The backwaters of West Bengal, where fishing is a way of life.

West Bengal, Indian East Coast

Summary of impressions from a visit to West Bengal in April 1992 by Dr Staffan Holmgren, BOBP. and of the discussions he had with the staff of the Central Inland Capture Fisheries Research Institute, Barrackpore, West Bengal.

39. THE GANGA AND THE HUGLI ESTUARY*

39.1 *Estuarine fisheries in West Bengal*

Of the 172 species of fish recorded in the Hugli-Matlah estuarine system, 73 are from the upper freshwater zone and 99 from the more saline marine zone. The fisheries of the system have been reported upon by Gupta (1970), De (1910), Naidu (1952), Jhingran and Gopalakrishnan (1971), Dutta et al. (1971) and others. The table alongside shows landings of important species from the Hugli-Matlah estuarine system during 1990-9 1.

Specieswise landing from Hugli-Matlah estuarine system during 1990-91 (in t)

Tenualosa ihsha	*1622.9*
Setipinna spp.	*3293.7*
Trichiurus spp.	*29966*
Harpodon nehereus	*4932.8*
Pama pama	*3756.1*
Sillaginopsis panijus	*23.3*
Tachysurus jella	*597.7*
Polynemous paradaeus	188.9
Coilia spp.	801.8
Tenualosa toli	*49.2*
Ilisha elongata	*447.4*
Elutheronema tetradactylum	*14.6*
Otolithoides biauratus	*303.6*
Pangasius pangasius	*11.1*
Lza parsia	*20.4*
Lores calcarifer	*6.2*
Pampus argenteus	*452.5*
Shrimp	2419.3
Miscellaneous	7733.2

39.2 Pollution in the estuary

The conditions in the Ganga in general and especially in the Hugli estuary are quite bad. The Hugli estuary is probably one of the most polluted estuaries in the world, with serious damage to fish and aquatic fauna and flora. In parts of the Ganga and Yamuna, sewage discharges cause anoxic conditions that result in no fish or zooplankton being present from January to August and a reappearance of the rotifer *Keratella* in September.

In 1981, there were 317 major industrial units operating along the banks of the Ganga and only 30 per cent of them followed some type of pollution control measures. Mixed discharges of industrial and domestic effluents were common. There were 96 factories from Nabadwip Island to the bar mouth discharging the impressive amount of almost half a billion litres of untreated wastes every day. Almost everything producing hazardous wastes are there: pulp and paper mills, pesticide manufacturing plants, chloralkali plants, distilleries, yeast, rayon, cotton, thermal power plants, and vegetable oil and soap, fertilizer, antibiotic factories etc.

In 1960, a rather comprehensive study was made of the environmental conditions in the Ganga and the Hugli estuary. A similar study was made in 1988 and it showed a clear deterioration in the Ganga. Chloride concentrations and alkalinity had increased, while oxygen had decreased. The nutrients had increased significantly. Surprisingly, there were no significant changes in the chemical parameters in the Hugli estuary during the period. The regular flushing by tidal water had evidently taken all wastes out to the sea and the estuary itself had not changed significantly.

A look at the statistics for fish catches was still more intriguing. In the Ganga, the catches had fallen from 50.3 kg/ha/year in 1960 to less than 20 kg in 1988. Of the 600 species found in the

* The figures regarding the environmental status of the river Ganga and the Hugli estuary are from the Central Inland Capture Fisheries Research Institute.

Ganga, 100 were endangered. In the estuary, the catches had increased: 1960: 7.5 t, 1970: 14.6 t and 1980: 24 t. Most of the increase was from the outer zone of the estuary. Scientific measures of the primary production showed that it was a real increased production and not increased fishing effort. If average primary production is set at 1 in the Ganga, it is 0.5 in the inner and middle zones and 2 in the outer zone. While there is damage in the inner zones due to pollution, the increased loads of nutrients in the outer zone have evidently been beneficial to fish production. In the estuary, almost 200 kg of fish is harvested/ha and year and this could be increased seven times without endangering the stocks (see Figure 28).

If chemical analyses are compared between 1960 and 1988, the following trends can be identified: pH decreased a little in the upper zone, but was surprisingly stable in the rest of the river; chloride and alkalinity increased due to sewage discharge and irrigation; oxygen concentrations were lower in areas with sewage and industrial discharges (Kanpur and Allahabad) and nutrients have increased somewhat, but not alarmingly. Conditions in the estuary have not changed significantly due to rapid changes, because of tidal damming up at high tide, flushing out at low tide. Also, freshwater discharge from Farakka has a remarkable ameliorating effect on pollution in the river/estuary. The industrial discharges are brought further out to sea. This method of diluting the pollutants is not a satisfactory method of combating pollution, the problems being just transferred to the sea instead. Riverine and estuarine plankton composition has changed significantly during the period with decreasing diversity indicating pollution. Bottom fauna has increased remarkably almost everywhere.

The N-content of fertilizers used in the Ganga area is about 900,000 t, P=200,000 t and K= 100,000 t. Ten to fifteen per cent of this will eventually end up in the sea.

About 3000 t of pesticides are used. The residues of DDT and BHC-Y in fish were highest in the industrial area of the tidal stretch of the river as compared with the estuary and river. Molluscs had the highest concentration of DDT: 65-150 ppb. Fish had 31-460 ppb, plankton 40-90 and sediments 20-70 ppb. The biomagnification, as compared with ambient water was almost 20,000 times for molluscs, 10,000 times for fish, 5000 times for gastropods and 2500 times for plankton. Analyses of fish in the Hugli estuary revealed that most fish had DDT residues. Large Hilsa had surprisingly low values. Less than lethal effects that DDT and BHC have had on fish are decline in growth, blood Hb and liver damage.

Heavy metals are found in fish in the Hugli estuary (see table alongside). Zinc in fish kidney up to 300 ppm has been recorded as well as high levels of copper, chromium, cadmium, lead and mercury. One fish at Delhi had 1.4 mg mercury/kg. In general, however, most values for heavy metals, as well as DDT in biota, were one or two orders of magnitude lower than what is found in Europe. But due to the stable and bioaccumulative nature of these substances, the concentrations found should be seriously considered.

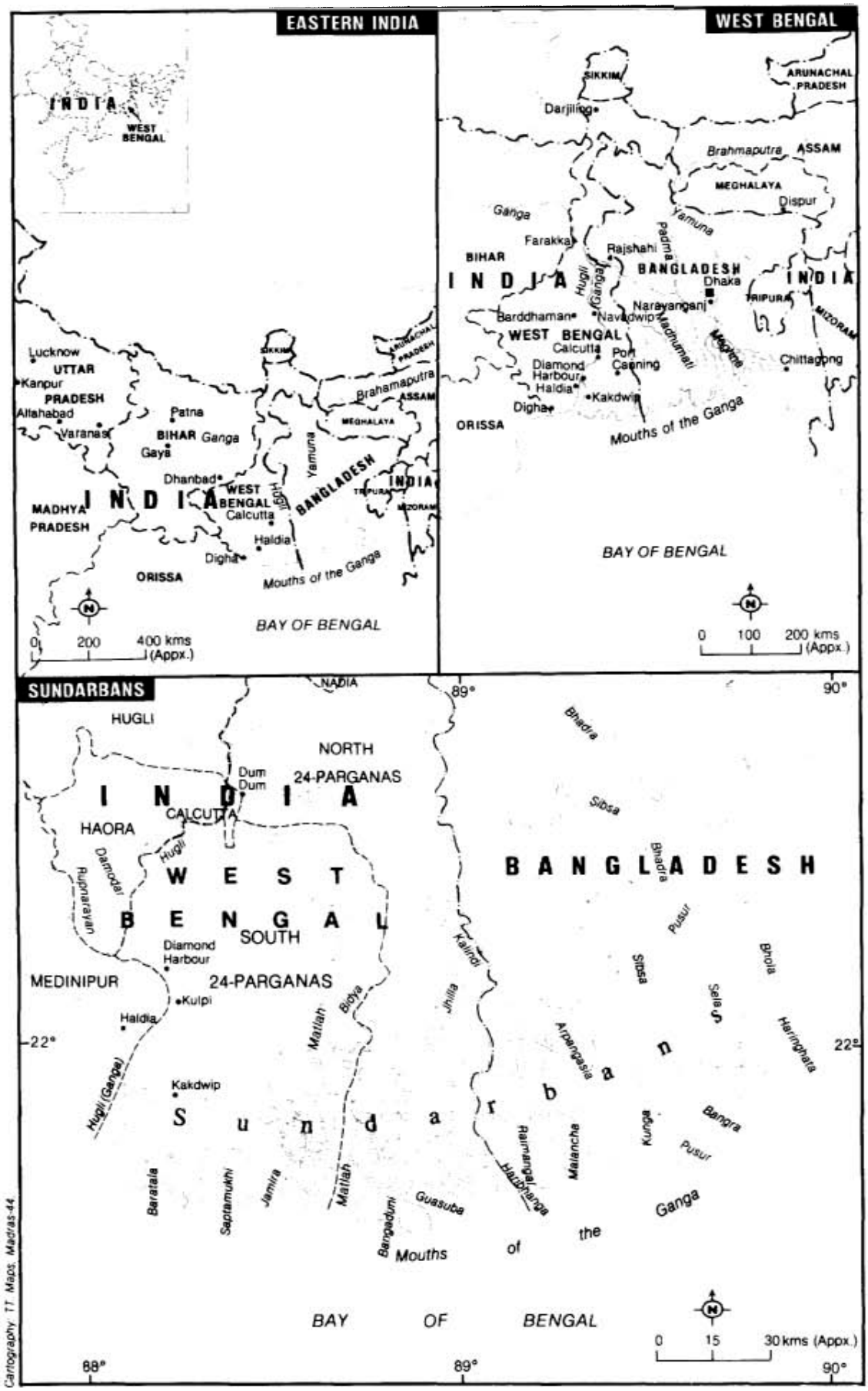
Mean composition of the sediments of the Ganga and Hugli (values in ppm)

Metals	Hugli estuary		Ganga	
	Bed	Suspended	Bed	Suspended
Chromium	61	98	52	264
Manganese	553	732	400	3450
Iron	31,036	42,111	21,600	99,000
Cobalt	36	53	22	223
Nickel	32	49	20	137
Copper	26	44	21	252
Zinc	71	151	46	1836

39.3 Fish ponds

Almost all the municipal waste of Calcutta passes through one or two systems of fish ponds before it is released into the Hugh River. The Mudiali Fishermen's Cooperative is one of the

Fig. 28. West Bengal and the Sundarbans



eighty cooperatives that have succeeded in using wastewater, in this case even industrial wastewater. By having the wastewater pass an ingenious system of ditches with dense vegetation of water hyacinths, *Eichhornia,* and *Valesneria,* they are able to use the treated water to produce 5-7 t of fish, without any addition of feed or fertilizers. By refining the method, they claim they can produce 15-20 t of fish/ha. They also use the treated waste water to irrigate and fertihze gardens and orchards. The income from the fish ponds, together with vegetables and fruit, can support about 2000-3000 people on 65 ha. The area had earlier been wasteland, belonging to the Port Authority, which had used it for waste disposal.

Most cooperatives and private enterprise fish ponds take their waste water from the main canal that has virtually only municipal waste. The industrial waste is usually led into a separate storm drainage canal. All values for mercury and pesticide residues in the flesh of fish grown in the ponds, as well as bacterial contents, were found to be well below WHO recommendations.

40. MANGROVES

40.1 *Mangroves*

The total area of mangroves in India is estimated at 6740 km^2. The east coast is endowed with the world's largest mangrove forest, the Gangetic Sundarbans in West Bengal (see Figure 28 on p. 151).

The Sundarban mangroves are of the deltaic type and show luxuriant and gregarious growth in the rich alluvial deposits at the mouth of the Ganga-Brahmaputra river system. As the freshwater discharge in this mangrove area is on the decline, the denudation process has started with the rise in the salinity of the region.

In the 4264 km^2 of the Sundarbans, mangroves like *Ceriops tagal, Excoecaria agallocha, Heritiera fomes, Sonneration apatala, Nypa fruteams* etc. are found. But more abundant are *Avicennia marina, A. alba, A. officinalis* and *Phoenix paludosa.* The Sundarbans is endowed with 30 of the 53 species of true mangroves in the world. Besides these, there are a good number of mangrove associates and obligatory mangroves. Weed flora, non-littoral plants and aquatic flora are also available.

Ghosh (1989) has provided fairiy good details about the living natural resources of the Sundarbans, which include benthic fauna and other species dependent on them. The region is rich in living natural resources. At least 70 species of common mangrove vegetation (including 30 tree, 20 shrub and 20 herb species) have been recorded from the Sundarbans delta. Besides the dominant flora, at least 16 species of algae, 33 species of phytoplankton and 184 species of fungal flora, including new species, have been documented in the mangrove swamps of this zone (Anon, 1987). These indicate the extent of available biomass and dynamics of the ecosystem. The components of the food-chain in an active cycle support a wide array of fauna.

At present, the undermentioned organizations, besides the West Bengal Forest Department, are working on the mangroves in West Bengal.

Central Inland Capture Fisheries Research Institute, Barrackpore.

Calcutta University, Calcutta.

Central Soil Salinity Research Institute, Canning.

Bidhan Chandra Krishi Viswavidayalaya, Mohanpur.

Botanical Survey of India, Calcutta

APPENDIX XXI

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