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# **Sustainable Resource Management**

## **Tools and Techniques**



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# **ENHANCING RESILIENCE TO ADVERSARIES OF CLIMATE CHANGE: A FISHERY PERSPECTIVE**

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## **Introduction**

Climate change is perhaps one of the most important issues confronting the global community and associated debates have intensified over the last decade, most recently with the submission of the final findings of the Intergovernmental Panel on Climate Change (IPCC, 2007). United Nations Framework Convention on Climate Change (UNFCCC) defines Climate change as “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods”. Today, climate change is a growing concern across the globe, due to its multidimensional impact upon the environment and human populations. Marine ecosystems are influenced by changes in their physical and biological environment at all timescales and we have evidence of the consequences from palaeological and archaeological records (Enghoff et al., 2007). Climate change can impact fisheries through multiple pathways like changes in water temperature, precipitation and oceanographic variables, such as wind velocity, wave action and sea level rise, which can bring about significant ecological and biological changes to marine and freshwater ecosystems and their resident fish populations directly impacting peoples whose livelihoods depend on those ecosystems.

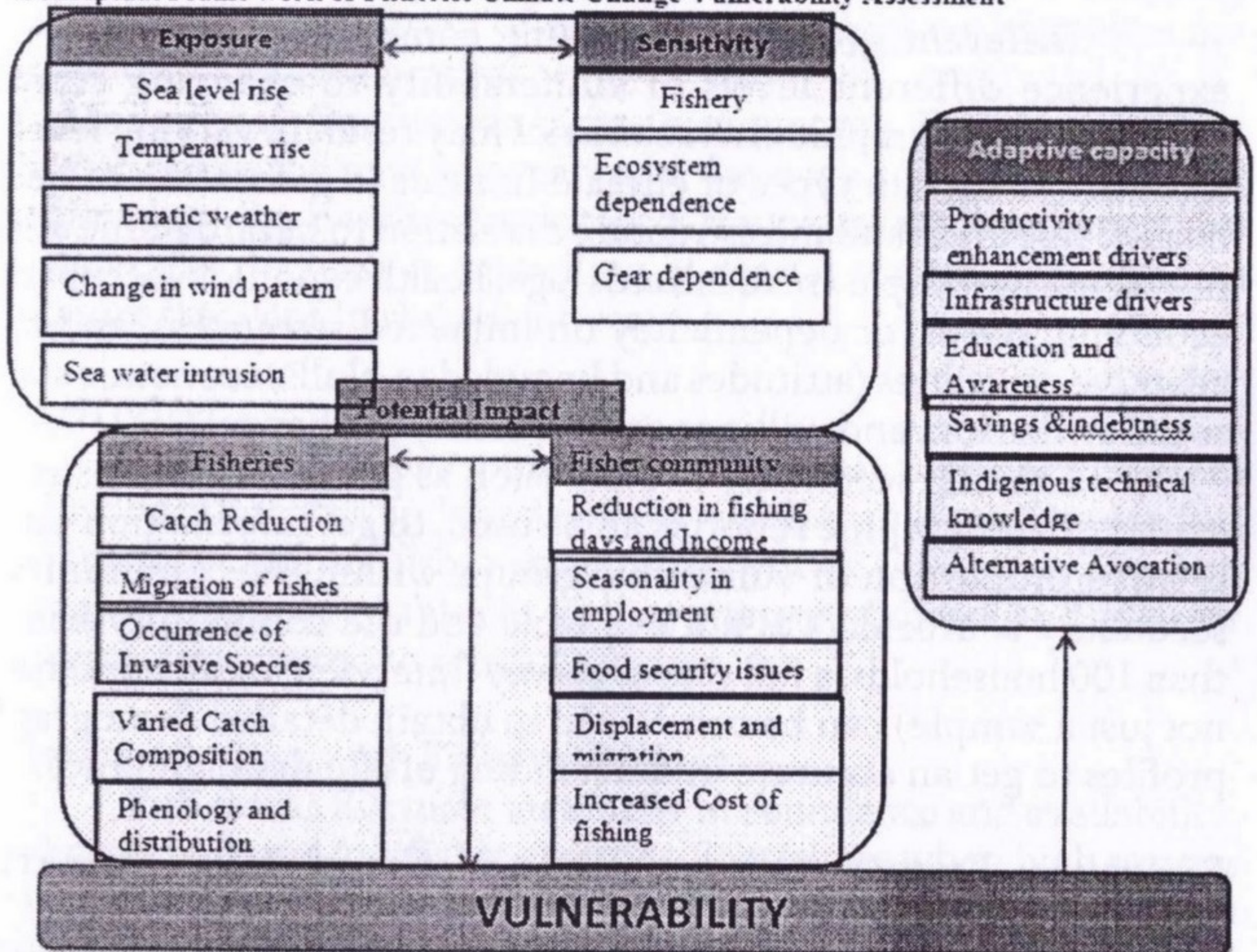
Fisherfolk depend major part of their livelihood on natural resources whose distribution and productivity are known to be influenced by climate dynamics (Allison et al., 2005). Many fisheries worldwide have declined sharply in recent decades due to heavy fishing pressures like overfishing and overexploitation, and many major fishing grounds are concentrated in zones threatened by pollution, mismanagement of freshwater and habitat, and coastal zone



modifications. The need for food security arises primarily due to the fluctuation in food plan and non-availability of sufficient food from domestic sources (Shyam et al., 2014).

The fisheries sector incorporates a diverse range of livelihood activities, from production and processing to marketing and ancillary functions, but many of the people engaged in these activities remain unrecognized as fish workers. Fisher households were dependent on coastal and marine goods and services to a great extent, which serve as an important indicator as to how sensitive they could be in relation to climate events. Though the physical exposure can significantly influence vulnerability for both human populations and natural systems on the coast, the lack of adaptive capacity is often the most important factor that creates a hotspot of human vulnerability. According to shyam et al., 2013, the fisher populations with better livelihood security have diversified their income sources beyond fisheries, the major ones being labour, agriculture, and business and non-farm activities.

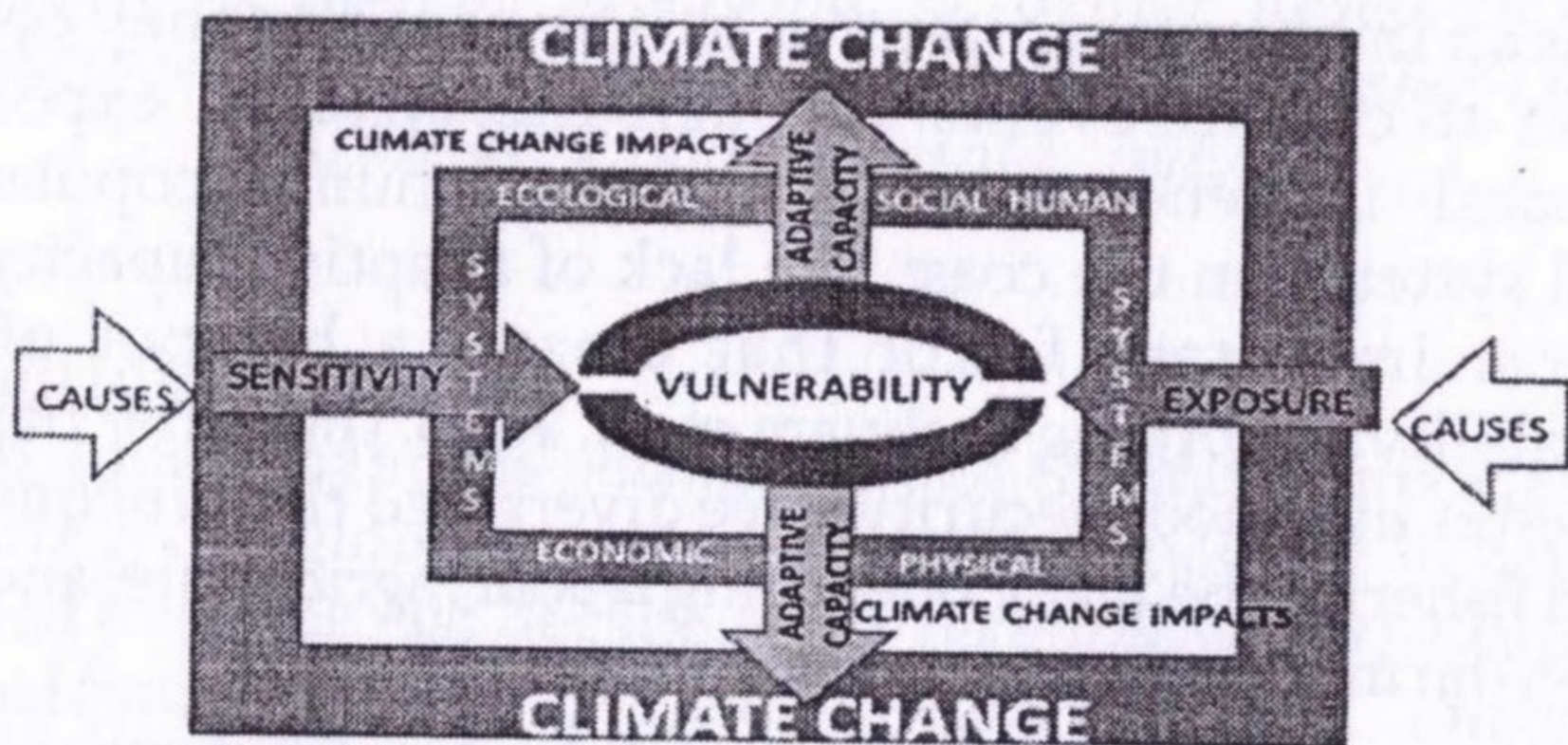
Conceptual Frame work of Fisheries Climate Change Vulnerability Assessment



(Modified form IPCC climate change vulnerability frame work)



According to Adger (1999) vulnerability is the extent to which a natural or social system is susceptible to sustaining damage from climate change. It is generally perceived to be a function of two components. The effect that an event may have on humans, referred to as capacity or social vulnerability and the risk that such an event may occur, often referred to as exposure.



Different groups in the same community or region may experience different levels of vulnerability to changing climate. Particular demographic characteristics may result in varying levels of exposure to certain types of climate hazards (e.g. location of home, needed resources and infrastructure in relation to hazard prone areas), how sensitive people are to hazards (age, health condition, occupation, economic status, or dependency on impacted resources), and their adaptive capacities (attitudes and knowledge, skills, economic status, social affiliation, and willingness and ability to change).

Existing secondary sources such as government census and existing demographic reports can be used, to get information on the relative proportion of vulnerable groups within the community. If secondary source data is not available and the community has less than 100 households, a full census survey (interviewing all households, not just a sample) can be conducted to obtain detailed demographic profiles to get an accurate understanding of site demographics.

**Exposure:** Expected fluctuations in the climate of marine ecosystem

The impact of Climate change is sensed in the marine ecosystem through different ways like increase in sea level, extreme weather events, destruction of habitats (Mangroves, Corals, Seagrass



bed, Wetlands/ etc), Seawater Inundation, Monsoonal fluctuation/ Erratic monsoon etc

- a) **Sealevel:** There is considerable rise in the sea level over the past years which resulted in submergence of low lying wetlands and dry lands, increase in considerable amount of coastal erosion and accretion which in turn had led to habitat shift.
- b) **Extreme Weather events:** There is considerable intensification in the severity of floods and droughts, occurrence of cyclones, uncertainties in daily temperature.
- c) **Habitat destruction:** The area under mangroves /seagrass beds have considerably abridged which resulted in decrease in juveniles seen in mangroves, and increase in coral bleaching events leads to loss of coral reefs and also loss of coral dwelling fishes. The area under wetlands also has considerably reduced.
- d) **Seawater Inundation:** Freshwater sources are seriously affected due to climate change. Groundwater consumption has become difficult consequent to seawater inundation. Productivity of the cropping system has diminished and there is shift in cropping pattern due to inundation of salt water. The highest high tides are higher than the last decades.
- e) **Monsoonal fluctuation/Erratic monsoon:** Erratic monsoon was noticed in the past few years and there is a substantial decrease in rainy days. Species distribution/occurrence has shifted; there is also considerable decrease in upwelling of coastal waters. Algal blooms are more frequent in the recent years.

## **Sensitivity**

Sensitivity reflects the responsiveness of a species or system to climatic influences, and the degree to which changes in climate affect current form. Marine fish communities will be directly exposed to changing climate variables as well as a range of direct and indirect ecosystem responses to climate change.

## **Climate change and Fishery impact**

Fish stocks fluctuate seasonally in abundance and availability, leading to high and low fishing seasons. Sometimes when high seasons coincide with the seasonal low there is a dearth of marine fishes, in such cases availability of other food sources such as agriculture, inland fisheries can increase food security. The impact of Climate change is affecting the fishery through different ways like changes in phenology and distribution, species composition, loss in fishery inventory etc.



a) **Phenology and distribution:** There is a changes in timing of ecological events, which could alter the biological success of those events (drastic shift in spawning season of major fishes, Fishes attain maturity at lower size than in the past). The occurrence of brooders/ young ones have decreased over the years. Coastal fishes have migrated to open sea. Pelagic fishes have moved to deeper waters. There is redistribution of stocks and species, usually but not always from lower latitude warmer and shallower nearshore waters, to higher latitudes with deeper and cooler temperature waters.

b) **Species composition:** There is a significant change in the species composition. In some places new fishery has emerged/ while some species decreased in abundance. Occurrence of invasive fishes is more these days, some of the fishes caught in yester decade are not available, the by-catch has increased over the years. Altered trophic level interactions, causing decreases (or increases) in abundance of valued species as well as of their predators and competitors.

c) **Catch:** The catch has decreased drastically over the years. The effort has increased fairly. The fishing ground has changed and the fishes are not available from the areas where they were abundant once.

### **Climate change and Social and Economic impact**

In general fisher communities are emotionally attached to their living environment as their livelihood is heavily dependent on sea .The impact of climate change in marine resource users includes, displacement of family members, food security issues, Migration of fisherfolk, fall in income level, seasonal employment, change in employment pattern, increased fishing cost, reduction of fishing days etc.

a) **Demography and Social standards:** Displacement of family members increased over the years, the young generation has a tendency to move out of fishing, Food security issues increased rapidly in recent years. Disguised unemployment is rampant in all sectors since earnings from marine fisheries are not proportionate to the increase in fishers. This has instigated labour migration induced by the earning potential in the distant waters coupled with limited resources in their vicinity

b) **Infrastructure sensitivity:** Increased frequency and severity of storms or weather, and sea conditions are ,unsuitable to fishing as



well as damaging to communities on shore through flooding, erosion, and storm damage. There is proximity to hazard areas the fisher household are highly prone to disaster dwellings and the property loss increased over the years.

c) **Income Effect:** The income levels of fishers decreased substantially over the years. The employment pattern has been mostly seasonal, and alternate avocation options are minimal, there is also economic loss due to loss in number of fishing days. Changed fishing ground caused increased cost of fishing and fish storage. The fuel cost, the cost of fishing gear and boat are increasing significantly over the years.

### **Adaptive Capacity**

The adaptive capacity of marine fisheries refers to the potential for species or systems (both natural and social) to adapt to changes in variability and extremes of climate, so as to maximize fitness, moderate potential damages, take advantage of opportunities and/or cope with consequences. Ecological indicators of fisheries adaptive capacity include stock status, reproductive potential, and influence of existing pressures, such as overfishing and pollution. Socioeconomic indicators of fisheries adaptive capacity include national life expectancy, education, governance, size of economy (Allison et al., 2009), and resource dependence.

### **Climate change Vulnerability**

Based on the vulnerability framework, marine fisheries most at risk from climate change are those fish stocks that experience the greatest ecological impacts due to their high exposure and sensitivity to changing ocean climate, have compromised resilience due to other pressures (such as overexploitation), and limited ability to adapt due to resource dependence and weak economies. Fisheries with stocks that have low exposure and sensitivity to changing climate conditions, coupled with high adaptive capacity, will have low vulnerability to climate change (Johanna and David., 2009)

### **Climate change awareness, preparedness and mitigation**

- Create awareness among the fisher community related to climate change: Facilitate Community involvement and mobilization to cope up with climate change. Explore Climate Change Indigenous Technical Knowledge



- **Provide Alternative Avocation Options:** a) If there is reduced profitability in fisheries, exit the fishery, or focus on other ways to maintain profits or explore for other alternative employment in order to diversify livelihoods b) If there is reduced yields in fishery access higher value markets/shifting targeted species, Increase effort or fishing power c) Aquaculture development
- **Increase Level of Government Support and Requirement:** a) Invest in improved vessel stability, safety and communications to cope up from dangers arising during fishing b) Engage with insurance schemes c) Fisheries management frameworks should be formulated which helpful in sustainability in fisheries d) Provide support for technological developments facilitating adaptive measures and Disaster preparedness and ensure policy coherence
- **Infrastructure drivers:** Vulnerability of infrastructure and communities to flooding, sea level rise and storm surges: Add new or improved physical flood and coastal defences, Managed retreat/accommodation, Rehabilitate infrastructure, design disaster response, Set up early warning systems, .Strategies for infrastructure (ensuring there are safe havens, and climate proofing developments).
- **Technological drivers:** a) Technical innovations to reduce fuel usage and emissions in fishing vessel engines b) Promotion of fuel-efficient fishing methods (e.g. static methods rather than trawling), through differential licensing conditions and/or decommissioning support c) Improvements in building design and handling practices e.g. through better insulation in ice plants, freezing plants d) Environmentally-friendly' technologies should be promoted
- **Ecological drivers:** Eco restoration process has to be promote through Mangrove protection/replanting, due to its role in carbon sequestration.

## **Conclusion**

Fisheries are vulnerable to over-exploitation of the resource, which can result in the loss of benefits that can be derived from them. The demands of growing populations will require substantial increases in aquatic food supply in the next 20 to 30 years, during which climate change impacts are expected to widen and increase. In the face of these impacts and the existing development and management constraints, the primary challenge for the sector will be to deliver food supply, strengthen economic output and maintain and enhance food security while ensuring ecosystem resilience. This will



require concerted, collaborative and determined action across all stakeholders, linking private sector, community and public sector agents. We should identify management arrangements and actions that support livelihood strategies and contribute to reducing the vulnerability to risks of poor people dependent on fisheries. Therefore management must control exploitation so that the fish stock is sustainable.

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