

Will fish be part of future healthy and sustainable diets?



The adoption of healthy and sustainable diets and food systems is recognised as a means to address the global challenge of malnutrition and poor-quality diets, and unprecedented environmental damage from food production and consumption.¹ Sustainable diets have also been recognised as a key strategy to achieve the Sustainable Development Goals. Reducing consumption of animal-source foods is frequently presented as key to improving the sustainability of food systems.² Fish and seafood can have a lower environmental impact and in many cases are considered more efficient than terrestrial animal production (albeit with wide variation) depending on the type of production or capture method,³ yet remain largely absent, or insufficiently articulated in the sustainable diets literature, rendering their future role in healthy diets unclear.⁴ This absence of specific consideration of fish and seafood extends to food security literature, in which the role of fish remains under-recognised and undervalued.⁵ Legitimate concerns exist regarding the environmental sustainability of fisheries and aquaculture systems; however, we argue that an overemphasis on the so-called doomsday portrayal of fish—which often dominates literature and the broader media—masks the myriad of positive contributions of the fisheries sector to nutrition and sustainability and limits its scope in contributing to healthy and sustainable food systems.

Fish have a wide range of nutritional benefits and should be included as part of a healthy diet.⁶ Firstly, fish is a concentrated source of highly bioavailable nutrients including vitamins, minerals, essential fatty acids, and high quality protein. The health benefits of fish are well documented, including protection against chronic disease as well as benefits for child growth and development. Although food safety issues such as contamination with methylmercury are a concern for some susceptible groups, the benefits of fish consumption generally outweigh the risks.⁷ Consumption of fish as part of a healthy diet offers a unique prospect to address the global health issue of malnutrition (undernutrition, micronutrient deficiency, and non-communicable diseases associated with overweight or obesity), which are simultaneously experienced in many parts of the world.

A frequently cited concern regarding aquaculture in environmental terms is the use of wild-caught fish in feed. However, the proportion of fish used for this purpose globally has been steadily declining, as fishmeal and fish oil are increasingly replaced with more sustainable sources such as fish by-products or plant-based ingredients.⁵ Feed conversion ratios have decreased by more than half in the past 25 years, and development of novel aquaculture feed ingredients such as microbial-derived nutrients, seaweed, and insects, offers the potential to further reduce reliance on wild-caught fish and terrestrial inputs in the future.⁸ Furthermore, efficient use of underutilised species, by-catch, and fish-by-products throughout the value chain (including by consumers) is growing and offers substantial potential to improve sustainability of the fisheries sector.⁹ Approaches such as integrated multi-trophic aquaculture (involving polyculture of several plant and animal species together) can improve sustainability, although understanding which forms will have the greatest ecological and economic benefits remains a challenge.

Although the majority of well documented capture fisheries are sustainably managed,¹⁰ overfishing and ecosystem damage remain major concerns for others. Wider recognition of the contribution of fish to the food system, and the consequences of reduced availability of fish for consumption, will help drive reforms in fishery management.

The contribution of fisheries to the broader social and economic dimensions of sustainability are also often overlooked. This sector underpins livelihoods for at least 140 million people, nearly all of whom live in developing countries operating within the small-scale sector,^{10,11} and has a substantial role in poverty reduction and improved food security of poor consumers.¹² The sector faces several social challenges including human rights misconduct, poor working conditions, and social inequalities, all of which are gaining increased policy attention. We suggest that rather than a barrier, with appropriate research and targeted interventions, these challenges offer an entry point for maximising the positive effects of the sector.

Fish does, and must continue to, play a key role both in human health and the economic, social,

and environmental sustainability of food systems. We identify several research and policy priorities for progression of this agenda. Firstly, aquaculture is a relatively new field and great scope remains for research and development, including broader consideration of species and breeding, improved efficiencies in inputs including feed, biosecurity, and the integration of aquaculture systems within broader ecosystems. In particular, a better understanding of how aquaculture and fisheries are integrated within freshwater management is required, as well as the environmental impacts of increasingly linked aquatic and terrestrial food production through aquaculture feed. Furthering the understanding of the importance of integration requires recognition of the diversity of capture fisheries and aquaculture systems, which often reflect a continuum, rather than distinct systems, with important inter-linkages and feedback loops. Sustainable intensification in this context must consider potential trade-offs at a broader system level, not only within but also beyond food systems, to the ecological, environmental, social, and economic systems, and their interactions.¹³ Attention in policy making and management implementation must also shift from predominantly large fisheries to smaller, food-critical fisheries, if the benefits of fisheries for food security are to be realised. Finally, transdisciplinary approaches to research and policy throughout fish value chains are fundamental.

*Jessica R Bogard, Anna K Farmery, David C Little,

Elizabeth A Fulton, Mat Cook

Commonwealth Scientific and Industrial Research Organisation, Agriculture and Food, Brisbane, QLD 4067, Australia (JRB, MC); University of Wollongong, Australian National Centre for Ocean Resources and Security, Wollongong, NSW, Australia (AKF); Institute of Aquaculture, University of Stirling, Stirling, FK9 4LA, UK (DCL); Commonwealth Scientific and Industrial Research

Organisation, Oceans and Atmosphere, Hobart, TAS, Australia (EAF); and Centre for Marine Socioecology, University of Tasmania, Hobart, TAS, Australia (EAF)
jessica.bogard@csiro.au

We declare no competing interests.

Copyright © 2019 The Author(s). Published by Elsevier Ltd. This is an Open Access article under the CC BY 4.0 license.

- 1 HLPE. Nutrition and food systems. A report by the High Level Panel of Experts on food security and nutrition. Rome: Committee on World Food Security, 2017. <http://www.fao.org/3/a-i7846e.pdf> (accessed Oct 9, 2018).
- 2 Willett W, Rockström J, Loken B, et al. Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *Lancet* 2019; **393**: 447–492.
- 3 Hilborn R, Banobi J, Hall SJ, Pucylowski T, Walsworth TE. The environmental cost of animal source foods. *Front Ecol Environ* 2018; **16**: 329–35.
- 4 Farmery AK, Gardner C, Jennings S, Green BS, Watson RA. Assessing the inclusion of seafood in the sustainable diet literature. *Fish and Fisheries* 2017; **18**: 607–18.
- 5 HLPE. Sustainable fisheries and aquaculture for food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition. Rome: Committee on World Food Security, 2017/2014. <http://www.fao.org/3/a-i3844e.pdf> (accessed Sept 10, 2015).
- 6 Thilsted SH, Thorne-Lyman A, Webb P, et al. Sustaining healthy diets: The role of capture fisheries and aquaculture for improving nutrition in the post-2015 era. *Food Pol* 2016; **61**: 126–31.
- 7 FAO, WHO. Report of the joint FAO/WHO expert consultation on the risks and benefits of fish consumption. Rome: Food and Agriculture Organization of the United Nations, World Health Organization, 2010. (accessed Sept 1, 2017).
- 8 World Economic Forum, McKinsey and Company. Innovation with a purpose: the role of technology innovation in accelerating food systems transformation. Geneva: World Economic Forum, 2018. http://www3.weforum.org/docs/WEF_Innovation_with_a_Purpose_VF-reduced.pdf (accessed Nov 11, 2018).
- 9 Stevens JR, Newton RW, Tlusty M, Little DC. The rise of aquaculture by-products: increasing food production, value, and sustainability through strategic utilisation. *Marine Pol* 2018; **90**: 115–24.
- 10 FAO. The state of world fisheries and aquaculture 2018—meeting the sustainable development goals. Rome: Food and Agriculture Organization of the United Nations, 2018. <http://www.fao.org/3/i9540en/i9540EN.pdf> (accessed March 4, 2019).
- 11 Mills D, Westlund L, de Graaf G, Kura Y, Willmann R, Kelleher K. Under-reported and undervalued: small-scale fisheries in the developing world. In: Pomeroy R, Andrew N, eds. Small-scale fisheries management frameworks and approaches for the developing world. Wallingford: CAB International, 2011.
- 12 Béné C, Arthur R, Norbury H, et al. Contribution of fisheries and aquaculture to food security and poverty reduction: assessing the current evidence. *World Dev* 2016; **79**: 177–96.
- 13 Little DC, Young JA, Zhang W, Newton RW, Al Mamun A, Murray FJ. Sustainable intensification of aquaculture value chains between Asia and Europe: A framework for understanding impacts and challenges. *Aquaculture* 2018; **493**: 338–54.