



United Nations Food Systems Summit 2021
Scientific Group
<https://sc-fss2021.org/>

Stanford
University

Stockholm Resilience Centre
Sustainability Science for Biosphere Stewardship



The Blue Food Assessment

Food Systems Summit Brief

Prepared by Research Partners of the Scientific Group for the Food Systems Summit
April 15, 2021

The Vital Roles of Blue Foods in the Global Food System

by

Jim Leape, Fiorenza Micheli, Michelle Tigchelaar, Edward H. Allison, Xavier Basurto,
Abigail Bennett, Simon R. Bush, Ling Cao, Beatrice Crona, Fabrice DeClerck,
Jessica Fanzo, Jessica A. Gephart, Stefan Gelcich, Christopher D. Golden, Christina C. Hicks, Avinash
Kishore, J. Zachary Koehn, David C. Little, Rosamond L. Naylor, Elizabeth R. Selig,
Rebecca E. Short, U. Rashid Sumaila, Shakuntala H. Thilsted, Max Troell, Colette C.C. Wabnitz
(for contributors' affiliations, please see back-page)

Executive Summary

Blue foods – fish, invertebrates, algae and aquatic plants captured or cultured in freshwater and marine ecosystems – play a central role in food and nutrition security for billions of people and are a cornerstone of the livelihoods, economies, and cultures of many coastal and riparian communities. Blue food systems are extraordinarily diverse, involving thousands of species in many different production systems and supporting a wide array of cultures and diets. Many blue foods are rich in bioavailable micronutrients and can be produced in ways that are more environmentally sustainable than terrestrial animal-source foods. Yet despite their unique value and interconnections with terrestrial food systems, blue foods are often left out of food system analyses, discussions, decisions, and solutions.

Realizing the potential of blue foods to play a central role in ending malnutrition and in building healthy, nature-positive and resilient food systems will require that governments embed blue foods in food-system governance. Here, we focus on three central imperatives for policymakers:

1. Bring blue foods into the heart of food system decision-making.

Governments should integrate blue foods into food policymaking, for example in a Ministry of Food, so that they can govern the entire food value chain, from producers to consumers, for both terrestrial and aquatic systems. They should ensure that blue foods are managed as a food system, not just a natural resource, for human sustenance and within environmental limits, and that they are fully included in policies for the food system as a whole.

2. Protect and develop the potential of blue foods to help end malnutrition.

Governments should recognize the Right to Food and manage blue foods as a source of nutrients that can help end malnutrition. To that end, food policy should harness the nutritional diversity of blue foods; take measures across the food system to reduce loss of nutrients from waste, environmental change and management failures; and ensure equitable distribution of blue food production and consumption.

3. Support the central role of small-scale actors in fisheries and aquaculture.

Small-scale actors supply most of the blue food for human consumption. Governments need to ensure they – including women and other vulnerable groups – are included in blue food decision-making and policy. Government policy should expand investment in small-scale actors, support sustainable development and diversification of their sector, and ensure that trade and economic policy takes account of their roles in providing equitable economic opportunity and nutrition.

Introduction

Debates and decisions about food systems generally focus on agriculture and livestock. Blue foods – fish, invertebrates, algae and aquatic plants captured or cultured in freshwater and marine ecosystems – are perennially neglected¹. Yet blue foods play a central role in food and nutrition security for billions of people and will be ever more important as the world seeks to create just food systems that support the health of people and the planet²⁻⁶. It is thus paramount that governments bring blue food systems into their food-related decision-making.

Last year, the UN Committee of World Food Security High Level Panel of Experts called for a transformation of the food system, moving “from a singular focus on increasing the global food supply through specialized production and export to making fundamental changes that diversify food systems, empower vulnerable and marginalized groups, and promote sustainability across all aspects of food supply chains, from production to consumption”⁷. Properly understood and managed, blue foods are profoundly suited to that shift.

The blue food portfolio is highly diverse. There are more than 3,000 species of marine and freshwater animals and plants used for food^{6,8}. Blue food systems are supported by a wide range of ecosystems, cultures and production practices – from large-scale trawlers on the high-seas to small-scale fishponds integrated within agricultural systems – supporting access to nutritious food for communities through global and local markets alike. This diversity supports resilience that can help local food systems withstand shocks like COVID-19 and climate extremes⁹⁻¹¹ and offers many possibilities for governments seeking to build food systems that are healthy, sustainable, and just.

Blue foods can be a cornerstone of good nutrition and health. Many of them are rich in bioavailable micronutrients that help prevent maternal and infant mortality, stunting, and cognitive deficits. And blue foods can be a healthier animal-source protein than terrestrial livestock: they are rich in healthy fats and can help reduce obesity and non-communicable diseases. In many parts of the world, blue foods are also more accessible and affordable than other animal-source foods^{12,13}. Aquatic plants, including seaweeds, are a traditional presence in diets in the Asia-Pacific region and offer a variety of possibilities for low-carbon, nutritious food.

Blue foods can have lighter environmental footprints than other animal-source foods¹⁴. Across a diverse sector, the details matter: greenhouse gas emissions and biodiversity impacts can be quite high for some blue food systems, such as bottom trawling or aquaculture systems with low feed efficiencies, especially when they are poorly sited or poorly managed. But many fisheries and aquaculture systems already offer footprints that are much lower than beef, with vast potential to be improved further¹⁴. In some cases, unfed aquaculture (such as filter-feeding shellfish and seaweeds) can actually improve the water quality of the environment it occupies.

Blue foods are important to livelihoods in many vulnerable communities. FAO estimates indicate that about 800 million people make their living in blue food systems⁴, mostly in small-scale fisheries and aquaculture. These systems produce a wide variety of blue foods, supporting healthy diets and resilience in the face of climate change and market fluctuations.

To capitalize on the potential of blue foods, decision-makers must address significant challenges. Wild capture fisheries, both marine and freshwater, need to be better managed^{15,16} as many fish stocks have become severely depleted and some technologies have high environmental footprints. Although aquaculture is becoming increasingly sustainable, growing use of feed in some sectors is putting pressure on the environment through overfishing, deforestation for feed crops and intensification of agricultural production. Intensification of aquaculture can concentrate nutrient pollution and exacerbate risks associated with pathogens and high dependence on antibiotics¹⁷.

The Bangladesh Story

The proliferation of diverse, freshwater aquaculture supply chains in Bangladesh in recent decades illustrates the potential for blue foods to meet domestic demand, improve food and nutrition security, and reduce rural poverty²⁸. This “hidden aquaculture revolution” has involved the participation of hundreds of thousands of small- to medium-scale actors along the supply chain, acting independently and in response to urbanization, growing incomes, and rising fish demand. Approximately 94% of the fish produced in freshwater aquaculture in Bangladesh is directed towards domestic markets and is not traded internationally. Although mostly small-scale, freshwater aquaculture systems have become increasingly intensive and commercial in their operations²⁹. Aquaculture growth and its contribution to food and nutrition security in Bangladesh have resulted from public investment in infrastructure, a positive business environment for small- and medium-size entrepreneurs, and the absence of government control over the type of systems and species produced²⁸.

Environmental stressors can also limit blue food production and must be mitigated. Climate change will increasingly affect the health and productivity of fish stocks and aquatic ecosystems¹⁸. These impacts will have implications for food security, livelihoods and economies worldwide and especially in wild-capture fisheries in Africa, East and South Asia, and small island developing states^{19,20}. Other kinds of pollution, from agricultural runoff to plastics, further threaten productivity and the safety of foods harvested from polluted waters^{21,22}.

Like all food systems, blue food systems are beset by inequities. Wealth-generating activities are often favored over those important to nutrition and health, livelihoods, and culture. Although blue food value chains employ roughly equal numbers of men and women⁴, their roles, influence over value chains, and benefits can be highly unequal. Progress toward gender equality is critical for development of more equitable and efficient blue food systems^{5,23}.

Blue foods are the most highly-traded food products – for developing countries, net revenues from trade of blue foods exceed those of all agricultural commodities combined^{24–26}. Global supply chains are complex and often opaque, however, making it difficult or impossible for buyers to ascertain environmental impacts and human rights abuses in production. In some places harvesting and trade of fish for high monetary-value global markets have undermined production that is important for local food security and livelihoods²⁷.

There is every reason to expect that total demand for blue foods will grow substantially in the years ahead, as population and incomes increase, and as attention toward healthy and sustainable food expands. If produced responsibly, they have essential roles to play in ending malnutrition and in building healthy, nature-positive and resilient food systems. Realizing that potential, however, will require that governments are thoughtful about how to develop those roles. Here, we focus on three central imperatives for policymakers:

1. Integrate blue foods into decision-making about food system policies, programs, and budgets, to enable effective management of production, consumption and trade, and the interconnections with terrestrial food production;
2. Understand, protect and develop their potential in ending malnutrition, fostering production of accessible, affordable nutritious foods; and
3. Support the central role of small-scale actors, with governance and finance that are responsive to their diverse needs, circumstances and opportunities.

POLICY RECOMMENDATION 1: Bring blue foods into the heart of food system decision-making.

The Problem:

Fisheries and aquaculture are typically ignored in management of food systems

Blue foods are deeply interconnected with the rest of the food system – in diets, in supply chains, and in the environment. Aquatic and terrestrial foods appear on the same plate and are often substitutes for each other in household food choices. Capture fisheries provide feed inputs for aquaculture and livestock; terrestrial crops provide feed inputs for aquaculture. Excess nutrients from agriculture and aquaculture pollute rivers and cause coastal dead zones, undermining fisheries; cultivation of filter feeding fish and seaweeds takes up nutrients and, if properly managed and scaled, can help protect ecosystem health. Genetic advances in crops and livestock have had positive spillover effects on aquaculture through selection and breeding and through improvements in nutritional performance and feed efficiency.

Yet blue foods are generally ignored in food system discussions and decision-making¹. Blue foods receive little attention in development assistance – the World Bank, the Gates Foundation and other major development funders have largely neglected the roles of fish, shellfish and aquatic plants in human nutrition and health. Blue foods also tend to be left out of food system policymaking at the national level. Ministries or agencies dedicated to capture fisheries and aquaculture tend to manage them as a natural resource, with a focus on economic interests – production and trade. In many countries, the result is that both fisheries and aquaculture are managed with an emphasis on high monetary value, export-oriented production. That orientation is reinforced by the market and naturally favors investments in innovations and enterprises that offer the highest financial return. Critical welfare functions are often neglected; indeed, fisheries agencies often lack the mandate to address the potential contributions of blue foods to food security and public health, to livelihoods and communities, and to cultural traditions and diets.

When fisheries and aquaculture are siloed and managed as a natural resource, policymakers miss vital opportunities for advancing their goals for nutrition, sustainability, resilience, and livelihoods, and they make unwitting tradeoffs among those interests. Fisheries that have sustained communities for generations are depleted by distant water fleets or outcompeted in the market by large volumes of inexpensive farmed fish. Farming of species that could remedy pressing nutrient deficiencies remains undeveloped because management and investment are directed to high-revenue products. Small-scale producers who are central to local diets, livelihoods and community resilience lose out to large commercial concessions.

The African Great Lakes

The small pelagic fisheries of the African Great Lakes region illustrate the opportunities in bringing blue foods into food system policymaking. These fisheries produce huge volumes of affordable, micronutrient-rich food traded throughout the region, but they have been given low priority for investment and management because they are seen as having low economic value. Food system policymaking approaches could include investments to a) reduce post-harvest loss, which can be substantial, and improve food quality and safety; b) strengthen domestic and intra-regional trade institutions to enhance small-scale trader market access; c) address challenges, risks and opportunities of female fish traders, who comprise a substantial portion of the post-harvest sector, and d) manage tradeoffs between sale for animal feed industries and direct human consumption.

The Solution:**Governments should fully integrate blue foods into their governance of the food system**

The potential of blue foods will only be realized if they are brought into food system decision-making. That requires integrated governance, systematic inclusion in policy, and a basic change in the way we think about fish. Specifically, governments should:

1. Create a governance structure that integrates green and blue

Governments should create a Ministry of Food or other structure that can govern the entire food system, managing synergies and tradeoffs in production, consumption and trade. Ministries of agriculture and of fisheries typically focus on production – generally on increasing volume – and often are captured by entrenched interests. A Ministry of Food or similar entity could manage the disparate interests of producers, consumers, and other stakeholders for improved nutritional, environmental, economic, and social outcomes. It could, for example, manage production and consumption to create markets for more nutritious species (see Section 2). It could also expand the capabilities of small-scale producers, through investment and allocation of resource rights to support livelihoods and community resilience (see Section 3). More broadly, it enables decision-makers to govern blue foods as a food system, and to ensure blue foods are fully included in all food system policies.

2. Govern blue foods as a food system

At the most basic level, integrating blue foods into food system decision-making also recognizes that fisheries and aquaculture should themselves be managed as food systems – they should be managed to deliver society’s goals for nutrition, health and equity, as well as for economics and sustainability. Government policy and management should embrace all aspects of the blue food sector – including fisheries, aquaculture development, distribution, exports and imports, and consumption.

Promoting a systems approach means that governments can ensure nutrient-rich aquatic foods are available and affordable to those for whom they are most important, both nutritionally and culturally. It can work across the value chain to identify and address the many threats to supply of blue foods, from overfishing to pollution to waste and loss in harvesting, processing and distribution (see Section 2). It can build a system that is just, ensuring equitable participation in production, accessibility for consumption, and broad representation in decision-making. By managing blue foods as a system, governments can also create policies and incentives across the value chain to shift both production and consumption to species and technologies that have lighter footprints and to foster diversity in production systems.

Looking at the whole system also enables the government to make public investments where markets fail. Private investment goes to blue food systems and enterprises that offer high financial returns. Governments can allocate public funds to develop innovations in fisheries and aquaculture that offer lower returns but are important for nutrition, livelihoods, and sustainability, and it can provide capital for small and medium-sized enterprises to take those innovations to scale.

To realize this vision, governments will need to collect data that enable good decisions – including data that enable monitoring of fisheries and supply chains, that capture the vital diversity of species that are produced and consumed, that survey the demographic diversity of participants in the sector, and that reflect the frequently profound heterogeneity in consumption across different regions of the country. They will also need to redesign policies to enable and incentivize the capabilities of key actors – from producers to consumers – to adopt transformative practices in the food system as a whole, in value chains, and in the places where they live (see Section 3).

3. Include blue foods in all food system policies

Structural reform must be followed by policy inclusion – governments should integrate blue foods into the policies that regulate, guide and support the food sector. Government strategies to meet the Human Right to Food, for example (see Section 2), should embrace the potential of blue foods to offer accessible, affordable sources of key nutrients. Dietary guidelines should include the nutritional contributions of different blue foods, to help consumers understand their value for addressing nutrient deficiencies and obesity, diabetes and coronary disease. Safety net programs for children and pregnant and lactating women should also include blue foods, as fish can be a rich source of essential micronutrients for those most vulnerable populations, helping to prevent stunting and cognitive deficits.

Including blue foods in policymaking for the food system allows governments to better manage the interconnections between terrestrial and aquatic food systems. That includes the regulation of agricultural and inland aquaculture runoff and other land-based pollution that can undermine coastal fisheries and marine aquaculture, such as nutrients that cause coastal dead zones and toxins that can compromise food safety. Governments can also better manage the allocation of crops and fish to competing uses – for food or feed – and support the development of a circular economy in which wastes or by-products from one part of the food system are used as feed inputs to another.

POLICY RECOMMENDATION 2: Protect and develop the potential of blue foods to help end malnutrition

The Problem:

Blue food systems are not managed for nutrition

Many blue foods contain high concentrations of bioavailable minerals and vitamins, essential fatty acids, and animal protein⁸ – globally roughly 8% of zinc and iron, 13% of protein, and 27% of vitamin B12 are derived from aquatic foods⁶. Blue foods can therefore make key contributions to diet-related health challenges. They can reduce micronutrient deficiencies that lead to disease; improve heart, brain and eye health by uniquely providing omega-3 fatty acids; and replace consumption of less healthy red and processed meats⁶. The micronutrient contributions of blue foods are especially important for childhood development, pregnant women and women of childbearing age^{30–32} and can reduce nutritional inequities for girls and women⁶.

Not all fish are equal. For example, a single serving of small indigenous species in Bangladesh contributes more than five times as much vitamin B12 as a single serving of tilapia⁸. Which blue foods are on a plate therefore matters as well as how much^{6,27}. Yet, blue food policy often considers blue foods only as a protein source, which neglects the nutrient diversity of fish (in terms of micronutrients and fatty acids) and excludes the contributions of aquatic plants altogether. In the Bangladesh case discussed above, for example, growth in (farmed) fish consumption has led to an increase in total protein consumption but a decrease in consumption of certain micronutrients, highlighting the challenge of balancing high nutrient content provided by small native fish – with employment and revenue generation offered by tilapia and pangasius production³³. Adopting a nutrition-sensitive approach to aquaculture and fisheries, rather than just a production-focus, can address these issues^{1,8,34}.

In many countries, ministries manage blue foods for their wealth-generating benefits, focusing policy on high economic-value blue food production, often for export. Such a focus risks undermining the critical welfare functions of blue foods by neglecting the nutritional characteristics, livelihood contributions, accessibility, and cultural patterns of blue food consumption^{1,5,8,27}. Nutrient-dense blue foods are regularly exported from nutritionally vulnerable countries to serve either as a high-quality product for wealthy consumers or to be reduced to fishmeal to feed farmed fish for high-income countries³⁵. Orientation towards export markets not only affects coastal and riparian populations, but also inland communities who have historically depended on richly nutritious dried or smoked fish transported from the coast³⁶.

The quantity, quality and safety of blue food supply are threatened by waste (amounting to 35% of fish harvested globally⁴), management failures (including overfishing and Illegal, Unreported, and Unregulated fishing), environmental degradation, and climate change¹⁸. It is estimated that declines in marine fish catch over the next three decades could subject an additional 845 million people (11% of the world's population) to vitamin A, zinc, or iron deficiencies²⁰. Though all of these pressures occur globally, their effects are highest and most strongly felt in tropical and low-income countries with high dependence on blue foods for nutrition and health, livelihoods and income^{19,20}.

Finally, blue food policy misses opportunities to support nutrition goals when it fails to address unequal distribution of the benefits from blue food systems or the concentration of power. Women in particular are underrepresented in policies and decision-making^{5,23,37}. Where gender equality is lacking, blue foods are less affordable⁵ and blue food waste and losses are greater³⁸.

The Solution:

Sustain and enhance the nutritional benefits of blue food systems

To manage blue food systems for the benefit of nutrition and health, governments should:

1. Recognize the centrality of the Right to Food in blue food trade and domestic policy

The Right to Food states that everyone is entitled to adequate, accessible, and safe food, that corresponds to their cultural traditions in a fulfilling and dignified manner³⁹. A Right to Food means that governance of and investment in blue food systems should seek balance between economic opportunities and local rights to food provisioning^{1,5}, aiming to sustain and innovate with the full diversity of species, production and harvest methods, product forms and distribution channels in mind⁵. Recognizing the Right to Food requires taking a food systems approach in which nutrition, sustainability, climate-resilience and equity can be considered together (see Section 1) and which ensures all actors are represented, including through engagement with grass-roots and civil society organizations (see Section 3)^{1,5}. At a national level, blue foods should explicitly be included in food and nutrition policy (see Section 1)^{1,8}. Internationally, blue foods should be positioned as a vital food source in the context of the UN Sustainable Development Goals, health national adaptation plans (HNAPs), and other international efforts to alleviate malnutrition¹.

2. Harness the nutritional diversity of blue foods

Governments should ensure that the nutritional potential of blue foods serves to improve the health and diets of nutritionally vulnerable people. They should recognize and harness the diversity of local blue food nutritional profiles, preparation methods and dietary practices¹⁹.

Governments should manage capture fisheries to optimize for nutritional benefits, not just for maximum sustainable yield, which can uncover opportunities to diversify fish production without increasing pressure on existing stocks^{6,40}. Aquaculture development should foster the sustainable

production of native small fish species that can supply context-specific nutrient needs. As an example, *mola*, a fish species from the Gangetic floodplains, can easily be produced in homestead ponds and offers 80 times more vitamin A than commonly farmed silver carp⁸.

Governments should evaluate exports and licenses to distant water fleets to ensure they don't compromise nutritional goals. In some cases (e.g., Namibia) retaining just a small portion of current exports could meet local nutrition goals²⁷, though this requires infrastructure to support equitable distribution and access to blue foods locally (see Section 3).

Public health policies and investments focused on reducing malnutrition should include blue foods in programs to address the specific nutritional needs of pregnant and lactating women, young children and the elderly – with appropriate consideration of food safety and pollutants – as was done with the introduction of dried small fish powder in Myanmar to support children's health⁴².

3. Halt loss of nutrients from blue food systems

To ensure that blue foods important for nutrition are available, accessible, and affordable, governments should take steps to reduce losses in the system. Improved processing methods can preserve and concentrate nutrients and increase availability and also improve nutritional quality⁴³.

In many places, better management of capture fisheries through harvest controls or spatial restrictions, for example, can restore fish stocks and increase yields^{15,16,44}. Better regulation of economic development in floodplains, riparian, coastal, and ocean ecosystems can help protect blue food production and reduce risks to food safety^{45,46}.

Fisheries and aquaculture policy should also anticipate and adapt to projected climate change^{18,19}. Governments should consider nature-based solutions like mangrove and seagrass restoration and restorative aquaculture that can help strengthen the resilience of aquatic ecosystems^{47,48}. Additional climate adaptation options are context-specific but include shifting to offshore resources⁴⁹, devising climate-smart agreements for transboundary resources⁵⁰ and investing in climate information systems, including early warning systems for extreme events^{51,52}.

4. Improve the distributional equity of blue food production and consumption

Participation in activities along the value chain is often socially differentiated; for example, men dominate blue food production and women blue food processing. Governments thus need to collect data on what roles, from fish producers to post-harvest processors, traders, and consumers, different groups in society hold and why. When divisions of labor exist because of unequal opportunities to participate across the value chain, they are likely to result in distributional and nutritional inequities³⁷. Investments to address the drivers of unequal opportunities, such as through strengthening women's empowerment, are known to lead to improvements in outcomes for women and their families. For example, in Zambia, strategies to uncover underlying structural barriers that limit participation, such as unequal norms and attitudes, increased women's participation in production processes, and their control over resources³⁸. Governments need to ensure the full diversity of actors, across social groups, including gender, class, and ethnicity, and along the value chain and scale of production, are fairly represented in decision-making processes⁵ (see Section 3). In addition, governments should recognize subnational differences in nutritional vulnerability and blue food access in national policy and align subnational policies and instruments with nutritional goals.

POLICY RECOMMENDATION 3: Support the central role of small-scale actors in fisheries and aquaculture

The Problem:

Limited recognition and support for the SSFA sector in supporting equitable and sustainable food systems

Small-scale fisheries and aquaculture (SSFA) have been marginalized in dialogues about sustainable and equitable food system transformation, despite being central to it in many contexts¹. SSFA play a key role in supplying nutrition and supporting local economies in many countries. They produce more than half of the global fish catch and contribute over two-thirds of aquatic foods destined for direct human consumption⁴, with the potential for lower environmental footprints (e.g., lower fuel use than in large-scale operations¹⁴). In addition, the value chains that process and sell their products support an estimated 800 million full- and part-time jobs, half of which are women⁴. SSFA produce a high diversity of aquatic foods. This diversity underpins healthy diets, and resilience in the face of shocks, climate and market changes^{27,34,53,54}. SSFA also contribute to intra-regional trade, especially in smoked and dried products, which can have more direct impacts on food security and poverty alleviation than the globalized system⁵⁵.

SSFA worldwide face a growing range of threats and challenges, including resource over-exploitation, habitat degradation, poor political representation, market-driven competition for resources (e.g. patterns of trade and foreign fishing), assumed links between informality and illegality⁵⁶, climate change⁵⁷, and shocks such as the current COVID-19 pandemic^{53,58,59}. Cumulatively, SSFA are being 'squeezed out' of the spaces they occupy on the land-water margins by other more powerful sectors, such as tourism, residential and industrial land use, oil and gas exploration, industrial fisheries and aquaculture⁶⁰. Within SSFA, inequitable access to resources and opportunities and limited gender and social inclusion are key threats. Finally, pervasive data and monitoring limitations pose major challenges to understanding the status of SSFA⁶¹ as a lack of data leads to underestimating SSFA contributions, marginalizing SSFA in policy and decision making, and aggregated and categorical data fail to represent the diversity of SSFA actors and benefits.

Governments and policies predominantly focus on industrialized, large-scale fisheries and aquaculture, leading to a lack of voice and support for SSFA. One reason for this persistent neglect is that policy makers struggle with the diversity, dynamism and perceived informality of SSFA and their associated cultures⁵. Most policies affecting the sector make unrealistic assumptions that SSFA are a homogenous group limited to producers^{62,63}. In contrast, the sector is extraordinarily diverse along many dimensions⁵⁹. Successful transformations of SSFA require supporting current activities, whilst exploring new opportunities and encouraging both the entry of new actors into the sector and the redeployment of some current actors to opportunities outside it.

The Solution:

Support SSFA capabilities and diversity through inclusive blue food policy

Governments of countries where SSFA operate should place this sector at the center of their national human development and food security strategies, creating initiatives that support the capabilities of the diverse SSFA actors. Supporting the viability of SSFA requires governments to:

1. Include actors from SSFA in decision-making and policy development

Inclusion of SSFA in decision-making is essential to enable more adaptive governance mechanisms and policies that build on the strengths of the diversity of SSFAs, acknowledge the cultural importance and specific roles of blue foods for diverse actors and steer food systems towards a more equitable distribution of blue food benefits.

Women are greatly underrepresented in policy and decision making even though they make up half of the workforce in SSFA globally. Recent efforts to improve gender equity in blue food policy have tended to adopt a narrow focus on women, overlooking men or gender relations²³. Such a narrow focus risks exacerbating inequities by placing the blame, or burden for change, on women⁵. Blue food policy development therefore not only needs to involve more input and leadership from women, but also should take a gender transformative approach to improving intersectional equity in SSFA^{5,23,64}.

Governments should support and strengthen multi-stakeholder initiatives that have the benefits of SSFA at their core, including organizations of fish workers, harvesters and producers at global, regional, and national levels such as the World Forum of Fish harvesters and Fishworkers (WFF), the World Forum of Fisher Peoples (WFFP), and the International Collective in support of Fish Workers (ICSF).

2. Expand capabilities through investment in institutions and human capital, and investment in environmental protection and restoration

Securing the future of SSFA requires adaptive action that supports the capabilities of SSFA to deliver both market and non-market societal benefits. Positive environmental outcomes, for example, require engagement of SSFA actors to co-produce knowledge, forge strategies for sustainability and climate adaptation, and participate in and lead environmental restoration, conservation and adaptation efforts.

Governments should create space for SSFA as they expand agricultural, and industrial aquaculture and fisheries sectors. They should use public and private regulation and financial mechanisms to enable SSFA actors to (re)gain control over the resources, rights, skills and knowledge necessary for environmentally resilient and socially equitable production and trade (including insurance, credit, and market mechanisms to buffer against extreme events).

Governments should also allocate and enforce land, water and labor rights to SSFA through user rights-based systems, creation of preferential access areas, coastal and inland land use zoning, or other measures. To support the roles of SSFA in creating livelihoods and resilient and equitable food systems, governments should also provide capital, through public and private financial mechanisms that empower rather than undermine SSFA actors.

3. Support diversification and sustainable intensification

For many SSFA producers, it will be crucial to find pathways for sustainable intensification or expansion of their operations or for diversification into other SSFA products or other sources of livelihood. To that end, governments should invest in R&D and facilitate access to venture capital to support innovation in species/production systems that are of high value for nutrition, livelihoods, and justice. They should also support the development of complementary livelihoods, which are often critical to continued participation by SSFA actors, their control of the resource base and its sustainability.

Costs, trade-offs, and potential environmental and social impacts of intensification and diversification should be carefully considered, and diversification should be proactively designed and monitored. To this end, efforts should be made towards better integration of different data types and sources and

enabling the effective and timely access and use of data by relevant actors. Investment is needed in monitoring systems for catch, effort, production and consumption, and in national surveys of engagement in SSFA which are fully gender-inclusive, and reflect intersections of gender, age and ethnicity. Promotion of R&D towards technological solutions to data collection, storage and communication/accessibility barriers would effectively support these needs.

4. Secure economic and nutritional benefits through trade policies and the development and protection of local and national markets

Governments, in particular low-income food insecure nations, need to be able to regulate the activities of large corporate actors and trade to protect the rights (e.g., labor rights, human rights, right to food) of SSFA workers, to ensure that terms, conditions, and revenues from trade are transparent and fair, do not impact on local food security, and where needed retain high nutritional value products for local consumption. Regulation should consider the potential trade-offs and linkages between nutritional and economic value of resources. It should establish transparent processes, monitoring systems, and accountability mechanisms to ensure traceability and visibility of social impacts. Market-based approaches that encourage actors to add value to products through processing, marketing or certification need to carefully consider trade-offs in economic, social, environmental, and public health outcomes (see Section 1).

Governments should also explore opportunities to support “alternative” systems based on short supply chains for products with strong local identities and local, decentralized production and processing. Diversity, deeply embedded in these food systems, could be supported by policies mandating or incentivizing local retention of SSFA products to ensure food self-sufficiency, for example, the development or control of local markets and school feeding programs.

Conclusion

Blue foods have vital roles to play in transformation of the global food system. In the face of growing challenges and rising demand, governments must act now to support and expand these roles. They should bring blue foods into the heart of their food decision-making, by creating a Ministry of Food or other governance structures that integrate blue foods fully into food policies, budgets and programs, managing the terrestrial and aquatic food systems as a whole. They should recognize the Right to Food and harness the nutritional diversity of blue foods in ways that ensure the equitable distribution of blue food production and consumption. And they should empower and support the millions of small-scale actors in fisheries and aquaculture who produce, process, distribute and trade most of the food we eat, and can be the key to a vibrant, sustainable, healthy, and equitable blue food economy. Recognizing and acting upon the potential role of blue foods in all dimensions of food policy would be a clear win for the 2021 U.N. Food Systems Summit.

References

1. Bennett, A. *et al.* Recognize fish as food in policy discourse and development funding. *Ambio* (2021) doi:10.1007/s13280-020-01451-4.
2. HLPE. *Sustainable fisheries and aquaculture for food security and nutrition*. <http://www.fao.org/3/a-i3844e.pdf> (2014).
3. Bennett, A. *et al.* *Contribution of Fisheries to Food and Nutrition Security: Current Knowledge, Policy, and Research*. (2018).
4. FAO. *The State of World Fisheries and Aquaculture 2020. Sustainability in Action*. <http://www.fao.org/3/ca9229en/ca9229en.pdf> (2020) doi:10.4060/ca9229en.
5. Hicks, C. C. *et al.* Towards justice in blue food systems. *Nature*.
6. Golden, C. D. *et al.* Aquatic foods for nourishing nations. *Nature* (in review).
7. HLPE. *Impacts of COVID-19 on food security and nutrition: developing effective policy responses to address the hunger and malnutrition pandemic*. <http://www.fao.org/3/cb1000en/cb1000en.pdf> (2020) doi:10.4060/cb1000en.
8. Thilsted, S. H. *et al.* Sustaining healthy diets: The role of capture fisheries and aquaculture for improving nutrition in the post-2015 era. *Food Policy* **61**, 126–131 (2016).
9. Troell, M. *et al.* Does aquaculture add resilience to the global food system? *Proc. Natl. Acad. Sci. U. S. A.* **111**, 13257–13263 (2014).
10. Béné, C. Resilience of local food systems and links to food security - A review of some important concepts in the context of COVID-19 and other shocks. *Food Secur* 1–18 (2020).
11. Love, D. C. *et al.* Emerging COVID-19 impacts, responses, and lessons for building resilience in the seafood system. *Global Food Security* **28**, 100494 (2021).
12. Ryckman, T., Beal, T., Nordhagen, S., Chimanya, K. & Matji, J. Affordability of nutritious foods for complementary feeding in Eastern and Southern Africa. *Nutr. Rev.* **79**, 35–51 (2021).
13. Ryckman, T., Beal, T., Nordhagen, S., Murira, Z. & Torlesse, H. Affordability of nutritious foods for complementary feeding in South Asia. *Nutr. Rev.* **79**, 52–68 (2021).
14. Gephart, J. A. *et al.* Environmental performance of blue foods. *Nature* (in review).
15. Hilborn, R. *et al.* Effective fisheries management instrumental in improving fish stock status. *Proc. Natl. Acad. Sci. U. S. A.* **117**, 2218–2224 (2020).
16. Melnychuk, M. C. *et al.* Identifying management actions that promote sustainable fisheries. *Nature Sustainability* 1–10 (2021).
17. Naylor, R. L. *et al.* A 20-year retrospective review of global aquaculture. *Nature* **591**, 551–563 (2021).
18. FAO. *Impacts of climate change on fisheries and aquaculture: Synthesis of current knowledge, adaptation and mitigation options*. vol. 627 (2018).
19. Tigchelaar, M. *et al.* Compound climate risk threatens aquatic food system benefits. *Nature Food*.
20. Golden, C. D. *et al.* Nutrition: Fall in fish catch threatens human health. *Nature* **534**, 317–320 (2016).
21. Bank, M. S., Metian, M. & Swarzenski, P. W. Defining Seafood Safety in the Anthropocene. *Environ. Sci. Technol.* **54**, 8506–8508 (2020).
22. Garrido Gamarro, E., Ryder, J., Elvevoll, E. O. & Olsen, R. L. Microplastics in Fish and Shellfish – A Threat to Seafood Safety? *J. Aquat. Food Prod. Technol.* **29**, 417–425 (2020).
23. Lawless, S., Cohen, P. J., Mangubhai, S., Kleiber, D. & Morrison, T. H. Gender equality is diluted in commitments made to small-scale fisheries. *World Dev.* **140**, 105348 (2021).
24. Gephart, J. A. & Pace, M. L. Structure and evolution of the global seafood trade network. *Environ. Res. Lett.* **10**, 125014 (2015).
25. Sumaila, U. R., Bellmann, C. & Tipping, A. Fishing for the future: An overview of challenges and opportunities. *Mar. Policy* **69**, 173–180 (2016).
26. FAO. *FAO Yearbook. Fishery and Aquaculture Statistics 2018/FAO annuaire. Statistiques des pêches et de l'aquaculture 2018/FAO anuario. Estadísticas de pesca y acuicultura 2018*. <http://dx.doi.org/10.4060/cb1213t> (2020) doi:10.4060/cb1213t.
27. Hicks, C. C. *et al.* Harnessing global fisheries to tackle micronutrient deficiencies. *Nature* **574**, 95–98 (2019).
28. Hernandez, R. *et al.* The “quiet revolution” in the aquaculture value chain in Bangladesh. *Aquaculture* **493**, 456–468 (2018).
29. Belton, B., Bush, S. R. & Little, D. C. Not just for the wealthy: Rethinking farmed fish consumption in the Global South. *Global Food Security* **16**, 85–92 (2018).
30. Kawarazuka, N. & Béné, C. The potential role of small fish species in improving micronutrient deficiencies in developing countries: building evidence. *Public Health Nutr.* **14**, 1927–1938 (2011).

31. Bogard, J. R. *et al.* Inclusion of Small Indigenous Fish Improves Nutritional Quality During the First 1000 Days. *Food Nutr. Bull.* **36**, 276–289 (2015).
32. Starling, P., Charlton, K., McMahon, A. T. & Lucas, C. Fish intake during pregnancy and foetal neurodevelopment—a systematic review of the evidence. *Nutrients* **7**, 2001–2014 (2015).
33. Bogard, J. R. *et al.* Higher fish but lower micronutrient intakes: Temporal changes in fish consumption from capture fisheries and aquaculture in Bangladesh. *PLoS One* **12**, e0175098 (2017).
34. Gephart, J. A. *et al.* Scenarios for global aquaculture and its role in human nutrition. *Rev. fish. sci. aquac.* **29**, 122–138 (2021).
35. Isaacs, M. The humble sardine (small pelagics): fish as food or fodder. *Agriculture & Food Security* **5**, 27 (2016).
36. Gordon, A., Finegold, C., Crissman, C. C. & Pulis, A. *Fish Production, Consumption, and Trade in Sub-Saharan Africa: A Review Analysis*. <https://digitalarchive.worldfishcenter.org/bitstream/handle/20.500.12348/884/WF-3692.pdf?sequence=1&isAllowed=y> (2013).
37. Udo, I. U. & Okoko, A. C. Seafood processing and safety: A veritable tool for transformation and empowerment of rural women in Nigeria. *Nigerian Journal of Agriculture, Food and Environment* **10**, 8–17 (2014).
38. Kaminski, A. M. *et al.* Fish Losses for Whom? A Gendered Assessment of Post-Harvest Losses in the Barotse Floodplain Fishery, Zambia. *Sustain. Sci. Pract. Policy* **12**, 10091 (2020).
39. Fakhri, M. *The right to food in the context of international trade law and policy*. <https://undocs.org/A/75/219> (2020).
40. Bernhardt, J. R. & O'Connor, M. I. Aquatic biodiversity enhances multiple nutritional benefits to humans. *Proc. Natl. Acad. Sci. U. S. A.* **118**, (2021).
41. Okafor-Yarwood, I. & Belhabib, D. The duplicity of the European Union Common Fisheries Policy in third countries: Evidence from the Gulf of Guinea. *Ocean Coast. Manag.* **184**, 104953 (2020).
42. Dried small fish powder provides opportunity for child health in Myanmar. *WorldFish Blog* <http://blog.worldfishcenter.org/2020/11/dried-small-fish-powder-provides-opportunity-for-child-health-in-myanmar/> (2020).
43. Siddhnath *et al.* Dry Fish and Its Contribution Towards Food and Nutritional Security. *Food Rev. Int.* 1–29 (2020).
44. Anderson, C. M. *et al.* How commercial fishing effort is managed. *Fish Fish* **20**, 268–285 (2018).
45. Niane, B. *et al.* Human exposure to mercury in artisanal small-scale gold mining areas of Kedougou region, Senegal, as a function of occupational activity and fish consumption. *Environ. Sci. Pollut. Res. Int.* **22**, 7101–7111 (2015).
46. de Oliveira Estevo, M. *et al.* Immediate social and economic impacts of a major oil spill on Brazilian coastal fishing communities. *Mar. Pollut. Bull.* **164**, 111984 (2021).
47. Gattuso, J.-P. *et al.* Ocean Solutions to Address Climate Change and Its Effects on Marine Ecosystems. *Frontiers in Marine Science* **5**, 337 (2018).
48. Hoegh-Guldberg, O. *et al.* *The ocean as a solution to climate change: Five opportunities for action*. http://oceanpanel.org/sites/default/files/2019-10/HLP_Report_Ocean_Solution_Climate_Change_final.pdf (2019).
49. McDonald, J. & Torrens, S. M. Governing Pacific fisheries under climate change. in *Research Handbook on Climate Change, Oceans and Coasts* (Edward Elgar Publishing, 2020).
50. Oremus, K. L. *et al.* Governance challenges for tropical nations losing fish species due to climate change. *Nature Sustainability* 1–4 (2020).
51. Cinner, J. E. *et al.* Building adaptive capacity to climate change in tropical coastal communities. *Nat. Clim. Chang.* **8**, 117–123 (2018).
52. Turner, R., McConney, P. & Monnereau, I. Climate Change Adaptation and Extreme Weather in the Small-Scale Fisheries of Dominica. *Coast. Manage.* **48**, 436–455 (2020).
53. Bennett, N. J. *et al.* The COVID-19 Pandemic, Small-Scale Fisheries and Coastal Fishing Communities. *Coast. Manage.* 1–11 (2020).
54. Campbell, S. J. *et al.* Immediate impact of COVID-19 across tropical small-scale fishing communities. *Ocean Coast. Manag.* **200**, 105485 (2021).
55. Béné, C., Lawton, R. & Allison, E. H. “Trade Matters in the Fight Against Poverty”: Narratives, Perceptions, and (Lack of) Evidence in the Case of Fish Trade in Africa. *World Dev.* **38**, 933–954 (2010).
56. Song, A. M. *et al.* Collateral damage? Small-scale fisheries in the global fight against IUU fishing. *Fish Fish* **21**, 831–843 (2020).

57. Monnier, L. *et al.* *Small-scale fisheries in a warming world: Exploring adaptation to climate change.* (2020).
58. Farmery, A. K. *et al.* Blind spots in visions of a “blue economy” could undermine the ocean’s contribution to eliminating hunger and malnutrition. *One Earth* **4**, 28–38 (2021).
59. Short, R. E. *et al.* Harnessing diversity of small-scale actors key to aquatic food futures. *Nature Food* (in review).
60. Cohen, P. *et al.* Securing a Just Space for Small-Scale Fisheries in the Blue Economy. *Frontiers in Marine Science* **6**, 171 (2019).
61. Pauly, D. & Zeller, D. Catch reconstructions reveal that global marine fisheries catches are higher than reported and declining. *Nat. Commun.* **7**, 10244 (2016).
62. Gelcich, S., Reyes-Mendy, F., Arriagada, R. & Castillo, B. Assessing the implementation of marine ecosystem based management into national policies: Insights from agenda setting and policy responses. *Mar. Policy* **92**, 40–47 (2018).
63. Johnson, D. S. Category, narrative, and value in the governance of small-scale fisheries. *Mar. Policy* **30**, 747–756 (2006).
64. Cole, S. M. *et al.* Gender accommodative versus transformative approaches: a comparative assessment within a post-harvest fish loss reduction intervention. *Gend. Technol. Dev.* **24**, 48–65 (2020).

Food Systems Summit Briefs are prepared by researchers of Partners of the Scientific Group for the United Nations Food Systems Summit. They are made available under the responsibility of the authors. The views presented may not be attributed to the Scientific Group or to the partner organisations with which the authors are affiliated.

This policy brief was prepared by researchers who are part of the Blue Food Assessment (BFA; <https://www.bluefood.earth/>), which provides a comprehensive examination of the role of aquatic foods in building healthy, sustainable, and equitable food systems. The key messages and policy recommendations in this brief were derived from several papers that are part of the BFA as well as related materials. A complete list of BFA paper abstracts can be found at <https://tinyurl.com/bfa-abstracts>.

The contributors are:

Blue foods in food system decision making

Jim Leape¹, Abigail Bennett², Beatrice Crona³, Fabrice DeClerck⁴, Jessica Fanzo⁵, Jessica A. Gephart⁶, Avinash Kishore⁷, Rosamond L. Naylor⁸, Elizabeth R. Selig¹, U. Rashid Sumaila^{9,10}, Max Troell³

Blue foods to combat malnutrition

Michelle Tigchelaar¹, Christopher D. Golden¹¹, Christina C. Hicks¹², J. Zachary Koehn¹, Shakuntala H. Thilsted¹³, Colette C.C. Wabnitz^{1,9}

Supporting small-scale actors in blue food value chains

Fiorenza Micheli^{1,14}, Edward H. Allison¹³, Xavier Basurto¹⁵, Simon R. Bush¹⁶, Ling Cao¹⁷, Christina C. Hicks¹², Stefan Gelcich¹⁸, David C. Little¹⁹, Rebecca E. Short³

¹ Center for Ocean Solutions, Stanford University

² Dept. of Fisheries and Wildlife, Michigan State University

³ Stockholm Resilience Centre

⁴ EAT Forum and One CGIAR

⁵ Berman Institute of Bioethics, Johns Hopkins University

⁶ Dept. of Environmental Science, American University

⁷ International Food Policy Research Institute

⁸ Center on Food Security and the Environment, Stanford University

⁹ Institute for the Oceans and Fisheries, University of British Columbia

¹⁰ School of Public Policy and Global Affairs, University of British Columbia

¹¹ Department of Nutrition, Harvard T.H. Chan School of Public Health

¹² Lancaster Environment Centre, Lancaster University

¹³ WorldFish, CGIAR

¹⁴ Hopkins Marine Station, Stanford University

¹⁵ Nicholas School of the Environment, Duke University


¹⁶ Environmental Policy Group, Wageningen University

¹⁷ School of Oceanography, Shanghai Jiao Tong University

¹⁸ Instituto Milenio en Socio-ecología Costera & Center of Applied Ecology and Sustainability, Pontificia Universidad Católica de Chile

¹⁹ Institute of Aquaculture, University of Stirling

For further information about the Scientific Group, visit <https://sc-fss2021.org> or contact info@sc-fss2021.org

 [@sc_fss2021](https://twitter.com/sc_fss2021)