



Climate Change: Devastating Impact on Fisheries and Aquaculture for last Decades

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The significance of fisheries and aquaculture: Billions of peoples around the world depend on important fastest growing sector fisheries and aquaculture sector for food supply, food security and livelihoods. The fisheries sector has been playing significant role in the Indian economy, contributing about 1% to the National GDP, 5.23% to the agricultural GDP.

What Is Climate Change? We live in a time of a changing climate. The term "climate change" refers to a rise in the average global temperature due to an increase in the concentration of atmospheric greenhouse gases, resulting shifts and impacts around the globe. "Global warming is a gradual increase in the earth's temperature generally due to the greenhouse effect caused by increased levels of carbon dioxide, CFCs, and other pollutants.



Climate change impacts on fisheries and aquaculture: Climate change is an issue of great environmental concern. There is no any doubt that our fisheries are already a highly vulnerable sector facing widespread and often profound changes. Climate change has serious implications for marine and Indian fisheries and aquaculture, which affect directly by influencing fish stocks and the global supply of fish for consumption, or indirectly by influencing fish prices or the cost of goods and services required by fishers and fish farmers.

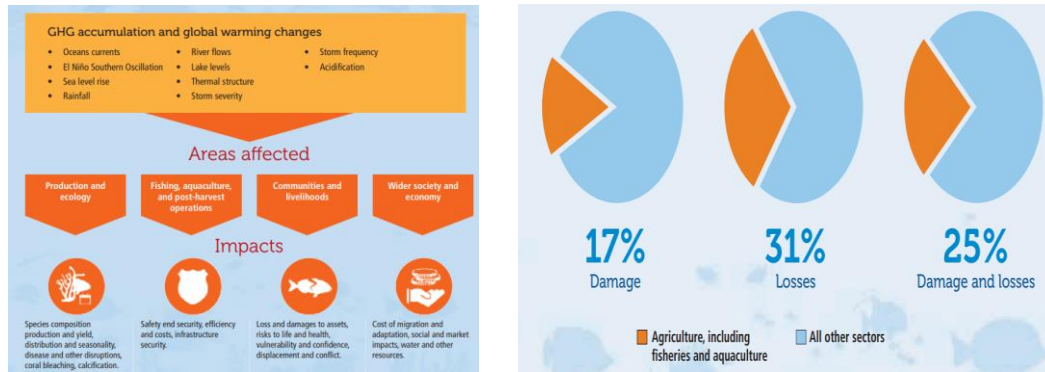


Figure 1. Climate change impact pathways in fisheries and aquaculture (Source: From Badjeck et al. (2010) and Damage and losses from climate related impacts on agriculture, fisheries and aquaculture (Source: FAO (2015), based on PDNAs)

Changing sea temperatures-Sea Surface Temperature (SST): Temperature plays a critical role in the growth and development of aquatic animals. Warming of water may impact fish diversity, distribution, abundance and phenology.

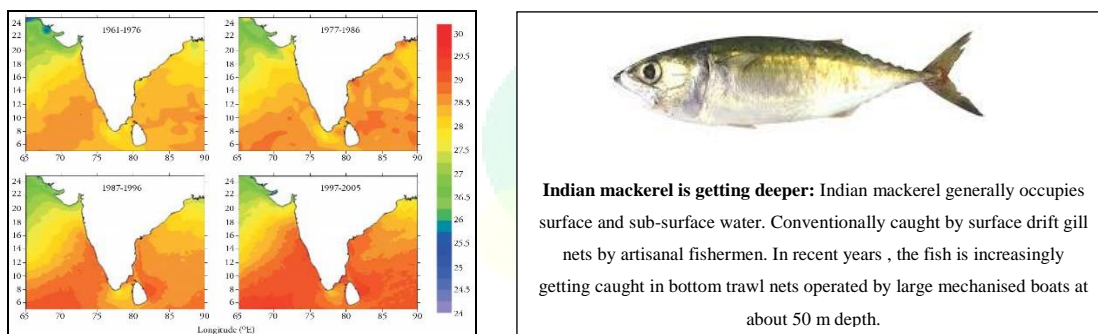
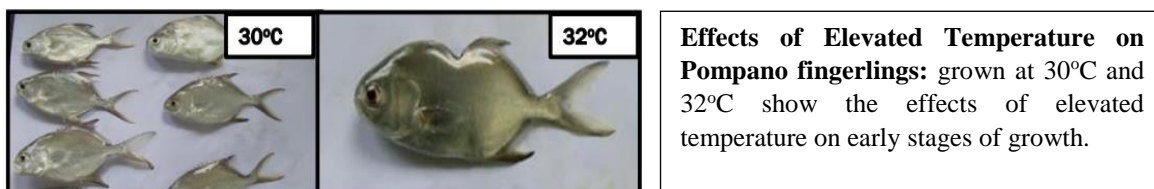


Figure 2. Plot of SST showing warming of sea surface along the Indian coast during 1961-2005.

With increase in SST, evidences is now available for: increase in dispersal, abundance, reduction in mean size, length at first maturity, fecundity, change in spawning season and diet composition in commercial fishery such as oil sardine, Indian mackerel, *Nemipterus* and coastal shrimps.



The leading cause of coral bleaching is climate change. A warming planet means a warming ocean, and a change in water temperature—as little as 2⁰ Fahrenheit—can cause coral to drive out algae. Coral may bleach for other reasons, like extremely low tides, pollution, or too much sunlight.



By the end of the century, 99% of coral reefs are likely to experience bleaching so severe as to cause coral death: we risk losing all our coral reefs.

Rising sea level (Sea Level Rise-SLR): Mean sea level is predicted to rise between 10 and 90 cm during this century, with most predictions in the range of 30-50 cm. This may destroy several coastal ecosystems, such as mangroves & salt marshes, aquaculture production, breeding programs, affect the cage and pen farming system and damage the livelihoods of communities.

Inland temperature changes: Higher inland water temperatures may reduce the availability of wild fish population by affecting water quality, worsening dry season mortality, bringing new predators & pathogens, and changing the abundance of food available to fishery species.

Changes in rainfall (Precipitation) pattern: Changes in rainfall patterns will affect aquaculture production and sustainability in two directly opposite ways; increased rainfall (Flooding) and periods of low or no rainfall (Drought). These risks include losing fish from ponds during floods, invasion of ponds by unwanted species and ponds damage. Drought events may lead to water stress, such as shortages and quality deterioration that have negative effects on aquaculture production.

Changes in Sea Surface Salinity (SSS): Salinity variations are caused by input of freshwater from precipitation, loss of water through evaporation, river runoff, rising temperature and ice freezing, melting, the mixing and circulation of ocean surface water or by climate change. Most aquatic organisms have specific salinity levels within which they can survive, any alterations may lead to mortalities.

Ocean Acidification (OA): Ocean acidification refers to the oceans becoming more acidic due to a decline in pH levels resulting from atmospheric CO₂ uptake and is often called “climate change’s evil twin”. Due to ocean acidification, more difficult for marine organisms such as shrimps, oysters or corals to form their shells a process known as calcification. Many important animals, such as zooplankton, that forms the base of the marine food chain have calcium shells. Thus the entire marine food web is being altered there are "cracks in the food chain".

Extreme events and worsening risk or Severe Climatic Events: Severe climatic events, such as cyclones, waves, and storms are expected to influence aquaculture development especially marine ornamental products, and those in coastal areas.



Changes in primary production: Climate change has altered the timing and amplitude of the seasonal cycle. While primary production has generally increased along with an intensified uptake of CO₂, some areas show a reduction in production.

Diseases and Harmful Algal Blooms (HABs): Diseases in aquaculture, such as bacterial, parasitic, viral, and fungal diseases are likely to be affected by a changing temperature regime, but in a largely unpredictable manner.

Changes in Fish Distribution: Production from capture fisheries has been stagnant during the past 10 years because of overfishing, unregulated fishing, habitat destruction and pollution; climate change may exacerbate this situation.

Major challenges to fishing communities posed by climate change: Coastal and fishing populations and countries dependent on fisheries are particularly vulnerable to climate change.

Short-Term Effects of climate change on fish harvests: We may summarize potential effects of climate change on fish harvests as follows, reduce the abundance of some species, Changes in harvests, Changes in fishing and processing employment, Changes in fish prices, Changes in fishing and processing income and profits, Changes in revenues, Social stresses and Political conflict.

Conclusion: Adverse impacts of climate change are putting enormous stresses on lives and livelihoods of the people engaged in fisheries. Developing policies and programs to improve the resilience of natural resources, through assessments of risk and vulnerability, by increasing awareness of climate change impacts and strengthening key institutions, would help the communities adapt to climate change.

- Develop knowledge base for climate change and marine fisheries
- Adapt the Code of Conduct for Responsible Fisheries (CCRF)
- Increase awareness on the impacts of climate change
- Strategies for evolving adaptive mechanisms
- Reducing energy consumption
- Low impact fishing methods and gears as ways to sequester carbon in aquatic ecosystems.

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