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Impact of Commercial Coastal Fishing on the Environment of Sundarbans for Sustainable Development

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Abstract

The “Sundarbans”, situated at the largest delta-face of Bhagirathi-Hoogly river systems in India is declared as World Heritage Site (1984) for the largest mangrove forest and the only mangrove tiger land in the world. It exhibits an excellent reserve of aquatic as well as forest resources, co-existing as the most complex mangrove food web. With increasing local population, aquatic resources of southern Sundarbans are being highly exploited by “Commercial Coastal Fishing & Aquaculture”, practiced continuously by local fishermen, big businessmen and Multi National Companies (MNCs) through years causing over-exploitation of commercially valuable aquatic species like commercial prawn, carps, prawn seedlings, etc. This anthropogenic interference into mangrove ecosystem of Sundarbans is achieving high economic profit at the cost of high ecological loss. This paper has revealed and assessed severe environmental impact of coastal fishing i.e. 1) loss of biodiversity 2) negative reflection of infra-structural development 3) increasing effect of trawling 4) effect of use of gill net 5) impact of coastal aqua-culture 6) pollution in coastal waters 7) loss of mangrove species 8) overall estuarine water pollution etc. It has also suggested a proper Environmental Management Plan in order to mitigate this man-made disaster to ensure conservative use of local aquatic resources leading towards sustainable development of the environment of Sundarbans.

Introduction

The Sundarbans is bestowed with a wide range of natural forest and aquatic resources, offering the largest mangrove concentration with a great biodiversity and the only mangrove tiger-land in the world. With increasing pressure of population, the vast aquatic resources available in the core forest area of southern Sundarbans are being continuously overexploited by intensive practice of coastal, estuarine and deep-sea fishing by local fishermen, businessmen and MNCs. This commercial exploitation of selected aquatic species (prawns, carps, prawn seedlings, etc.) is readily offering a high profit to the population at the cost of high ecological loss to the environment of

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Materials and Methods

Being a group of estuarine islands, Sundarban region is located at the delta-face of Ganga-Bhagirathi river system in India. Indian part of the Sundarbans comprises of 9630 sq. kms out of the total 71885 sq.kms., covering six and 13 police station areas of districts of North and South 24 Parganas, respectively, of the State of West Bengal, demarcated by Dampier & Hodges Line towards North, Bay of Bengal towards South, river Hooghly towards West and Ichhamati-Kalindi-Raimangal rivers towards East. Its geodetic location stretches from 21° 30' N to 22° 39' N latitudes and from 88° 5' E to 89° 09' E longitudes.

Everywhere in this universe ecosystem exists at a wide range of scales (Mather, 1986). In the unique bio-climatic zone of Sundarbans, Mangrove Ecosystem exists on land in the dense forest as well as in estuarine water with extremely diverse plant and animal communities closely textured in a symbiotic relationship of Mangrove Food Web (Fig.1).



Figure 1. Mangrove Food Web

Huge reserve of microscopic phyto-planktons under water and mangrove vegetation with detritus of the forest has formed an extensively broad base of energy-fixers of this food web. It can be well understood that if any of these baseline components is found missing by any human intervention, the mangrove food pyramid existing in the Sundarbans would obviously collapse in the long run, posing a great threat to the existence of all top consumers, even human beings in the locality. Indiscriminate clearing off mangroves for fuel wood and fishing boats, random collection of prawn seedlings for commercial aquaculture, destruction of other non-commercial seedlings, damage to fish population and their habitats by modern gears, coastal water pollution by industries, etc. are gradually shortening the broad base of this food pyramid, endangering the existence of all top consumers. This human intervention into Nature will surely cause an irreparable damage to their very existence at the penultimate stage.

Location and nature of commercial coastal fishing

The Sundarbans at present enjoys an estimated water area under fishing and aquaculture about 27085.39 ha. and 19390.73 ha. in its Northern and Southern parts, respectively. Southern Sundarbans is the actual core zone of the forest lying in 13 blocks covering 19390.73 hectares under commercial fishing and aquaculture. Tidal rivers, creeks, estuaries and coastline of Bay of Bengal in Sundarbans offer a very rich reserve of aquatic resource, which is being commercially exploited in the following ways.

Commercial Coastal and Estuarine Fishing

A number of individual, groups of commercial fishermen and MNCs are collecting large-scale commercial catch from vast coastal, estuarine and deep sea zone of Sundarbans throughout the year. Total commercial catch amounts 8388,2400 kg in the year 1997-'98, as per primary data collected from field survey at five major fish-launching stations of Sundarbans, shown in Table1.

Use of latest fishing crafts and gears like big bull trawlers, mechanized boats, PVC (poly vinyl chloride)-made trawl, gill and bag nets, built-in slaughting-washing units, artificial units are collectively helping in profitable export-based fishing economy as well as in degrading the sensitive aqua-mangrove ecosystem of Sundarbans.

Collection of Prawn post larvae

Large section of poor tribal population of Sundarbans especially, the females and minors living far below subsistence level were engaged in the practice of spawn collection of *Penaeus monodon* and *Fenneropenaeus indicus*, during daily tides using unscientific gears like mosquito-nets.

Table 1. Magnitude of commercial coastal fishing in southern Sundarbans

P. S	Total Production In Kgs (1997-'98)	No. of Vessels	Distance of Fishing trips	No. of Trips/ months	Capacity Of Vessels
Canning	50,40,000	Trawlers-10 Mechanised Boats-12	60 kms(monsoon), 100kms(winter).	7 daysx4 trips(monsoon), 15daysx2 trips (winter).	8000 kgs.
Diamond Harbour	151,60,000	Trawler-100 Mechanised boats-60	25 kms. (monsoon),180 kms(winter).	7days x 4 trips (monsoon), 10days x 3 trips(winter).	18,000 kgs.
Kakdwip	435,40,000.	Trawlers-100, Mechanised boats-2000.	80 kms., (monsoon)180 kms (winter)	7 days x 4 trips,15 (monsoon), 15 Days x 2 trips (winter).	12,000 kgs.
Roydighi	62,22,400	Trawlers-200, Mechanised boats-600	100 km.s (monsoon), 180 kms (winter)	7 days x 4 trips (monsoon), 15 days x 2 trips (winter).	8000kgs trips
Namkhana	1,49,200,00	Trawler-200, M.boat-500	70 km.s (monsoon),200 kms (winter).	10 days x 4trips, (monsoon), 15 days x 2 trips(winter).	8000kgs.

Source : primary data from field survey at Namkhana, Kakdwip, Diamond Harbour, Roydighi & Canning on 30.4.99, 25.4.99, 23.4.99, 1.4.99 & 14.4.99 respectively.

Coastal Aquaculture ('Bheri' Fishing)

Local fishermen have converted many coastal swamps into *bheries* i.e., artificial enclosures for taking the tidal saline water in and out through sluices from nearby rivers for commercial pisciculture. About 1392 *bheries* have covered 43,000ha. of the Sundarbans (Sinha, 1998). Big *bheries* namely, Sundarban Aquatic Farms Ltd. at Namkhana, Andrew Yule at Canning, Madhumita Aquatic Farm at Bakkhali, etc. are producing commercial prawns by both semi-scientific and unscientific way for large scale prawn export. The Survey conducted at Sundarban Aquatic Farms Ltd. on 10 July

1998 revealed huge input of chemical fertilizers and pesticides, CaCO_3 (eg. 120kgs/acre water area), MgCO_3 , Calcium Sulphate, urea, super phosphate, ready fish-food Bio-2, into pond water to increase the productivity.

Fresh Water Aquaculture

In some parts, especially at the estuarine mouth where salinity is lowered by fresh water discharge through rivers 'paddy cum fish cultivation' were practiced. The study conducted by CIFRI for four years since 1985 in Southern Sundarbans, recorded the fish production of 1000 kg/ha in two crops along with paddy production of 3000 kg/ha in one crop every year (Ghosh. et al.1985). Commercial production of *L.parsia*, *L.tade*, *R.corsula*, *L.calcarifer*, *M.gulio*, *M.rosenbergii*, *M.rude*, *M.brevicornis*, *M.monoceros*, *P.monodon* were obtained from these paddy-fields with sufficient application of chemical fertilizers (urea, super phosphate, ammonium sulphate, potash) and fungicides (Hinasan, Dimecron, etc) at the cost of destroying some ecologically valuable indigenous fish species, locally named as *Vada*, *Khalisa*, *Mourala*, *Nados*, *Chanda*, *Khaira*, etc. To achieve specific objectives of the study, methodological steps were: a) Collection of secondary data from background literatures, Census reports, 1951 to 2001, Cadastral and Topographic maps, NATMO (National Atlas and Thematic Mapping Organisation) and Satellite Imageries, 1996, 1997 and 1998, State Remote Sensing Center, West Bengal, b) Retrieval of primary data from field survey following purposive sampling method in five major fish-launching stations and fish markets of Canning, Roydighi, Diamond Harbour, Kakdwip and Namkhana and interviews with some experienced fishermen and trawler-owners at Canning on 14 April 1999 –(Mr. Dulal Ghosh), Roydighi on 1 April 1999(Mr. Dilip Baidya, Mr. Budhhiswar Haldar), Kakdwip on 25 April 1999(Mr. Kalinga Das, member of Fishermen's Assn., Mr. Kironlal Das, Fellow of Sagar Research Project), Namkhana on 30 April 1999(Mr. Bidesh Mondal, Bablu Giri, etc.) and Diamond Harbour on 23 April 1999(Mr. Bishnu Halder, Secretary, Fishermen's Assn.), c) Collection of primary information from some experts concerned named Mr. Harekrishna Debnath, Chairman, Mr. Gopinath Das, member, National Fish Workers Forum (N.F.F) and Mr. A Choudhury, ex-professor, Marine Science, University of Calcutta. d) Survey into a coastal aqua-cultural farm named The Sundarbans Aquatic Farms Ltd. on 10 June 1998 and e) Processing and tabulation of primary and secondary in formations.

Results

Intensive field survey has revealed a profound impact of commercial fishing on the biosphere of Sundarbans and caused severe environmental degradation as follows:

Loss of biodiversity

Many poor females and minors of Sundarbans are sustaining on unscientific collection of prawn seedlings by mosquito nets. They destroy all other juvenile species while sorting out prawn seedling alone, that are to be sold to commercial *bheri*-owners. In 40 km stretch of Hooghly estuary from Kulpi to Namkhana, 5000 seed collectors of 21 villages operated 7000 nets. On an average, they collected 2500 seeds of *P.monodon*/day (8 hrs) which is 28% of total mixed fry catch caught by them. Seeds of tiger prawns alone were segregated and the rest were destroyed (Bhaumik et al.1992). As per another study, considering 240 operational days, 181.4 millions of seeds of other uneconomic varieties shell and finfish were destroyed by collectors during January to September, 1992 (Bhaumik et al.). CIFRI surveyed in 1996 at the estuaries of river Matla, Thakuran and Saptamukhi showing annual loss of 456 millions other ichthyoplanktons (Banabithi, 1996). In six major estuaries of Sundarbans, during 1994-1998, the average annual catch of seeds varied between 8174 and 10,062 no./net/day. After segregation of tiger shrimps(2.9 –4.0%), rest of seeds were destroyed at estuaries of Hooghly(930.0 millions), Matla(568.8 millions), Saptamukhi(775.0millions), Thakuran(233.4 millions), Bidya(196.2millions) & Jhilla(160.0 millions)(Bhaumik et al.). This wanton killing of other ecologically valuable baseline components can be considered as one of the most effective factors causing a gradual narrowing down of the broad base of mangrove food pyramid posing a great threat to all predators. It may lead towards an ultimate collapse of entire foodchain in the long run. Field survey has already revealed an extinction of *chandana hilsa* (last available before 25 years), sea-conch, *chiruni* and endangering *pangas*, shark etc. in coastal Sundarbans, reported by experienced fishermen of Namkhana, Kakdwip, Diamond Harbour, Roydighi and Canning during field survey (Das,2002).

Impact of infrastructural development

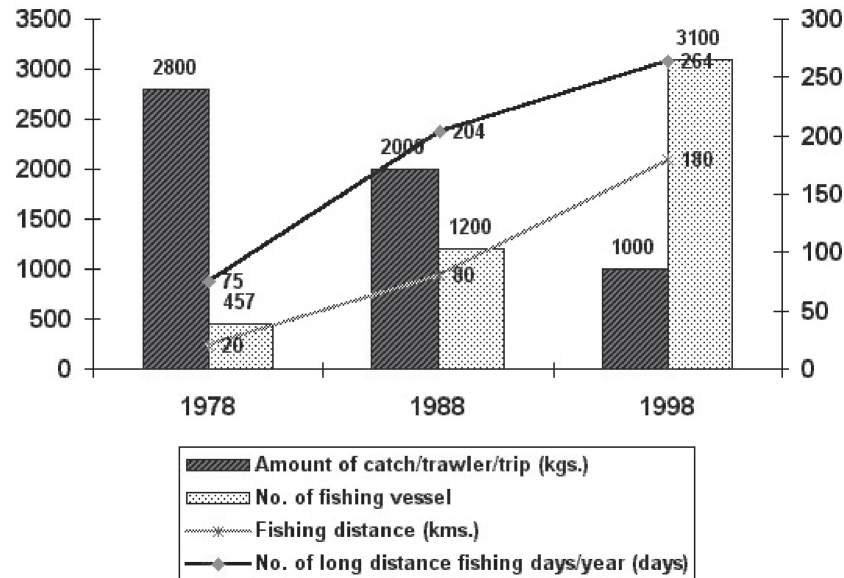
In spite of a decadal development of infrastructure and increase in intensity of fishing in coastal Sundarbans during 1977-78, 1987-88, and 1997-98 (Table 2), at random commercial fishing and seedlings collection during the last 30 years is likely to have contributed at least 50% shortage of total catch/ trawler/day. Fig.2 depicts the situation at Kakdwip.

Table 2. Decadal difference in fishing particulars in Southern Sundarbans

Fish-launching Stations	No of Fishing Vessels 1978	No of Fishing Vessels 1988	No of Fishing Vessels 1998	Fishing Distance 1978	Fishing Distance 1988	Fishing Distance 1998	Fishing Trips & Days 1978	Fishing Trips & Days 1988	Fishing Trips & Days 1998
Kakdwip	Trawler-7, *C.boats -150, ♦M.boats-300	Trawler-200, M & C Boats-1000	Trawler -1100, M.boats-2000	20 kms	80 kms	180 kms	5 tripsx 5days in 3 monsoon months	4trips x 7days (monsoon) 2tripsx 10 dats (winter)	4trips x 7days (monsoon) 2tripsx 15days (winter)
Namkhana	M.boat-150, C. boats-200.	Trawler -20, M & C. boats-	Trawler-100, M.boats -600	15-20 kms	60-80 kms	200 kms	Local Daily Fishing For 6 months	“	“
Diamond Harbour	M.boat-50, C. boats-100	Trawler-50, M. boats-60, C boats -150.	Trawler-100, M .boats -100	15-20 kms	60 kms	180 kms	“	“	“
Roydighi	C.boats-100 boats-	Trawlers -20, M. .boats 200, C.boats -150	Trawler-200, M boats -500	8-10 kms	“	“	“	“	“
Canning	C.boats -50.	Trawler -2, M. boats-6, C. boats 100	Trawlers -10, M boats-12, C.boats -150	10 kms.	60 kms	100 kms	“	“	“

Source : primary data from field survey at Namkhana, Kakdwip, Diamond Harbour, Roydighi & Canning on 30.4.99, 25.4.99, 23.4.99, 1.4.99 & 14.4.99 respectively.

♦ M.boat – mechanized boat, *C.boat –country boat(manually operated).



Source: Primary production data from field survey at Kakdwip on 25.04.1999.

Figure 2. Decadal decrease in the amount of catch/trawler/trip in spite of infrastructural development in Kakdwip

Impact of Increased Trawling

Modern bull trawlers with 120 horse power engines are dragging bigger trawl net through ocean-bottom to chase tiger prawns leading to destruction of on-bottom habitat of prawn, other shell fishes, marine algae, seaweeds and plankton. This causes gradual narrowing of the baseline of aqua-mangrove food chain. This is likely to have contributed to the recent crisis of prawn seedlings and absence of some sea conch in coastal Sundarbans. The degree of intensification of trawling in coastal Sundarbans may also have an impact on the aqua-mangrove ecosystem.

Impact of using Gill nets

Fishermen of Sundarbans have started indiscriminate commercial exploitation of shrimps of all sizes by modern pvc gill nets, instead of traditional cotton nets, for its changeable mesh size, non-biodegradability, more hardness, endurance and invisible sea water colour. But it is allowing increasing number of by-catch and immature catch by fishermen of Sundarbans. This vulnerable exploitation leads to an undesirable imbalance in the aquatic food chain of Sundarbans, ensuring future crisis of fish which is also supported by experts concerned.

Intensive Shrimp Monoculture & Coastal Aqua-culture

Intensive shrimp monoculture into *bheries* discharging toxic waste water is likely to encourage flocks of fish away not to concentrate near the coastal Sundarbans. Moreover, Fresh Water Aquaculture or 'fish cum paddy cultivation' is purposively causing death to some ecologically valuable species of small indigenous fish, locally named as *Vada*, *Khalisa*, *Mourala*, *Nados*, *Chanda*, *Khaira*, etc. which are quickly becoming endangered in the vicinity of coastal Sundarbans.

Pollution in Coastal Water

Frequent oil leakage and regular washing of increasing numbers of petrol-operated trawlers and vessels is causing water pollution near local sand heads. It is suspected by local fishermen as an important factor for recent lack of fish gathering on those fishing spots. As a case study, according to local fishermen no fish gathering is found nowadays surrounding the sand heads near Diamond Harbour and population of *Hilsa* that enters inshore from deep sea has also been reduced greatly at Diamond Harbour, once famous site for *Hilsa*.

Estuarine Water Pollution

Rapid pace of industrialization and urbanization in the lower Bhagirathi-Hoogly basin is specially polluting Hooghly-Matla estuarine mouth including Sundarbans by : a) Urban Domestic waste : 1,125 million liters of waste water is discharged per day through Hooghly estuary as per UNEP report and lower stretches receive sewage and waste load of $396 \times 10^6 \text{ m}^3/\text{h}$ with annual runoff of 493 km^3 (Sinha,1998), b) Industrial waste from textile mills, chemical plants, pharmaceutical, plastic, detergent, jute, tire factories, etc. of Hooghly Industrial Belt is highly polluting estuarine and coastal water in Sundarbans (Sinha,1998), c)Agricultural waste containing residues of pesticides and insecticides including chlorinated hydrocarbon and organophosphates is also major polluting agent in Hooghly-Matla estuarine mouth (Sinha,1998), d)Petrochemical waste from oil refineries & tankers, ships, fishing vessels, etc. is more acutely polluting Bay of Bengal tanker route ($0-69.75 \text{ mg/m}^2$) as compared to Arabian sea tanker route ($0-6 \text{ mg/m}^2$) (Sinha,1998), e)Heavy metal pollution by industrial left-outs from 84 townships of lower Hooghly basin contains maximum concentration of arsenic, cadmium and mercury along with manganese(732 ppm),nickel(49 ppm), copper(44 ppm), zinc(151 ppm), chromium(98 ppm) lead(32 ppm), (Sinha,1998). Overall estuarine pollution is likely to have contributed to a great extent to recent unavailability and decline in local fish population and much less concentration of estuary-loving *Hilsa* from deep sea towards estuarine Sundarbans, once famous site for it.

Discussion

This study has proved various anthropogenic mal-practices in coastal Sundarbans. Now, this endangered ecosystem is waiting for conservative use of its resources to attain sustainable development. It can only be achieved through a proper Environmental Management Plan which should be directed to : 1) To conserve aquatic resources, local population must switch over to alternative sources of earning, specially prospective agriculture (paddy monoculture, oil seeds, red chillies, watermelons), agro-industries(oil mill, rice mill, rice packaging & transport), household units(cotton net weaving, leaf-packets manufacturing, rural grocery), forest based(honey collection, bee-wax, *golpata* (local thatching material) and highly prospective tourism(providing job after training), 2)Local government should form Environmental Monitoring Cell to implement a)ban of trawl net and substitution of it by ‘trammel net’, a naturally floating devise without destruction of undersea fish habitats with much lesser amount of by-catches, b) replacement of pvc gillnet by traditional biodegradable cotton nets with fixed mesh-size to stop indiscriminate by-catches, to avoid ecological imbalance and to save a number of traditional cotton net weaver’s families, c) rotation of fishing grounds to ensure conservative use of aquatic resources, d) restriction of trawler routes only into deep sea to minimize damage to under-sea fish habitats and e) ban of night trawling and monsoon trawling to ensure undisturbed fish spawning and growth of seedlings, 3) Only eco-friendly practice of fishing may be allowed into exisisting *bheries* forming Joint Water Management involving local people, Government and N.G.Os to follow strictly the “Guidelines For Increasing Production & Productivity In Traditional & Improved Traditional Systems Of Shrimp Farming”, published by Aqua-cultural Authority, Ministry Of Agriculture, Govt. of India on 28 January 1998, under instruction of The Supreme Court Of India and 4) Government of India should strictly take disciplinary action against violation of related rules in Sundarbans. Though State Government has very recently emphasized the production of watermelons, red chillies, oilseeds(experimentally) and eco-tourism to some extent in Sundarbans, this is negligible compared to what is actually needed for environmental sustainability in this area.

Conclusion

Survey into ecologically as well as economically resourceful area of Sundarbans should be finally concluded with conservative use of aquatic resources as the best way to achieve environmental sustainability in Sundarbans. It must aim at ensuring protection, conservation and better management of resources which must not debar people from using these resources but aims at a particular pattern of use of resources so that these will neither be exhausted, nor polluted or destroyed. Ultimately, an E. M. P will only be required to change human attitude towards Nature as well as economic development.

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