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IMPACT, ADAPTATION AND VULNERABILITY OF MARINE FISHERIES TO CLIMATE CHANGE: A CASE STUDY OF KERALA

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ABSTRACT

"Climate Change is the greatest ecological, economic and social challenge of our time".

Climate change has been attracting growing attention for its immediate and potential impacts upon the environment and human populations. Marine and coastal ecosystems are considered to be extremely vulnerable to climate-change processes such as ocean warming and sea-level rise, which have a direct impact upon the lives and livelihoods of coastal fishing communities. Local adaptation to climate change impacts are increasingly observed across communities. This study is focused on the assessment of vulnerability to climate change and documents the adaptation practices relevant to Marine Fisheries of the Kerala state in India. The study aims to provide a background to fisheries in Kerala with focus on seafood export from the State using commodity, quantity, and value.

KEYWORDS: Vulnerability, Adaptation, Fishing community, Climate change, IPCC, Export fish products, FAO.

INTRODUCTION

The most important aspect of this change is that the average temperature of the Earth is raising, slowly but steadily, as a consequence of the emission of greenhouse gases (GHGs) and their increasing concentration in the atmosphere. The earth's climate is frequently changing and leading to degradation of biodiversity, water and soil resources, desertification, coastal erosion, decrease in agricultural productivity etc. As per the Intergovernmental Panel on Climate Change (IPCC), climate change refers to any change in climate over time, either due to natural variability or as a result of human activity (IPCC 2007b). Climatic changes are likely to impact the geographic distribution and mortality of marine organisms. Depending on the mobility of the species, the area they occupy might expand or shrink. Any distributional changes will directly affect the nature and abundance of fishes. Fish spawning is especially sensitive to temperature, and several species of marine fish are known to spawn only at a particular water temperature. Climatic changes are already affecting the

availability, behaviour and distribution of some commercial fish.

REVIEW OF LITERATURE

Sathaye et al., (2006) argue that from the perspective of a developing country like India, a sustainable development agenda will be the prudent way to address the concerns over climate change. ***(Grover, 2004),*** Global warming and climate change are often interchangeably used and understood. However, these terms are not identical. Climate change includes both warming and cooling conditions while global warming pertains only to climatic changes related to increase in temperature. ***(IPCC, 2007a),*** The climatic system is a complex interactive system consisting of the atmosphere, land surface, snow and ice, oceans and other bodies of water and living things. The atmospheric component of the climatic system most obviously characterizes climate. It is often defined as 'average weather'. Climate is usually described in terms of the mean and variability of temperature, precipitation and wind over a period of time ranging from months to millions of years. ***(IPCC 2007b),*** The UN Framework Convention on Climate Change (UNFCCC) refers to climate change as a change that is attributable directly or indirectly to human activity that alters the composition of the global atmosphere in addition to the natural climate variability observed over comparable periods of time.

OBJECTIVES OF THE STUDY

- Assess perceptions of fishing communities about the impact of climate variability/ change on their lives and livelihoods.
- Identity adaptation and mitigation measures that may need to be adopted by fishing communities and the State in relation to climate change.
- Propose measures to protect the lives and livelihoods of small-scale fishing communities in the context of climate-change policies and programmes at different levels.
- To assess the vulnerability of the Marine Fisheries to climate change.

1.INDIA FISHERIES DEVELOPMENT

Marine fisheries have very important roles for food supply, food security and income generation in India. About one million people work directly in this sector, producing 3.1 million tonnes annually. The fisheries sector, presently contributes around one percent to the GDP and 4.72 percent to Agricultural GDP of our country (Sathiadhas *et al.*, 2012). The marine fish landings of India during the year 2010 has been estimated as 3.07 million tonnes (Table 1) with a decrease of about 1.31 lakh tonnes compared to the estimate for 2009.

Table: 1 Profile of Marine Fisheries in India

Component	Profile
Physical Components	
Coastline length (km)	8129
Exclusive Economic Zone (million km2)	2.02
Continental shelf area (million km2)	0.5
Area within 50m depth (million km2)	0.18
Human Components	
Marine fisher population (million)	4
Active fisher population (million)	1.5
Infrastructure Components	
Landing centres	1511
Mechanized vessels	72559
Motorized vessels	71313
Non-motorized vessels	50618
Fish Catches	
Annual landings (2010) (million tonnes)	3.07
Potential yield (million tonnes)	3.92

Source: CMFRI, 2010

Fisheries and aquaculture make crucial contributions to the world's wellbeing and prosperity. According to the FAO, Fisheries and Aquaculture Department 2012, in the year 2010, the total fisheries and aquaculture supply in the world was about 148 million tonnes of fish (with a total value of US$217.5 billion) out of which about 128 million tonnes were utilized for human consumption. As, our study is based on Kerala perspective fishery, in the below Table-2 represents production fish over the years, how marine and inland fishery flocculates in global and national sphere.

Table: 2 Total Fish production (Inland & Marine) Lakhs tonnes

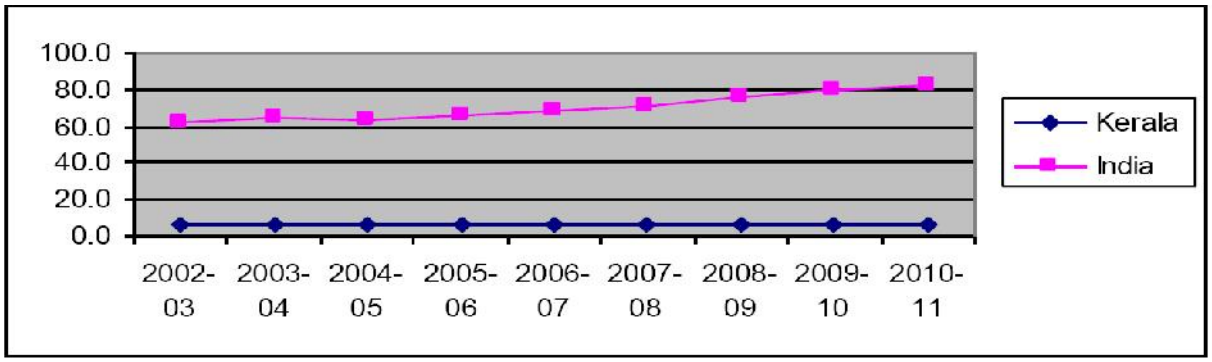
Inland Production						
	2006	**2007**	**2008**	**2009**	**2010**	**2011**
World	98000000	100000000	102000000	104000000	112000000	115000000
India	37.55	38.45	42.07	46.39	48.1	50.7
Kerala	0.78	0.8	0.91	1.03	1.17	1.21
Marine Production						
	2006	**2007**	**2008**	**2009**	**2010**	**2011**
World	802000000	804000000	795000000	792000000	774000000	789000000
India	28.16	30.24	29.2	29.78	31.03	32.2
Kerala	5.59	5.98	5.86	5.83	5.7	5.6
Total production						
	2006	**2007**	**2008**	**2009**	**2010**	**2011**
World	900000000	903000000	897000000	896000000	886000000	904000000
India	65.71	68.69	71.27	76.17	79.13	82.9
Kerala	6.37	6.78	6.77	6.86	6.87	6.81

Sources: FAO Fisheries and Aquaculture and Department of Fisheries Kerala.

2. AN OVERVIEW OF THE FISHERIES SECTOR IN KERALA

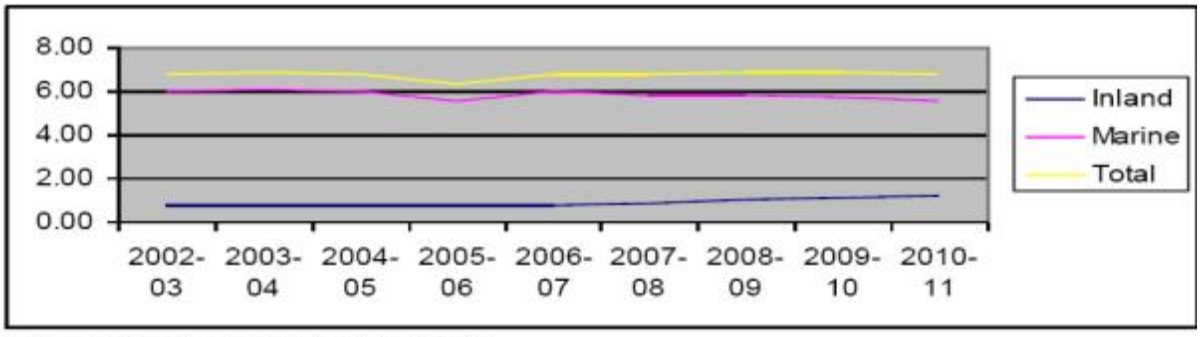
In Kerala, fishing industry occupies an important position in its economy. Kerala's share in the national marine fish production is about 20-25%. The water resources of the state comprise of coastline of 590 km length. Fisheries sector contribute 3% of the GSDP of the state. The share of Kerala is 8.2% to India on total fish production.

Fig-1 Total Fish production in India and Kerala from 2002-2011



The above Fig-1 represents, total fish production in Kerala is declining over the years, whereas in the national prospective, the total fish production of India is rising after 2006-07. However, it is noticeable that during 2010-11, 5.6 lakhs tonnes of marine fish were produced in Kerala showing decrease of 0.10 lakhs tonnes (1.75%) than the previous year. The below Fig-2 shows the inland fish production has risen from 2007-08, while the marine fish production tends to fluctuate.

Fig-2 Fish production in Kerala (2002-2011) in lakhs tonnes



Sources: Department of Fisheries Kerala

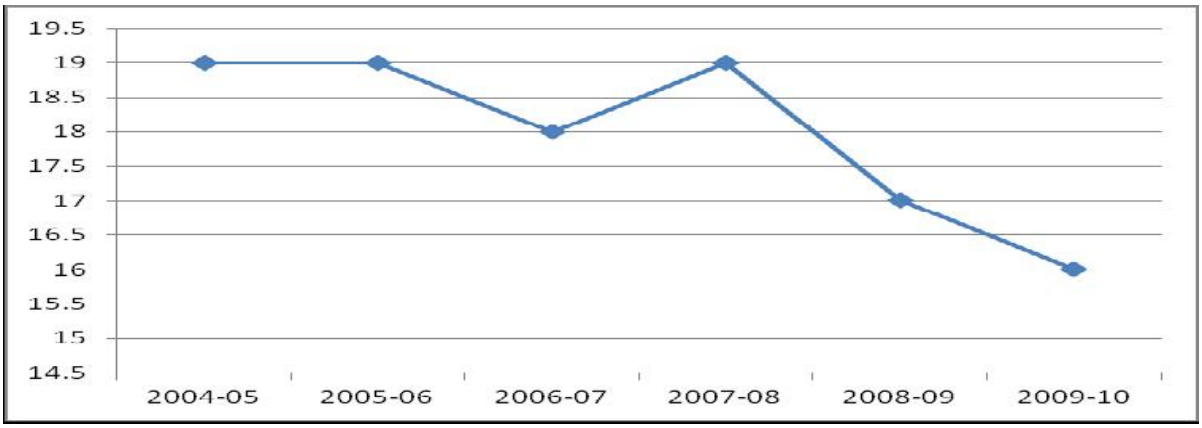
2.1 Marine fishing in Kerala:-

Kerala is coastal state and is bordered on the west by the Arabian Sea consisting rich marine flora and fauna. The share of marine fish production in Kerala contributes 82% of the total fish production of Kerala. On the contrary, India's marine fish production is 45% that contributes the total fish production. Gradually, over the years (shown the above Fig-2) marine species are diminishing.

2.2 Export of Marine Products in Kerala:-

During 2010-11 the share of marine fish production to the total fish production of the statewas 82% and is one of the major contributors to foreign exchange earnings through sea food exports. Of the 10 lakh active fishermen spread over nine coastal states, 2.5 lakh fishermen belong to Kerala. During 2009-10 Kerala export on marine products 15.8% to India's marine products. The percentage share marine export product of Kerala over India is decreasing. This is shown in the below Fig-3.

Fig-3 Percentage share marine export product of Kerala over India



Sources: Department of Fisheries Kerala

2.3 Kerala fishing communities:-

The fishing communities of Kerala also depend on seafood exports for their livelihood. Fishermen population in Kerala is about 11.52 lakh out of 33.38 million of the total population. The Government of India and other agencies have already put forces in improving Kerala fishing scenario, by implementing schemes and programmes like Housing Scheme, Matsyakeralam, Insurance cover for fishing implements, Pension to fishermen, modernization of country crafts, purchase of fishing nets, saving cum relief scheme for the poor fishermen.

3.VULNERABILITIES OF CORALS

Kerala is specifically vulnerable to the changing climatic dynamics owing to its location along the sea coast and steep gradient along the western slopes of the Western Ghats.

- ★ Extreme intensity precipitation can cause heavy damage to the otherwise productive and fertile soils due to heavy runoff and resultant erosion.
- ★ High quantum of water use in uplands and midlands from surface water resources as well as ground water resources increases the incidence of salinity intrusion in the coastal areas.
- ★ Paddy cultivation being mainstay of food security is especially vulnerable to climatic extremities and unpredictability.
- ★ High population density in coastal areas adds to the vulnerable to the vagaries of coastal erosion, sea level rise, tsunami like recurrences and livelihood concerns as impact of commercial fisheries activities.
- ★ On human development aspects, high population density and high state of urbanization results in high per capita energy needs and thus carbon intensity. Sea

level rise may shrink the habitats by coastal erosion, flooding of productive agricultural areas and ingress of salinity, risking the sustainability of habitation.

★ The rapidly expanding infrastructure development in the state as well as large proportion of goods and traffic movement through road transport has been a cause of increasing quantum of carbon based emissions in the state.

4. OPTIONS FOR FISHERIES SECTOR FOR ADAPTATION

4.1 Tackling Overfishing: The impact of climate change depends on the magnitude of change, and on the sensitivity of particular species or ecosystems (Brander 2008). Fish populations are facing the familiar problems of overfishing, pollution and habitat degradation. Food and Agriculture Organization has estimated that about 25% of all fish stocks are overexploited and 50% are fully exploited (FAO 2007).

4.2 Develop knowledge base for climate change and marine fisheries: As the ability to sustain fisheries will rest on a mechanistic understanding of the interactions between global change events and localized disturbances, it is important to recognize the regional responses to climate change. Hence, considerable effort should be made for gathering historical climatic and oceanographic data in addition to monitoring these key parameters to suit climate change research.

4.3 Cultivation of Sea Plants: Sea plants are excellent carbon sequestration agents and many of them sequester at a rate better than their terrestrial counterparts (Zon 2005). CO2 sequestration by the common sea plants such as the red algae *Gracilaria corticata* and *G.edulis*, brown alga *Sargassum polycystum* and the green alga *Ulva lactuca* has been qualified in laboratory studies in India by Kaladharan *et al.* (2008). The seaweed *Kappaphycus alvarezii* has been collected and experiments are in progress. Initial results suggest that the seaweed has good carbon sequestration potential (CMFRI, 2010).

4.4 Cultivation of Halophytes: In coastal areas and mudflats near the sea, where the salinity does not allow farming of the usual food crops, plants that grow and flourish those conditions are advocated.

4.5 Adopt Code of Conduct for Responsible Fisheries: Reducing fishing mortality in the majority of fisheries, which are currently fully exploited or overexploited, is the principal means of reducing the impacts of climate change (Brander, 2007). Hence, some of the most effective actions which we can take to tackle climate impacts are to deal with the old familiar problems such as overfishing (Brander, 2008), and adapt Code of Conduct for Responsible Fisheries and Integrated Ecosystem-based Fisheries Management (FAO, 2007).

4.6 Increase awareness on the impacts of climate change: Specific policy document with reference to the implications of climate change for fisheries needs to be developed for India. This document should take into account all relevant social, economic and environmental policies and actions including education, training and public awareness related to climate change.

5. KEY CLIMATE-CHANGE FACTORS AFFECTING FISHERIES

A summary of the key changes relating to each climate-change/variability issue is provided from the fishers' perspectives.

5.1 Sea-Level rise: The increase in sea level is reported to manifest itself in a number of ways, affecting waves, currents and bottom pressure in the nearshore regions.

5.2 Sea-Surface temperature: Sea-surface temperature is considered to be an indicator of ocean variability as well as more complex ocean processes.

5.3 Sea-Surface salinity: Sea-level rise could mean incursion of sea water into the

coastal and upstream areas, making groundwater more saline, harming freshwater fisheries, aquaculture and agriculture, and limiting industrial and domestic water uses.

5.4 Wind patterns: The wind velocities have reportedly decreased, which is reported to have impacted upon the currents, upwelling processes, fish movements, navigation and fishing effort.

5.5 Seasonality and seasonal patterns: The fishers are as dependent on the monsoons as the farming communities, and the consequences of a poor or delayed monsoon are just as hard for them. The monsoons have become quite irregular and playing hide-and-seek which affected the fish availability.

5.6 Rainfall: Within a year, rainfall is not spread evenly through a season; the entire annual rainfall occurs within a very short period, creating problems, both immediate (swamping) and long-term (reduced upwelling).

5.7 Natural disasters: Ocean warming plays a major role in sea-level rise, intensified cyclone activity and heightened storm surges. For the fishers, especially in Kerala, the unique—but devastating—tsunami of 2004 is a major indicator of climate change.

5.8 Tidal action: Changes in tidal action are felt particularly in the estuarine regions, and evidence of both increase and decrease in tidal amplitude has been reported in the Kerala state. An important (natural) phenomenon appears to be the fluctuations in tidal cycles based on the lunar phases.

5.9 Mud flows and Turbidity: Mud flows from upstream, which carried soil and nutrients to the lower reaches of the rivers, have declined in Kerala state, which decrease the nutrient content in the coastal waters, with consequences on fish breeding and nursery grounds. Turbidity has also been reported to have increased due to construction activities on, or near, creeks and beaches; oil spills from rigs and passing ships; and intensive drilling activities on the sea bed.

5.10 Shoreline changes: Erosion, which is reported to affect 23 per cent of the shoreline along the Indian mainland (Vivekanandan, 2011), is a major threat faced by many fishing communities in Kerala state.

CONCLUSION

Climatic changes are likely to impact the geographic distribution and mortality of marine organisms. Any distributional changes will directly affect the nature and abundance of fishes. Climatic changes are already affecting the availability, behaviour and distribution of some commercial fish. The study suggests in relevance to Kerala fishing scenario, there is an urgency to carry out sea-friendly fishery practices to be adopted soon considering the global decline in the marine fisheries production. However, while doing the same, there should proper checks and balances, as a large number of populations have been dependent of fishing historically and therefore, livelihood concerns of the poor fishermen should be kept in mind. In the context of Kerala, it is hard to build as new structure of fishing in Kerala, as the rural fishing community is based on traditional thought in fishing. Therefore, it is imperative that some inclusive growth within the traditional fishing sector should be enhanced, by providing improved livelihood opportunities, that way they can earn high income and better life.

REFERENCES

1. *A. Arivudai Nambi and Chandra Sekhar Bahinipati, (2012), "Adaptation to Climate Change and Livelihoods: An Integrated Case Study to Assess the Vulnerability and Adaptation Options of the Fishing and Farming Communities of Selected East Coast Stretch of Tamil Nadu, Asian Journal of Environment and Disaster Management, Research Publishing Services, Vol. 4, No. 3, pp 297–321, India,*
2. *Anna Ranuzzi and Richa Srivastava, (2012), "Impact of Climate Change on Agriculture and Food Security" ICRIER Policy Series, No. 16.*
3. *Brander, K.M. (2008), "Tackling the old familiar problems of pollution, habitat alteration and overfishing will help with adapting to climate change", Marine Pollution Bulletin, 56, 1957-1958.*

4. *CMFRI, (2010), "Annual Report 2010-11", Central Marine Fisheries Research Institute, Cochin, India, p. 126.*
5. *E Vivekanandan and R Jeyabaskaran," Impact and adaptation options for Indian marine fisheries to climate change", Central Marine Fisheries Research Institute, Cochin, Kerala, pp-107-117.*
6. *FAO, (2007), "State of World Fisheries and Aquaculture", Food and Agriculture Organization of the United Nations, Rome, p 153.*
7. *IPCC (2007), "Impacts, Adaptation and Vulnerability summary for policy makers", Working Group II, Fourth Assessment Report, Intergovernmental Panel on Climate Change, pp 16.*
8. *J Sundaresan and Lavkush Kumar Patel, (2011), "Climate change impact – A novel, initiative for Kerala", Indian Journal of Geo-Marine Sciences, New Delhi, Vol. 40(4), pp. 483-486.*
9. *K N Ninan and Satyasiba Bedamatta, (2012), "Climate Change, Agriculture, Poverty and Livelihoods: A Status Report", The Institute for Social and Economic Change, Bangalore, ISBN 978-81-7791-133-6.*
10. *Kerala Environment Congress – (2012), Edited by Rani Mary George and Syda Rao G, "Marine Fishery Development and Climate Change", Centre for Environment and Development, Thozhuvancode, Vattiyoorkavu, Thiruvananthapuram, Kerala.*
11. *Rajlaxmi Mohanty, (2013), "Review on Fishery in Kerala Perspective", National Council of Applied Economic Research, New Delhi.*
12. *Response to climate change: Strategy and action, Kerala state action plan on climate change, Department of Environment and Climate Change, Government of Kerala, Thiruvananthapuram.*
13. *Sathiadhas, R. and Narayanakumar, R. (2001), "Environmental Economic Analysis of Inshore Fishery Resource Utilization of Coastal Kerala'. Final Report, EERC Working Paper Series: MES-3, CMFRI, Kochi.*
14. *Venkatesh Salagrama, (2012), "Climate Change and Fisheries: Perspectives from Small-scale Fishing Communities in India on Measures to Protect Life and Livelihood", Ed, by KG Kumar, International Collective in Support of Fish workers, Chennai, ISBN 978 93 80802 06 0.*
15. *Vivekanandan E and M Rajagopalan, (2009), "Impact of rise in seawater temperature on the spawning of threadfin breams", In: Aggarwal PK (Ed.), "Impact, Adaptation and Vulnerability of Indian Agriculture to climate change", Indian Council of Agricultural Research, New Delhi.*