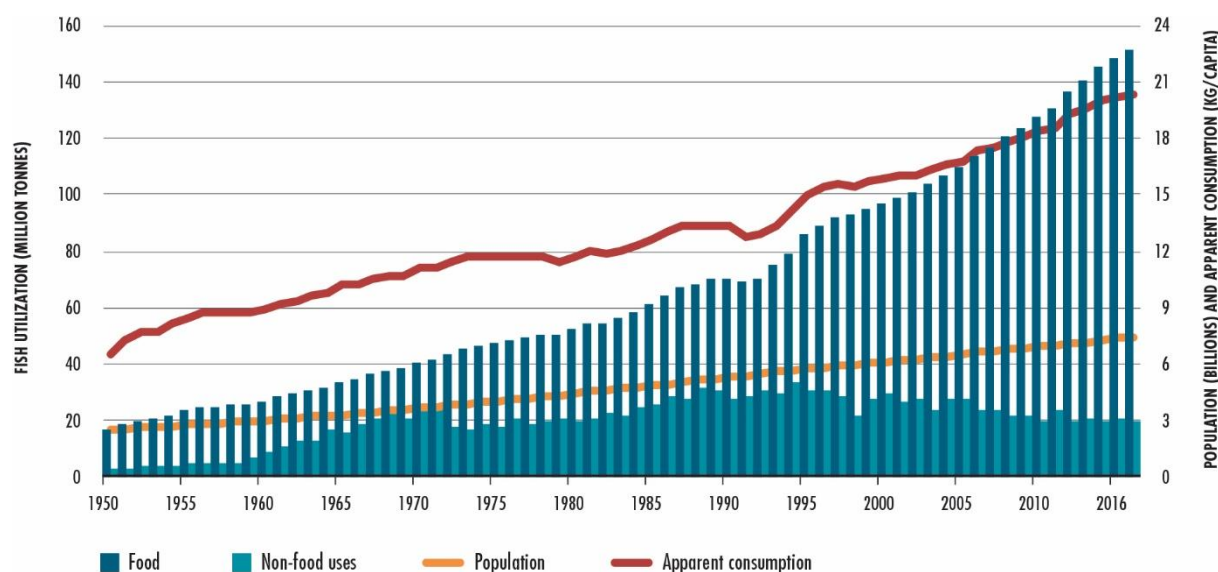
³¹ FAO. 2018. The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals. Rome. <http://www.fao.org/3/I9540EN/i9540en.pdf>

³² Cai, J. and P.S. Leung. 2017. Short term projection of global fish demand and supply gaps. FAO Fisheries and Aquaculture Technical Paper 606. - <http://www.fao.org/3/a-i7623e.pdf>

FISH CONSUMPTION³³

22. In per capita terms, food fish consumption has grown from 9.0 kg in 1961 to 20.2 kg in 2015, at an average rate of about 1.5 percent per year. Preliminary estimates for 2016 and 2017 point to further growth to about 20.3 and 20.5 kg, respectively (Figure 2). It is however noted that another recent study³⁴ proposes global per capita consumption estimates that are higher.

Figure 2.



23. In any case, the expansion in consumption has been driven not only by increased production, but also by a combination of many other factors, including reduced wastage, better utilization, more regular supplies, improved distribution channels and growing demand, linked with population growth, rising incomes and urbanization.

24. Europe, Japan and the United States of America together accounted for 47 percent of the world's total food fish consumption in 1961 but only about 20 percent in 2015. Of the global total of 149 million tonnes in 2015, Asia consumed more than two-thirds (106 million tonnes at 24.0 kg per capita). Oceania and Africa consumed the lowest share. The shift is the result of structural changes in the sector and in particular, the growing role of Asian countries in fish production, as well as a significant gap between the economic growth rates of the world's more mature fish markets and those of many increasingly important emerging markets around the world, particularly in Asia. Live, fresh or chilled is often the most preferred and highly priced form of fish and represents the largest share of fish for direct human consumption, amounting to 45 percent in 2016, followed by frozen (31 percent), prepared and preserved (12 percent) and cured (dried, salted, in brine, fermented smoked) (12 percent).

25. The expansion of aquaculture production, especially for species such as shrimps, salmon, bivalves, tilapia, carp and catfish (including *Pangasius* spp.), is evident in the relative growth rates of

³³ FAO. 2018. The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals. Rome. <http://www.fao.org/3/I9540EN/i9540en.pdf>

³⁴ Guillen, J., Natale, F., Carvalho, N. et al. 2019. Global seafood consumption footprint. *Ambio* (2019) 48: 111. <https://doi.org/10.1007/s13280-018-1060-9>. <https://link.springer.com/content/pdf/10.1007%2Fs13280-018-1060-9.pdf>; <https://ec.europa.eu/jrc/en/news/how-much-fish-do-we-consume-first-global-seafood-consumption-footprint-published>

per capita consumption of different species groups in recent years. Since 2000, average annual growth rates have been most significant for freshwater fish (3.1 percent), molluscs, excluding cephalopods (2.9 percent) and crustaceans (2.8 percent). In 2015, global per capita consumption of freshwater fish was 7.8 kg, or 38 percent of the total, as compared with 17 percent in 1961. Human food supplies from aquaculture surpassed supplies from fishing already in 2013. In 2016, the share of fish destined as food for human consumption produced by aquaculture amounted to 53 percent. This share continues to grow.

PROJECTIONS OF HUMAN CONSUMPTION OF FISH

26. Global seafood consumption has more than doubled in the past 50 years.³⁵ Global fish production will continue to grow, with aquaculture contributing more to the total production as capture fisheries has levelled off/plateaued. Based on the assumption of higher demand and improved technology, global fish production from both sources (aquaculture and capture fisheries) was projected to increase to about 201 million tonnes by 2030.³⁶

27. A growing share of fish production is expected to be destined for human consumption (around 90 percent).³⁷ World food fish consumption in 2030 is projected to be 20 percent (or 30 million tonnes live weight equivalent) higher than in 2016. However, it is predicted that average annual growth rate of global fish consumption will be slower in the projection period 2017-2030 (+1.2 percent) than in the 2003–2016 period (+3.0 percent), mainly because of reduced production growth, higher fish prices and a deceleration in population expansion.

28. In per capita terms, world fish consumption is projected to reach 21.5 kg in 2030, up from 20.3 kg in 2016. The highest growth rates are projected for Latin America (+18 percent) and for Asia and Oceania (+8 percent each). In Africa, per capita fish consumption is expected to decrease by 0.2 percent per year up to 2030, declining from 9.8 kg in 2016 to 9.6 kg in 2030, as a result of population growth outpacing supply.

NUTRITION AND AQUACULTURE: OPPORTUNITIES AND CHALLENGES

29. Globally, fish and fish products provide an average of only about 34 calories per capita per day. However, peering deeper at national and sub-national levels, fish stands as a primary source of animal-food for many food insecure populations, often the lifeline to stable access to sufficient food. The dietary contribution of fish is significant in terms of high-quality, easily digested animal proteins, minerals and trace elements, fat-soluble vitamins and essential fatty acids often lacking in food insecure populations.³⁸ A portion of 150 g of fish provides about 50 to 60 percent of an adult's daily protein requirement. Fish proteins possess excellent amino acid scores and digestibility characteristics. Amino acid composition and bioavailability in fish are more suitable than those from plant protein sources.³⁹ The Biological Value (BV) and Protein Efficiency Ratio (PER), indices of the amino acid profile and ability to support

³⁵ Guillen, J., Natale, F., Carvalho, N. et al. 2019. Global seafood consumption footprint. *Ambio* (2019) 48: 111.

<https://doi.org/10.1007/s13280-018-1060-9>. <https://link.springer.com/content/pdf/10.1007%2Fs13280-018-1060-9.pdf>;

<https://ec.europa.eu/jrc/en/news/how-much-fish-do-we-consume-first-global-seafood-consumption-footprint-published>

<http://www.fao.org/news/story/en/item/1144274/icode/>; <http://www.fao.org/state-of-fisheries-aquaculture/en/>

³⁷ FAO. 2018. The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals. Rome.

<http://www.fao.org/3/I9540EN/i9540en.pdf>

³⁸ Bene et al. 2016. Contribution of Fisheries and Aquaculture to Food Security and Poverty Reduction: Assessing the Current Evidence. *World Development* (79):171-196. <https://www.sciencedirect.com/science/article/pii/S0305750X15002892>

³⁹ Friedman, M. 1996. Nutritional Value of Proteins from Different Food Sources. A Review. *Journal of Agricultural and Food Chemistry*, 44(1):6–29. <http://dx.doi.org/10.1021/jf9400167>

growth are higher for fish than for beef, pork, chicken and milk proteins.^{40,41} Fish provided about 3.2 billion people with almost 20 percent of their average per capita intake of animal protein.

30. Fish can be very important for low-income countries, especially for ensuring livelihoods, as most frequently consumed animal source of essential nutrients and irreplaceable, valuable contribution to the diversity of everyday diets dominated by carbohydrate-rich staples.

31. Fish is an important source of both macronutrients and micronutrients for humans, providing high-quality protein, minerals and trace elements, fat-soluble vitamins and essential fatty acids. In West African coastal countries, the proportion of dietary protein that comes from fish is very high: 63 percent in Sierra Leone and Ghana, 62 percent in the Gambia and 47 percent in Senegal. Also in Asia and some small island States the contribution is high: 71 percent in Maldives, 59 percent in Cambodia, 57 percent in Bangladesh, 54 percent in Indonesia and 53 percent in Sri Lanka.⁴² But beyond protein, even small quantities of fish can provide crucial essential fats and micronutrients, such as iron, iodine, vitamin D and calcium, which are often lacking in vegetable-based diets^{43,44} (see also Box 3).

⁴⁰ Hosomi, R., Yoshida, M., Fukunaga, K. 2012. Seafood consumption and components for health. *Global journal of health science*, 4(3), 72–86. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4776937/>

⁴¹ Sheeshka, J., Murkin, E. 2002. Nutritional Aspects of Fish Compared with Other Protein Sources, *Comments on Toxicology*, 8:4-6, 375-397. <https://www.tandfonline.com/doi/abs/10.1080/08865140215065?journalCode=gcot20>

⁴² Thilsted et al. 2014. Maximizing the contribution of fish to human nutrition. http://www.fao.org/3/a-i3963e.pdf;www.fao.org/fileadmin/user_upload/agn/pdf/ICN2Fish_Nutrition.pdf

⁴³ Thilsted, S.H. 2012. The potential of nutrient-rich small fish species in aquaculture to improve human nutrition and health. In R.P. Subasinghe, J.R. Arthur, D.M. Bartley, S.S. De Silva, M. Halwart, N. Hishamunda, C.V. Mohan & P. Sorgeloos, 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.

http://pubs.iclarm.net/resource_centre/WF_3140.pdf
<https://www.worldfishcenter.org/content/potential-nutrient-rich-small-fish-species-aquaculture-improve-human-nutrition-and-health>

⁴⁴ Thilsted, S.H. 2018. How fish can play a stronger role to achieve globally set goals. Presentation at IFRPI/FAO Conference. <https://www.slideshare.net/ifpri/how-fish-can-play-a-stronger-role-to-achieve-globally-set-goals> .
<https://www.youtube.com/watch?v=QRksSQ-TZz0&list=PLeqdWbb3KnJ8ojDhXC0uR1QVbnqft0Xk&index=5&t=0s>
 In: IFPRI. 2019. *Accelerating the end of hunger and malnutrition: A global event: Synopsis*. Proceedings of IFPRI-FAO Bangkok Conference. 28-30 November 2018. Bangkok, Thailand. Washington, DC: Food and Agriculture Organization (FAO) and International Food Policy Research Institute (IFPRI). <https://doi.org/10.2499/9780896293533>
<http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/133063/filename/133275.pdf>
<https://www.ifpri-faobangkokconference.org/files/2018/12/Bangkok-at-a-Glance.pdf>

Box 3: Examples of interventions to improve micronutrient intakes (Thilsted, 2012; Thilsted et al. 2014, Thilsted, 2018)

In Bangladesh, innovative production technologies for increasing nutrient-rich small fish production have been developed for household ponds and wetlands. Building on the highly successful model of small-scale aquaculture, pond polyculture of carps and mola has resulted in a two fold increase in total fish production, of which mola contributed 31 percent of total production. In addition to increased household income from the sale of fish, this production technology leads to higher intakes of vitamin A, calcium, and other micronutrients from consumption of mola. Community-based sustainable management with enhanced stocking of mola in wetlands led to a threefold increase in total fish production, increase in fish species diversity from 49 to 68 and mola contributing 8 percent of total fish production.

Small fish are a rich source of animal protein, essential fatty acids, vitamins and minerals. Studies in rural Bangladesh and Cambodia showed that small fish made up 50–80 percent of total fish intake in the peak fish production season. Although consumed in small quantities, the frequency of small fish intake was high. As many small fish species are eaten whole; with head, viscera and bones, they are particularly rich in bioavailable calcium, and some are also rich in vitamin A, iron and zinc. A traditional daily meal of rice and sour soup, made with the iron-rich fish, “trey changwa plieng” (Mekong flying barb, *Esomus longimanus*), with the head intact can meet 45 percent of the daily iron requirement of a Cambodian woman. Small fish are a preferred food and, often, irreplaceable source of multiple, essential, highly bioavailable nutrients and with positive perceptions for nutrition, health and well-being.

Dried small fish is considered a super food for nourishment all year-round, as it provides for much greater concentration of essential micronutrients, long shelf life; it is easy to store and overcomes seasonality, it increases duration and frequency of consumption; and it is used to make easy-to-eat, easy-to-prepare fish-based for first 1000 days of life.

From a nutritional point of view by-products might be of higher value than the main product, particularly in terms of essential fatty acids and micronutrients such as minerals and vitamins. The increasing demand for fish oil as a nutritional supplement has made it profitable to extract highly valued fish oil from by-products such as tuna heads. Mineral supplements can be made out of fish bones, although this is not yet widely done. A recent pilot production of a fish bone based mineral product showed high levels of most essential minerals, with e.g. 85 mg/kg of zinc, 350 mg/kg of iron and 84g/kg of calcium. The product was successfully mixed into traditional school feeding meals and highly appreciated by school children in Ghana.

Improving methods for fish processing and storage and using fish parts that were removed in processing, cleaning, cooking and serving can help increase supply of micronutrient-rich fish and reduce fish waste and loss.

32. Foods from the aquatic environment are a unique source of the essential long-chain omega-3 fatty acids, such as docosahexaenoic acid [DHA] and eicosapentaenoic acid [EPA]), which are important for optimal neurodevelopment in children and vascular health respectively. Sufficient intake of omega-3 fatty acids is particularly important during pregnancy and the first 1000 days of life. Fish consumption among adults lowers the risk of coronary heart disease mortality by up to 36 percent owing to a combination of the effects of EPA and DHA.⁴⁵ Fish consumption within the range of 0–100 g/day has been associated with reduced risk of cardiovascular disease and improved child cognitive performance and neurodevelopment. Fish can also substitute in diets other food ingredients that may create health issues. However, dietary practices continue to be discussed (Willet et al. 2019,⁴⁶ Box 4).

Box 4: Dietary practices – under discussion (Willet et al. 2019)

Recommendations by a recent EAT-Lancet Commission report (Willet et al. 2019) point that about 28g per capita per day of fish can provide essential omega-3 fatty acids, which is associated with reduced risk of cardiovascular disease. A range of 0 – 100 g/day is suggested because high intakes are associated with excellent health. Small fish consumption is recommended, since mercury toxicity can be avoided. Moreover, small fish is usually consumed with heads and bones as a whole, which is a good source of Vitamin A and D.

However, it is noted that the EAT-Lancet Commission report set to out to identify how sustainable food systems could remain within planetary boundaries. In lieu of specific goals for individual foods, species or commodities, the established boundaries were considered for the food system as a whole. A comparison of future production estimates with the healthy reference diet shows a potential production-consumption gap. Subsequent discussions between FAO and multiple authors of the commissioned report are ongoing, in attempt to support the positive message of sustainable food systems while accurately portraying the crucial role of fisheries and aquaculture in such efforts.

33. In recent years, through initiatives such as Scaling Up Nutrition⁴⁷ and 1000 Days, there has been focus on the role of fish as a rich animal-source food containing multiple nutrients for health and well-being, and specifically as a source of essential fats for brain development and cognition in the first 1000 days of life. Dietary interventions with children in rural Southern Malawi⁴⁸ with soft-boned fish enhanced mid-upper-arm circumference and arm muscle area, reduced incidence of anaemia and common infections, and improved intakes of protein, calcium, zinc and vitamin B12. Nutritional rehabilitation of malnourished children in Northern Uganda using low-cost food including dried fish showed results of weight gain and helped reduce mortality rates and nutritional failures.⁴⁹ Aquaculture

⁴⁵ FAO & WHO. 2011. Report of the Joint FAO/WHO Expert Consultation on the Risks and Benefits of Fish Consumption, Rome, 25–29 January 2010. FAO Fisheries and Aquaculture Report No. 978. Rome. <http://www.fao.org/3/ba0136e/ba0136e00.pdf>

⁴⁶ Willet, W et al. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet Commissions. Volume 393, Issue 10170, P447–492, February 02, 2019.

<https://www.thelancet.com/action/showPdf?pii=S0140-6736%2818%2931788-4>

⁴⁷ <https://scalingupnutrition.org/about-sun/the-vision-and-principles-of-sun/>

⁴⁸ Gibson, R.S. et al. 2003. Experiences of a Community-Based Dietary Intervention to Enhance Micronutrient Adequacy of Diets Low in Animal Source Foods and High in Phytate: A Case Study in Rural Malawian Children, The Journal of Nutrition, Vol 133, Issue 11. <https://doi.org/10.1093/jn/133.11.3992S>

⁴⁹ Greco, L. 2006. Effect of a low-cost food on the recovery and death rate of malnourished children. Journal of Pediatric Gastroenterology & Nutrition, 43(4), 512. <https://doi.org/10.1097/01.mpg.0000239740.17606.49>

can provide micronutrient-rich small fish which are being included in complementary foods for young children in efforts worldwide.⁵⁰ See also example in Box 5.

Box 5. Including fish in school meals in Guatemala

FAO, in coordination with the Ministries of Agriculture, Livestock and Food and Education promoted the implementation of the "Sustainable Healthy Schools" model within the National School Feeding Programme (PAE by Spanish acronyms). The model guides students to have better eating and nutrition practices at home, as well as receiving a nutritionally balanced snack suiting their nutritional requirements. Initially, the PAE programme did not include fish among the foods for school meals. However, a FAO pilot in the municipality of Chiquimula generated evidence and indicators supporting the inclusion of fish in school meals and its gradual scaling up at national level. Pilot results presented during the development of a new School Feeding Law led to revisions of this law, generating provisions on fish consumption and the proper inclusion of fish within the PAE.

Guatemalan legislation allows that the PAE provides food acquired through decentralized local public purchases. The new School Feeding Law established that 50 percent of the food supplied is purchased from family farmers, thereby enhancing the local economy. To support the process, aquaculture farmers were trained in associative, productive, administrative and artisanal transformation of fish products and food safety. Recipe books were published promoting local traditional food habits and recipes meeting the expenses for individual meals established by the PAE. The PAE still faces challenges in scaling up to national level, including the establishment of a purchase schedule and the distribution of the fish or by-products according to national food safety legislation.

Source: Tobar Hurtado, S. 2019. Proyecto piloto para la inclusión del pescado en la alimentación escolar en el Departamento de Chiquimula, Guatemala. Informe final, segunda fase. FAO Guatemala

34. Small scale aquaculture contributes to the well-being of both urban and rural populations, who are most of the chronically food insecure and undernourished populations.⁵¹ In three key ways, small scale aquaculture sustainably provides nutritious food for self-consumption; lowers food prices for consumers (improving food access, both for staples and more diverse nutrient-rich foods); and enhances incomes for farmers (and mostly women farmers). This can be reflected in the International Year of Family Farming 2014,⁵² and the proposed International Year of Artisanal Fisheries and Aquaculture in 2022.

⁵⁰ Thilsted, S.H., James, D., Toppe, J., Subasinghe, R., Karunasagar, I. 2014. Maximizing the contribution of fish to human nutrition. ICN2 Second International Conference on Nutrition. FAO and WHO. <http://www.fao.org/3/a-i3963e.pdf>; www.fao.org/fileadmin/user_upload/agn/pdf/ICN2Fish_Nutrition.pdf

⁵¹ FAO and WHO. 2013. Enhancing the Role of Smallholder Farmers in Achieving Sustainable Food and Nutrition Security <http://www.fao.org/3/a-as563e.pdf>

⁵² FAO. 2013. Enhancing the contribution of small-scale aquaculture to food security, poverty alleviation and socio-economic development. FAO Fisheries and Aquaculture Proceedings No. 31 <http://www.fao.org/3/i3118e/i3118e.pdf>

35. Increasing seafood consumption has been proposed as part of a strategy to combat the current non-communicable disease (NCD) pandemic.⁵³ The health benefits associated with regular consumption of moderate amounts of seafood in place of meats, and increased consumption of vegetables and fruits, could help reduce rates of NCDs. Aquaculture practice is also successful as a sustainable control tool for malaria and schistosomiasis reduction, through predatory fish for mosquito and snail control.⁵⁴

36. Food safety issues and risks associated with aquaculture products⁵⁵ have been and are being studied extensively⁵⁶. Aquatic pollution and aquaculture self-pollution resulting from no or poor management of wastes and wastewaters^{57,58} can cause contamination of aquaculture stocks as well as enhanced stress to fish and exposure to pathogens. Environmental toxins such as phycotoxins associated with harmful algal blooms can accumulate in farmed shellfish, posing serious food safety risks to consumers. Antibiotic residuals from use of antimicrobials in farmed fish and shrimp, may cause indirect risks to human health if antimicrobial resistance is developed.⁵⁹ Significant biosecurity measures are needed and promoted through industry codes of practice, vaccines, safe and prudent use of antimicrobials, antibiotic residue testing in farmed and processed fish with a view to addressing increasing antimicrobial resistance. However, when exposed to reduced contaminant levels some aquaculture products may have lower concentration levels of heavy metal and persistent organic pollutants, and lower ciguatoxin bioaccumulation when compared with some products from capture fisheries.⁶⁰ Experts agree that the positive effects of high fish consumption largely outweigh the potential negative effects associated with contamination or other safety risks.⁶¹

37. Aquatic biodiversity in integrated agriculture-aquaculture ecosystems is an important source of human food. The combination of different plant and animal species makes the farming systems productive and nutritionally rich. Rice-fish and other similar horticulture-aquaculture agroecosystems supply substantial energy and nutrient-rich (micronutrients, proteins, and essential fatty acids) foods that are especially important in addressing issues with malnutrition. Introducing farmers to simple low-cost integrated agriculture-aquaculture practices, with support to test and adapt the practices, results in all year-round supply of nutritious food for participating farmers/families while also contributing to better livelihood.⁶² High yields, fish sales and savings on inputs from integrated agriculture-aquaculture system

⁵³ Willet, W et al. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet Commissions. Volume 393, Issue 10170, P447–492, February 02, 2019; <https://www.thelancet.com/action/showPdf?pii=S0140-6736%2818%2931788-4>

⁵⁴ FAO. 2015. FAOSTAT. Online statistical database: Food balance http://faostat3.fao.org/download/FB/*E

⁵⁵ FAO/WHO. 1999. Food safety issues associated with products from aquaculture. Report of a Joint FAO/NACA/WHO study group. www.who.int/iris/bitstream/10665/42141/http://apps.who.int/iris/bitstream/10665/42141/1/WHO_TRS_883.pdf; https://apps.who.int/iris/bitstream/handle/10665/42141/WHO_TRS_883.pdf?sequence=1

⁵⁶ Lusher, A.L.; Hollman, P.C.H.; Mendoza-Hill, J.J. 2017. Microplastics in fisheries and aquaculture: status of knowledge on their occurrence and implications for aquatic organisms and food safety. FAO Fisheries and Aquaculture Technical Paper. No. 615. Rome, Italy. <http://www.fao.org/3/a-i7677e.pdf>; <http://www.fao.org/3/MX201EN/mx201en.pdf>

⁵⁷ Jana, B.B. et al. 2018. Wastewater management through aquaculture. Springer. <https://link.springer.com/content/pdf/10.1007%2F978-981-10-7248-2.pdf>

⁵⁸ WHO. 2006. Wastewater and excreta use in aquaculture. Volume 3. Non-serial publication. https://www.who.int/water_sanitation_health/publications/gsuweg3/en/ http://whqlibdoc.who.int/publications/2006/9241546840_eng.pdf?ua=1

⁵⁹ Okocha, R.C. et al. 2018. Food safety impacts of antimicrobial use and their residues in aquaculture. Public Health Reviews (2018) 39:21. <https://doi.org/10.1186/s40985-018-0099-2> https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6081861/pdf/40985_2018_Article_99.pdf

⁶⁰ Willet, W et al. 2019. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet Commissions. Volume 393, Issue 10170, P447–492, February 02, 2019; <https://www.thelancet.com/action/showPdf?pii=S0140-6736%2818%2931788-4>

⁶¹ FAO & WHO. 2011. Report of the Joint FAO/WHO Expert Consultation on the Risks and Benefits of Fish Consumption, Rome, 25–29 January 2010. FAO Fisheries and Aquaculture Report No. 978. Rome. <http://www.fao.org/3/ba0136e/ba0136e00.pdf>

⁶² FAO. 2017. Building capacity for integrated rice-fish systems through the regional rice initiative and south-south cooperation. <http://www.fao.org/3/a-i7239e.pdf>

could raise income up to 100 - 400 percent higher than income from rice monoculture.⁶³ Thus, the farming system presents an opportunity to reduce poverty and contribute to meeting national nutrition security targets.

38. The contribution of aquaculture development however needs to be considered holistically and inclusively to other agricultural sectors. The relation between fish, aquaculture, hunger, food supplies, nutrition, good health and dietary practices are all complex issues, that are not always necessarily positively interconnected and, in some cases, and may result in trade-offs and unforeseen impacts to the health of humans and environment. Considerable knowledge gaps continue to exist regarding the contribution of fisheries and aquaculture to food security, nutrition and poverty reduction.⁶⁴ These authors identify data gaps and research needs on impacts of fish production and trade on low-income households, gender relations, health and safety, distribution of developmental benefits, impact of fish availability on micronutrient status (relating to cognition, infections, growth and development) and how fish contribute to the diets of the poor. A particular gap relates to the causal relationships—either positive or negative—between aquaculture development and food security, economic growth, and impacts on poor people. In aquaculture, many questions remain concerning who benefits, and at what costs to whom. However, methodologies⁶⁵ for the assessment of the contributions of aquaculture to economic growth, poverty alleviation and food security have been developed and are continuously advanced and improved.

39. Moreover, prevailing cultural norms and values, and social relations may influence the development outcomes in populations dependent on fish in the diet.⁶⁶ As with other animal-source foods, often the most nutritious and prized fish are consumed by the male head of household, or given to children before women of reproductive age. Consumption of aquaculture products should therefore be encouraged and promoted for all, especially women of reproductive age, in order to provide sufficient and nutritious food supply for vulnerable households in rural and urban areas.

40. With a higher proportion of freshwater fish in diets supplied from aquaculture, people are deriving smaller amounts of omega-3 fatty acids and micronutrients from aquatic foods,⁶⁷ because these nutrients are often more prevalent in fish from marine capture fisheries than from freshwater fish aquaculture.⁶⁸ The 2014 HLPE reported that while some fish farming-practising households enjoy a higher energy intake and lower undernutrition from the consumption of fish, this is not always the case and the contribution of aquaculture to nutrition may not be as strong as in prior years.^{69,70} Another study indicated that in Bangladesh, the rapid development of aquaculture in the last two decades had allowed the sector to significantly increase its contribution and share to the fish food supply. Yet simultaneously,

⁶³ FAO. 2015. Save and grow farming system fact sheet 8: A richer harvest from paddy fields. <http://www.fao.org/3/a-i5311e.pdf>

⁶⁴ Bene et al. 2016. Contribution of Fisheries and Aquaculture to Food Security and Poverty Reduction: Assessing the Current Evidence. *World Development* (79):171-196. www.sciencedirect.com/science/article/pii/S0305750X15002892

⁶⁵ Cai, J.; Leung, P.; Hishamunda, N. 2009. Commercial aquaculture and economic growth, poverty alleviation and food security: assessment framework. FAO Fisheries and Aquaculture Technical Paper. No. 512. Rome, FAO. 2009. 58p. <http://www.fao.org/3/i0974e/i0974e.pdf>

⁶⁶ Morgan M, Terry G, Rajaratnam S, Pant J. 2017. Socio- cultural dynamics shaping the potential of aquaculture to deliver development outcomes. *Reviews in Aquaculture*. 2017 Dec;9(4):317-25. doi: 10.1111/raq.12137

⁶⁷ Bogard J, Farook S, C Marks G, Waid J, Belton B, Ali M, Toufique K, Mamun A, Thilsted S. 2017. Higher fish but lower micronutrient intakes: Temporal changes in fish consumption from capture fisheries and aquaculture in Bangladesh. *PLoS ONE*. 12(4). DOI:10.1371/journal.pone.0175098.

⁶⁸ Beveridge, M.C.M., Thilsted, S.H., Phillips, M.J., Metian, M., Troell, M. & Hall, S.J. 2013. Meeting the food and nutrition needs of the poor: the role of fish and the opportunities and challenges emerging from the rise of aquaculture. *Journal of Fish Biology*, 83: 1067–1084. doi:10.1111/jfb.12187.

⁶⁹ Morgan M, Terry G, Rajaratnam S, Pant J. 2017. Socio- cultural dynamics shaping the potential of aquaculture to deliver development outcomes. *Reviews in Aquaculture*. 2017 Dec;9 (4):317-25. doi: 10.1111/raq.12137

⁷⁰ HLPE, 2014. Sustainable fisheries and aquaculture for food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome 2014. <http://www.fao.org/3/a-i3844e.pdf>

the contribution of essential micronutrients to local diets from fish may have declined, especially for the poorest income groups: while fish consumption had increased by 30 percent from 1991–2010, at the same time there were significant decreases in iron and calcium intakes from fish consumption.^{71,72}

41. Some consider that increasingly intensive aquaculture production methods, with greater use of crop-based feedstuffs and lower fishmeal and fish oil inclusion rates, would be likely to influence the nutrient contents of farmed aquatic products, particularly fat content and fatty acid profiles. Innovations have been introduced to replace wild fish by more sustainable feed ingredients such as plant crop. However, concerns soon emerged as farmed fish fed these innovative feed had a lower nutritional value, especially with regards to the omega-3 long-chain fatty acid levels.⁷³ However, there is evidence that farmed salmon contains significantly more n-3 LC-PUFA and total fat than wild-caught salmon.⁷⁴ A focus on the nutrient content of farmed aquatic foods is especially important where they play a critical role in the diet of local and food insecure populations.

42. Gender, alongside factors such as economic class, ethnic group, age or religion, must be considered when promoting the contribution of aquaculture to food security and nutrition outcomes. Understanding and addressing how men and women of different ages are impacted in different environments and food systems is critical for effective and sustainable benefits. However, the pathways between fish, gender and the nutritional status of individuals and households are not sufficiently researched to date.⁷⁵ Women are involved in household food security and nutrition through the education and care of children, the preparation of safe and nutritious meals, and the diversification of household food intake through their home garden and incomes.

43. In addition to providing nutrients, fish also contributes to the food and nutritional security of poor households in developing countries through livelihood diversification and income generation^{76,77,78}. At the same time, poor working conditions in the aquaculture sector can also be a cause for bad health resulting from occupational injuries and diseases.^{79,80} This illustrates the importance of measuring aquaculture impacts in a holistic human health scope, as well as designing aquaculture interventions with considerations of human health and well-being from inception.

⁷¹ Belton B., van Asseldonk I.J.M., Thilsted S.H., 2014. Faltering fisheries and ascendant aquaculture: Implications for food and nutrition security in Bangladesh. *Food Policy* 44: 77-87. <https://doi.org/10.1016/j.foodpol.2013.11.003>

⁷² Bogard JR, Farook S, Marks GC, Waid J, Belton B, Ali M, Toufique K, Mamun A, Thilsted SH. 2017. Higher fish but lower micronutrient intakes: Temporal changes in fish consumption from capture fisheries and aquaculture in Bangladesh. *PLoS one*. 2017 Apr 6;12(4):e0175098. <https://doi.org/10.1371/journal.pone.0175098>

⁷³ Sprague, M., Dick, J.R. & D.R. Tocher. 2016. Impact of sustainable feeds on omega-3 long-chain fatty acid levels in farmed Atlantic salmon, 2006–2015. *Scientific Reports* volume 6, Article number: 21892. <https://www.nature.com/articles/srep21892>

⁷⁴ Seves, M. et al., 2016. Sustainability aspects and nutritional composition of fish: evaluation of wild and cultivated fish species consumed in the Netherlands. <https://link.springer.com/content/pdf/10.1007%2Fs10584-015-1581-1.pdf>

⁷⁵ HLPE, 2014. Sustainable fisheries and aquaculture for food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome 2014. . <http://www.fao.org/3/a-i3844e.pdf>

⁷⁶ Thompson, B. and L. Amoroso. 2014. Improving diets and nutrition: food-based approaches. Rome, FAO. <http://www.fao.org/3/a-i3030e.pdf>

⁷⁷ Béné, C. et al. 2015. Feeding 9 billion by 2050 – Putting fish back on the menu. *Food Sec.* (2015) 7:261–274. DOI 10.1007/s12571-015-0427-z. <https://link.springer.com/content/pdf/10.1007%2Fs12571-015-0427-z.pdf>

⁷⁸ FAO. 2018. The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals. Rome. Licence: CC BY-NC-SA 3.0 IGO.

⁷⁹ Fröcklin S, de la Torre-Castro M, Lindström L, Jiddawi NS, Msuya FE. Seaweed mariculture as a development project in Zanzibar, East Africa: A price too high to pay?. *Aquaculture*. 2012 Aug 1;356:30-9.

⁸⁰ Ngajilo, D. and M. Jeebhay. 2019. Occupational injuries and diseases in aquaculture – A review of literature. *Aquaculture* (507): 40-55. <https://doi.org/10.1016/j.aquaculture.2019.03.053>. <https://www.sciencedirect.com/science/article/pii/S0044848618323561/pdf?md5=d091a25b4cc427ce994ee673e15d85a8&pid=1-s2.0-S0044848618323561-main.pdf>

POLICIES FOR NUTRITION-SENSITIVE AQUACULTURE DEVELOPMENT

44. A 2013 review found that “fish is strikingly missing from strategies for reduction of micronutrient deficiency, precisely where it could potentially have the largest impact”.⁸¹ Limited attention⁸² has been given so far to fish as a key element in food security and nutrition strategies at national level and in wider development discussions and interventions. The policy agenda of the fisheries and aquaculture sector tends to be oriented towards commercial interests neglecting social interests and needs, and undervalues the importance of the sector for food security and nutrition.^{83,84} As a result, the tremendous potential for improving food security and nutrition embodied in the strengthening of the fishery and aquaculture sectors is missed. International food security experts and decision-makers seem often lack awareness and data to utilize fish in the fight against malnutrition.⁸⁵ The problem is particularly pronounced in the current debate on how to make food systems more nutrition sensitive, i.e., how to change and improve food systems in order to advance nutrition.⁸⁶ Although the sector’s untapped potential is now being recognized and is attracting global interest, it is still a challenge to incorporate the sector into the global food security and nutrition agenda (and vice versa).⁸⁷ Given the prevalence of fish in diets and its nutritional value, it is important to include fish in the design of nutrition-sensitive agriculture and food-based approaches to food security and nutrition.⁸⁸

⁸¹ Allison, E.H., Delaporte, A. & Hellebrandt de Silva, D. 2013. Integrating fisheries management and aquaculture development with food security and livelihoods for the poor. Report submitted to the Rockefeller Foundation. Norwich, UK, School of International Development, University of East Anglia.

⁸² Béné, C. et al. 2015. Feeding 9 billion by 2050 – Putting fish back on the menu. *Food Sec.* (2015) 7:261–274. DOI 10.1007/s12571-015-0427-z. <https://link.springer.com/content/pdf/10.1007%2Fs12571-015-0427-z.pdf>

⁸³ FAO & EU. 2016. Strengthening sector policies for better food security and nutrition results: fisheries and aquaculture. Policy Guidance Note 1. Rome. <http://www.fao.org/3/a-i6227e.pdf>

⁸⁴ Kurien, J., & Rios, J.L. 2013. Flavouring fish into food security: A Preliminary Assessment of the Integration of Fisheries and Aquaculture into Food and Nutrition Policy Frameworks of East and South Africa and Indian Ocean Countries. REPORT/RAPPORT: SF-FAO/2013/14. <http://www.fao.org/3/a-az021e.pdf>

⁸⁵ HLPE, 2014. Sustainable fisheries and aquaculture for food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome 2014. . <http://www.fao.org/3/a-i3844e.pdf>

⁸⁶ Allison, E.H., Delaporte, A. & Hellebrandt de Silva, D. 2013. Integrating fisheries management and aquaculture development with food security and livelihoods for the poor. Report submitted to the Rockefeller Foundation, School of International Development, University of East Anglia Norwich, UK. 124 p

⁸⁷ FAO & EU. 2016. Strengthening sector policies for better food security and nutrition results: fisheries and aquaculture. Policy Guidance Note 1. Rome. <http://www.fao.org/3/a-i6227e.pdf>

⁸⁸ Kawarazuka, N. & Béné, C. 2010. Linking small-scale fisheries and aquaculture to household nutritional security: an overview. *Food Security*, 2: 343–357. <https://link.springer.com/content/pdf/10.1007%2Fs12571-010-0079-y.pdf>

Box 6: Nutrition key to SDGs success

Without adequate and sustained investments in good nutrition, the SDGs will not be realised. The ambition to ‘End hunger, achieve food security and improved nutrition and promote sustainable agriculture’ is captured in SDG 2, however, at least 12 of the 17 Goals contain indicators that are highly relevant to nutrition. *“Nutrition is both a maker and a marker of development. Improved nutrition is the platform for progress in health, education, employment, empowerment of women and the reduction of poverty and inequality, and can lay the foundation for peaceful, secure and stable societies”* (Ban Ki-moon, former UN Secretary General in his message for the SUN Movement Strategy and Roadmap (2016-2020). The United Nations Decade of Action on Nutrition for 2016–2025, led by FAO and the World Health Organization (WHO), provides a critical opportunity to raise awareness about the role of fish – whether caught, farmed or processed - and to ensure its mainstream incorporation into food security and nutrition policy.

45. If the vision⁸⁹ of the SDGs (Box 6) is to be attained, the aquaculture 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. The present narrow focus on productivity gains and economic outputs will not suffice. Farmed fish could play a major role in supplementing under-nutritious diets, especially if specific policies are put in place to ensure access of the food to those who need it, not only those who can afford it. A more balanced approach to growth in diverse aquaculture systems is required, 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, as well as in particular regions such as Africa^{90,91,92,93} (Box 8). For example, thanks to various public interventions, Kenya has had an impressive 20 percent annual growth in aquaculture production since 2000. Yet deliberate efforts must be made to create an enabling environment for both public and private investments in the industry in order to unleash Kenya’s full potential in aquaculture for improving the country’s food and nutrition status.⁹⁴

⁸⁹ <https://scalingupnutrition.org/nutrition/nutrition-and-the-sustainable-development-goals/>

⁹⁰ Thilsted, SH, Thorne-Lyman, A, Webb, P, Bogard, JR, Subasinghe, R, Phillips, MJ & Allison, EH 2016, 'Sustaining healthy diets: The role of capture fisheries and aquaculture for improving nutrition in the post-2015 era' Food Policy, vol. 61, pp. 126-131. <https://doi.org/10.1016/j.foodpol.2016.02.005>

⁹¹ Chin et al. 2019. Prospects and challenges of fish for food security in Africa. Global Food Security 20 (2019) 17-25. <https://doi.org/10.1016/j.gfs.2018.12.002> ; <https://doi.org/10.1016/j.gfs.2018.12.002>.

¹ Chin et al. 2019. Prospects and challenges of fish for food security in Africa. Global Food Security 20 (2019) 17-25. <https://doi.org/10.1016/j.gfs.2018.12.002> ; <https://doi.org/10.1016/j.gfs.2018.12.002>.

² FAO, 2018. Fishery and aquaculture statistics. Global production by production source 1950-2016 (FishstatJ). FAO Fisheries and Aquaculture Department [online], Rome (Updated 2018). www.fao.org/fishery/statistics/software/fishstatj/en

³ FAO, 2017b. Fishery and aquaculture statistics. Food Balance Sheets 1961-2013 (FishstatJ). FAO Fisheries and Aquaculture Department [online], Rome (Updated 2017). (<http://www.fao.org/fishery/statistics/software/fishstatj/en>).

⁹² FAO, 2018. Fishery and aquaculture statistics. Global production by production source 1950-2016 (FishstatJ). FAO Fisheries and Aquaculture Department [online], Rome (Updated 2018). www.fao.org/fishery/statistics/software/fishstatj/en

⁹³ FAO, 2017b. Fishery and aquaculture statistics. Food Balance Sheets 1961-2013 (FishstatJ). FAO Fisheries and Aquaculture Department [online], Rome (Updated 2017). <http://www.fao.org/fishery/statistics/software/fishstatj/en>

⁹⁴ Obiero, K., Cai, J., Abila, R. and O. Ajayib. 2019. Kenya: High aquaculture growth needed to improve food security and nutrition. FAO/IFAD Policy Brief.

Box 7: Fish for food security in Africa

Fish deserve more attention in food and nutrition policies due to its prominence in the African food basket. Fish provide 19% of animal protein intake to Africans, providing a range of micronutrients and essential fatty acids. Fish is also an efficient converter of feed into high quality food.

About one-sixth of total production of food fish in Africa in 2016 came from aquaculture². Africa is a net fish importer by quantity³. As many lower income countries, most African countries are exporting higher value seafood in order to be able to finance economic growth, while retaining and importing lower value small pelagic fish species (e.g. mackerel). This might create negative impacts on local populations' food security and livelihoods. The fish supply deficit in most African countries however presents significant opportunities and prospects for aquaculture development.

Continued population growth and robust income growth will fuel strong increases in demand for fish, requesting rapid expansion of aquaculture. Policies to promote sustainable aquaculture growth, to facilitate international and intra-African trade, and to reduce post-harvest losses while working on better distributing the benefits of increased fish availability are recommended.

46. In order to improve the quality and quantity of fish supply (which can improve diets of both producers and consumers), Thilsted et al., (2016) suggest that policies for nutrition-sensitive fisheries and aquaculture should ensure that multi-sectoral policy solutions should 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.⁹⁵ 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.⁹⁶ Where the importance of fish is not reflected in food security, nutrition and public health policies, filling key data and knowledge gaps should be a priority so that necessary policy shifts and investments can be identified to improve nutrition and to make the sector nutrition-sensitive^{97,98} (Box 8). Any scoping of the sector's potential to better contribute to nutrition and food security needs to evaluate the potential of the sector to increase availability of and access to fish, as well as what drives demand.

⁹⁵ Thilsted, SH, Thorne-Lyman, A, Webb, P, Bogard, JR, Subasinghe, R, Phillips, MJ & Allison, EH 2016, 'Sustaining healthy diets: The role of capture fisheries and aquaculture for improving nutrition in the post-2015 era' Food Policy, vol. 61, pp. 126-131. <https://doi.org/10.1016/j.foodpol.2016.02.005>

⁹⁶ Belton, B. & Thilsted, S.H. 2014. Fisheries in transition: food and nutrition security implications for the global South. Global Food Security, 3(1), pp.59-66. <https://www.sciencedirect.com/science/article/pii/S2211912413000515>

⁹⁷ FAO & EU. 2016. Strengthening sector policies for better food security and nutrition results: fisheries and aquaculture. Policy Guidance Note 1. Rome. <http://www.fao.org/3/a-i6227e.pdf>

⁹⁸ Thilsted, S.H. 2018. How fish can play a stronger role to achieve globally set goals. Presentation at IFRPI/FAO Conference. <https://www.slideshare.net/ifpri/how-fish-can-play-a-stronger-role-to-achieve-globally-set-goals>. <https://www.youtube.com/watch?v=QRksSQ-TZz0&list=PLeqdWbb3KnJ8ojDhXC0uR1QVbnqft0Xk&index=5&t=0s>
In: IFPRI. 2019. Accelerating the end of hunger and malnutrition: A global event: Synopsis. Proceedings of IFPRI-FAO Bangkok Conference. 28-30 November 2018. Bangkok, Thailand. Washington, DC: Food and Agriculture Organization (FAO) and International Food Policy Research Institute (IFPRI). <https://doi.org/10.2499/9780896293533> .
<http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/133063/filename/133275.pdf>
<https://www.ifpri-faobangkokconference.org/files/2018/12/Bangkok-at-a-Glance.pdf>

Box 8. Three action points for nutrition-sensitive investment in capacity development, monetary and other resources (Thilsted, 2018).

- invest in analyses of nutrient content and food safety of common fish species and fish products and make data open access;
- invest in the development of well-liked, affordable nutritious safe ready-to-eat, easy-to-prepare fish products for the first 1000 days of life;
- invest in global and national policies and strategies and research to increase the access to and intake of micronutrient-rich fish species, especially by the poor

47. Approaches and measures for safe and sustainable aquaculture intensification⁹⁹ were discussed at the 2019 FAO/WHO/AU International Food Safety Conference, with priorities given inter alia to adequate biosecurity governance, the “One Health” approach, aquatic biotoxins, toxic contaminants, inputs and waste management, antimicrobials, residues, and antimicrobial resistance, alternative dietary protein and lipid sources for aquafeeds, farming of non-carnivorous or lower trophic level species, recirculation and aquaponics systems, and application of the ecosystem approach to aquaculture. As a component of the global food system, the sustainability of aquaculture production and intensification should thus be viewed from a holistic global food systems perspective. Transparency around these interlinked environmental, health, nutritional, food safety and economic factors is essential to allow stakeholders across the value chain, from producers and retailers to consumers and policy makers, to make informed benefit-risk decisions and to build trust between these actors in order to sustainably utilize the aquaculture sector. Similar considerations were suggested by others^{100, 101, 102} (Box 9).

⁹⁹ Beveridge, M. and JM Burgos. 2019. Safe and sustainable aquaculture intensification. The First FAO/WHO/AU International Food Safety Conference Addis Ababa, 12-13 February 2019. IFSC-1/19/TS2.4. <http://www.fao.org/3/CA2964EN/ca2964en.pdf> ; <https://www.who.int/food-safety/international-food-safety-conference>

¹⁰⁰ Troell, M., Jonell, M. and B. Crona. 2019. The role of seafood for sustainable and healthy diets. The EAT-Lancet commission report through a blue lens. Beijer Discussion Paper Series No. 266. http://www.beijer.kva.se/PDF/27575616_Disc266.pdf

¹⁰¹ Willet, W et al. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet Commissions. Volume 393, Issue 10170, P447-492, February 02, 2019; <https://www.thelancet.com/action/showPdf?pii=S0140-6736%2818%2931788-4>

¹⁰² Troell, M., Naylor, R.L., Metian, M., Beveridge, M., Tyedmers, P.H., Folke, C., Arrow, K.J., Barrett, S., Crépin, A.S., Ehrlich, P.R. & Gren, Å. 2014. Does aquaculture add resilience to the global food system? Proceedings of the National Academy of Sciences, 111(37), pp.13257-13263. <https://www.pnas.org/content/111/37/13257>

Box 9. Considerations on seafood for sustainable and healthy diets

The recent EAT-Lancet Commissions report (Troell, Jonel and Crona, 2019; Willet et al., 2019) suggests some selected key messages:

1. Filling the anticipated future demand of seafood will require increased production - particularly from aquaculture -, along with significant waste reduction (from harvest to plate), and a reduction in environmental and social footprints of fisheries and aquaculture;
2. Farmed non-feed dependent animal species (e.g. mussels, oysters) might be a more sustainable alternative than farmed feed-dependent species (depending on levels of continued deterioration of water quality due to pollution and ocean acidification);
3. Support should be given to nutrition-sensitive production that takes the nutritional qualities of farmed seafood into consideration;
4. Future aquaculture feeds addressing the demand from the growing aquaculture sector will likely include a combination of terrestrial, marine and more innovative feeds, including single cell organisms and insects;
5. There is potential for enhanced use of seaweed/macroalgae for human consumption as they can provide for proteins, omega-3 and micronutrients, and low environmental footprint.

48. Possible general approaches and actions that could be considered by governments and their fisheries and aquaculture administrations include:

- Raise awareness of the importance of nutritional quality in sustainable aquaculture development.
- Development and appropriate implementation of food-based dietary guidelines (FBDGs) that includes fish as an important component of diets.
- Increase the sustainable contribution of aquaculture to food security, health and nutrition, and encourage nutrition-sensitive aquaculture potentially through:
 - Funding in scientific researches on sustainably culturing nutritious species;
 - Develop capacity in human resources and institutions to improve nutrition through the aquaculture sector, supported with adequate financing;
 - Increase incentives (and decrease disincentives) for availability, access, and consumption of diverse, nutritious and safe fish products through nutrition-sensitive food supply chains including production, processing, distribution and trade;
 - Monitor dietary consumption and access to fish;
 - Support multi-sectoral strategies to develop nutrition-sensitive aquaculture within national, regional, and local government structures;
 - Advocacy and education on the role of fish in healthy and nutritious diets.
- Strengthen international collaboration on knowledge sharing and action to improve food security, health and nutrition through sustainable aquaculture practice.

49. Additional more specific considerations can be adapted from key recommendations¹⁰³ developed for improving nutrition through agriculture and food systems (Box 10), for possible use by aquaculture decision-makers.

¹⁰³ FAO. 2015. Key recommendations for improving nutrition through agriculture and food systems. <http://www.fao.org/3/a-i4922e.pdf>

Box 10: More specific considerations and measures (adapted from FAO, 2015)

- Incorporate explicit nutrition objectives and indicators into aquaculture programme design, and track and mitigate potential harms, while seeking synergies with economic, social and environmental objectives.
- Assess the context at the local level, to design appropriate activities to address the types and causes of malnutrition.
- Target the vulnerable and improve equity through participation, access to resources, and decent employment in aquaculture activities. Vulnerable groups include smallholders, women, youth, the landless, urban dwellers, the unemployed.
- Collaborate and coordinate with other sectors (health, environment, social protection, labour, water and sanitation, education, energy) and programmes, through joint strategies with common goals, to address concurrently the multiple underlying causes of malnutrition through aquaculture.
- Maintain or improve the natural resource base (water, soil, air, climate, biodiversity), critical to the livelihoods and resilience of vulnerable farmers and to sustainable food and nutrition security for all. Manage water resources in particular to reduce vector-borne illness and to ensure sustainable, safe water sources.
- Empower women in aquaculture by ensuring access to productive resources, income opportunities, extension services and information, credit, labour and time-saving technologies (including energy and water services), and supporting their voice in household and farming decisions. Equitable opportunities to earn and learn should be compatible with safe pregnancy and young child feeding.
- Facilitate production diversification, and increase production of nutrient-dense fish species (focus on omega 3 PUFA and micronutrients) and small-scale livestock (for example, horticultural products and fish at a small scale, and biofortified species).
- Improve processing, storage and preservation of fish to retain its nutritional value, shelf-life, and food safety, to reduce seasonality of food insecurity and post-harvest losses, and to make healthy fish products convenient to prepare.
- Expand markets and market access for vulnerable groups, particularly for marketing nutritious species that vulnerable groups have a comparative advantage in producing. This can include innovative promotion (such as marketing based on nutrient content), value addition, access to price information, and farmer associations.
- Incorporate nutrition promotion and education around sustainable aquaculture systems that builds on existing local knowledge, attitudes and practices. Nutrition knowledge on fish consumption can enhance the impact of production and income in rural households, especially important for women and young children, and can increase demand for nutritious fish products in the general population.
- Examples:
 - Sustainably increase in production and nutrient contents of current species through innovative techniques (e.g. polyculture) and novel fish feeds (e.g. a combination of terrestrial, marine and more innovative feeds, including single cell organisms and insects)
 - Promote consumption of low toxicity indigenous small fish, which is nutritious eaten as whole and environmentally friendly
 - Promote school feeding programmes using fish as ingredient.

50. Food security impacts and nutrition benefits of aquaculture should be monitored, when possible in connection with indicators of SDG2 targets,¹⁰⁴ including the Household Food Insecurity Access Scale¹⁰⁵, as well as other indicators such as the Household Dietary Diversity Score.¹⁰⁶

51. “Leaving no one behind” is a central theme of Agenda 2030 which is fully supported by FAO’s Right to Food Guidelines¹⁰⁷. The right to food is the right of every child, woman and man to have continuous access to the resources needed to produce, earn or purchase enough food to prevent hunger and enjoy an active and healthy life. Aquaculture has an important role in the realization of the right to food^{108, 109, 110} (Box 11).

¹⁰⁴ FAO, IFAD, UNICEF, WFP and WHO. 2018. The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition. Rome, FAO. Licence: CC BY-NC-SA 3.0 IGO

¹⁰⁵ Cafiero, C. 2018. Beyond Hunger: Monitoring Food Insecurity in the SDG Era. Presentation at IFPRI/FAO Conference . <https://www.slideshare.net/ifpri/beyond-hunger-monitoring-food-insecurity-in-the-sdg-era>. In: IFPRI. 2019. Accelerating the end of hunger and malnutrition: A global event: Synopsis. Proceedings of IFPRI-FAO Bangkok Conference. 28-30 November 2018. Bangkok, Thailand. Washington, DC: Food and Agriculture Organization (FAO) and International Food Policy Research Institute (IFPRI). <https://doi.org/10.2499/9780896293533>
<http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/133063/filename/133275.pdf>
<https://www.ifpri-faobangkokconference.org/files/2018/12/Bangkok-at-a-Glance.pdf>

¹⁰⁶ FAO. 2016. Compendium of indicators for nutrition-sensitive agriculture. <http://www.fao.org/3/a-i6275e.pdf>

¹⁰⁷ FAO. 2005. Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security. <http://www.fao.org/3/a-y7937e.pdf>

¹⁰⁸ Bojic-Bultrini, D. and Reantaso, M. 2008. Aquaculture and ‘the Right to Food’: for Mutual Supportiveness. FAO Aquaculture Newsletter (40). Editorial. <http://www.fao.org/3/i0305e/i0305e01.pdf>

¹⁰⁹ FAO & EU. 2016. Strengthening sector policies for better food security and nutrition results: fisheries and aquaculture. Policy Guidance Note 1. Rome. <http://www.fao.org/3/a-i6227e.pdf>

¹¹⁰ FAO. 2012. Voluntary guidelines on the responsible governance of tenure of land, fisheries and forests in the context of national food security. <http://www.fao.org/3/a-i2801e.pdf>

Box 11: Aquaculture and the Right to Food

In 2004, the FAO Council adopted the Right to Food Guidelines¹ addressed to all states to help implement good practices in food security policies. These guidelines suggest a full range of actions to construct an enabling environment for people to feed themselves in dignity and to establish appropriate safety nets for those who cannot. They emphasize the importance of facilitating access of fish farmers to water bodies and land for aquaculture production, and providing support for traditional, community-based and small-scale aquaculture.

These guidelines reflect the human-rights emphasis on human dignity, equality, non-discrimination and empowerment, transparency and participation in decision-making processes and demands accountability from everyone but especially those in positions of authority. Human rights principles, such as the right to food, also require governments to monitor food security, environmental and social impacts of aquaculture operations and take adequate measures to enable those who are threatened or negatively impacted to have access to reliable and alternative sources of support.

Aquaculture decision-makers should consider promoting:

- the participation of fishing communities and fish workers in all decisions that impact their livelihoods and enjoyment of the right to adequate food as defined by national laws.
- the implementation of the ‘Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security’ (VGGT), recognizing the particular relevance of article 8.3 on collectively used and managed land, fisheries and forests.
- the protection of existing rights and ongoing tenure over sites for food-insecure people, fishing communities and indigenous and tribal peoples, taking into account the VGGT.

FAO’S ROLE

52. For countries to succeed in their efforts of ensuring food security and nutrition, they must turn political commitment into concrete action. When food systems are more efficient, sustainable and nutrition-sensitive, countries can deliver on their commitments under Agenda 2030. FAO is uniquely placed to guide and assist countries in their efforts.

53. FAO supports countries in adopting or redesigning policies, strategies, laws and investment plans, within and across sectors, to sharpen their effectiveness in addressing food insecurity and malnutrition. Incorporating food security and nutrition considerations in the design and implementation of these investment programmes makes them more effective in reducing hunger and various forms of malnutrition.

54. One example of an FAO supported global policy process is the development of the Right to Food Guidelines¹¹¹ by the Committee on World Food Security (CFS). Since then, many governments and civil society organizations use the Right to Food Guidelines to build “an enabling environment for people to feed themselves in dignity and to establish appropriate safety nets for those who are unable to do so”, prioritizing the most vulnerable in policy design and implementation, and by adopting principles

¹¹¹ FAO. 2005. Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security. <http://www.fao.org/3/a-y7937e.pdf>

such as participation, accountability, non-discrimination, transparency, human dignity, empowerment and rule of law.

55. Further, FAO policy advice on food security and nutrition to the governments of Ethiopia, Ghana, Kenya, Lesotho and Zambia, in 2014–2015, has improved the impact of agricultural and social protection policies on food security and nutrition.¹¹²

56. The Fisheries and Aquaculture Department of FAO is currently in process with the formulation and implementation of aquaculture sectoral plans and investment plans for enhanced national food security and nutrition in line with COFI:AQ guidance. It is aimed to raise awareness among decision makers, notably at the COFI:AQ, of the contribution of aquaculture to resolving food security and malnutrition and of the interrelationships between climate change and food security and nutrition-related policy objectives, especially in relation to the first 1000 days of life. FAO has an important role in coordinating existing databases on the nutritional composition of fish and fish products and in addressing information gaps and research needs to inform policy.¹¹³ FAO has long since facilitated dialogue between the two realms of scientific evidence and policy analysis, to demonstrate the importance of fish and fish products in food security and nutrition.¹¹⁴ Nutrition-sensitive food systems continue to be prioritized in the activities of FAO's Strategic Programme One¹¹⁵ (Box 12).

Box 12: FAO's emphasis on nutrition-sensitive food systems

FAO's programmatic emphasis for its medium-term plan 2018–2021 foresees that its Strategic Programme 1 will deepen efforts to better link policy, programmes and investment to accelerate improved nutrition and food security through sustainable and nutrition-sensitive agriculture and rural development. A main focus will be on creating a clearer common understanding and better evidence base of the contribution of agricultural and food systems as drivers of the various forms of malnutrition, including obesity, and diet-related chronic diseases, as well as the linkages with the drivers of climate change and biodiversity.

FAO will support governments and non-state actors to work in a coordinated and focused manner to address the immediate and underlying causes that keep the hungry, food insecure and malnourished trapped in a vicious cycle of chronic deprivation, and support the adoption of healthy diets through sustainable agriculture and food systems. More focused support to country-identified needs will be further scaled-up; and special attention will be given to leveraging partnerships to stimulate exchanges on policy implementation issues at regional, subregional and country levels, including through South-South and Triangular Cooperation (SSTC). Additional resources will be allocated to strengthen activities around addressing all forms of malnutrition, in particular at regional and country level, and to promote nutrition-sensitive food systems.

FAO. 2019. FAO Director General's Medium Term Plan 2018-2021 and Programme of Work and Budget 2020-2021. Forty-first Session of the FAO Conference, 22 – 29 June 2019C2019/3. <http://www.fao.org/3/my734en/my734en.pdf>

¹¹² FAO. 2017. Strategic work of FAO to help eliminate hunger and malnutrition. <http://www.fao.org/3/a-i6431e.pdf>

¹¹³ FAO, IFAD, UNICEF, WFP and WHO. 2018. The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition. Rome, FAO. Licence: CC BY-NC-SA 3.0 IGO

¹¹⁴ FAO, IFAD, UNICEF, WFP and WHO. 2018. The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition. Rome, FAO. Licence: CC BY-NC-SA 3.0 IGO

¹¹⁵ FAO. 2019. FAO Director General's Medium Term Plan 2018-2021 and Programme of Work and Budget 2020-2021. Forty-first Session of the FAO Conference, 22 – 29 June 2019C2019/3. <http://www.fao.org/3/my734en/my734en.pdf>

57. Based on FAO's Vision for Sustainable Food and Agriculture¹¹⁶ FAO has developed recommended actions to guide decision-makers on how to transform food and agriculture to achieve the SDGs.¹¹⁷ This guidance is highly relevant to aquaculture decision-makers. One of these key actions recommends to improve nutrition and promote balanced diets and further suggests:

- creating nutrition-sensitive agriculture and food systems requires taking action at all stages of the food chain;
- school feeding programmes can involve local producers and provide new market opportunities for fresh products;
- nutrition education and awareness programmes to improve household dietary habits;
- promoting the consumption of locally grown nutritious food helps foster the local economy;
- promoting diverse foods and investigating the potential of underutilized food crops and animal species, or breeds;
- accelerating efforts to address all forms of malnutrition, and
- the Decade of Action on Nutrition (2016-2025)¹¹⁸ provides a framework for collective action.

58. A stepwise approach is suggested¹¹⁹ in addressing food security and nutrition in fisheries and aquaculture policies: (i) conducting a situational analysis, (ii) mapping the fisheries and aquaculture policy landscape, (iii) analyzing the policy framework, and (iv) understanding the political economy.

59. FAO remains ready and committed to further strengthening technical and policy assistance to Members in support of their efforts of mainstreaming nutrition policies and actions in national aquaculture development strategies¹²⁰, and vice versa: ensuring aquaculture is adequately embedded in national strategies for combating malnutrition and food insecurity.

¹¹⁶ FAO. 2014. Building a common vision for sustainable food and agriculture – principles and approaches. Rome. . www.fao.org/3/a-i3940e.pdf

¹¹⁷ FAO. 2018. Transforming Food and Agriculture to Achieve the SDGs: 20 interconnected actions to guide decision-makers. Rome, 71 pp. <http://www.fao.org/3/19900EN/i9900en.pdf>

FAO. 2018. Transforming Food and Agriculture to Achieve the SDGs: 20 interconnected actions to guide decision-makers. Technical Reference Document. Rome. 132 pp; <http://www.fao.org/3/CA1647EN/ca1647en.pdf>

¹¹⁸ UN. 2016. Decade of Action on Nutrition (2016-2025). https://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/70/259; <https://www.unscn.org/en/topics/un-decade-of-action-on-nutrition> ; <http://www.fao.org/about/meetings/sustainable-food-systems-nutrition-symposium/en/>

¹¹⁹ FAO & EU. 2016. Strengthening sector policies for better food security and nutrition results: fisheries and aquaculture. Policy Guidance Note 1. Rome. <http://www.fao.org/3/a-i6227e.pdf>

¹²⁰ FAO. 2015. Key recommendations for improving nutrition through agriculture and food systems <http://www.fao.org/3/a-i4922e.pdf>; see also : <http://www.fao.org/nutrition/policies-programmes/toolkit>; <http://www.fao.org/nutrition/policies-programmes/strategic-guidance/en/>

Box 13. Accelerating the end of hunger and malnutrition – FAO-IFPRI, 2018.

“Our generation is better positioned than any other before us to address the challenge of hunger and malnutrition in all its forms. We have the tools and the knowledge to take action.” Kostas Stamoulis, Assistant Director-General, Economic and Social Development Department, FAO.

“We must use nutrition as an opportunity to transform agriculture, an opportunity to promote economic growth, an opportunity to improve human capital.” Shenggen Fan, Director General, IFPRI.

IFPRI. 2019. Accelerating the end of hunger and malnutrition: A global event: Synopsis. Proceedings of IFPRI-FAO Bangkok Conference. 28-30 November 2018. Bangkok, Thailand. Washington, DC: Food and Agriculture Organization (FAO) and International Food Policy Research Institute (IFPRI). <https://doi.org/10.2499/9780896293533>