Food and Agriculture Organization of the United Nations

IN BRIEF

INTEGRATING BLUE FOODS INTO NATIONAL CLIMATE STRATEGIES

CAPTURE FISHERIES

Aquatic foods and climate policy

Aquatic foods are increasingly in the spotlight. Playing a critical role in global food and nutritional security, and supporting hundreds of millions of livelihoods in developing countries, aquatic foods and their supply chains are becoming a key focus for policymakers – and there is a growing awareness of their importance in national climate strategies too.

Foods from aquatic sources – both wild-caught and farmed – generally have a significantly lower carbon footprint than terrestrial animal-source foods, and targeted investments in sustainable aquatic foods can support low-emission development strategies. But climate change is also posing severe challenges to the sector, driving shifts in species distribution and abundance in capture fisheries, and affecting production capacity in the aquaculture industry. Vulnerable groups who rely on aquatic foods – such as small-scale fishers, women in post harvest and trade, and communities in the Global South – face the largest impacts.

Historically, aquatic foods have been overlooked in climate discussions, and underfunded in mitigation and adaptation financing. Today, though, as understanding and momentum are growing, it is essential that policymakers fully integrate aquatic foods into nationally determined contributions (NDCs) and other climate processes, to foster resilience in this vital sector, specifically in support of adaptation of vulnerable communities and reduction of the sector's greenhouse gases (GHG) wherever relevant.

As countries are submitting their updated NDCs, it is time to step up action on aquatic foods. Key policy options for capture fisheries are discussed below.

Capture fisheries production

Capture fisheries play a critical role in the world's food systems. In 2023, they produced a total output of 90.4 million tonnes of aquatic animals (86.7 percent from marine sources and 13.3 percent from inland waters) and contributed an estimated USD 154 billion to the global economy. Worldwide, nearly half a billion people derive their livelihoods from small-scale fisheries, mostly in developing and vulnerable countries.

But as a sector that relies entirely on natural resources, capture fisheries are highly vulnerable to climate change impacts, and their sustainability is increasingly under threat. Warming waters, sea level rise, extreme weather events and shifting

rainfall patterns threaten fish stocks and degrade coastal and freshwater ecosystems, and their effects are amplified by other anthropogenic stressors, from infrastructure development to chemical and plastic pollution.

In the marine environment, pelagic fisheries are already being disrupted by shifts in species distribution, while coral reef fisheries are being hit by ocean warming and acidification. Inland, changes in the quality, quantity and flows of freshwater are harming many aquatic species populations.

Capture fisheries were estimated to contribute about 0.5 percent of global GHG emissions, mostly from fuel used by fishing vessels. Reducing this percentage should be a target in every NDC. Even so, most food produced in capture fisheries has a far lower carbon footprint than animal production on land. Inland and small-scale capture fisheries, in particular, have low carbon footprints because they rely on non-motorized operations, local consumption, with low or no emissions from transportation, feed production and land-use change. Additionally, minimal infrastructure and energy-efficient processing further reduce their environmental impact. While adapting to a heating world is of existential importance to the sector, it also has a vital strategic role to play in mitigating global emissions levels.

There are three key policy options for effectively integrating capture fisheries into NDCs and related climate plans: develop sustainable and climate-adaptive fisheries management; reduce emissions from fishing; and support climate-adaptive livelihoods and practices for fishers and fishing communities.

CAPTURE FISHERIES IN NUMBERS

Production and livelihoods

2023

90.4 million tonnes of **aquatic animals**.

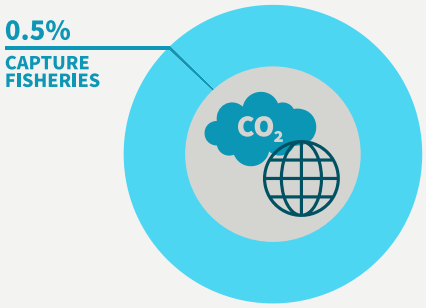
Over **USD 154 billion** first sale value.

500 million people supported, directly or indirectly, by **small-scale fisheries**.

GHG emissions

2012*

172 $MtCO_2e$ from marine and inland fishing vessels, around **0.5%** of total **global emissions**.

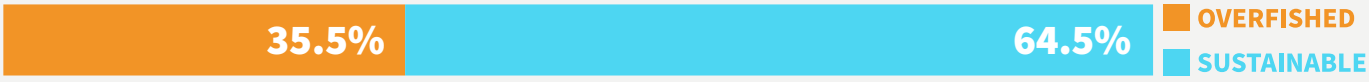


*Latest estimates available.

Sustainability challenge

2021

MARINE FISHERY RESOURCES



Source: **FAO.** 2024. *The State of World Fisheries and Aquaculture 2024 – Blue Transformation in action.* Rome. https://doi.org/10.4060/cd0683en;
FAO, Duke University & WorldFish. 2023. *Illuminating Hidden Harvests – The contributions of small-scalefisheries to sustainable development*. Rome. https://doi.org/10.4060/cc4576en;
FAO. 2025. *Review of the state of world marine fishery resources.* Rome. https://doi.org/10.4060/cd5538en
He, P., Davy, D., Sciortino, J., Beveridge, M.C.M., Arnason, R. & Gudmundsson, A., 2018. *Countering climate change: measures and tools to reduce energy use and greenhouse gas emission in fisheries and aquaculture.* In: Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S. & Poulain, F. eds. 2018. Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. https://openknowledge.fao.org/server/api/core/bitstreams/9aeb8ade-a623-4954-8adf-204daae3b5de/content

POLICY OPTION 1

Develop sustainable and climate-adaptive fisheries management

Rationale

Globally, wild fish populations are declining under climate change. By 2050, under a high emissions scenario, commercial stocks in many regions are projected to fall by more than 10 percent, threatening food and nutritional security as well as millions of livelihoods. If global temperature rises are kept to 1.5–2 °C, however, these declines could be limited to 10 percent or less: the need for concerted mitigation of GHG emissions is very clear.

In either case, science-based fisheries management will ensure healthier stocks better able to withstand environmental stressors. This must take an adaptive approach, adjusting mechanisms in response to climate-driven changes in productivity and distribution. Nuanced measures are required, tailored to different species and locations.

If all stocks were sustainably managed, the catch per unit effort would be higher – meaning vessels would need less fuel to catch the same amount of fish. Some estimates suggest that this could lead to a reduction in the fishing emissions of the global fleet of almost 50 percent, contributing to Paris Agreement targets. However, emissions vary significantly depending on the species and production system concerned, and there is considerable scope for improving overall sector performance on climate metrics by making changes here. Most obviously, promoting aquaculture of species with lower or no feed demands would contribute to lowering the total carbon footprint of the aquaculture sector; while in fed aquaculture, emissions can be reduced by adapting feed formulas to incorporate lower-emission ingredients.

Concrete measures

> Conduct baseline assessments to evaluate the current status of fisheries, including social considerations such as the roles of women in fisheries, and assess the potential impacts of climate change on livelihoods, habitats, and species. Employ data-limited assessment tools where information is scarce.

> Integrate environmental variables and climate risks into fisheries assessment models, particularly in data-rich systems, to enhance stock management accuracy.

> Establish comprehensive community-based monitoring programmes that engage local fishers and marginalized groups, such as women, in data collection and reporting.

> Introduce flexible management tools such as dynamic fishing seasons, tradable fishing rights, and adaptive plans that allow for real-time responses to climate-driven events and shifting harvest limits.

> Implement multispecies quota systems to ensure sustainable harvest levels, reduce bycatch, and adapt to shifting species distributions.

> Implement measures to protect and restore critical habitats, habitat connectivity, and keystone species to maintain ecosystem health.

> Strengthen collaboration with neighbouring countries through diplomatic channels, regional fishery bodies (including regional fisheries management organizations and advisory bodies) and basin management organizations to manage the transboundary movement of fish stocks across national waters.

> Apply marine spatial planning and integrated coastal and water resource management to balance sustainable fisheries production with other activities, such as renewable energy production in coastal areas.

> Enact a precautionary pause, or at minimum require environmental impact assessments, on developing commercial fisheries targeting mesopelagic zone (200–1 000 m depth) species for human consumption or fishmeal and fish oil until the ecological and carbon sequestration roles of these organisms are fully understood.

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CASE STUDY

Co-benefits

- Sustainably managed stocks secure long-term food and nutritional security through low-carbon sources.
- Transboundary cooperation for shared stocks can foster regional stability and promote more sustainability across borders.

Potential issues

- Top-down fisheries management may exclude local communities from resources they depend on for food and livelihoods.
- Small-scale fishers may lack resources to adapt to new regulations or technologies, exacerbating inequality in the sector.
- Changes in other sectors – coastal infrastructure, agriculture and land use, energy production etc. – may undermine climate-adaptive fisheries management initiatives.

Sistema de Alerta, Predicción y Observación (S.A.P.O.)

Many fish stocks are shared between more than one nation, and as the changing climate drives shifts in productivity and distribution, the need for cross-border cooperation and collaboration in fisheries management continues to grow. Chile, Peru and Ecuador have joined forces to develop the Sistema de Alerta, Predicción y Observación (S.A.P.O.), an oceanographic monitoring and early warning system designed to support climate-resilient fisheries across South America. S.A.P.O. 2.0, a mobile app, gives fishers real-time information on climate-driven species movements and availability, enabling them to adapt their fishing practices accordingly and negotiate more effectively with buyers.

POLICY OPTION 2

Reduce emissions from fishing


© FAO/Ibrahima Mbengue

Rationale

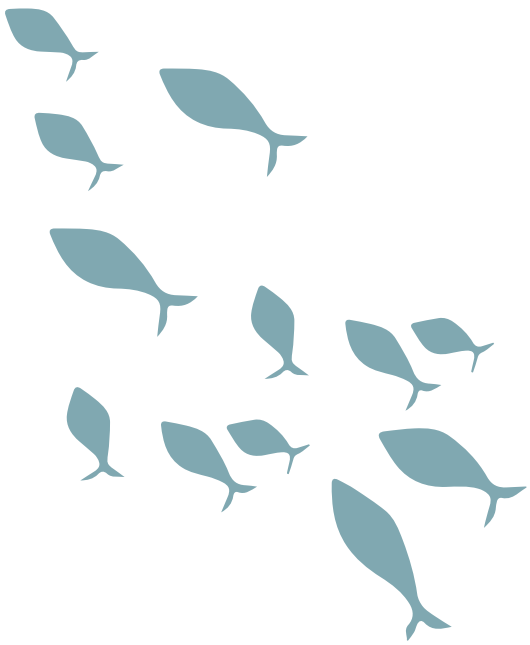
Fuel use is the largest source of GHG emissions in wild capture fisheries. Recent data are scarce, but the sector is thought to be responsible for approximately 4 percent of all food production emissions, and 0.5 percent of the annual global total. Asia has the largest wild capture fleet and thus produces the most emissions, followed by Europe and Africa.

Reducing these emissions will contribute to global climate mitigation efforts. This means adopting low-fuel gear, which could reduce emissions by between 4 percent and 61 percent depending on the species concerned, and transitioning to other low-impact, fuel-efficient ('LIFE') practices. These include optimizing the shape of vessels' hulls and making their propulsion systems more efficient, as well as changing to hybrid or fully electric sources of power – ashore as well as onboard. Some of this work could be funded by redirecting harmful subsidies away from fossil fuels.

The International Maritime Organization (IMO) is aiming to achieve net-zero emissions from international shipping by 2050, and widespread adoption of alternative and near-zero emissions fuels by 2030. While fisheries are not specifically targeted, the direction of travel is clear: the sector must do its part.

Concrete measures

- Support the World Trade Organization (WTO) Agreement on Fisheries Subsidies to eliminate harmful fossil fuel subsidies and promote sustainable fishing practices.
- Establish and enforce mandatory emission standards or bans on high-emission fishing gear, and promote the adoption of low-impact, low-emission alternatives.
- Provide incentives for retrofitting existing fishing vessels with low-emission technologies and support the development of "green" shipbuilding.
- Invest in research and development of alternative energy sources for fishing vessels, such as green methanol, biogas, green hydrogen, and wind propulsion. This includes retrofitting vessels, adopting new engine designs, and upgrading port infrastructure.
- Improve the energy efficiency of port infrastructure and support the transition to renewable energy sources in port operations.
- Develop a global system for data collection, monitoring, and reporting of fishing fleet emissions, tailored for small-scale and artisanal fisheries, building on the experiences of the IMO and FAO.



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CASE STUDY

Co-benefits

- Cleaner energy sources improve air and water quality, benefiting public health and the environment.
- Renewable energy can reduce fuel costs over time, leading to lower operational costs and higher profits.
- Decreasing dependence on fossil fuels enhances energy security.

Potential issues

- High initial capital requirements may be a barrier to vessel retrofits and the transition to renewable energy technologies.
- Cheaper fuel costs could drive increased fishing effort, leading to overfishing if not carefully managed.

European Union Energy Transition Partnership (ETP)

In 2023, the European Union (EU) set up a multistakeholder platform to improve collaboration and knowledge-sharing between the public and private sector to accelerate the energy transition in fisheries and aquaculture. By bringing together stakeholders and fostering dialogue, the ETP creates practical, actionable solutions. It also serves as a knowledge hub where innovations and best practices are shared and showcased. The ETP's initial aim is to reduce fossil fuel intensity by at least 15 percent between 2019 and 2030, with the ultimate goal of a net-zero footprint for EU fisheries by 2050.

POLICY OPTION 3

Support climate-adaptive livelihoods and practices for fishers and fishing communities


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Rationale

While concerted global efforts to mitigate climate change as far as possible must continue, adapting to the new reality is essential too – and this is a pressing priority for fishers and fishing communities. Taking measures to enhance the resilience both of fisheries and of the people who depend on them puts both in a better position to withstand the pressures of a heating planet.

These include improving community preparedness in the face of extreme weather events like storm surges, marine heatwaves, or droughts. Early warning systems and climate information services should be made widely accessible, while disaster response capabilities should be strengthened. Coastal defence facilities should be upgraded to withstand greater impacts.

Promoting culturally appropriate alternative livelihoods can help communities whose fisheries are becoming less productive under climate change. Addressing socioeconomic inequality through insurance, social protection and gender-sensitive approaches can support vulnerable groups and increase community resilience.

Concrete measures

- Establish early warning systems and enhance disaster preparedness to protect fishers and fishing communities from extreme weather events.
- Fund local climate projections, extension services, and data-limited assessment and monitoring systems to provide essential climate information and services to fishers and their communities to support adaptive decision-making.
- Engage fishers and especially marginalized voices, such as those of women and Indigenous Peoples, in the fisheries value chain to identify local adaptation initiatives through participatory planning processes, and create financial instruments to support these projects.
- Invest in capacity building and knowledge sharing among fisheries managers, scientists, and local communities, including regional networks and platforms for exchanging best practices, adaptation options, and innovative management approaches.
- Strengthen social protection systems and safety nets for fishers and communities to manage climate-related shocks, including insurance options, disaster relief funds, and unemployment benefits. Recognize that fisheries can also serve as safety nets and support local adaptation strategies.
- Improve women's access to affordable and accessible credit, tenure rights, and labour-saving technologies to boost uptake of adaptation measures, increase incomes and intrahousehold decision-making, and reduce gender-related climate vulnerability.
- Support the relocation or adaptation of landing and processing facilities to align with shifting fish populations and environmental conditions.
- Create policy frameworks for marine spatial planning that support livelihood diversification in fishing communities – including aquaculture, tourism, and small-scale manufacturing – to enhance climate resilience.

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Co-benefits

- Adaptive measures can diversify income sources and enhance financial stability as well as supporting food and nutrition security.
- Investment in infrastructure and capacity-building can also promote poverty reduction.
- Gender-sensitive adaptation measures can support women's roles in fisheries.

Potential issues

- Risk reduction measures may not be equally accessible to all community members.
- Financial support such as gear subsidies or insurance mechanisms could encourage unsustainable fishing or increase dependency.
- Diversifying away from traditional fishery practices could erode cultural heritage.

Caribbean Ocean and Aquaculture Sustainability Facility (COAST)

The Caribbean Ocean and Aquaculture Sustainability Facility – COAST – is an innovative parametric insurance product that has been piloted in Grenada and Saint Lucia. COAST is aimed at vulnerable fishing communities, providing coverage for loss and damage to vessels, gear and infrastructure caused by adverse weather. The parametric model – where fixed payouts are triggered when bad weather occurs – provides rapid relief when it's most urgently needed, enabling communities to build back better and enhance their resilience after extreme events. The intention is for all those who work in the fisheries sector – crew members, captains and owners, vendors and processors (the latter group mostly being women) – to be included in the coverage.

Existing NDC examples

- Saint Lucia has identified sustainable fisheries management as a key priority to ensure the long-term viability of its fisheries sector in view of the adverse impacts of climate change. It also expects to implement fuel-efficient technologies to reduce GHG emissions from fishing operations.
- The Republic of the Marshall Islands has highlighted fisheries adaptation measures, including innovative approaches for sustainable fisheries management, that it has taken as part of the Pacific Islands Fisheries Forum Agency (FFA), such as the Harmonized Minimum Terms and Conditions for Access by Fishing Vessels (agreed minimum standards for licensing and access of foreign fishing vessels to the waters of FFA members).
- The United Kingdom of Great Britain and Northern Ireland is committed to co-developing climate-adaptive fisheries measures in collaboration with the seafood sector, to support a sustainable fishing industry alongside a healthy and productive marine environment. It has also provided grant funding to support the purchase of new, more fuel-efficient engines to help reduce GHG emissions from fisheries, as part of the United Kingdom Seafood Fund.

FAO tools and resources

Azzurro, E., Bahri, T., Valbo-Jørgensen, J., Ma, X., Strafella, P. & Vasconcellos, M. eds. 2024. *Fisheries responses to invasive species in a changing climate – Lessons learned from case studies.* FAO Fisheries Technical Paper, No. 704. Rome, FAO. https://doi.org/10.4060/cd1400en

Bahri, T., Vasconcellos, M., Welch, D.J., Johnson, J., Perry, R.I., Ma, X. & Sharma, R. eds. 2021. *Adaptive management of fisheries in response to climate change.* FAO Fisheries and Aquaculture Technical Paper No. 667. Rome, FAO. https://doi.org/10.4060/cb3095en

Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S. & Poulain, F. eds. 2018. *Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options.* FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. https://openknowledge.fao.org/server/api/core/bitstreams/9aeb8ade-a623-4954-8adf-204daae3b5de/content

Blanchard, J.L. & Novaglio, C., eds. 2024. *Climate change risks to marine ecosystems and fisheries – Projections to 2100 from the Fisheries and Marine Ecosystem Model Intercomparison Project***.** FAO Fisheries and Aquaculture Technical Paper, No. 707. Rome, FAO. https://doi.org/10.4060/cd1379en

Brugère, C. & De Young, C. 2020. *Addressing fisheries and aquaculture in National Adaptation Plans. Supplement to the UNFCCC NAP Technical Guidelines.* Rome, FAO. https://doi.org/10.4060/ca2215en

Brugère, C. & De Young, C. 2015. *Assessing climate change vulnerability in fisheries and aquaculture: Available methodologies and their relevance for the sector.* FAO Fisheries and Aquaculture Technical Paper No. 597. Rome, FAO. https://openknowledge.fao.org/server/api/core/bitstreams/c9952117-8951-476e-a1f1-3992767cc4ca/content

Comte, A. 2021. *Recent advances in climate change vulnerability/risk assessments in the fisheries and aquaculture sector.* FAO Fisheries and Aquaculture Circular No. 1225. Rome, FAO. http://www.fao.org/3/cb4585en/cb4585en.pdf

Cook, K., Rosenbaum, K. L. and Poulain, F. 2021. *Building resilience to climate change and disaster risks for small-scale fisheries communities. A human-rights-based approach to the implementation of Chapter 9 of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication.* Rome, FAO. https://doi.org/10.4060/cb7616en

FAO. 2024. *El Niño impacts and policies for the fisheries sector. FAO Innovation for Blue Transformation.* Rome. https://doi.org/10.4060/cd3812en

FAO. 2024. *The fisheries and aquaculture adaptation finance gap.* Rome. https://openknowledge.fao.org/handle/20.500.14283/cd1588en

FAO. 2021. *FAO's work on climate change – Fisheries and aquaculture 2020***.** Rome. https://doi.org/10.4060/cb3414en

FAO. 2021. Fisheries and aquaculture response to emergencies (FARE). https://elearning.fao.org/course/view.php?id=789

FAO. 2020. Climate change adaptation and mitigation in fisheries and aquaculture. FAO Elearning Academy. https://elearning.fao.org/course/view.php?id=544

FAO. 2020. Climate-smart fisheries and aquaculture. FAO Elearning Academy. https://elearning.fao.org/course/view.php?id=579

FAO. 2015. *Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication*. Rome. https://openknowledge.fao.org/server/api/core/bitstreams/edfffbfc-81e5-4208-a36f-334ff81ac10f/content

FAO & CANARI. 2022. *Toolkit for vulnerability and capacity assessments in Caribbean coastal and fishing communities – Developed under the Climate Change Adaptation in the Eastern Caribbean Fisheries Sector Project (CC4FISH).* Rome. https://openknowledge.fao.org/server/api/core/bitstreams/b0083646-18cb-483d-a74f-8a0fac5a5080/content

Levin, L., Baker, M. & Thompson, A. eds. 2019. *Deep-ocean climate change impacts on habitat, fish and fisheries.* **F**AO Fisheries and Aquaculture Technical Paper No. 638. Rome, FAO. http://www.fao.org/3/ca2528en/CA2528EN.pdf

Ma, X., Bahri, T., Meybeck, A., Bernoux, M. & Kaugure, L. 2024. *Navigating the waters of the United Nations Framework Convention on Climate Change – A guide for the aquatic food sector.* FAO Fisheries and Aquaculture Technical Paper, No. 718. Rome, FAO. https://doi.org/10.4060/cd1401en

Puri, M., Kojakovic, A., Rincon, L., Gallego, J., Vaskalis, I. & Maltsoglou, I. 2023. *The small-scale fisheries and energy nexus – Opportunities for renewable energy interventions.* Rome, FAO. https://doi.org/10.4060/cc4903en

Stanford Center for Ocean Solutions, WorldFish, FAO, Beijer Institute of Ecological Economics, CARE & Environmental Defense Fund. 2024. *Integrating blue foods into national climate strategies: Enhancing nationally determined contributions and strengthening climate action.* Stanford Center for Ocean Solutions. https://openknowledge.fao.org/handle/20.500.14283/cd2482en

Watkiss, P., Ventura, A. & Poulain, F. 2019. *Decision-making and economics of adaptation to climate change in the fisheries and aquaculture sector.* FAO Fisheries and Aquaculture Technical Paper No. 650. Rome, FAO. https://openknowledge.fao.org/server/api/core/bitstreams/32239839-8f34-4bd8-8a8b-ebba5c1dceeb/content

Scan to read the full report

This briefing is based on information contained in *Integrating blue foods into national climate strategies*, a joint report from Stanford Center for Ocean Solutions, WorldFish, FAO, Beijer Institute of Ecological Economics, CARE, and Environmental Defense Fund, on how nations can use aquatic foods to enhance their nationally determined contributions and strengthen climate action.