T20 INDONESIA 2022 THINK

Policy Brief

INTEGRATING BLUE FOODS INTO FOOD SYSTEM POLICY AND PRACTICE

Task Force 4
Food Security and Sustainable Agriculture

Michelle Tigchelaar (Stanford University)
Maria Honig (WWF)
Gridanya Mega Laidha (Indonesia Ocean Justice Initiative)
Fadilla Octaviani (Indonesia Ocean Justice Initiative)
Adityo Setiawan (EDF)
Jessica Landman (Council Fire)
Tom Grasso (EDF)
Karly Kelso (EDF)
Shakuntala H. Thilsted (WorldFish)
Jim Leape (Stanford University)
Ghislaine Llewellyn (WWF)

Abstract

Blue foods – fish, shellfish, algae and plants cultivated and captured in freshwater and marine environments – are highly diverse, are rich in protein, essential micronutrients and fatty acids, and can offer sustainable alternatives to many terrestrial animal-source foods. Two-thirds of blue foods destined for human consumption are produced by small-scale fisheries and aquaculture. Thoughtful investments and policies that foster a thriving, regenerative blue food sector could help solve some of the most pressing challenges facing the world today. This brief recommends that the G20: (i) Manage blue foods as an integral part of food systems; (ii) Identify and reform policies and practices that impede transformation; (iii) Protect and harness diversity for nutrition, accessibility and environmental sustainability; (iv) Recognize and support the central role of small-scale actors; and (v) Commit to human rights in policy and practice. It provides on-the-ground examples from blue food systems in Indonesia to highlight best practices and success stories.

.

Challenges

Food systems are at the intersection of concurrent crises of widespread malnutrition, global environmental change, and growing inequality. Blue foods have much to offer in addressing these crises: As diverse, sustainable and affordable sources of essential nutrients, blue foods can help reduce nutrient deficiencies and the incidence of non-communicable diseases, can lower the environmental footprint of nutritious diets and can reduce pressures on over-taxed terrestrial systems (Crona et al., in review; Gephart et al., 2021; Golden et al., 2021; Tigchelaar et al., 2022). Yet despite their unique value and interconnections with terrestrial food systems, blue foods are often left out of food system analyses, discussions, policies, and investments (Bennett et al., 2021; Koehn et al., 2021). In addition, ministries or agencies dedicated to capture (wild) fisheries and aquaculture tend to manage them as a natural resource, with a focus on economic interests or rents. While there are examples of instances where economic rents contribute to social goals (such as the Pacific Vessel Day Scheme Program), agencies are generally not well equipped to consider their potential to contribute to food and nutrition security, public health, livelihoods and communities, and to cultural traditions and diets (P. Cohen et al., 2019; Hicks et al., in review; Österblom et al., 2020). This siloing of fisheries and aquaculture management, and focus solely on revenue generation, causes policy makers to make poor trade-offs between sustainable development outcomes, such as overexploitation of fisheries by distant water fleets, underdevelopment of farming of nutrient-rich fish species, and loss of access to key aquatic resources and other tenurial rights for small-scale fishers and fish farmers. Policies and actions to promote blue foods will thus require a food systems approach that examines nutrition and health, justice, economic and environmental outcomes and trade-offs across land, freshwater and sea (Crona et al., in review).

To capitalize on the potential of blue foods, decision-makers must address significant challenges and simply increasing the production of blue foods is not the solution. Wild capture fisheries, both marine and freshwater, need to be better valued, managed, and rebuilt (Hilborn et al., 2020; Melnychuk et al., 2021; World Bank, 2017), as many fish stocks have become severely depleted due to overfishing and Illegal, Unreported, and Unregulated (IUU) fishing. In addition, some fishing methods have significant impacts on sensitive habitats or biodiversity and need to be modified.

Although aquaculture is becoming increasingly sustainable, improvements in inland, coastal and offshore aquaculture are still needed: the use of wild-caught species as feed, siting issues associated with aquaculture facilities, deforestation for aquaculture feed crops, concentration

of nutrient and chemical pollution, disease spread and high dependence on antibiotics – all require attention (Naylor, Hardy, et al., 2021).

Environmental stressors limit blue food production and climate change will increasingly affect the health and productivity of fisheries and aquaculture, with implications for food security, livelihoods and economies worldwide (Barange et al., 2019; Cao et al., in review; IPCC, 2019; Tigchelaar et al., 2021). Furthermore, climate change impacts such as increased extreme heat and cold, stormy weather and rough seas will exacerbate the already significant occupational dangers of work in fisheries and aquaculture (Cavalli et al., 2020; Doza et al., 2021; Heck et al., 2021). Various kinds of pollution, from agricultural nutrient runoff to urban runoff to plastics, further threaten the productivity and the safety of foods harvested from polluted waters.

The benefits of blue foods are distributed unevenly. Wealth generation from aquatic harvests and spatial uses often comes at the expense of contributions to local nutrition and health, livelihoods, and culture (Hicks et al., in review). The aquatic resource management systems, knowledge, and rights of Indigenous Peoples and traditional small-scale actors in fisheries and aquaculture have often been undermined, marginalized or overlooked in fisheries policy and decision-making, water management, and ocean planning and governance (Bennett et al., 2021; Cohen et al., 2019; Farmery et al., 2021). Aside from the uneven distribution of benefits of government infrastructure, facilities and assistance, small-scale fishers also disproportionately bear the risk of market instability (Short et al., 2021), most acutely evident during the COVID-19 pandemic (Bennett et al., 2020; Love et al., 2021).

Although men and women participate in blue food value chains in roughly equal numbers, their roles, influence over value chains, benefits, and recognition can be highly unequal (Wabnitz et al., 2021). Progress toward gender equality is critical for development of more equitable and efficient blue food systems. Global supply chains are complex and often opaque, making it difficult or impossible for buyers to ascertain environmental impacts and human rights abuses in production (Selig et al., 2022). Blue food supply chains need to be socially responsible and adhere to the principles of inclusive development to ensure the protection of human rights.

ABOUT BLUE FOODS

The blue food portfolio is immensely diverse. More than 2,500 animal species or species groups are caught and harvested in freshwater and marine ecosystems (Golden et al., 2021) – about 96 million tons in wild-capture fisheries and 82 million tons in aquaculture (FAO, 2020b) – with half of the catch contributed by small-scale fishers (FAO, 2020b). In contrast, of the animal-source protein produced on land, beef, pork and poultry together make up 93% (*FAO's Animal Production and Health Division: Meat & Meat Products*, n.d.). Estimated blue food species diversity would be even greater if the many nutritious aquatic plants and algae were included. Blue food production systems and practices are similarly diverse, ranging from large-scale trawlers on the high-seas to small-scale fishponds integrated within agricultural systems (Fig. 1) (Short et al., 2021).

Blue and green food systems are deeply interconnected – in diets, in supply chains, and in the environment (Cottrell et al., 2018). For example, capture fisheries provide feed inputs for aquaculture and livestock; terrestrial crops provide feed inputs for aquaculture. Excess nutrients from agriculture and aquaculture can pollute rivers and cause coastal dead zones, undermining fisheries and ecosystems. Blue foods are globally the most traded food products – for developing countries, net revenues from trade of blue foods exceed those of all agricultural commodities combined (FAO, 2020a).

Many blue foods contain high concentrations of bioavailable minerals and vitamins, essential fatty acids (in particular EPA and DHA), and animal protein (Thilsted et al., 2016) – globally, humans derive roughly 8% of zinc and iron, 13% of protein, and 27% of vitamin B12 from blue foods (Golden et al., 2021). In some countries, the contribution of blue foods to consumption of these nutrients is much higher: in the Maldives for example, more than a third of *all* protein (plant and animal) derives from blue foods. Amongst the diversity of blue foods, nutrient content varies substantially (Fig. 2). A serving of small pelagic fish, for example, yields approximately eight times more iron, five times more omega-3 fatty acids and four times more vitamin B-12 than a serving of tilapia (Golden et al., 2021; Thilsted et al., 2016).

The right blue foods can make key contributions to diet-related health challenges. They can reduce micronutrient deficiencies that have particularly serious consequences for children, pregnant women and women of childbearing age (Bogard et al., 2015; Starling et al., 2015). It is estimated that an 8% increase in the sustainable production of species consumed today would prevent 166 million micronutrient deficiencies by 2030 (Golden et al., 2021). The omega-3 fatty acids blue foods contain can also support heart, brain and eye health in people of all ages. By

replacing overconsumption of less healthy red and processed meats – or averting the transition to diets that contain large quantities of such foods – blue foods can also help reduce the incidence of non-communicable diseases, such as heart disease and cancer.

Blue foods can generally be produced with lower climate footprints than terrestrial animal-source foods, but within the diversity of blue foods large differences exist (Gephart et al., 2021). Greenhouse gas emissions in wild-capture fisheries derive mostly from fuel use, while in fed aquaculture they result primarily from feeds. Across blue food systems, locally caught, locally consumed, low trophic species (such as small pelagic fish) or non-fed aquaculture (such as seaweed and bivalves) have the lowest footprint. Flatfish and crustacean fisheries produce the highest footprints. Large opportunities exist to improve performance further. The use of low-fuel gear, for example, can reduce greenhouse gas emissions in some fisheries by 61 percent, while reducing feed usage and switching to deforestation-free inputs can reduce emissions from aquaculture by half.

Within fisheries and aquaculture, both industrial and small-scale actors play important roles. With relatively low production costs and efficient supply chains, industrial systems have helped increase the availability and affordability of blue foods globally, and in many countries they are an important source of revenue and supply. Small-scale actors in both fisheries (inland and coastal) and aquaculture typically receive less attention, even though they account for nearly 90% of jobs in the sector (FAO, 2020b). They produce more than two-thirds of the blue food destined for human consumption (FAO, 2020b) and account for most of the diversity in blue foods (Hicks et al., 2019), as industrial operations tend to focus on a few commercial species. This diversity underpins healthy diets in many coastal, rural and Indigenous communities (Hicks et al., 2019), and resilience in the face of shocks, climate and market changes (Béné, 2020; Ferguson et al., 2022; Hertel et al., 2021; Stoll et al., 2021). Small-scale actors contribute to intra-regional trade, especially in smoked and dried products, which can have more direct impacts on food and nutrition security and poverty alleviation than the globalized system (Béné et al., 2010). Small-scale actors are a diverse group, varying widely in assets and capacities, the degree of specialization or diversification, the markets they serve and the challenges they face (Short et al., 2021). This diversity is often poorly reflected in policies and data about the sector.

TRANSFORMING BLUE FOOD SYSTEMS

There is every reason to expect that total demand for blue foods will grow substantially in the years ahead – nearly doubling by 2050 as population and incomes increase (Naylor, Kishore, et al., 2021) – with growth in supply primarily expected to come from aquaculture (FAO, 2020b). If produced responsibly, blue foods can have important roles to play in ending malnutrition and in

building healthy, nature-positive and resilient food systems – contributing to progress on nine of the 17 Sustainable Development Goals (Fig. 3). Realizing that potential, however, will require that governments are thoughtful about how to develop those roles. Even though the diversity of blue food species and systems offers opportunities for health, sustainability and resilience, not all blue foods will inherently contribute to these outcomes and many challenges around social and environmental impacts, as well as resource management, remain to be addressed (see "Challenge"). Here, we focus on five elements critical to a blue food transformation:

1. Manage blue foods as an integral part of food systems

The governance of fisheries and aquaculture is often separate from the governance of agriculture and food policy, and that needs to change. Blue foods have remained absent from many contemporary food system discussions and policies on both health and sustainability. Similarly, ocean policy often neglects blue food contributions to human nutrition and benefits to communities producing them. Addressing food system challenges that span land and sea, and/or encompass production, processing, trade and consumption, will only be feasible through systemic food policy that 'mainstreams' blue foods across relevant government policy arenas, identifies co-benefits, and navigates trade-offs. To do so, governments could:

- Evaluate the current and potential nutritional value of local blue food systems in planning for domestic livelihoods and food and nutrition security, and re-assess export strategies and leases accordingly
- Incorporate investments in blue food systems into national climate strategies, by making sustainable, nature-positive blue foods (such as bivalves, seaweeds and other blue carbon production methods) a key part of Nationally Determined Contributions, and by including blue food ecosystems, infrastructure, workers, and assets in National Adaptation Plans
- Factor in improvements to blue food production potential when calculating the costs of reducing aquatic pollution, such as run-off of fertilizer, heavy metals, pesticides, plastics, sewage and antibiotics from industry, cities and farms; conversely, protect fishers and fish farmers from impacts on fisheries and aquaculture when developing marine spatial plans to safeguard livelihoods and food security
- Leverage bilateral aid programs, memberships and participation in institutional official development assistance (ODA) programs and ongoing collaborations for a heightened focus on the role of blue foods in investments.

2. Identify and reform policies and practices that impede transformation

Many features of food systems make transformation difficult or impossible. Subsidies and other incentive programs can drive practices that are unsustainable and would otherwise be unprofitable. One study estimates that over half the fishing on the high seas is profitable only

because of subsidies. Decision-makers need to shift public funding to support all actors – large and small, aquatic and terrestrial – producing public goods and implement practices that safeguard vulnerable fisheries, mitigate climate change or improve water and environmental quality. To remove obstacles to more healthy, sustainable and just food system outcomes, governments could:

- Continue to push for reforms in WTO subsidy negotiations – building on progress at the recently concluded Twelfth Ministerial Conference – to promote beneficial impacts on (1) CO_2 emissions, (2) destructive fishing practices, (3) forced labor practices, and (4) the sustainability of wild-caught fisheries, while enabling fishery management resources to be redirected to better management of coastal fisheries
- Regulate the use of environmentally-destructive fishing gears and production methods, such as bottom trawling, and support a transition to sustainable fishing methods.
- Control overfishing and eliminate illegal, unreported, and unregulated (IUU) fishing by robustly managing domestic fisheries, regulating distant water fleets and instituting effective port controls, utilizing available bilateral, regional, and global cooperation as reinforcements in the fight against transnational organized fisheries crime (see Indonesia Box). For example, in the context of the ongoing negotiations of the Voluntary Guidelines for Transshipment, aim for the most effective possible controls on transshipment at sea and in port, to protect against illegal products entering the supply chain and to curb labor abuses and risks to crew safety

3. Protect and harness diversity for nutrition, resilience, livelihoods, and environmental sustainability

The future of food systems lies in moving away from homogenization and toward diversity. As climate change and other human pressures on the Earth increase uncertainty about the future, diversity can help local food systems withstand shocks such as climate extremes and pandemics that disrupt markets. The extraordinary diversity of aquatic species along with the diversity of blue food production systems and uses, offers many options for building food systems that are healthy, sustainable and just. To promote and capitalize on this diversity, governments could:

- Support the collection and curation of data on blue food production, consumption, and loss and waste with granularity beyond the typical single category of 'fish' and representing the full diversity of blue food actors, including gender-disaggregated data
- Transform demand by including a diversity of blue foods in dietary guidelines and school food programs, safety net programs and broader procurement to help shape preferences and build markets for healthier, locally produced, more sustainable options

- Streamline regulation, mobilize inclusive financing, and support R&D for blue food species and production systems that are both nutrient-dense and have low environmental footprints
- Establish food handling and phytosanitary policies that encourage making effective use of all species and avoid wasting of fish and fish processing byproducts; adopt mechanisms that incentivize use of non-commercial species (sometimes stigmatized as 'trash fish') for their nutritional potential
- Invest in climate resilience using strategies like multi-species fishery co-management which can be deployed for varied climates and both industrial and small-scale fisheries

4. Recognize and support the central role of small-scale actors

Small-scale actors in fisheries (inland and coastal) and aquaculture (SSFA) produce, process and sell most of the blue food destined for human consumption. They provide livelihoods for hundreds of millions of people and offer vital sources of nutrition locally and regionally. However, environmental degradation and change, poor political representation, and competition with more powerful sectors are threatening SSFA. Governments and policies predominantly focus on industrialized, large-scale fisheries and aquaculture and struggle with the diversity and perceived informality of small-scale actors and their associated cultures. The unanimous adoption in 2014 of the Voluntary Guidelines for Securing Sustainable Small-scale Fisheries in the Context of Food Security and Poverty Eradication by the FAO Committee on Fisheries signaled that policy-makers understand that thriving, sustainable SSFA are central to building dynamic, resilient, and equitable blue food systems. To further empower and support SSFA, governments could:

- Recognize and empower SSFA actors, including women, Indigenous communities and other marginalized groups, to be represented and actively involved in public participation fora, decision-making processes, policy development and co-management of blue food resources
- Allocate and enforce land and water rights to SSFA – through user rights-based systems, creation of preferential access areas, coastal and inland land use zoning, or other measures – including recognition of the rights of women and the sovereign rights of Indigenous Peoples. Examples of inclusive coastal development include the Locally Managed Marine Area Network (https://lmmanetwork.org/), which offers community-led, community-designed natural resource management that delivers the dual goals of biodiversity conservation and sustainable blue food production.
- Include fishers, fish workers and fish farmers in social safety net unemployment and health insurance programs (which often fail to consider fishers who do not have an 'employer' since they work on the water or for themselves), taking into account the need for publicly available, transparent, and accessible information

- Invest in the capabilities of SSFA, including (a) environmental stewardship and climate adaptation, (b) access to financial capital and services and insurance, (c) infrastructure (incl. safe and commercially successful processing), (d) timely and accurate access to market information, and (e) effective co-management

5. Commit to human rights in policy and practice

Increasingly unequal distributions of economic and livelihood benefits leave more than 3 billion people unable to afford a healthy diet and nearly 690 million hungry. Despite the potential for blue food systems to provide economic and nutritional benefits, the distribution of benefits in the sector is highly uneven. While blue foods support the welfare (e.g., through jobs and nutrient rich blue food) of millions of people, the wealth-generating benefits (e.g., export revenues) of blue foods flow predominantly to industrial-scale firms that control global supply chains. Social and political barriers that contribute to injustice are often inadequately recognized in (blue) food policies. To steer blue food systems toward more just access to affordable and nutritious blue foods, governments could:

- Embed principles of justice, equitable participation and the right to food in trade policies and agreements to prioritize access to the economic and nutritional benefits of blue foods by communities that need them most
- Advance gender equality by ensuring women in blue food systems are represented and included in key global policies and initiatives, such as the Committee on World Food Security's Voluntary Guidelines on Gender Equality and Women's and Girls' Empowerment in the Context of Food Security and Nutrition, and explicitly targeted in Official Development Assistance
- Act to rapidly and fulsomely implement the Port State Measures Agreement, the International Labor Organization's Work in Fishing Convention 188, and the IMO Cape Town Agreement to protect the rights of fishers, end forced labor, ensure safety at sea and ensure that they are able to return promptly and safely to port and receive promised wages
- Establish transparency and traceability standards in supply chains through initiatives such as Global Fishing Watch, thereby promoting (a) sustainability of fish stocks for long term food security, (b) legal fishing for a level playing field, and (c) better accountability for fisherfolk

CASE STUDY: BLUE FOOD SOLUTIONS IN THE INDONESIAN FISHERIES SECTOR

2 million people work in the Indonesian capture fisheries sector, 90% of whom are small-scale fishers or coastal communities that depend directly on this sector. Indonesia's fish stocks are currently estimated at 12.01 million tons, with a Total Allowable Catch of 8.6 million tons (Indonesia MMAF, 2022). The export value of Indonesian fishery products reached USD 4.56 billion (Indonesia MMAF, 2021) and Non-Tax State Revenue of up to USD 64.04 million (Indonesia MMAF, 2021), with the main commodities produced by capture fisheries including Tuna, Mackerel, and Skipjack, and Shrimp and Seaweed for aquaculture (BPS, 2022).

Despite Indonesia's substantial fisheries resources, 11.34% of small-scale fishers still live below the poverty line (BPS, 2022), and are often marginalized. Main challenges faced by small-scale fishers include access to benefits, markets and capital, market instability, tenure conflicts, and genuine participation in decision-making processes. Here we present three examples of blue food policy successes that have improved economic, social and sustainability outcomes for SSFA communities in Indonesia.

ACCESS TO CAPITAL IN BULUTUI, CENTRAL MALUKU

The Indonesian government provides access to capital within SSFA communities through Peoples' Business Credit or *Kredit Usaha Rakyat* ('KUR') scheme as alternative capital with low interest rates (3-9%). Bulutui village is one of the areas where the SSFA community has successfully used this scheme to develop their productive business activities, namely for fishing gear and shipbuilding. They were given guidance, socialization, and assistance directly from the bank and government officers.

KUR schemes can remove the role of middlemen who use debt bondage as a way to exploit SSFAs. Moreover, under this scheme, debts under 50 million rupiah do not require any collateral, making it even easier for fishers to access funding.

COMBATING IUU FISHING AND ITS IMPACT TO SMALL-SCALE FISHERS

Considering its transnational nature, international cooperation is pivotal to combating IUU fishing. With the support of INTERPOL Global Fisheries Enforcement, Indonesia spearheaded the unraveling of transnational networks of fisheries crime in some notorious cases such as FV Viking, STS-50, Silver Sea 2, Fu Yuan Yu 831, and MV Nika. The efforts were carried out through Multinational Investigative Support Team **(MIST)** and Regional Investigative Case Meeting **(RIACM)** where associated countries and multilateral agencies provided technical

assistance, and intelligence information and analysis, and transnational enforcement support (Witbooi et al., 2020).

Combating IUU fishing in Indonesia has increased purchasing power and overall welfare for SSFAs. It gives the chance for fish resources to recover, thus enabling fishers to get more and bigger catches, while also ensuring SSFAs access to the fishery resources (Cabral et al., 2018).

EMPOWERING WOMEN IN BLUE SWIMMING CRAB (BSC) FISHERIES MANAGEMENT

BSC is Indonesia's third most lucrative seafood export, producing over $300 million USD annually (Fish Quarantine and Inspection Agency, 2021) involving 90,000 fishers and 185,000 seafood supply chain workers around Indonesia (APRI, 2019). The Lampung provincial government with partners has assisted small-scale fishers, supply chain workers, and women to set up institutions and develop systems to implement BSC sustainable fishery management, including: (1) defined management areas that give preferential access to local fishers, (2) juvenile crab protected areas, (3) multi-stakeholder co-management institutions; and (4) empowering fishers, women, and supply chain groups in co-management institutions to take on more roles and responsibilities

To increase women's roles in BSC management, improve households' livelihoods, and minimize the environmental impacts from crab processing, they are encouraged to create nutritious value-added products made from the BSC waste such as crab tempe chips, crab sticks, and crab crackers. The initiative has gained support from the provincial government and two women's groups are now actively involved and contribute to the BSC fisheries management.

Fig. 1 – Blue food production systems. From BFA report.

Figure 1: Nutrient diversity of aquatic animal-source foods in relation to terrestrial animal-source foods. Aquatic (blue) and terrestrial (green) food richness assessed as a ratio of concentrations of each nutrient per 100 grams to the daily recommended nutrient intake. Each shaded box represents the median value of each nutrient in a muscle tissue across all species within each taxonomic group. Food groups were ordered vertically by their mean nutrient richness with higher values meeting a higher percentage of the daily recommend intake. (Gloden et al. 2021)

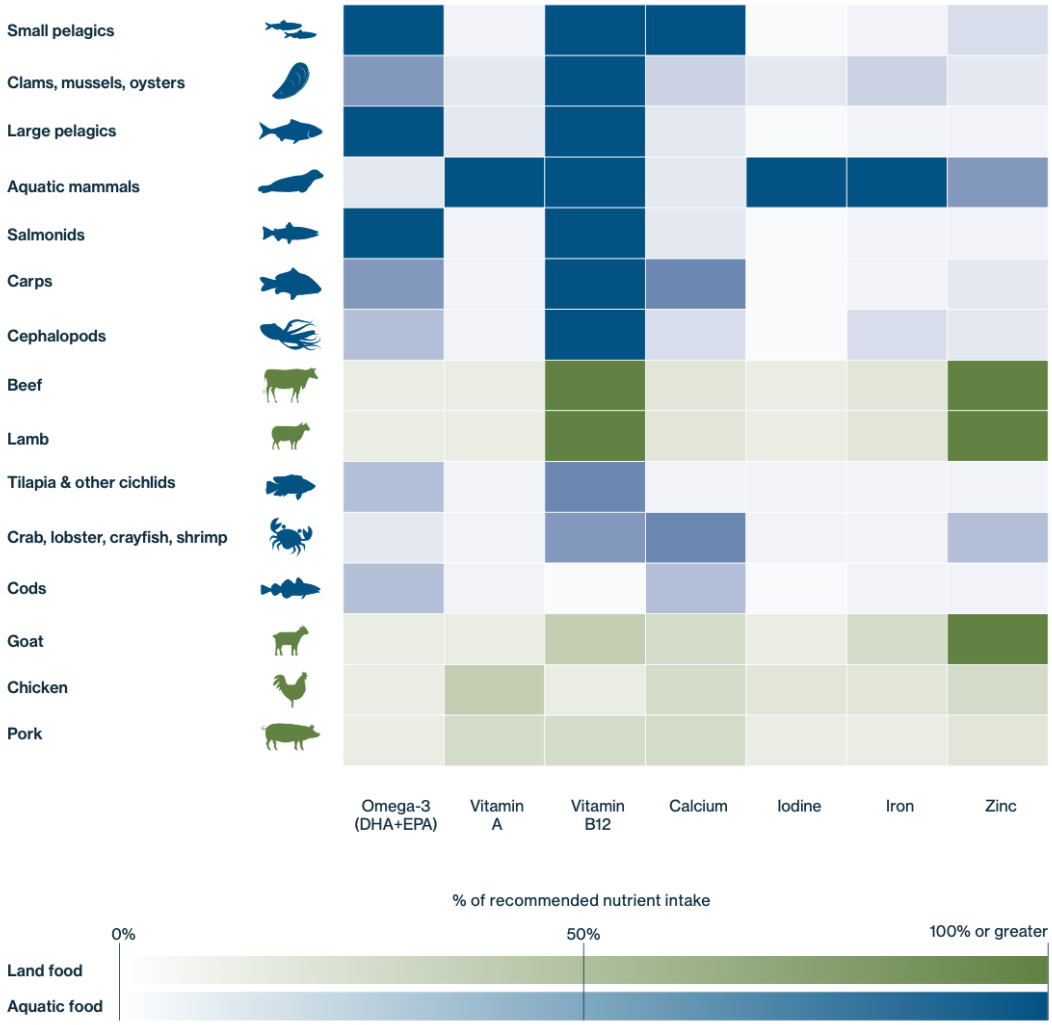

Fig. 2 – Nutrient diversity of aquatic animal-source foods in relation to terrestrial animal-source foods. Aquatic (blue) and terrestrial (green) food richness as assessed as a ratio of concentrations of each nutrient per 100 grams to the daily recommended nutrient intake. Each shaded box represents the median value of each nutrient in a muscle tissue across all species within each taxonomic group. Food groups were ordered vertically by their mean nutrient richness with higher values meeting a higher percentage of the daily recommended nutrient intake. Adapted from Golden et al. (2021).

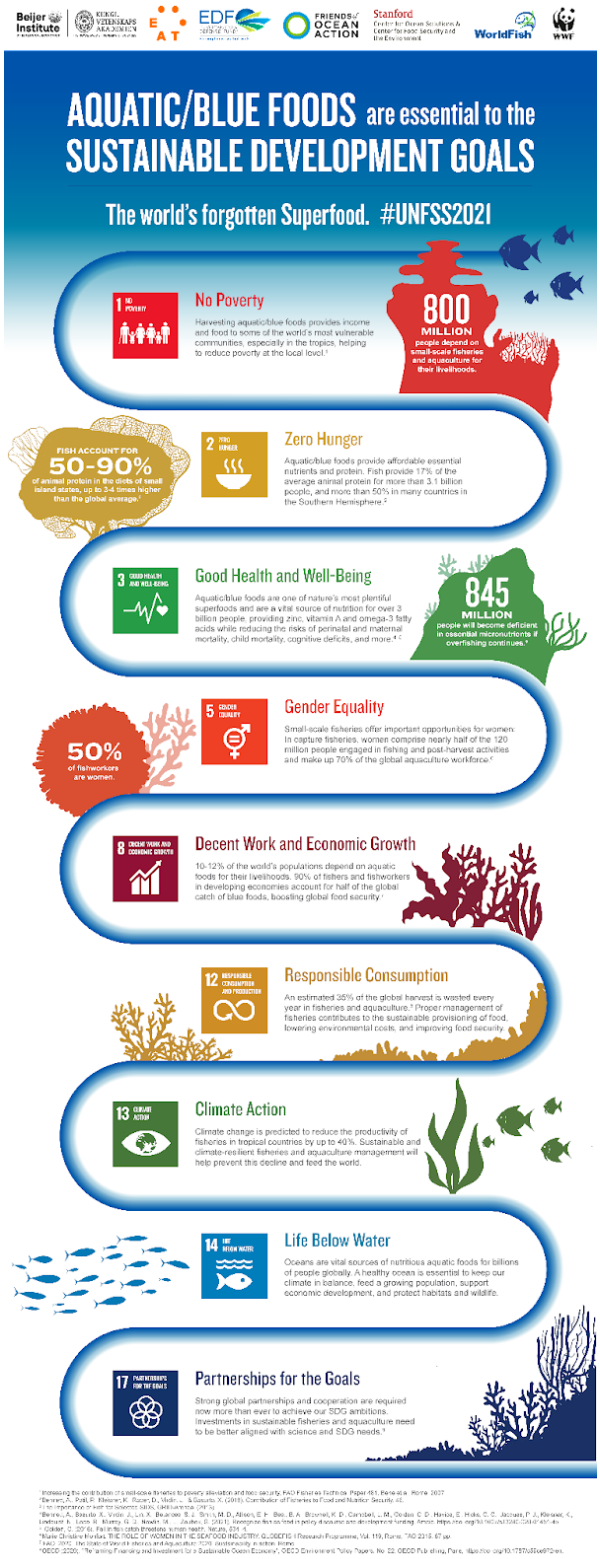

Fig. 3 – If produced responsibly, blue foods can have important roles to play in ending malnutrition and in building healthy, nature-positive and resilient food systems – contributing to progress on nine of the 17 Sustainable Development Goals.

References

APRI. (2019). *Indonesian Blue Swimming Crab Fishery Improvement Project*. APRI. https://www.apri.or.id/fip/

Barange, M., Bahri, T., Beveridge, M. C. M., Cochrane, K. L., Funge-Smith, S., & Poulain, F. (Eds.). (2019). *Impacts of climate change on fisheries and aquaculture: Synthesis of current knowledge, adaptation and mitigation options* (Vol. 627). FAO.

Béné, C. (2020). 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 Security*, 1–18.

Béné, C., Lawton, R., & Allison, E. H. (2010). "Trade Matters in the Fight Against Poverty": Narratives, Perceptions, and (Lack of) Evidence in the Case of Fish Trade in Africa. *World Development*, *38*(7), 933–954.

Bennett, A., Basurto, X., Virdin, J., Lin, X., Betances, S. J., Smith, M. D., Allison, E. H., Best, B. A., Brownell, K. D., Campbell, L. M., Golden, C. D., Havice, E., Hicks, C. C., Jacques, P. J., Kleisner, K., Lindquist, N., Lobo, R., Murray, G. D., Nowlin, M., … Zoubek, S. (2021). Recognize fish as food in policy discourse and development funding. *Ambio*. https://doi.org/10.1007/s13280-020-01451-4

Bennett, N. J., Finkbeiner, E. M., Ban, N. C., Belhabib, D., Jupiter, S. D., Kittinger, J. N., Mangubhai, S., Scholtens, J., Gill, D., & Christie, P. (2020). The COVID-19 Pandemic, Small-Scale Fisheries and Coastal Fishing Communities. *Coastal Management: An International Journal of Marine Environment, Resources, Law, and Society*, 1–11.

Bogard, J. R., Hother, A.-L., Saha, M., Bose, S., Kabir, H., Marks, G. C., & Thilsted, S. H. (2015). Inclusion of Small Indigenous Fish Improves Nutritional Quality During the First 1000 Days. *Food and Nutrition Bulletin*, *36*(3), 276–289.

BPS. (2022). *Central Bureau of Statistics Indonesia* [Data set]. https://www.bps.go.id/

Cabral, R. B., Mayorga, J., Clemence, M., Lynham, J., Koeshendrajana, S., Muawanah, U., Nugroho, D., Anna, Z., Mira, Ghofar, A., Zulbainarni, N., Gaines, S. D., & Costello, C. (2018). Rapid and lasting gains from solving illegal fishing. *Nature Ecology & Evolution*, *2*(4), 650–658.

Cao, L., Halpern, B. S., Troell, M., Short, R. E., Zeng, C., Jiang, Z., Liu, Y., Zou, C., Liu, S., Liu, C., Liu, X., Cheung, W. W. L., Cottrell, R., DeClerck, F., Gelcich, S., Gephart, J., Godo-Solo, D., Kaull, J., Micheli, F., … Tigchelaar, M. (in review). Vulnerability of blue foods to human-induced environmental change. *Nature Sustainability*.

Cavalli, L. S., Marques, F. B., & Watterson, A. (2020). A critical overview of work-related injury and illness in aquaculture workers from Brazil. *Reviews in Aquaculture*, *12*(2), 1157–1164.

Cohen, P. J., Allison, E. H., Andrew, N. L., Cinner, J., Evans, L. S., Fabinyi, M., Garces, L. R., Hall, S. J., Hicks, C. C., Hughes, T. P., Jentoft, S., Mills, D. J., Masu, R., Mbaru, E. K., & Ratner, B. D.

(2019). Securing a just space for small-scale fisheries in the blue economy. *Frontiers in Marine Science*, *6*, 171.

Cottrell, R. S., Fleming, A., Fulton, E. A., Nash, K. L., Watson, R. A., & Blanchard, J. L. (2018). Considering land-sea interactions and trade-offs for food and biodiversity. *Global Change Biology*, *24*(2), 580–596.

Crona, B., Jonell, M., Koehn, J. Z., Short, R. E., Tigchelaar, M., Daw, T., Wassénius, E., Golden, C. D., Gephart, J. A., Allison, E. H., Bush, S. R., Cao, L., Cheung, W. W. L., DeClerck, F., Fanzo, J., Gelcich, S., Kishore, A., Halpern, B. S., Hicks, C. C., … Wabnitz, C. C. C. (in review). Blue food policy objectives: An analysis of opportunities and trade-offs. *Nature*.

Doza, S., Bovbjerg, V. E., Vaughan, A., Nahorniak, J. S., Case, S., & Kincl, L. D. (2021). Health-Related Exposures and Conditions among US Fishermen. *Journal of Agromedicine*, 1–8.

FAO. (2020a). *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*. https://doi.org/10.4060/cb1213t

FAO. (2020b). *The State of World Fisheries and Aquaculture 2020. Sustainability in Action*. https://doi.org/10.4060/ca9229en

FAO's Animal Production and Health Division: Meat & Meat Products. (n.d.). Retrieved April 19, 2022, from https://www.fao.org/ag/againfo/themes/en/meat/backgr_sources.html

Farmery, A. K., Allison, E. H., Andrew, N. L., Troell, M., Voyer, M., Campbell, B., Eriksson, H., Fabinyi, M., Song, A. M., & Steenbergen, D. (2021). Blind spots in visions of a "blue economy" could undermine the ocean's contribution to eliminating hunger and malnutrition. *One Earth*, *4*(1), 28–38.

Ferguson, C. E., Tuxson, T., Mangubhai, S., Jupiter, S., Govan, H., Bonito, V., Alefaio, S., Anjiga, M., Booth, J., Boslogo, T., Boso, D., Brenier, A., Caginitoba, A., Ciriyawa, A., Fahai'ono, J. B., Fox, M., George, A., Eriksson, H., Hughes, A., … Waide, M. (2022). Local practices and production confer resilience to rural Pacific food systems during the COVID-19 pandemic. *Marine Policy*, *137*, 104954.

Fish Quarantine and Inspection Agency. (2021). *Indonesia Seafood Export Statistic*. BKIPM. http://bkipm.kkp.go.id/bkipmnew/?r=stats/#_ops_volume/E,I,M,K,T/Kg/d/6/2022/1/kd_upt

Gephart, J. A., Henriksson, P. J. G., Parker, R. W. R., Shepon, A., Gorospe, K. D., Bergman, K., Eshel, G., Golden, C. D., Halpern, B. S., Hornborg, S., Jonell, M., Metian, M., Mifflin, K., Newton, R., Tyedmers, P., Zhang, W., Ziegler, F., & Troell, M. (2021). Environmental performance of blue foods. *Nature*, *597*(7876), 360–365.

Golden, C. D., Koehn, J. Z., Shepon, A., Passarelli, S., Free, C. M., Viana, D. F., Matthey, H., Eurich, J. G., Gephart, J. A., Fluet-Chouinard, E., Nyboer, E. A., Lynch, A. J., Kjellevold, M., Bromage,

S., Charlebois, P., Barange, M., Vannuccini, S., Cao, L., Kleisner, K. M., … Thilsted, S. H. (2021). Aquatic foods to nourish nations. *Nature*. https://doi.org/10.1038/s41586-021-03917-1

Heck, N., Beck, M. W., & Reguero, B. (2021). Storm risk and marine fisheries: a global assessment. *Marine Policy*, *132*, 104698.

Hertel, T., Elouafi, I., Tanticharoen, M., & Ewert, F. (2021). Diversification for enhanced food systems resilience. *Nature Food*, *2*(11), 832–834.

Hicks, C. C., Cohen, P. J., Graham, N. A. J., Nash, K. L., Allison, E. H., D'Lima, C., Mills, D. J., Roscher, M., Thilsted, S. H., Thorne-Lyman, A. L., & MacNeil, M. A. (2019). Harnessing global fisheries to tackle micronutrient deficiencies. *Nature*, *574*(7776), 95–98.

Hicks, C. C., Gephart, J. A., Koehn, J. Z., Nakayama, S., Payne, H., Allison, E. H., Belhabib, D., Cao, L., Cohen, P. J., Fanzo, J., Fluet-Chouinard, E., Gelcich, S., Golden, C. D., Gorospe, K. D., Isaacs, M., Kuempel, C. D., Lee, K. N., MacNeil, M. A., Maire, E., … Naylor, R. L. (in review). Towards justice in blue food systems. *Nature Food*.

Hilborn, R., Amoroso, R. O., Anderson, C. M., Baum, J. K., Branch, T. A., Costello, C., de Moor, C. L., Faraj, A., Hively, D., Jensen, O. P., Kurota, H., Little, L. R., Mace, P., McClanahan, T., Melnychuk, M. C., Minto, C., Osio, G. C., Parma, A. M., Pons, M., … Ye, Y. (2020). Effective fisheries management instrumental in improving fish stock status. *Proceedings of the National Academy of Sciences of the United States of America*, *117*(4), 2218–2224.

Indonesia MMAF. (2021). *MMAF Press Conference No. SP. 1228/SJ.5/XII/2021: MMAF Non Tax Revenue Approached IDR 1 Trillion*. Indonesia MMAF. https://kkp.go.id/artikel/37005-cetak-sejarah-menteri-trenggono-bawa-pnbp-kkp-dekati-rp1-triliun

Indonesia MMAF. (2022). *Updated Fish Potential Estimation Data, Total 12.01 Million Tons per Year*. Indonesia MMAF. https://kkp.go.id/djpt/artikel/39646-kkp-perbarui-data-estimasi-potensi-ikan-totalnya-12-01-juta-ton-per-tahun

IPCC. (2019). *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (H.-O. Pörtner, D. C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, & N. M. Weyer, Eds.).

Koehn, J. Z., Allison, E. H., Villeda, K., Chen, Z., Nixon, M., Crigler, E., Zhao, L., Chow, M., Vaitla, B., Thilsted, S. H., Scholtens, J., Hicks, C. C., & Andrew, N. (2021). Fishing for health: Do the world's national policies for fisheries and aquaculture align with those for nutrition? *Fish and Fisheries* , *faf.12603*. https://doi.org/10.1111/faf.12603

Love, D. C., Allison, E. H., Asche, F., Belton, B., Cottrell, R. S., Froehlich, H. E., Gephart, J. A., Hicks, C. C., Little, D. C., Nussbaumer, E. M., Pinto da Silva, P., Poulain, F., Rubio, A., Stoll, J. S., Tlusty, M. F., Thorne-Lyman, A. L., Troell, M., & Zhang, W. (2021). Emerging COVID-19 impacts, responses, and lessons for building resilience in the seafood system. *Global Food Security*, *28*, 100494.

Melnychuk, M. C., Kurota, H., Mace, P. M., Pons, M., Minto, C., Osio, G. C., Jensen, O. P., de Moor, C. L., Parma, A. M., Richard Little, L., Hively, D., Ashbrook, C. E., Baker, N., Amoroso, R. O., Branch, T. A., Anderson, C. M., Szuwalski, C. S., Baum, J. K., McClanahan, T. R., … Hilborn, R. (2021). Identifying management actions that promote sustainable fisheries. *Nature Sustainability*, 1–10.

Naylor, R. L., Hardy, R. W., Buschmann, A. H., Bush, S. R., Cao, L., Klinger, D. H., Little, D. C., Lubchenco, J., Shumway, S. E., & Troell, M. (2021). A 20-year retrospective review of global aquaculture. *Nature*, *591*(7851), 551–563.

Naylor, R. L., Kishore, A., Sumaila, U. R., Issifu, I., Hunter, B. P., Belton, B., Bush, S. R., Cao, L., Gelcich, S., Gephart, J. A., Golden, C. D., Jonell, M., Koehn, J. Z., Little, D. C., Thilsted, S. H., Tigchelaar, M., & Crona, B. (2021). Blue food demand across geographic and temporal scales. *Nature Communications*, *12*(1), 5413.

Österblom, H., Wabnitz, C. C. C., Tladi, D., Allison, E. H., Arnaud-Haond, S., Bebbington, J., Bennett, N., Blasiak, R., Boonstra, W., Choudhury, A., Cisneros-Montemayor, A., Daw, T., Fabinyi, M., Franz, N., Harden-Davies, H., Kleiber, D., Lopes, P., McDougall, C., Resosudarmo, B. P., & Selim, S. A. (2020). *Towards ocean equity*. World Resources Institute. https://digitalarchive.worldfishcenter.org/bitstream/handle/20.500.12348/4486/71d48a67e55853a80e461c0ba5529caf.pdf

Selig, E. R., Nakayama, S., Wabnitz, C. C. C., Österblom, H., Spijkers, J., Miller, N. A., Bebbington, J., & Decker Sparks, J. L. (2022). Revealing global risks of labor abuse and illegal, unreported, and unregulated fishing. *Nature Communications*, *13*(1), 1612.

Short, R. E., Gelcich, S., Little, D. C., Micheli, F., Allison, E. H., Basurto, X., Belton, B., Brugere, C., Bush, S. R., Cao, L., Crona, B., Cohen, P. J., Defeo, O., Edwards, P., Ferguson, C. E., Franz, N., Golden, C. D., Halpern, B. S., Hazen, L., … Zhang, W. (2021). Harnessing the diversity of small-scale actors is key to the future of aquatic food systems. *Nature Food*, *2*(9), 733–741.

Starling, P., Charlton, K., McMahon, A. T., & Lucas, C. (2015). Fish intake during pregnancy and foetal neurodevelopment--a systematic review of the evidence. *Nutrients*, *7*(3), 2001–2014.

Stoll, J. S., Harrison, H. L., De Sousa, E., Callaway, D., Collier, M., Harrell, K., Jones, B., Kastlunger, J., Kramer, E., Kurian, S., Lovewell, M. A., Strobel, S., Sylvester, T., Tolley, B., Tomlinson, A., White, E. R., Young, T., & Loring, P. A. (2021). Alternative Seafood Networks During COVID-19: Implications for Resilience and Sustainability. *Frontiers in Sustainable Food Systems*, *5*. https://doi.org/10.3389/fsufs.2021.614368

Thilsted, S. H., Thorne-Lyman, A., Webb, P., Bogard, J. R., Subasinghe, R., Phillips, M. J., & Allison, E. H. (2016). Sustaining healthy diets: The role of capture fisheries and aquaculture for improving nutrition in the post-2015 era. *Food Policy*, *61*, 126–131.

Tigchelaar, M., Cheung, W. W. L., Mohammed, E. Y., Phillips, M. J., Payne, H. J., Selig, E. R., Wabnitz, C. C. C., Oyinlola, M. A., Frölicher, T. L., Gephart, J. A., Golden, C. D., Allison, E. H., Bennett, A., Cao, L., Fanzo, J., Halpern, B. S., Lam, V. W. Y., Micheli, F., Naylor, R. L., … Troell, M. (2021). Compound climate risks threaten aquatic food system benefits. *Nature Food*, *2*(9), 673–682.

Tigchelaar, M., Leape, J., Micheli, F., Allison, E. H., Basurto, X., Bennett, A., Bush, S. R., Cao, L., Cheung, W. W. L., Crona, B., DeClerck, F., Fanzo, J., Gelcich, S., Gephart, J. A., Golden, C. D., Halpern, B. S., Hicks, C. C., Jonell, M., Kishore, A., … Wabnitz, C. C. C. (2022). The vital roles of blue foods in the global food system. *Global Food Security*, *33*, 100637.

Wabnitz, C. C. C., Blasiak, R., Harper, S., Jouffray, J.-B., Tokunaga, K., & Norström, A. V. (2021). *Gender dynamics of ocean risk and resilience in SIDS and coastal LDCs* (Ocean Risk and Resilience Action Alliance (ORRAA) Report).

Witbooi, E., Ali, K.-D., & Santosa, M. (2020). *Organised Crime in the Fisheries Sector*. World Resources Institute. https://oceanpanel.org/blue-papers/organised-crime-associated-fisheries

World Bank. (2017). *The sunken billions revisited: Progress and challenges in global marine fisheries*. The World Bank.