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WORKING PAPER

Climate Change and Adaptation in Fisheries and Aquaculture

Because they live near water, fisherfolk are among the first to suffer the effects of floods, droughts, storms, and sea level rise. Fishery resources are also highly sensitive to variations in climate-forced biophysical processes, such as ocean currents, river flows and lake-level fluctuations and related changes in ocean, coastal and floodplain productivity. With such a high exposure to climate-related risks, adaptation to climate change is becoming a high priority for fishery sector policy. Although fisheries have always had to cope with variable production and unpredictable changes in weather, future climate change will bring shifts in climatic means and in the frequency and severity of extreme events that are beyond the coping capacity of even the more flexible, adapted fishery systems.

This brief examines predicted climate change, the pathways by which predicted changes are likely to impact fisheries and aquaculture, the likely extent and geographical distribution of these impacts, the options for adapting to these changes and the policy measures that can assist this adaptation. The overall argument presented is that despite uncertainties in the location, magnitude and direction of change, and given existing high variability in fishery production systems, it is still worth investing in building the capacity of fishery production systems to adapt to future climate change. The main reason is that most options for building adaptive capacity are also required to manage fish stocks effectively and to reduce the poverty and vulnerability of fishing-dependent people. In other words, reducing poverty is the main route to adapting to future climate change in the fishery sector – and we are trying to reduce poverty anyway. The win-win scenario is that a fishery sector that is able to plan adaptively to change (whether climate-induced or other) will be more likely to deliver continued benefits to food security and poverty reduction than a sector that is merely reacting and coping.

1. CLIMATE-INDUCED CHANGES IN AQUATIC SYSTEMS

The Intergovernmental Panel on Climate Change (IPCC Fourth Assessment)[1] concludes that:

- In the low latitudes of the tropics, many wet areas will get wetter and dry areas, drier, aggravating drought and flood tendencies.
- Weather events will become more extreme, creating more variability in water supplies that drive agricultural and hydrological systems.
- Rising water temperatures may reduce the upwelling of nutrients that drive ocean and large-lake pelagic (upper water layer) productivity.
- Increased carbon dioxide in the atmosphere will increase the acidity of water bodies, potentially adversely affecting shellfish and coral reefs.
- Coastal areas and islands will be especially hard-hit by rising sea levels and more intensive oceanic storms such as typhoons or hurricanes.

While many of these changes will severely undermine fisheries, some may deliver benefits. For example, with the right technologies and farming systems, producers can use flooded and saline areas no longer suitable for crops to cultivate fish. They can also use the water in reservoirs and ponds used for fish culture to moderate the swings between drought and flood. Waste nutrients and water from such water bodies can help sustain crops during periods of drought, thereby increasing the resilience of the farming system. Some ocean areas may show increased primary productivity (e.g. the Arabian Sea), which may translate into greater fisheries production.

[1] IPCC (2007) 4th Assessment: Summary for Policy Makers. Intergovernmental Panel on Climate Change, *http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf*

2. CLIMATE, FISHERIES AND AQUACULTURE: POTENTIAL IMPACT PATHWAYS

Climate change can affect the productivity or distribution of fishery resources of both marine and inland waters in a variety of ways:

- Changes in water temperature and precipitation affect the dynamics of ocean currents, the flow of rivers and the area covered by wetlands. This will have effects on ecosystem structure and function and on the distribution and production of fish stocks. Ocean acidification may also affect shellfish fisheries and aquaculture, as well as aquatic food chains. Warming also increases the incidence of coral bleaching – death of reef-building corals and their associated ecosystems and fisheries.
- Increased incidence of extreme events such as floods, droughts and storms will affect the safety and efficiency of fishing operations and increase damage and disruption to coastal and riparian homes, services and infrastructure.
- Sea level rise, melting of glaciers at the headwaters of major rivers and other large-scale environmental changes will have unpredictable effects on coastal and wetland environments and livelihoods, and fish production. For example, in Bangladesh, it is difficult to predict which likely changes in the Ganges and Brahmaputra Rivers will have the greater net effect on fish production: reduced dry season flows (causing decreased fish survival and reproduction) or increased wet season flooding (providing increased feeding for young fish).
- Complex links between climate change, fisheries and other sectors will have indirect effects too. These include fisheries being affected by changing water demands from agriculture, changing prices of, and access to, aquaculture feedstuffs, and diversion of government and international financial resources away from fisheries management and into emergency relief after extreme weather events.

3. WHERE ARE CLIMATE CHANGE IMPACTS ON FISHERIES LIKELY TO BE OF GREATEST SOCIAL AND ECONOMIC SIGNIFICANCE?

A recent study on the vulnerability of national economies and food systems to climate impacts on fisheries [2] has revealed that African countries are most at risk. What makes them so vulnerable? The first reason is ecological — it is because many African countries are semi-arid and therefore water-stressed already, with significant coastal or inland fisheries. This gives them high exposure to future increases in temperature and linked changes in rainfall, hydrology and coastal currents. The second reason is social and economic — these countries also depend greatly on fish for protein, and have low capacity to adapt to change due to their comparatively small or weak economies, weak governance, and low human development indices. Countries in this category include Angola, Congo, Mauritania, Mali, Niger, Senegal and Sierra Leone. Other vulnerable African nations include Rift Valley countries such as Malawi, Mozambique and Uganda. Beyond Africa, Asian nations dependent on river fisheries, including Bangladesh, Cambodia and Pakistan, are most vulnerable.

The often overlooked links between fisheries and agriculture also make the semi-arid areas of Africa vulnerable. In these areas the higher-potential agricultural zones are around lakes, swamps and river-floodplains. Here fisheries often provide both safety nets and capital to invest in agricultural inputs and livestock. If the fishery system is under stress, the potential of the other components of the 'tri-economy' is reduced. The system as a whole is resilient to local-scale perturbation, but with reduced rainfall stressing both fisheries and crop agriculture, that resilience could be threatened by climate change. It is important therefore to consider fisheries in the wider discussion of adaptation and coping in these systems — and particularly fisheries of inland and near-shore waters.

[2] Allison et al. Effects of climate change on the sustainability of capture and enhancement fisheries important to the poor: analysis of the vulnerability and adaptability of fisherfolk living in poverty. DFID study; *http://www.dfid.gov.uk/pubs/files/summary_climatechangefisheries.pdf*

4. PRINCIPLES FOR INVESTMENT IN BUILDING CAPACITY OF FISHERIES AND AQUACULTURE TO ADAPT TO CLIMATE CHANGE

Helping the fisheries sector to adapt to climate change makes sound economic sense because it adds little cost to what is needed to secure benefits from fisheries by investing in improved governance, better cross-sectoral planning, and appropriate social and economic development intervention in fishing-dependent communities. The following policy initiatives and investments can help achieve this:

i. Support climate-change risk assessments, including determining the costs of adaptation and the potential changes in economic contributions from the fishery sector under likely climate scenarios.

ii. Invest in initiatives to reduce fishing effort in overexploited fisheries. Lightly-fished stocks are likely to be more resilient to climate change impacts than heavily-fished ones.

iii. Integrate disaster management and risk reduction planning, especially concerning planning coastal or flood defenses. Apply 'soft engineering' solutions where possible, including conservation of natural storm barriers, floodplains, and erodable shorelines to manage costs and damage impacts.

iv. Enhance resilience in fishing communities by supporting existing adaptive livelihood strategies and management institutions that are designed to support adaptation to climate change and variability, such as reciprocal access arrangements.

v. Identify cross-sectoral factors that will increase or decrease impacts and adaptation potential in fishing communities, and incorporate these conclusions in sectoral and food security plans. Address longer-term trends or potential large-scale shifts in resources or ecosystems in PRSPs and National Adaptation Programmes of Action.

5. FURTHER READING

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