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Case studies on climate change impact and mitigation of India

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Abstract

Due to direct and indirect effects on natural resources, climate change will likely have both good and negative effects on the aquaculture and fishing industries. The temperature, rain patterns, freshwater shortage, circulation, upwelling, sea level rise, and sea water intrusion in estuarine areas are the key climate change factors that could have an impact on fisheries and aquaculture activities. Climate change elements that are important to the coastal and fishing populations in India. In this case studies of coastal communities' (perceived or actual) responses to climate change, including how they used traditional ecological knowledge or combined it with modern research. Policies, laws, and programmers already in place to address climate change-related challenges, particularly in respect to adaptation and mitigation strategies for fishing communities.

Key word: Climate change, Case studied, Impact, Mitigation.

Introduction

The direct and indirect effects of climate change are the key factors that could potentially have an impact on aquaculture production. The temperature changes, freshwater availability, sea level fluctuations, and an increase in the frequency of extreme events are all direct impact of climate change on fisheries (Salman, 2021). Aquatic production can be sustainable through the use of aquaculture practices. Since capture fisheries have continued to produce in an unsustainable manner, the industry is viewed as the only way to satisfy the increasing worldwide demand for aquatic products (Maulu *et al.,* 2021). The existing physical, ecological, and economical stresses on the coastal region will be made worse by climate change (Mohammed and Uraguchi, 2013). The most significant effects of climate change of the aquatic systems (like: oceans, seas, lakes, and rivers) and in especially on the elements that related to aquatic production (Barange *et al.,* 2018). Freshwater and marine fisheries are predicted to be impacted by climate change both directly and indirectly, with repercussions for ecosystems, fishing populations along the coast, and economic systems (Islam *et al.,* 2020).

Overview of the impact of climate change on fisheries and aquaculture:

The physical changes like (Water Surface Temperature Rise, Sea Level Rise Globally, Increasing Water Salinity or Ocean Acidification) and biological changes ((Phillips and Perez-Ramirez, 2017) are two major categories in which climate change's effect on fish stocks. The changes like, increases in sea surface temperature, sea level, salinity, and ocean acidification are examples of physical changes and the distribution of fish stocks and changes in primary output are examples of biological changes. These elements acting collectively will negatively affect on the resource (Cochrane *et al.*, 2009).

Studies on the Climate Change in the relevance to coastal fisheries in India:

1. ICAR: A national network project on "The impact, adaptation and vulnerability of Indian Fisheries to climate change" was carried out during on the year 2006 and they were salient findings-

- Along India's northeast, southeast, and northwest coasts, the Southern Oscillation Index had a detrimental effect on sea surface temperature. The sea surface temperature trend along the maritime nations between 1960 and 2002 revealed a considerable rise. With an increase in current year SST, sea surface temperature in the northeast coast demonstrated a negative link with total landings, demersal, cephalopod, and crustacean landings, leading to low catches in the following year. The sea surface temperature along the southwest coast showed a favorable link with pelagic and total landings, leading to high catches in the following year with an increase in the current year's SST. The distribution of oil sardines has expanded to the northern latitudes, and the capture has grown as SST has risen (Salagrama, 2012).
- Fish eggs and larvae, as well as copepods, were found in greater quantity along the Mangalore coast in the early months of the year, indicating phenological changes.
- Hooghly Estuary biodiversity shift: Due to increased freshwater discharge from the Farakka barrage, the estuary's salinity regime has shifted and a significant chunk of its middle stretch has nearly completely converted into a freshwater zone.
- For threadfin breams, spawning temperatures in the range of 28°C and 29°C may be ideal, although shifting SST may affect spawning timing.
- According to studies, coral reefs are likely to lose their reef-building corals as the dominant organisms between 2020 and 2040, and the corals are likely to become remnant among 2030 and 2040 in the Lakshadweep region and between 2050 and 2060 in the Andaman and Nicobar region.

However, these projections only took into account increases in SST; if acidity levels rise, the effects may be accelerated.

- In Andhra Pradesh, India, Network of Aquaculture Centres in Asia-Pacific (NACA) conducted a case study. The project's main objective was to map small-scale farmers' views and attitudes concerning the effects of climate change as well as their capacity for adaptation to deal with those effects. The district's shrimp farming regions were visited on December 3, 2009, and on December 4, 2009, Vijayawada hosted a stakeholder workshop (SW). Seasonal shifts, heavy rains, floods, and cyclones in the interior shrimp farming area and high temperatures, floods, low/unseasonal rain fall, low temperatures, cyclones, and low tidal amplitude in the coastal shrimp farming area were the impacts of climate change that were prioritised (Venkatesh, 2013).

4. Policies:

- **National Action Plan on Climate Change:** The Delhi Declaration (2007) required India to establish regional DRR initiatives. The effects of climate change and that practical steps should be taken in accordance with the UNFCCC and Kyoto Protocol to integrate disaster risk reduction with climate change adaptation initiatives at all levels. India's Prime Minister issued the "National Action Plan on Climate Change" in June 2008 (Pandve, 2009).
- **National Environment Policy 2006:** The subject of climate change, which affects various areas and sectors, is mentioned in India's National Environment Policy from 2006 (Czarnezki, 2006).
- **Fisheries Policy in India:** Marine fisheries inside the territorial seas are the domain of maritime states whilst fisheries beyond this boundary inside the EEZ fall under the jurisdiction of Central Government. The Central Government besides playing an advisory role also will provide financial assistance to the States/Union Territories for implementation of National capital Sector and Central Sector Schemes. The policy objectives of the Marine Fishing Policy of 2004 (Kizhakudan *et al.*, 2015).
- **National Disaster Management Policy 2009:** There are clear indications that climate change will make natural disasters like cyclones, floods, and droughts more frequent and intense in the years to come, according to Section 5.1.7 (Das, 2012).

Legislation: CRZ 2011 and Island Protection Zone Regulation 2011

The 1991 CRZ Notification was replaced by the CRZ 2011 and IPZ 2011 notifications, which were published in the official gazette on January 6, 2011. The CRZ 2011 notification is fundamentally similar to the 1991 notification, but it has some significant alterations in perspective (Sharma, 2011).

Indigenous or Traditional Knowledge to Responses to Climate Change – Case Studies

Indian fishermen's Indigenous Knowledge (IK) or Traditional Ecological Knowledge (TEK) relates to activities that aid in the planning of their fishing operations, such as predicting rains (by observing the production, movement, and colour of clouds as well as the intensity of winds), forecasting winds (direction, speed) to aid in navigation, and determining the colour of the sea and current flows during various seasons (Gómez-Baggethun *et al.*, 2013).

Concluding

One of the most crucial takeaways from this volume as a whole is that any new interventions should be planned and carried out with full consideration of this complexity and how they will affect not only the immediate targets of the actions but the system as a whole. To develop and maintain resilient and productive aquatic ecosystems, effective adaptation will be needed at all levels and in all areas of fisheries and aquaculture.

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