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Climate Change Adaptation Strategies for Sustainable Fisheries

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Abstract

As climate change continues to represent a significant danger to the environment, adapting to its negative consequences has become more important for the vocations that rely on natural resources for their livelihood. Fisher are one of the main occupational groups who are dependent on nature are expected to experience many new challenges from the changing climate. Aspects such as risks reduction, climate change knowledge, coping mechanisms, involvement in adaptation planning and access to credit are recommended to be considered because they provides synergy for climate change adaptation. It examines capture fisheries and aquaculture sensitivity and vulnerability to climate change, as well as instances of existing adaptation strategies at present. Overall these adaptation strategies are highly useful to maintain sustainable fisheries in future.

Introduction

Fishing undoubtedly depends on nature. People who engaged in this occupation are going to face many new challenges from climate change. Already fisheries worse affected by variable climate, upwelling failures, winds, cyclones and flooding. Climate change is more likely to be felt as a rise in the frequency of weather events than as a gradual increase in temperature. The prominent thing is to analyze reaction of fisheries in adaption of climate change. The best method to respond to the climate change impacts is by adapting to it. According to the European Commission (2014), the term 'adaptation to climate change' can be described as to reduce the unfavorable impacts of climate change and making the suitable action to restrict the harm that may occur or exploiting the chances that may emerge. Increased adaptation capacity decreases the detrimental effects of climate change on the environment. Sustainable livelihoods framework includes Natural capital (soil, water, air, and genetic resources), Physical capital (basic infrastructure and producer goods needed to support livelihoods), financial capital (cash, credit/debt, savings and other economic assets), human capital (skilled labors), social capital (Networks, Associations).

UNEP on Climate Change Adaption

United Nations Environment Programme terms that reducing carbon emissions is no longer enough to halt the impacts of climate change. Many countries are realizing it's time to start adapting to a warming world. UNEP has assisted over 70 projects on climate change adaptation at global, regional and national levels for over 50 countries. These projects cover four priority areas (UNEP, 2021).

• Ecosystem-based Adaptation - Implementing projects that utilize biodiversity and ecosystem services as part of a holistic adaptation strategy.

• Knowledge, analysis and networking - Spreading vital adaptation knowledge through well-connected global networks, such as the Global Adaptation Network.

• World Adaptation Science Programme - Providing an interface between the adaptation research community and decision-makers.

• National Adaptation Plans (NAPs) - Supporting countries to advance their National Adaptation Plan process.

National Action Plan on Climate Change

The National Action Plan on Climate Change (NAPCC) was launched in 2008 in order to address climate change concerns and to promote sustainable development. There are eight National Missions, which form the core of the NAPCC. They are Jawaharlal Nehru National Solar Mission, National Mission for Enhanced Energy Efficiency (NMEEE), National Mission on Sustainable Habitat (NMSH), National Water Mission (NWM), National Mission on Sustainable Agriculture (NMSA), National Mission on Green India, National Mission on Strategic Knowledge for Climate Change (NMSKCC), National Mission on Sustaining Himalayan Ecosystem (NMSHE) (Pandve, 2009).

State Action Plans on Climate Change

After the National Action Plan on Climate Change (NAPCC) was announced, all States were asked to prepare their State level action plan to deal with the challenges of climate change. 27 States and 5 Union territories (UTs) namely, Andaman and Nicobar Islands, Andhra Pradesh including Telangana, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Kerala, Karnataka, Lakshadweep, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Puducherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal have submitted their SAPCCs. Other states and UTs are in the process of finalizing the State Action Plans.

Impacts of Climate Change on Fishermen

Impact on Physical Infrastructure

The fishermen's productive physical capital such as vessels and fishing gears are vulnerable to the changing climate. Hurricanes/ Cyclones can damage fishing gears, Crafts which results in the fishermen losing their income as well as facing increasing costs of replacement and maintenance, eventually affecting fishermen's ability to continue fishing after such disasters. Because of the salt water penetration and sanitation concerns, coastal residential facilities are most likely to trigger salinization issues. Climate change also affects transport and marketing of captured fishes.

Impact on Health Conditions

The impact of climate change on the health conditions of fishermen in coastal populations also an important concern. Warmer temperatures have been associated with increasing incidence of malaria and diarrhea, respiratory diseases, morbidity and mortality related to ground-level ozone, heat stress, skin diseases and asthma. The number of dengue cases recorded has been considerably and significantly impacted by climate change. The Union of concerned Scientists has confirmed that a rise in temperature exposes the community to the dangers of allergies and asthma, heart disease.

Impact on Social Circumstances

Fishermen with smaller vessels are more vulnerable to extreme winds, waves and thunderstorms because of abnormal climatic patterns in recent years. They are not aware of such events on their fishing trips due to lag of information. The World Resources Institute (WRI) has confirmed that number of deaths increased with regard to strong winds, waves and extreme temperatures (Shaffril *et al*., 2017).

Impact on Aquaculture

Aquaculture methods are defined by location, time, and size with some maneuverability. Aquaculture takes place in three distinct environments: freshwater, marine water and brackish water. Each adapted to certain groupings of aquatic animals with distinct physiological characteristics. Climate change may have direct or indirect effects on aquaculture and not all aspects of climate change will have an influence on aquaculture. Climate change is expected to cause substantial changes in brackish water habitats, notably in terms of salinity and temperature, which will have an impact on aquaculture productivity. Present aquaculture operations might relocate farms or cultivate more saline resistant strains in response to the degree of sea level rise and the migration of brackish water. Inland temperature and salinity have interactive effects, with one impacting the other. All cultivated aquatic animal species for human use are poikilothermic, unlike other farmed animals. As a result, any change in habitat temperature, whether positive or negative, would have a major impact on general metabolism, growth rate and hence total output, reproduction, seasonality and reproductive effectiveness.

Climate Change Exposure and Sensitivity of Fisheries

Marine and freshwater fisheries are both vulnerable to the effects of climate change. Climate change poses a number of threats to aquatic systems, including the reduced area coastal wetlands, coral bleaching,

and alterations in fresh water flows (distribution and timing). According to the International Panel on Climate Change (IPCC) in 2007 and acknowledged the unpredictability of ocean acidification, which is expected to have significant consequences for marine ecosystems. The intense seasonality of many highly productive flood plain fisheries is prominent thing in socio-economics of inland fisheries by its interaction with climate change. Inland fisheries are increasingly being managed by people who do not consider themselves to be fishermen, but rather engage in seasonal fishing as a supplement to other sources of income.

Adaptation of Fisheries to Climate Change

Adaptation is a collection of techniques and behaviours used by people to improve or sustain their well-being in response to change. Adaptation involves increasing the ability of individuals and groups by building adaptive capacity. Adaptation can be implemented in response to the effects of a changing climate. If the problem is reduced yield, then we have to invest more resources into the fishery which includes spending more time at sea, increasing the number, size and efficiency of gears, fishing farther or deeper than before. If over exploitation is a problem in the fishery, such adaptation responses are bound to have negative long-term consequences. Timing and accountability can be used to conceptualize adaptation responses. Industrialized fisheries are likely to have different adaptations than small-scale fisheries. Every member of the fishing communities has to be prepared to both mitigate the climate change effects and take advantage of available opportunities to do so. Efforts should also be made to strengthen the fishermen ability to adapt to the changes which are inevitable.

In order to improve social adaptation, the following main strategies should be emphasized: (i) minimization of the risks associated with fishing routines of fishermen (insurance, communication); (ii) strengthening of social relationships; (iii) management of knowledge on changes in the climate; (iv) learning and acquisition of alternative skills; (v) involvement in the planning of adaptation to changes in the climate; and (vi) provision of credit facilities (helps to recover after disaster).

Ongoing Adaptation Interventions (SOFIA, 2020)

- Design of an integrated information system (climate change and fisheries).
- Institutional strengthening.
- Strengthening of artisanal producers' organizations.
- Monitoring of local climate change indicators.
- Thematic maps.
- Climate change adaptation recognition.
- Use of by catch.
- Algae farming in allocated areas for benthic resource management and exploitation.
- Mollusks farming in allocated areas for benthic resource management and exploitation.
- Training in improved collection of natural bivalve spats (scallops, mussels).
- Value addition to all fisheries-product landings.
- Identification of tourism-related options.
- Artificial reefs.
- Awareness raising of coastal communities.

Table 1: Some potential adaptation measures

Sl. No.	Impact on fisheries	Potential adaptation measures
1	Reduced productivity	Approach market with higher value, fishing effort should increase
2	Trade and market shocks	Diversification of markets and products
3	Increased risks associated with fishing	Insurance, weather warning systems, compensations.
4	Fisheries distribution changes	Improving technologies to ensure availability of fish stocks in particular area.
5	Increased variability of yield	Precautionary management for resilient ecosystems

Chile Takes Action

Due to its low-lying coastal regions, Chile is extremely vulnerable to climate change. The combination of overfishing and variability in environmental conditions are having social and economic effects, with food-security implications, on Chile's fisheries and aquaculture communities Launched in 2016, Strengthening Chilean Fisheries and Aquaculture Sector adaptive Capacity to Climate Change is a project sponsored by the Global Environment Facility and implemented by FAO. Stakeholders from the public and private sectors (central and regional officials and regulatory bodies) are also actively involved.

Coping Mechanisms in Aquaculture

Most aquaculture farmer's adaptation responses are coping mechanisms, and they are based on a variety of factors, including adaptation strategies awareness, early-warning information to the farmers, credit access and extension consultant workshops and conferences. The documented responses to flooding are building higher pond dikes, netting and fencing around the low elevated ponds, community-based flood protection and changing

stocking dates. Drought-related responses have included pumping out groundwater, changing fish culture, and rainwater harvesting (Galappaththi *et al*., 2020).

Common Adaptive Strategies in Aquaculture

Future Benefit Strategies

Flood protection and water storage functions can be restored by restoring ecosystems. Provide a wide spectrum of breeding for greater heat tolerance. Through research and development the following measures have to be ensured:

• Introduction of innovative technologies at the farm level to enhance water productivity.

• Providing financial assistance for community based participation in watershed management.

• Improving climate risk information systems and accessibility through research and development.

• Installation of rainwater harvesting tanks and harvested rain water should be used for fish culture and pond-dike farming.

Easier-Early Strategies

Participate in zone production to ensure that aquaculture has enough water. Support integrated water resource management that recognizes the importance of aquaculture. Participate in value-added processing on the farm. Reduce input costs and reliance on input providers by repurposing trash and integrating resources into the farm. Set up early-warning systems to gather data on floods, droughts, and heat waves. Create mutual or weather-indexed aquaculture insurance. To increase farm pricing, develop new export markets and reinforce current markets for farmed fish products. Develop standards to enhance the management of climate and water-related risks.

Upfront Strategies

Install water treatment equipment in storage ponds using recirculating technology, and construct large-scale water storage and infrastructure development to cater for aquaculture water requirements. Create a flood-protection dike around the aquaculture pond. Avoid high-risk locations and relocate the manufacturing site to a less-risky place. Look for floodplain aquaculture options.

Conclusion

A key role should be played by fisheries extension services in the practical implementation of policies for climate change adaptation by small-scale fishing communities. Using such services, research organizations and higher education institutions can focus on specific research needs and help provide transfer of knowledge and skills to the fishing communities within the irrespective regions. Such co-operation and collaboration can help fishermen to be better prepared for the future. Uncertainty in the nature causes stress and shocks to fisheries as a result of climate change. Investing in general adaptive capacity and resilient fisheries systems appears to be a good strategy for supporting future. Fisheries with better management and more versatile and egalitarian organizations are supposed to be more adaptable.

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