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Negative Impacts on Coastal Fisheries: A Global and Local Scenario with Special Reference to Coastal West Bengal

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Abstract: ***Fish protein is one of the best solutions to meet the protein demand of rapidly rising population in the coming centuries. Aquaculture in coastal of West Bengal has played a significant role in local as well as state economy. However, due to several negative threats operating on this important biotic reservoir, the fish community is gradually altering with respect to quantum and composition. The present paper is a critical analysis on the threats operating on fish community in the frame work of mangrove dominated Indian Sundarbans.***
Keywords: ***Aquaculture, Anthropogenic threats, Fish protein, Fish community***

I. INTRODUCTION

Anthropogenic threats on marine and estuarine fishes are consequences of human activities like industrialization, urbanization, tourism, aquaculture, deforestation, destructive fishing activities etc. The degree and types of threats are, however, site - and time specific, *e.g.*, the type of threats in Indian Sundarbans (like loss of ichthyoplankton due to wild harvest of tiger prawn seeds or cutting of mangroves for fuel) are not similar to that of Goa coast (where tourism is a major activity) or south Indian coasts (where salt production through development of mass scale salt pans make the surrounding coastal environment highly hypersaline). Again honey or mangrove fruit collection by the island dwellers of Sundarbans is regulated by season (time - specific).

The major threats on marine and estuarine fishery sector of West Bengal may be broadly divided into six heads.

1) *Study Site:* West Bengal has a vast coastal area with several possibilities of resource exploration, i.e. biotic and aboitic resources. Southern part of North 24 Pargonas and Purba Midnapore district is contributing the major proportion coastal part of West Bengal. This area is largely crowed with coastal fisherman and people with depended on mangrove. Mangroves are offering them with numerous scopes for their daily life. On the other hand, because of deltaic structure, significant water mixing, accumulation of bio mass produced by the Sundarban, a favourable condition is prevailing there for fish breeding and growth. These conditions are indicating that there is a huge supply of natural fish food. But beside these, some of negative factors are operating on that area. Our present work is to thrust these factors.

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A. Pollution

The magnitude and threat of marine pollution becomes more and more acute everyday with the growing use of sea for commerce, the increasing size and variety of cargo ships and tankers, and also the use of seabed for mineral extraction. The other reasons may be the river runoff from the land carrying large amount of pollutants, atmospheric deposition, oil spills and other wastes. Nuclear weapon testing has added another dark chapter to the health and biodiversity of oceans.

Table 1: Potential sources of marine and estuarine pollution

S. No.	Major sources of pollution
1	Domestic sewage
2	Sewage sludge
3	Industrial wastes
4	Solid wastes
5	Shipboard wastes
6	Aquacultural farms
7	Pesticides and Fertilizers
8	Offshore oil exploration and production wastes
9	Oil spills
10	Radioactive wastes
11	Heat: Thermal pollution from power plants
12	Fly ash from thermal power plants
13	Continental run-off
14	Antifouling paints
15	Barges and other metallic structures
16	Ocean mining
17	Precipitation of air borne pollutants
18	Oil from tanker cleaning and deballasting
19	Weathering of the earth's crust
20	Volcanic eruptions
21	Natural submarine oil seeps
22	Dredge spoils
23	Military wastes (weapon testing *etc*.)
24	Tourism and recreational activities

The pollutants discharged from these sources pose considerable effects on the biotic community, species, cellular and even genetic levels of fish species. The effects are again species-specific in nature. The magnitude of hazard ranges from moderate to extreme depending on the nature of the chemicals. In coastal West Bengal, considerable amount of pollutants (like zinc, copper, lead) are released from the paints used to prevent corrosion of fishing vessels and trawlers. The chain of factories situated along with Hooghly estuary also contribute appreciable amount of pollutants in the coastal water of West Bengal. Large numbers of shrimp farms release their waste water (consisting of organic loads, antibiotic residues and microbes) into the adjacent coastal waters and estuaries. This activity is very common in South 24 Parganas and Medinipur districts of coastal West Bengal.

The problem of pollution from non-point sources is very complex. Most of the non-point sources are carried by surface run-off, which enters the surface water in a diffused manner and at intermittent intervals that are mostly related to the occurrence of meteorological events.

In coastal West Bengal problems associated with non-point pollution are follows:

1) Non-point sources contribute roughly 80% of the total nitrogen and more than 50% of the phosphorus load into receiving water.
2) Agricultural run-off may contain large quantities of toxic metals, pesticides and other organic chemicals.
3) Large amounts of decomposable organics originate as a part of soil loss from non-point source that may form objectionable mud deposits in the surface water.

For fecal and total coliform counts, non-point sources account for over 98%.

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Many of the larger cities and metropolitan areas in the world are on or near coastlines. The over-increasing amount of solid wastes generated from these places, have greatly increased the pressure to dispose them off to the sea. Pollution of ocean by solid waste is caused by the oceanic dumping of wastes, and by the pollutants that reach the ocean through surface run-off. Thickened sewage sludge, industrial solid wastes such as spent clays, catalysts, sludge and drilling mud, refuse and explosive materials from military and chemical warfare agents have been dumped for years and continue to be disposed off at designated and approved locations in many countries. Two basic methods are used for chemical waste disposal in the ocean. Wastes are either transported to sea aboard tank barges, or disposed off in sealed weighted barrels, which will ultimately leak. Refuse dumping methods are two types-loose and bale dumping. Baling of refuse is more efficient, neat and ecologically sound than loose dumping, but it is expensive. Loose dumping is difficult to handle and requires more storage space and it floats. Sometimes, incinerator residues are dumped into the ocean instead of spreading in landfill. The radioactive wastes are also dumped into the ocean. Certain chemicals if released untreated, *e.g.*, cyanides, mercury, and polychlorinated biphenyls are highly toxic and exposure can lead to disease or death of organisms inhabiting the ecosystem.

B. Aquaculture

Aquaculture has become an important source of seaweed, shellfish and finfish, especially for human food and production from this particular sector is likely to continue and expand well into next century. Mariculture has both direct and indirect impacts on biodiversity through the consumption of natural resources and the production of wastes. Wastes, comprising uneaten food, fecal and urinary products, chemicals and pathogens are released into the environment, whose quantities are also being largely dependent upon production methods. In West Bengal, there are no hatcheries of shrimp production due to low salinity. As a result, the shrimp culturists have to depend on wild collection of prawn seeds. During this operation a large variety of finfish and shell fish are also caught in the net, which are finally thrown away and destroyed. This is also a major threat to fishery sector of West Bengal.

C. Unplanned tourism

There are greatly increasing stresses on coasts caused by tourism. The most serious threats are those of habitat destruction. Mangroves are often removed, wetland areas filled in and estuaries reclaimed to make way for tourist complexes without there being any evaluation of the benefits of the intact systems or the ecosystem services connected with the system. Once built the resort may lead to effects on adjacent habitats through sewage discharge and other threats and ultimately to the loss of habitats and their resources. Establishment of hotels adjacent to intertidal mudflats and beaches is becoming popular and often leads to the destruction of the habitat. Such scenarios are often witnessed in Digha, Mondarmoni, Bokkhali regions of coastal West Bengal. In many cases, the Coastal Regulation Zone (CRZ) norms have been violated. The tourism activities of these hotels directly and indirectly pose negative impact on fishery sector. The sewage discharged from these hotels without treatment causes eutrophication and reduces the dissolved oxygen level of coastal waters. These factors greatly affect the fish species and sometimes high mortality is observed in the coastal waters, which is related to Harmful Algal Bloom (HAB).

Several tourist units and hotels have been constructed without giving any importance to the endemic biodiversity in developing countries. In addition to the concrete structures, some additional threats of tourism includes the left away plastic bottles, cans etc. by the tourists or enjoying in the estuarine system with lighted vessels and boats, thereby posing an adverse impact on the endemic wildlife associated with the estuaries.

D. Introduction of alien species

About half of the crude oil produced per year is transported through the sea. After unloading of cargo of oil from a tanker, it carries seawater as ballast. It is a general practice to fill several of tanks (25 – 30 % of the total capacity of the tanker) with seawater to ballast the ship for the voyage back to the loading terminal. These ballast waters are discharged prior to filling the tanks again with new oil. Alien species are mostly introduced into a system mainly through ballast discharge. The ctenophore *Mnemiopsis leidyi* was imported from the US East coast to the Black Sea, probably in ballast water. The introduction of the ctenophore species caused a catastrophic alteration in the whole trophic web and contributed to a huge reduction in stocks of commercial fisheries [1]. Other concerns covered by GESAMP are the transport of species of algae that may cause toxic blooms in new areas and other introductions which have led to dramatic effects at regional levels. Alterations in biodiversity are also highly likely although this is poorly documented. In the maritime state of West Bengal, Haldia is an estuarine/riverine port where large number of oil tankers discharge ballast water. This activity has high probability to introduce exotic microbes to the ambient water. However, no report is available till date on the introduction of exotic microbial strains or plankton species in the coastal waters of West Bengal.

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E. Development of coastal structures

Coastal zones face a variety of pressures. Coastal development results in the infilling of lagoons, reclamation of coastline. Historically, the Dutch have fought a long battle with the North Sea and by an extensive system of dykes have extended their landmass and turned the semi-enclosed marine Zuider Zee into the freshwater IJsselmeer. However, most coastal development is piecemeal and insidious and hence difficult to effectively regulate. The cumulative effects of such developments within a particular estuary can be depressing.

For instance, about 2500 ha of mudflats in the Fifth of Forth, Scotland have disappeared over the last 200 years through a series of individually unspectacular schemes, leading to a reduction in the estuary's fish biomass by 50% [2]. This scale of loss of intertidal zone has occurred or is forecast for many UK areas [3] and must apply to most of the world's industrialized estuaries. Development, whether by dykes or coastal defenses, seaside promenades, residential 'marinas' or dock complexes, tends to shorten the foreshore and reduces the extent of mudflats, upper-shore creek and salt-marsh systems.

Sometimes coastal structures become indispensable to promote the rapid pace of industrialization and urbanization in the coastal zone, which is now a common scene in developed and developing countries. This can cause dramatic change in the coastal landscape. Examples of such alterations include the construction of seawalls, breakwaters, revetments, groins, and jetties. Each of these structures, aimed at protecting coastal property, refracts energy away from the shore, and can cause erosion and increase currents that can harm sea grasses.

In the Hooghly estuarine stretch of West Bengal, construction of a 2.5 km guard wall along the Nayachar Island (opposite of Haldia port-cum complex) resulted in massive siltation and such process is still ongoing. It is also stated that this guard wall is the root cause of erosion along the bank of Haldia industrial belt.

F. Negative fishing

Over fishing is one of the major anthropogenic threats on the living resources of the marine and estuarine ecosystems. It may be defined as the level of fishing which puts at risk values endorsed either by the fishery management agency, by the nation in whose water fishing takes place, or within widely accepted international agreements.

Despite the fact that most fisheries resources are now within the jurisdiction of coastal states nearly all the world's fish resources are overexploited [4]. Between 1988 and 1990 the marine fish catch declined in nine key fishing areas and especially of Peru, pelagic fish of Japan, of the Northeast coast of the US and in European seas. The consequences of heavy fishing pressure on commercial species are that the size distribution changes and this leads to loss of genetic diversity, *e.g.* Orange Roughly [5]. In many areas of the Northwest Atlantic there have been dramatic changes in the composition of fish stocks as a consequence of fishing. Highly important commercial species have declined (*e.g.* herring and Arctic cod) and other less valuable species have increased *e.g.* sand eels, [6] and sharks.

Several studies show that changes in fish species composition have dramatic effects on other species dependent on fish such as sea birds and mammals [7, 8]. Exploitation of fish resources can lead to local or regional species extinctions. The Blue Walleye (*Stizostedlion vitreum glaucum*) was over-shed in Lake Erie and became locally extinct [9]. The Coelacanth (*Latimeria chalumnae*), which lives in caves in the Cormora islands, has a total world population of under 500 individuals and is being harvested accidentally as a by catch of fishing for other species [10] and is in real danger of becoming extinct. Local extinctions of fish can also occur where estuaries are made unfit for spawning. Trawling for bottom-living fish species is having a major effect on the habitat for species other than target species. It has been estimated that all of the sea bed of the North Sea is trawled over at least twice per year and the gear is getting heavier over time [11]. Trawls have destroyed long-lived species of molluscs and echinoderms in the North Sea. Since these species play important functional roles in biogeochemical cycling the consequences may be far-reaching. There are plans to designate trawl-free areas where by comparison with trawled areas effects of trawling can be assessed. Fishing using explosives on coral reefs [12] occurs globally in areas where reefs are not properly protected. The ensuing destruction of the reef habitat, which sustains not only the fish but all other species dependent on the reef, has catastrophic consequences for biodiversity.

In coastal West Bengal, instances of negative fishing are often witnessed either through over exploitation and bottom trawling or by reducing the mesh size of the net. As per the Government norms, the knot-to-knot will not be more than 45 mm. This is done to allow the larvae during the fish catch, which can attain the adult stage and sustain the population of the species. This is however, not obeyed in coastal West Bengal and the massive availability of small sized Hilsha (*Tenualosa ilisha*) in the local market is an acid test of this negative fishing.

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G. Salinity alteration

Past observations on the mean sea level along the Indian coast indicate a long-term rising trend of about 1.0 mm year^{-1} on an annual mean basis. However, analysis of the recent data suggests a rising trend of 2.5 mm year^{-1} along the Indian coastline. Model simulation studies based on an ensemble of four A-O GCM outputs indicate that the oceanic region adjoining the Indian subcontinent is likely to warm up at its surface by about 1.5-2.0^{o}C by the middle of this century and by about 2.5-3.5^{o}C by the end of the century. The corresponding thermal expansion related sea level rise is expected to range between 15 to 38 cm and 46 to 59 cm respectively. This simulated rise in sea level by 46 to 59 cm along Indian coastline is comparable with the projected global mean sea level rise of 50 cm by the end of this century and may have significant impact on coastal zones of India. It has been documented that about 5,958,744 persons sustain their life through fishery or aquaculture [13] in the coastal region of the subcontinent and the figure of such population in the east coast of India alone is 9,50,000. Any global warming-induced climatic change such as increase in sea surface temperature, change in frequency, intensity of tracks of cyclones, sea level rise may aggravate the potential risks to coastal zones. Projected climate change could halve or double average harvests of any given species; some fisheries may disappear, and other new ones may develop. Warmer water species will migrate poleward and compete for existing niches, and some existing populations may take on a new dominance. These factors may change the population distribution and value of the catch that has profound influence on economies particularly on stakeholders whose livelihoods are directly related to fishing and fishery.

The rich mangrove diversity of Indian Sundarbans (West Bengal), Orissa etc. have made the east coast of India rich in fishery, but recent surveys are pointing towards replacement of economically important fish species with low priced trash variety. The example of pomfret (*Pampus* spp.) and bombay duck (*Harpodon nehereus*) catch pattern in western and central Indian Sundarbans is a relevant case study in this context. The catch of these species are almost consistent in the western part of Indian Sundarbans due to flow of freshwater through Farakka barrage that prevents the aquatic salinity from being rising as revealed from the long term survey since 1985. In the central sector, the gradual increase of low priced bombay duck is a clear signal of increase of salinity due to obstruction of freshwater from Ganga-Bhagirathi system as a result of heavy siltation. The resource base in the fishery sector of the central Indian Sundarbans is gradually depleting owing to saline water intrusion from the Bay of Bengal region. Inter-linking the freshwater dominated Hooghly River of the western Indian Sundarbans with the salty tide-fed Matla River in the central portion can save this ecosystem along with its resource base.

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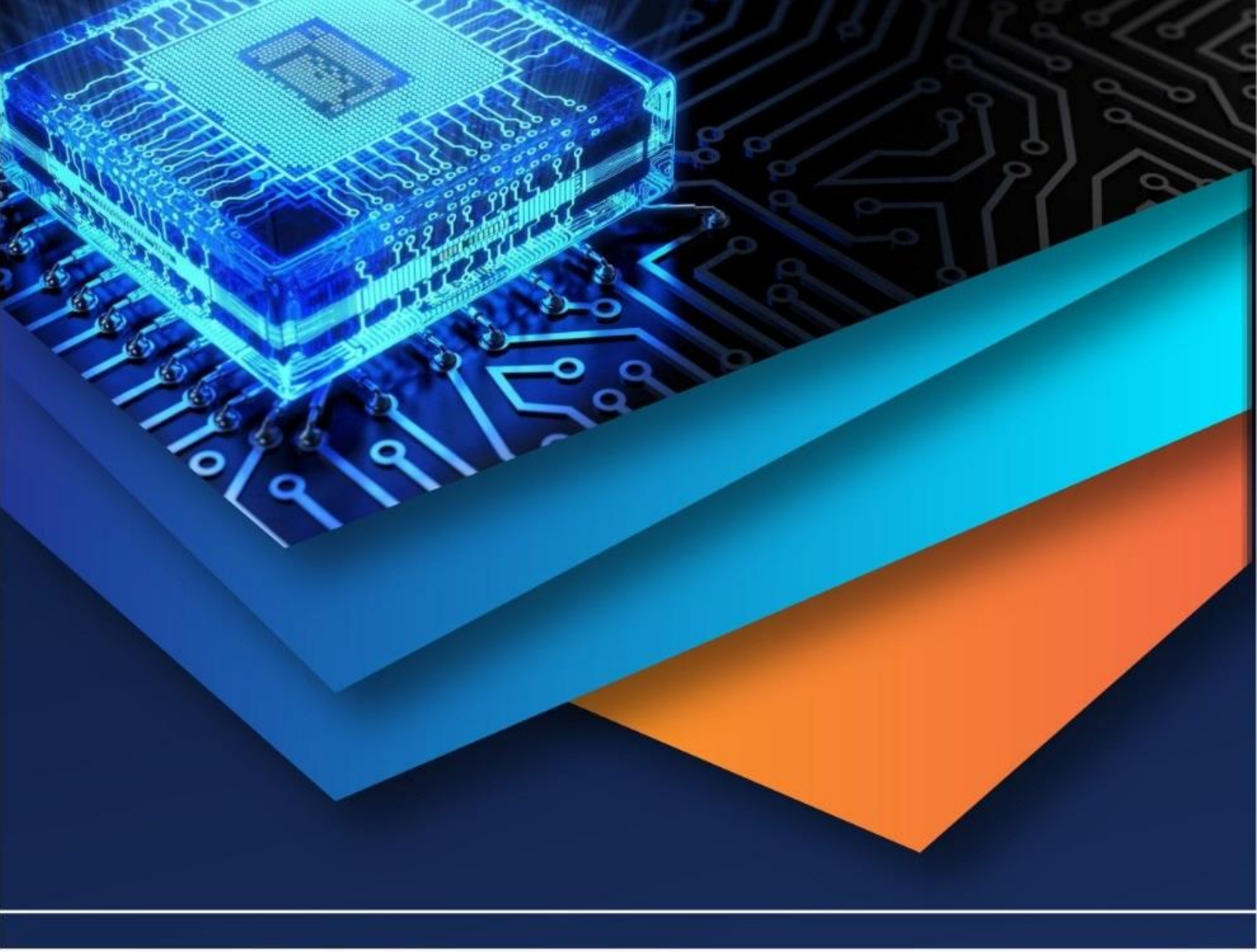

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