

Fisheries and Aquaculture in our Changing Climate

Coastal communities, fishers and fish farmers are already profoundly affected by climate change. Rising sea levels, acid oceans, droughts and floods are among the impacts of climate change. Oceans provide the very air, the oxygen we breathe, and climate change is altering the ancient balance between oceans and the atmosphere.

This policy brief highlights the key issues to ensure that decision-makers and climate change negotiators are aware of and understand the changes and their impacts, and the opportunities for adaptation and mitigation in aquatic ecosystems, fisheries and aquaculture in national and local responses to climate change. The brief also reflects the consensus of concerned international and regional agencies.



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The build-up of carbon dioxide and other greenhouse gases in our atmosphere [1] is changing several of the features of the earth's climate, oceans, coasts and freshwater ecosystems that affect fisheries and aquaculture. Air and sea surface temperatures, rainfall, sea level, acidity of the ocean, wind patterns, and the intensity of tropical cyclones are all changing. The impact of climate change on aquatic ecosystems, and on fisheries and aquaculture, however, is not so well known.

Climate change is modifying the distribution and productivity of marine and freshwater species and is already affecting biological processes and altering food webs. The consequences for sustainability of aquatic ecosystems for fisheries and aquaculture, and for the people that depend on them, are uncertain. Some countries and fisheries will benefit while others will lose – the only certainty is change and decision-makers must be prepared for it.



It is clear that fishers, fish farmers and coastal inhabitants will bear the full force of these impacts through less stable livelihoods, changes in the availability and quality of fish for food, and rising risks to their health, safety and homes. Many fisheries-dependent communities already live a precarious and vulnerable existence because of poverty and their lack of social services and essential infrastructure. The well-being of these communities is further undermined by overexploited fishery resources and degraded ecosystems. The implications of climate change for food security and livelihoods in small island states and many developing countries are profound.

Fisheries, aquaculture and fish habitats are at risk in the developing world

Deltas and estuaries are in the front line of climate change. For example, sea level rise and reduced river flows are causing increasing saltwater intrusion in the Mekong delta and threatening the viability of catfish aquaculture. This industry produces about 1 million tonnes per year, valued at \$1 billion and provides over 150 000 livelihood opportunities, mostly for women.

Investments are urgently needed to mitigate these growing threats, to adapt to their impacts and to build our knowledge of complex ocean and aquatic processes. The overarching requirement is to reduce global emissions of greenhouse gases -- the primary human driver of climate change. Fisheries and aquaculture need specific adaptation and mitigation measures that:

- improve the management of fisheries and aquaculture and the integrity and resilience of aquatic ecosystems;
- respond to the opportunities for and threats to food and livelihood security due to climate change impacts; and
- help the fisheries and aquaculture sector reduce greenhouse gas emissions.

Healthy aquatic ecosystems contribute to food security and livelihoods

Fisheries and aquaculture contribute significantly to food security and livelihoods, but depend on healthy aquatic ecosystems. These contributions are often unrecognized and undervalued.

- Fish (including shellfish) provides essential nutrition for 3 billion people and at least 50% of animal protein and minerals to 400 million people in the poorest countries.
- Over 500 million people in developing countries depend, directly or indirectly, on fisheries and aquaculture for their livelihoods.
- Aquaculture is the world's fastest growing food production system, growing at 7% annually.
- Fish products are among the most widely traded foods, with more than 37% by volume of world production traded internationally.



Crucial role of healthy oceans in climate change

- Oceans are the earth's main buffer to climate change and will likely bear the greatest burden of impacts.
- Oceans removed about 25% of atmospheric carbon dioxide emitted by human activities from 2000 to 2007.
- Oceans absorb more than 95% of the sun's radiation, making air temperatures tolerable for life on land.
- Oceans provide 85% of the water vapour in the atmosphere, and these clouds are key to regulating climate on land and sea.
- Ocean health influences the capacity of oceans to absorb carbon.

Sustainable aquatic ecosystems are crucial for climate change adaptation

Healthy aquatic ecosystems are critical for production of wild fish and for some of the 'seed' and much of the feed for aquaculture. The productivity of coastal fisheries is closely tied to the health of coastal ecosystems, which provide food, habitats and nursery areas for fish. Estuaries, coral reefs, mangroves and sea grass beds are particularly important. In freshwater systems, ecosystem health and productivity is linked to water quality and flow and the health of wetlands. The stocks of small schooling fish like anchovies and sardines found in schools in the ocean are highly sensitive to changes in ocean conditions. These small pelagic fish are a basic food for millions and are often processed into fishmeal and used to feed cultured fish, as well as poultry and pigs.



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Coastal ecosystems that support fisheries also help protect communities from the impacts of natural hazards and disasters [2]. Mangroves create barriers to destructive waves from storms and hold sediments in place within their root systems, reducing coastal erosion. Healthy coral reefs, sea grass beds and wetlands provide similar benefits. Climate change imperils the structure and function of these already stressed ecosystems.

Ecosystem approach - balancing resource use with nature's ability to respond to climate change

Coral reefs are degrading with increasing water temperatures and acidification of the oceans [3], and are growing more sensitive to the threats of over-fishing, pollution, poor tourism practices and invasive species. This will affect the quantity and type of fish available to coastal communities in developing countries and small island states. Ecosystem-based approaches to fisheries and coastal management are required. These approaches recognize the need for people to use coral reefs for their food security and livelihoods while enabling these valuable ecosystems to adapt to the effects of climate change, and to reduce the threats from other environmental stresses.

Fisheries and aquaculture can support mitigation and adaptation

Adaptation measures are well known by managers and decision makers, but political will and action is often lacking. To build resilience to the effects of climate change and derive sustainable benefits, fisheries and aquaculture managers need to adopt and adhere to best practices such as those described in the FAO Code of Conduct for Responsible Fisheries, reducing overfishing and rebuilding fish stocks. These practices need to be integrated more effectively with the management of river basins, watersheds and coastal zones.

Aquaculture of herbivorous species can provide nutritious food with a small carbon footprint. Farming of shellfish, such as oysters and mussels, is not only good business, but also helps clean coastal waters, while culturing aquatic plants helps remove wastes from polluted waters. In contrast to the potential declines in agricultural yields in many areas of the world, climate change opens new opportunities for aquaculture as increasing numbers of species are cultured, as the sea encroaches on coastal lands, as more dams and impoundments are constructed in river basins to buffer the effects of changing rainfall patterns, and as urban waste demands more innovative disposal.



Fisheries and aquaculture need to be blended into national climate change adaptation strategies. Without careful planning, aquatic ecosystems, fisheries and aquaculture can potentially suffer as a result of adaptation measures applied by other sectors, such as increased use of dams and hydropower in catchments with high rainfall, or the construction of artificial coastal defences or marine wind farms.

Mitigation solutions reducing the carbon footprint of fisheries and aquaculture will require innovative approaches. One example is the recent inclusion of mangrove conservation as eligible for Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD) funding, which demonstrates the potential for catchment forest protection. Other approaches to explore include: linking vessel decommissioning with emissions reduction funding schemes, finding innovative but environmentally safe ways to sequester carbon in aquatic ecosystems, and developing low-carbon aquaculture production systems.

Many capture fisheries and their supporting ecosystems have been poorly managed, and the economic losses due to overfishing, pollution and habitat loss are estimated to exceed \$50 billion per year [4]. Improved governance, innovative technologies and more responsible practices can generate increased and sustainable benefits from fisheries. The current fishing fleet is too large to catch available fish resources efficiently and therefore consumes more fossil fuel than necessary. Reducing fleet overcapacity will not only help rebuild fish stocks and sustain global catches, but can substantially reduce carbon emissions from the sector.



Changing the investment climate

Increasing investment in fisheries, aquaculture and aquatic ecosystems is an investment in the 'liquid assets' of adaptation. Aquatic ecosystems play a crucial role in buffering and distributing climatic shocks, whether from storms, floods, coastal erosion or drought. Investment in aquatic science is fundamental -- investment in knowledge of aquatic ecosystems, in the complex biological and chemical processes that determine the ocean carbon cycle, and in knowledge of the currents and eddies that generate hurricanes. Equally important is an understanding of the ways that people cope with and adapt to living in a changing climate, and how their institutions and livelihood systems have evolved to maintain resilience to future change in aquatic ecosystems.

Investment in awareness is also essential, from the local council considering a seawall to policy-makers considering fuel subsidies. Awareness is crucial for the millions who will lose their farms to the sea and need options and alternatives for their own investments and those of their local communities.

Vulnerability and risk assessment can inform these decisions; technologies and education can offer alternatives. Applying best practices in natural resources stewardship and governance is a 'no regrets' pathway, generating current and future benefits, increasing resilience of aquatic ecosystems and economies, and often reducing emissions.



What Can We Do Now?

- Implement comprehensive and integrated ecosystem approaches to managing coasts, oceans, fisheries, aquaculture; to adapting to climate change; and to reducing risk from natural disasters.
- Move to environmentally friendly and fuel-efficient fishing and aquaculture practices.
- Eliminate subsidies that promote overfishing and excess fishing capacity.
- Provide climate change education in schools and create greater awareness among all stakeholders.
- Undertake assessments of local vulnerability and risk to achieve climate proofing.
- Integrate aquaculture with other sectors.
- Build local ocean-climate models.
- Strengthen our knowledge of aquatic ecosystem dynamics and biogeochemical cycles such as ocean carbon and nitrogen cycles.
- Encourage sustainable, environmentally friendly biofuel production from algae and seaweed.
- Encourage funding mechanisms and innovations that benefit from synergies between adaptation and mitigation in fisheries and aquaculture.
- Conduct scientific and other studies (e.g. economic) to identify options for carbon sequestration by aquatic ecosystems which do not harm these and other ecosystems.
- Consider appropriate regulatory measures to safeguard the aquatic environment and its resources against adverse impacts of mitigation strategies and measures.

Implementing the aquatic agenda

Implementing adaptation and mitigation pathways for communities dependent on fisheries, aquaculture and aquatic ecosystems will need increased attention from policy-makers and planners. Sustainable and resilient aquatic ecosystems not only benefit fishers and coastal communities but also provide goods and services at national and global levels, for example, through improved food security and conservation of biodiversity.

For fishers, fish farmers and coastal peoples in the front line of climate change, for example, residents of low-lying developing countries and small island states, key actions should include securing resources to:

- fill critical gaps in knowledge to assess the vulnerability of aquatic ecosystems, fisheries and aquaculture to climate change;
- strengthen human and institutional capacity to identify the risks of climate change to coastal communities and fishing industries, and implement adaptation and mitigation measures; and
- raise awareness that healthy and productive ecosystems, which arise from well-managed fisheries and aquaculture, and careful use of catchments and coastal zones, are a cross-sectoral responsibility.

Resources

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