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CLIMATE CHANGE-IMPACT ON FISHERIES

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Abstract: Marine capture fisheries are already facing multiple challenges due to overfishing; habitat loss and weak management are poorly positioned to cope with new problems stemming from climate change. In India 14 million people depend on fisheries and aquaculture as a source of income. Indian fisheries are increasingly contributing to the nutritional security of the country. Indian fisheries occupy the second position in global fish production also at risk, threatening the food supply and livelihood of poorest population. Fish farming will also be affected nearly 65 percent of aquaculture is inland and concentrated mostly in the tropical and subtropical regions of Asia. Often in the delta areas of major rivers at the mid to upper levels of the tidal ranges. Sea level rise over the next decades will increase upstream salinity, affecting cop farming.

Keywords: Fisheries contribution, warming, NPP, impact, ecosystem.

1. Introduction

The earth's climate is showing perceptible changes on both global and regional scales. There is no doubt that fisheries are already a vulnerable sector facing wide spread and often profound changes. Climate changes and it is warming effects are now being felt across many parts of the world including India. Climate change could represent an additional stress on ecological and socio-economic system that is already facing tremendous pressure due to rapid

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urbanization and economic development. The unequivocal warming of the climate system is now evident. The increase in greenhouse gases was 70 percent between 1970 and 2005. The global increase in carbon dioxide concentration is primarily due to fossil fuel use and land use change, while those of methane and nitrous oxide are primarily from agriculture. These increases in greenhouse gases have resulted in warming of the climate system by 0.74^0c between 1906 and 2005. Marine and freshwater ecosystems are profoundly affected by process like ocean acidification, coral bleaching industrial effluents and altered river flows etc. with obvious impacts on fisherflok. Fisheries which make a significant contribution to FAO and nutritional security globally will be very much affected due to climate changes.

2. Contribution of fisheries to food sector:

- Fisheries is a sunrise sector with varied resources and potential. Indian fisheries is increasingly contributing to the nutrional security of the country. The sector engages 14 million people at the primary level and is earning over Rs10, 000 crore annually through export. Fish consumption has shown an increasing trend assuming greater importance in the context of 'Health Foods'. It's expected that the fish requirement by 2025 would be of the order of 16 million tons.
- While capture production has remained around 90 million tons since 2001, aquaculture production has continued to show strong growth, increasing at an average annual growth rate of 6.3 percent from 34.6 million tons in 2001 to 59.9 million tons in 2010. The value of aquaculture production was estimated at USD 119.4 billion in 2010.
- Aquaculture experienced high average annual growth rate of 10.8 percent and 9.5 percent during the 1980s and 1990s, respectively. However, the rate eased to an average of 6.3 percent in the 2000s.
- Indian fisheries occupy the second position in global fish production with an annual growth rate of 4.7 percent, recording 3.2 percent growth in marine sector and 6.2 percent growth in inland sector there by contributing 1.10 percent to the total GDP and 5.3 percent to the agricultural GDP of the nation. In 2009, global per capita consumption of

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fish was estimated at 18.4 kg, with fish accounting for 16.5 percent of the global population's intake of animal proteins and 6.4 percent of all proteins consumed. Preliminary estimates for 2010 indicate a further growth in consumption at about 18.6kg, with the share of aquaculture production in total food supply at 47 percent.

- Hundreds of millions of other people work in the sector as occasional fisheries or in associated activities including supply and post-harvest services, marketing and distribution. Growth in sector employment, largely outpacing that of agriculture, has been mainly in small scale fisheries and in the aquaculture sector in the developing world where it has important seasonal income, food supply and security impacts. (FAO, 2008).

3. Evidence of climate changes:

India's First National Communication, 2004 (NATCOM) submitted to United Nations Framework Convention on Climate changes (UNFCCC). Some of the changes of relevance to fisheries are described here.

3.1.Surface temperature:

At the national level, increase of 0.4^0c has been observed in surface air temperatures over the past century.

3.2.Rainfall:

A trend of increasing monsoon seasonal rainfall has been found along the west coast, northern Andhra Pradesh, and north-western India (+10% to 12% of the normal over the last100 years) while a trend of decreasing monsoon seasonal rainfall has been observed over eastern Madhya Pradesh, north-eastern India, and some parts of Gujarat and Kerala (-6% to -8% of the normal over the last 100 years).

3.3.Extreme weather event:

Trends are observed in multi-decadal periods of more frequent droughts, followed by less severe storm incidence along the coast @0.011 event per year. While the states of West Bengal and Gujarat have reported increasing trends, a decline has been observed in Odisha.

ISSN: 2348-1358
Impact Factor: 6.057
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3.4.Impact on Himalayan glaciers:

The Himalayas possess one of the largest resources of snow and ice and its glaciers form a source of water for the perennial rivers such as the Ganga, and the Brahmaputra. Glacial melt may impact their long-term lean-season flows, with adverse impacts on the economy in terms of water availability and hydropower generation.

3.5.Sea level rise

Sea level has remained fairly stable for the last few thousand years. However, the mean global rate of sea level rise during the 20^{th} century was nearly 2 mm per year, which is 10-fold higher than the average of the past several millennia. The Intergovernmental Panel on Climate Change (IPCC) has projected that the global annual sea water temperature and sea level would rise by 0.8 to 2.5^0C and 8 to 25 cm, respectively, by 2050. The historic level rise for Cochin is estimated as 2 cm in the last one century. However, the rate of increase is accelerating, and it is projected that the sea level may rise at the rate of 5 mm per year in the coming decades. Considering this, it is possible that the sea level may rise by 25 to 30 cm in 50 years. An increase in mean sea level waves, currents and bottom pressure in the near- shore region. In general, an increase in mean water depth will be accompanied by an increase in mean wave height resulting in a more severe wave attack on the coast and a greater wave induced littoral drifts.

4. Climate change and its impacts on Fisheries:

Oceans are warming in the 0-300 m layer, which is the zone where most of the world fisheries exist. It is predicted that the Mean Sea Level would rise between 10 and 90 cm in the 21^{st}centaury. Changes in ocean currents, as well as having a substantial influence on the world's climate, may have significant direct effects on aquaculture through changes in temperature, primary productivity and hence food availability, and distribution of disease causing toxic algae blooms and predators (Handisyde *et al*, 2008).

The rising ocean acidity makes it 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.

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Thus the entire marine food web is being altered – there are 'cracks in the food chain'. As a result, the distribution, productivity, and species composition of global fish production is changing, generating complex and inter-related impacts on oceans, estuaries, coral reefs, mangroves and sea grass beds that provide habitats and nursery areas for fish. Changing rainfall patterns and water scarcity is impacting on river and lake fisheries and aquaculture production.

5. Alteration in Water level:

As fish are cold blooded (poikilotherms), unable to maintain their body temperature. Therefore, increasing water temperatures make the fish move to waters more suitable to them. One of the certain outputs of the climate change is mean sea level rise and changes in current patterns. Mean sea level rise would take place over a long time period scale. Though it is difficult to forecast the consequent changes due to both of these two factors, it is assumed that it may affect distribution of fish stocks and migration patterns. Sea level rise and the increased penetration of seawater is believed to be preferentially increasing the halo-tolerant mangroves in the Sunderbans. This could result in an increase in the brackish water fish and a decrease in the freshwater fish.

For inland waters, climate change will bring alterations to the evaporation and precipitation cycles that may well be much more serious and take place much more rapidly than for the case of salt water aquaculture. Although one may be able to predict temperature rise due to climate change, the evaporation and precipitation will be much more variable and difficult to forecast. The former will depend on cloud cover and windiness in addition to temperature, while the precipitation climate is not only expected to change, but may increase or decrease depend on the region concerned. So the major concern.

6. Alteration in Supporting Ecosystems

Some important marine ecosystems such as mangroves, sea grass and coral reefs, that are hugely under stress due to habitat destruction by human interference, pollution etc, and climate change may add more stress to it and may completely bring the structural and behavioral change

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in the ecosystem. Lakshmi, and Ramaya, (2009) has reported that Climate change is also expected to increase the number of extreme events such as tropical cyclones. Brander, K.M. (2007) has cited three reasons i.e. (*i*) the rate of future climate change is predicted to be more rapid than previous natural changes; (*ii*) the resilience of species and systems is being compromised by concurrent pressures, including fishing, loss of genetic diversity, habitat destruction, pollution, introduced and invasive species, and pathogens; and (*iii*) rising CO_2levels are lowering the pH of the oceans, with consequences that are largely unknown.

7. Net Primary Productivity

Net Primary Production of any water body regulates the production system and very importantly in coming years a good assessment of NPP in relation to climate change may forecast the future trend of oceanic production. The productivity of water body depends upon phytoplankton populations which depend on the availability of light and nutrients, which in turn are governed by runoff, atmospheric dust deposition, ocean mixing processes, cloud cover, and the solar cycle. Satellite measurements of ocean color over the past two decades show changes in global NPP but with large regional differences that can be related to changes in upper-ocean temperature gradients, wind stress, and atmospheric iron deposition (Behrenfeld *et al.*, 2006). It is assumed that temperature may alter the thermal stratification of the water body which may affect the net exchange of gases and nutrients at the water surface that in turn may cause an alteration of the primary productivity and as a result it could seriously bring the changes in the food chain and food web that could eventually result in alteration of species assemblages because of changes in food availability, species specific differences in thermal tolerances, disease susceptibility and shifts in the competitive advantage of species. There is also evidence from both the Pacific and Atlantic that nutrient supply to the upper productive layer of the ocean is declining because of reduced meridional overturning circulation, increased thermal stratification, and changes in windborne nutrients (Curry and Mauritzen 2005).

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8. Impacts on Economics and Community:

Perhaps the grave concern about climate change would be regional climate variability. Productivity and specific species resources in the region may be varied. That eventually may decrease the catch per unit effort and compel to go further for harvest which would demand more effort and cost. Moreover changing environmental conditions i.e., cyclones, rough weather will make the whole scenario more risk prone. Allison *et al.* (2009) used an indicator based approach to compare the vulnerabilities of 132 nations to potential climate change impacts on their capture fisheries. They found that countries in central and western Africa as well as some in Asia were most vulnerable. Indirect economic impacts will depend on the extent to which local economies are able to adapt to new conditions in terms of labor and capital mobility. Change in natural fisheries production is often compounded by decreased harvest capacity and reduced access to markets (FAO, 2006).

9. Conclusion:

Fisheries are a sunrise sector with varied resources and potential. Indian fisheries are increasingly contributing to the nutritional security of the country. The sector engages 14 million people at the primary level. Aquaculture experienced high average annual growth rate of 10.8 percent and 9.5 percent during the 1980s and 1990s, respectively. However, the rate eased to an average of 6.3 percent in the 2000s. Gradually it's drawing attention in the international area about the potential impact due to Climate Change. Several reports have been placed already and created a mixed response in both a detrimental and beneficial way but, as the ocean ecosystem is very complex, the exact outcome seems very unpredictable to coin. As Asian countries mainly dominate the fisheries and aquaculture sector and this is the region where greater poverty and aquaculture related livelihood prevails, it should draw attention of policy makers and world aquaculture fisheries authority to take the matter seriously and find out remedial measures or policy to cope up with Global Climate Change.

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