



A fishing village on the shore near Pentakota in Orissa.

Orissa, Indian East Coast

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41. MARINE HABITATS OF ORISSA

41.1 Chilika Lake

Chilika Lake, the largest brackishwater lake in Asia, is also one of the best studied coastal lagoons in the tropics. It is connected to the Bay of Bengal by a long (35 km) and narrow channel. Chilika Lake covers an area of approximately 790 km² (1989). During the monsoon season, the area swells several hundreds square kilometres due to a larger inflow of freshwater. The salinity varies from traces to 36 ppt (parts per thousand). In 1987, the maximum depth was 3.4 m. Further environmental characteristics are given in the table below:

Environmental characteristics of the Chilika Lake

Physico-chemical Properties		Naupli	: 16.0 - 18.0
Temperature (°C)		Protozoans	: 7
Surface water	: 17.5 - 32.0	Rotifers	: 4
Salinity ppt		Polychaetes	: 2
Range	: Traces - 36.0	Mysids	: 1.5
pH		Biomass (gm/m)	: 0.32 - 3.30
Range	: 7.6 - 10.0	Macrophytes	
Dissolved oxygen (mg/litre)	: 1.3 - 13.4	Dominant species	: <i>Potamogeton pectinatus</i> <i>Halophila ovata</i> <i>Najas gramineae</i> <i>N. falciolata</i> <i>Rupia maritima</i> <i>Eichornia crassipes</i> <i>Scirpus articulatus</i> <i>Gracilaria verucosa</i>
Transparency (Secchi disc depth in m.)	: Minimum - 0.32 Maximum - 1.40	Area covered by macrophytes (km ²)	: 1973 - 20 1977 - 60 1982- 100 1985 -200 1991-440
Nutrients (mg/litre)		Zoobenthos	
Nitrate	: Traces - 0.19	Total no. of species	: 62
Phosphate	: Traces - 0.18	Dominant groups	: Foraminifera Nematoda Polychaeta Copepoda Ostracoda Isopoda Amphipoda Gastropoda Bivalvia
Silicate	: 0.10 - 0.60	Biomass (gm/m ²)	: Northern sector 11.1 Central sector 18.3 Outer channel area 13.8 Southern sector 11.1
Trace elements (ppm)		Average annual production (gm/m ²)	: 13.5 - 16.5
Copper	: 0.02 - 0.04	Fisheries	
Zinc	: 0.025 - 0.19	Fish catch (tonnes)	: 1986-87 to 1991-92 : Min 4185.0 Max 8815.7 Avg. - 6034.2
Iron	: 0.12 - 0.32	Rate of fish production (kg/ha)	: 65 - 122
Sediments		Faunistic composition	: Ichthyofauna - 166 species P r a w n s 21 species C r a b s 5 species
Carbonate contents (%)	: 1.6-3.8	Birds & mammals	
Trace metals (ppm) in sediments		No of species of birds	: 151 (26 families) Migratory % Resident 55
Copper	: 5 - 66 (37) ^o	Mammals	: Dolphin (<i>Coryphaena</i> sp.) Sea cow (<i>Dugong dugong</i>)
Nickel	: 150- 270 (195) ^o		
Chromium	: 30- 270 (188) ^o		
Lead	: 72 - 122 (91)^o		
Phytoplankton			
Phytoplankton density			
Mishra et al. (1988)	: 2.10 ³ - 3.10 ⁴		
Panigrahy (1985)	: cells/litre (appx.)		
Relative species abundance (%)			
Diatoms	: 70%		
Blue-green algae	: 25%		
Dinoflagellates	: 3%		
Green algae	: 2%		
Phytoplankton pigment (mg/m ³)			
Total Chlorophyll ND 67.05	: 67.05		
Chlorophyll a ND	: 13.38		
Chlorophyll b ND	: 18.60		
Chlorophyll c ND	: 59.03		
Primary productivity	: 7.70 mg C/m ³ /h		
Zooplankton and secondary productivity			
Plankton volume (ml/litre)	: 0.03 - 0.27		
Faunistic composition	: 170 species (26 groups)		
Relative abundance of dominant groups (4)			
Copepoda	: 43.0- 70.0		
Veligers	: 5.0 - 30.0		

* Average value

Source: Asthana (1978); Banerjee & Raja Choudhury (1966); Jhingran & Natarajan (1966, 1969); Misra et al (1988); Mohanty (1981); Mohapatro et al (1988); Patnaik (1973); Patnaik (1988); Patnaik & Sarkar (1976); Panda (1988); Panigrahy (1985); Raman et al. (1990); Sarma (1988).

Chilika Lake is at present showing many symptoms of environmental degradation. A constant inflow of silt, 13 million t per year, due to soil erosion in the catchment area, is choking the lake mouth. Satellite images indicate that an area of 46 km² has been silted up and this area is now heavily infested with weeds and grasses. The shrinkage has been calculated at 1.5 km² per year. Due to the decrease in salinity and the excess nutrients (from the silt), weeds have spread over approximately one-fourth of the lake.

The drop in salinity (due to choking of the mouth) has also led to decreasing production of fish and prawn (see table alongside). However, if fish landings from 1930 to 1990 are considered (see second table on right), the picture is different. Recognizable changes have also occurred in the ranking order of different groups of fish and prawn catch (see third table on right).

There are conflicting opinions regarding changes in fish catches and species composition [(Jhingran and Natarajan (1966, 1969); Kowtal(1967); Misra (1988); Mishra and Satapathy (1992)]. The reason for this is probably because there are two opposite processes going on; on the one hand, the increasing inflow of nutrients causes increased production, while, on the other, siltation and reduced salinity cause diminished fish production.

41.2 Mangroves

A recent study made by the Forest Survey of India indicates that the mangrove area in Orissa is more than 195 km² in extent, of which 174 km² are in Cuttack District and 21 km² in Balasore District. (Personal communication of Harbola, 1992). The mangrove forests are mainly located in the Bhitarkanika area in Cuttack District and the Mahanadi delta between the Cuttack and Puri Districts.

One estimate puts the degradation of mangrove forests in Orissa at 20 km² over ten years (Samal *et al.*, 1988). Both Bhitarkanika and Mahanadi delta mangroves are now degraded due to conversion of mangroves into paddy fields and aquaculture ponds.

42. FISHERIES

There are 329 marine fishing villages in Orissa, with over 20,800 fisherfolk households and a population of 126,000 fishermen, of whom 30,700 are actively engaged in fishing.

The total marine fish catch of the state was 55,000 t in 1985-86 and increased to 80,000 t in 1990-91. This growth was possible due to country craft motorization and infrastructure development such as harbours, jetties etc.

Orissa's total marine product exports was 2842 t (Rs. 1,600 million) in 1981-82. This increased to 3841 t (Rs. 5,400 million), in 1990-91.

Ranking of ten different catches in Chilika Lake

Groups	Periods of assessment				
	1949/50	1957/58	1981-82	1986-90	1990-92
	1954-55	1965-66			
Prawn	1	1	3	3	2
Mulletts	3	2	4	6	5
Clupeids	4	4	1	1	4
Perch	5	5	5	4	6
Catfish	6	3	6	5	3
Threadfins	7	6	7	7	7
Scianids	8	7	9	*	*
Beloni- forms	9	9	8	8	8
Elasmo- branches	10	10	10	*	*
Miscel- laneous	2	8	2	2	1

* included in 'miscellaneous'

Five-yearly trends of fish landings in Chilika Lake from 1930 to 1990

Year	Fish landings (t)
1930-34	1452
1935-39	1738
1940-44	1755
1945-49	3078
1950-54	4821
1955-59	5616
1960-64	3681
1965-69	3160
1971-75	6152
1976-80	5696
1981-85	6811
1986-90	7740

Annual production of fish and prawns

Year	Production of fish and prawns (t)
1985-86	8590
1986-87	8872
1987-88	8104
1988-89	6128
1989-90	6670
1990-91	4273

The estimated harvestable potential of marine fish upto 100 m depth is 125,000 t. Based on the MSY estimates made by the Fishery Survey of India (1990), and the current production, it is estimated that an additional yield of 30,000 t of fish and crustaceans per annum can be harvested from the continental shelf along the Orissa coast.

The total estimated area suitable for brackishwater fish/prawn culture in Orissa is 32,000 ha, out of which approximately 29,000 ha have been surveyed and found suitable. Development has taken place in around 9,000 ha. Fish and prawn production from aquaculture is shown in the table alongside.

Total shrimp/fish production from brackishwater aquaculture in Orissa (1985-86 to 1990-91)

Year	Production (t)
1985-86	20s
1986-87	904
1987-88	1075
1988-89	1860
1989-90	2900
1990-91	2564

43. MARINE POLLUTION

43.1 Domestic wastes

Most urban areas have some disposal system and, therefore, a sizeable part of urban waste water find its way to the natural drainage channels. In rural areas, however, there are no organized systems of water supply and drainage. Most sewage is, therefore, totally absorbed by the soil.

The pollution load of the Mahanadi River in terms of BOD and COD load from domestic and livestock sources is estimated at 217,000 and 251,500 t/year respectively. Water quality parameters upstream and downstream of Cuttack are presented in the table below. The figures give an indication of the extent of pollution in this river due to domestic waste. The domestic pollution rates in other Orissa rivers has not been assessed.

Water quality parameters at Cuttack

Parameter	Upstream Cuttack U/S		Downstream Cuttack D/S	
	Range	Average	Range	Average
pH	7.2-8.7	7.4	7.0-8.7	7.9
DO	5-8.8	6.7	5.0-8.8	6.4
BOD	1.0-5.8	3.4	2.0-12.4	4.8
COD	1.6-26.0	11.3	4.8-30.0	18.2
TC (MPN/100ml)	28-110.0	353.0	75-300	1646
FC (MPN/100ml)	15-1100	209.0	75-2400	430
Conductivity (m mhos/m)	15.5-43.0	26.3	14.6-60	29.3
Chloride	4.6-66.8	14.9	9.4-33.8	18.0
Sulphate	20.0-140.0	49.8	5-280.0	84.3
Calcium	32.0-70.0	53.15	36.0-90.0	67.1
Magnesium	8.0-50.0	32.8	8.0-70.0	39.7
Total hardness	40.0-120.0	84.9	56.0-160.0	103.8
Alkalinity	72-230.0	121.0	90.0-290.0	141.6
Sodium	5.0-48.0	19.6	4.0-46.0	23.3
Turbidity (NTU)	4.0-450.0	93.0	7.0-660	127.0
Temp (°C)	25.0-33.0	26.3	24.0-33.0	28.4

Note : Values of parameter, if not otherwise stated, are in mg/litre

43.2 Industries

The table below lists the major industries in the coastal districts of Orissa. Pollution points and points of metal contamination are shown in Figures 29 and 30 on the facing page.

The Brahmani River at Raurkela and in the Talcher Nalco region and the Mahanadi at Brajrajnagar and the Rusikulya estuary near Gopalpur are the most polluted areas of the state. There are reports of fish kills, fall in catches (particularly CPUE) and even in diminished fish quality. Fish caught from the affected areas do not fetch good prices. The entire Orissa coast, particularly at Gopalpur, and the stretch of the Mahanadi river near Brajrajnagar are polluted due to heavy metal deposits,

Distribution of different types of industries in the coastal districts of Orissa.

Type or Industry	Total in the state	Distribution in the coastal districts			
		Ganjam	Puri	Cuttack	Balasore
Giant Industries (Investment more than Rs. 2000 crores)	2	Nil	Nil	Nil	Nil
Major/Large Industries (investment more than Rs. 25 crores)	27	<ol style="list-style-type: none"> Ganjam: <i>Products:</i> NaOH, HCl, H₂SO₄, Cl₂, SO₂. Ganjam <i>Product:</i> Synthetic Rutile, Ilmenite & Thorium 	<ol style="list-style-type: none"> Chandaka Industrial Complex. <i>Products:</i> Piping & Fittings, Condenser Tubes. Panipolliia. <i>Product:</i> Sugar Bhubaneshwar. <i>Product:</i> Repairing of Railway coaches. 	<ol style="list-style-type: none"> Choudwar. <i>Product:</i> High carbon Ferrochrome/Chargechrome. Choudwar. <i>Products:</i> Textiles & yarn. Paradwip. <i>Product:</i> Diammonium phosphate. Choudwar. <i>Products:</i> Different types of paper. 	<ol style="list-style-type: none"> Chhanpur. <i>Products :</i> Tyres & Tubes. Randia. <i>Product:</i> Chargechrome. Balgopalpur. <i>Products:</i> Silicon metal, High Ferro-silicon & Silica manganese.
Large Industries (Investment Rs. 5 crores- Rs. 25 crores)	58	<ol style="list-style-type: none"> Aska: <i>Products:</i> Sugar, Rectified spirit & Carbon-dioxide. Aska. <i>Products:</i> Fine cotton yarn & synthetic yarn. 	<ol style="list-style-type: none"> Bhubaneshwar. <i>Products:</i> Microprocessor based computers. Bhubaneshwar. <i>Products:</i> Printed circuit boards. <i>Products:</i> Stainless steel watch cases. Bhubaneshwar. <i>Products:</i> Television sets (B.W. Portable and Colour). Bhubaneshwar. <i>Products:</i> Hard Perrite. Bhubaneshwar. <i>Products:</i> Refined Oil (Groundnut, Mustard) Bhubaneshwar. <i>Products:</i> EPABX Push Button Telephone. Khurda. <i>Products:</i> Textiles and yarn. Bhubaneshwar. <i>Products:</i> Radio communication equipment. Bhubaneshwar. <i>Products:</i> Repair and maintenance of professional electronic equipment. 	<ol style="list-style-type: none"> Kendrapada. <i>Products:</i> Grey cloth. Chhatia. <i>Products:</i> Grey cloth. Paradwip. <i>Products:</i> Beer. Jaipur. <i>Products:</i> High carbon ferrochrome products. Dhanamandal. <i>Products:</i> Jute fabrics and Bags, Tarpaulin canvas, Hycee light weight cement packing items, various types of twine. Bhagalpur. <i>Products:</i> Cotton and viscose yarn. Baranga. <i>Products:</i> Sanitary wares, refractory and SW pipes. Sunapal. <i>Products:</i> Sugar. 	<ol style="list-style-type: none"> Balgopalpur. <i>Products:</i> Multi wall papers sacks. Balasore. <i>Products:</i> HDPE woven sacks. Balagopalpur. <i>Products:</i> Writing and printing paper. Somanathpur. <i>Products:</i> Sanitaryware, such as Indian water closets. Gopinath. <i>Products:</i> Textiles and yarn. Somanathpur. <i>Products:</i> Granite, Tiles, Monuments for 100% export surface plates. Ganeswarpur. <i>Products:</i> Aluminium extrusions. Somanathpur. <i>Products:</i> Rubber prophylactics. Tigiria. <i>Products:</i> Textiles and yarn. Tirtol. <i>Products:</i> Textiles and yarn.
Medium Industries (Investment Rs. 1 crore . 5 crores)	103	3	33	21	24

Source : Industries Department, Government of Orissa.

* Non-polluting industries.

Fig. 29. Map of Orissa showing pollution points

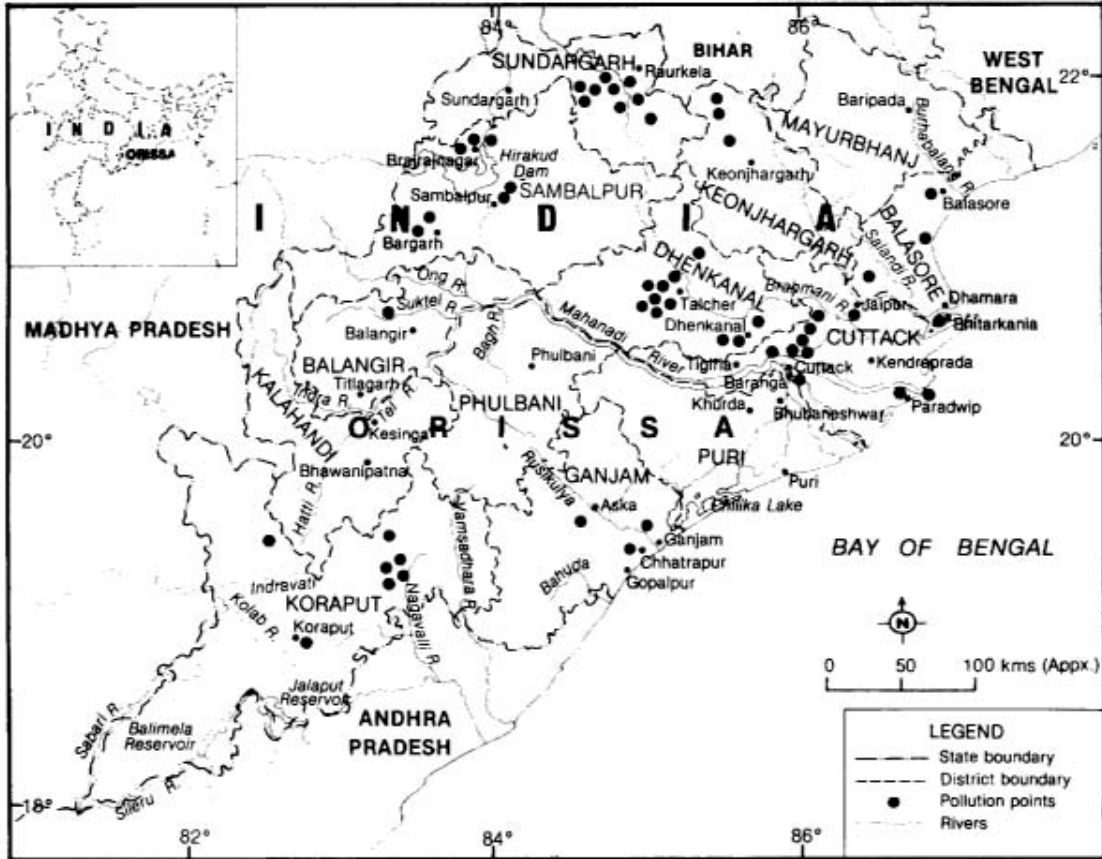
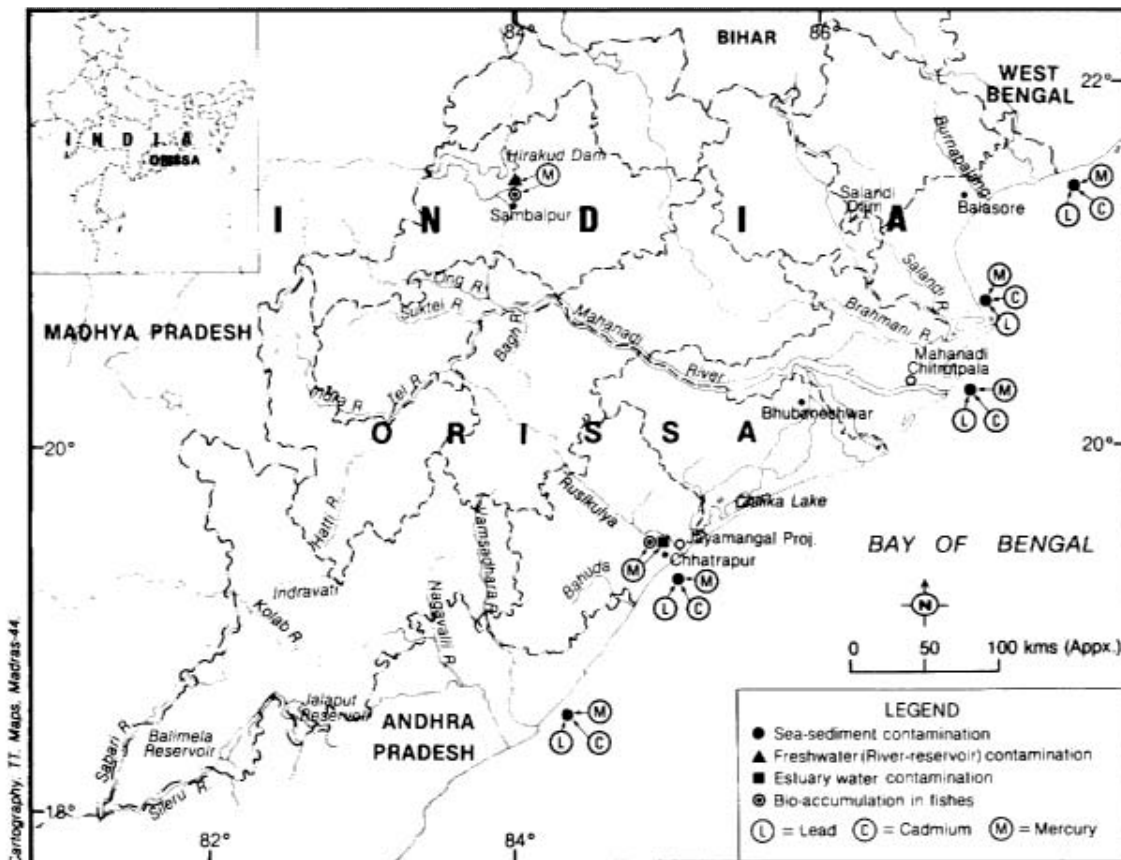


Fig. 30. Map of Orissa showing pollution points of metal contamination



Cartography, T. T. Mazur, Madras-44

which are bioaccumulative. Fish samples have been found to contain substantially high levels of mercury. There is total extinction of all forms of aquatic life in certain sections of rivers like the Nandira and Ib, due to such pollution. Pollution has also reportedly been the cause of the loss of the *Hilsa* fishery in the Rusikulya River and the freshwater prawn fishery in the entire stretch of the Brahmani river.

A study of the Orissa coast was carried out in 1990-91 to detect changes in the biochemical regime of the marine system brought about by coastal pollution. Five transects, namely Kalingpatanam, Gopalpur, Paradwip, Dhamara and Dyhiaha, were fixed for the study. Each transect included a number of stations, starting from river estuaries nearer the coast and going deep into the sea, up to a distance of 5.7 km. Only a few series are available, but in the near future, similar series of samples are to be taken all along the Indian coast. (Source: *Report on Marine Pollution Monitoring Studies*. Department of Ocean Development Unit for Coastal Ocean Monitoring and Predictive System (COMAPS), Regional Research Laboratory, Bhubaneswar). Some of the values of mercury, cadmium and lead in the sediments were surprisingly high, but could not be related to specific pollution sources.

The mercury concentration in the Gopalpur transect near the Rusikulya estuary was the highest. Due to this, there are enhanced levels of mercury in the planktonic organisms as well. This is due to the effect of effluents discharged from a chemical plant in Ganjam. Shaw *et al.* (1989) found a heavy mercury contamination of 1.85 mg/l in effluent from this factory which is much higher than the permissible limit of 0.01 mg/l prescribed by the Central Pollution Control Board.

A study was made on the geographical distribution of mercury around the chlor-alkali plant of this factory (Shaw *et al.*, 1988). The concentration of mercury was found highest in the samples collected from the solid waste deposit area. Mercury levels decreased with the increase in the distance from the factory. Mercury concentration in samples collected from the solid waste deposit area was as high as 640 (+ 33 mg/kg). Mercury concentration in fish flesh from the Rusikulya estuary was also studied (Shaw *et al.*, 1985). It was found that the concentration was as high as 2.18 (+ 0.03 mg/kg) in fish muscle; 2.1 (+0.12 mg/kg) in fish liver and 1.89 (+ 0.19 mg/kg) in fish brain.

Presence of mercury in the Ib section of the Hirakud reservoir, around Brajrajnagar, has also been reported. Das *et al.* (1985) carried out detailed water sediment analyses and fish sampling, both upstream and downstream, as well as at the effluent discharge point (see table alongside). The bioaccumulation of heavy metals in fish detected from this region is more than twice the limit prescribed by the WHO.

Water sediment analyses and fish sampling in the Ib River

	Water	Sediment	Magnification
Upstream	Nil	Nil	Nil
Lagoon	0.0075	0.4275-2.16	57-288
Discharge point	0.005	0.4-1.2	80-240
Downstream	0.0025	1.2-1.92	480-768
Plants (one species)	Upstream: Nil; Downstream: Nil; Lagoon: 0.125		
Fish	Downstream		
- <i>Amblypkaryngodon</i> sp. (<i>mahuradi</i>)		0.95	(380)
- <i>Mastaceinbellus pancalus</i> (<i>todi</i>)		1.075	(429)
- <i>Ckanna punctatus</i> (<i>gadisa</i>)		1.1	(440)
- <i>Ckanda range</i> (<i>patpania</i>)		1.25	(480)
- <i>Wallago attu</i> (<i>balia</i>)		1.33	(532)
Upstream			
- <i>Mustus keletius</i> (<i>kantia</i>)		0.475	(190)
- <i>Puntius sophore</i> (<i>kerandi</i>)		0.60	(240)
Different tissues of <i>Wallago attu</i>			
- ovary		0.87	(348)
- Heart		0.968	(387)
- Liver		1.38	(552)
- Alimentary canal			

Note : Study month: Feb-March, 1985; Mercury concn. ppm dry weight n = 3; Names in parentheses are local names; Values in parentheses refer to magnification from downstream water.

Source : Das *et al.* (1986). Pollution load in the Mahanadi River System, *IE Journal* Vol. XII

43.3 Treatment of waste water

In certain cases, waste water is diverted into marshes or other detention basins. By physical detention, diversion, filtration and other chemical treatment, the harmful substances are broken down into simpler harmless substances, reducing the intensity of pollution. This is a simple form of what may be called the Effluent Treatment System.

A survey was conducted by the Orissa State Prevention and Control of Pollution Board in 1991-92, and it discovered that out of 66 large and medium scale industries causing pollution, 37 have installed full-fledged effluent treatment ponds (ETP), 21 were in the process of installation, while installation of ETP in 8 others was still in the planning stage.

In 1992, Sirajuddin Khan visited twenty polluting industries in the state. His experiences from this survey are presented below.

Out of twenty industries visited, two had practically no ETP system and directly discharged their effluents into the water courses. The other 18 had regular ETP systems. Some of these were of the diversion and retention types. Here, the waste liquid was diverted into adjoining marshes or into retention basins, where, by natural processes, it was broken down.

Most managements readily showed Khan round their ETP and sewage treatment pond (STP) systems and provided information. Only one refused to show its ETP system or furnish any information. The following are some impressions of the effectiveness of the state's effluent treatment systems.

Almost all the industries using D.M. plants had an acid-alkali neutralization pit with a pH monitoring system. Other industries had very good effluent treatment plants in the area for their liquid wastes. Some recently established industries had most modern ETP systems.

Some of the older industries plan to adopt modern production technology and effluent treatment in order to avoid hazardous wastes like mercury. A substitute for mercury cell processes by membrane cell technology is, in fact, envisaged.

Several industrial units were conscious of the reduced use of waste water in pollution abatement. Large volumes of waste water are, in fact, recycled in the production process, as well as in effluent and sewage treatment processes. Effluents are also utilized in quenching boiler ash and making ash slurry.

Many of the industries had effluent quality control units with well-equipped laboratories and qualified technical staff to monitor the quality of the treated effluents. They maintained meticulous records of every analysis, and their reports (which are not always in agreement with the periodic monitoring reports of the State Pollution Board) show that all parameters of treated effluents are within the permissible limits.

Many industries have, besides the usual ETP systems, provision for emergency draining outlets for factory effluents, which flow directly into the water course. These, the managements said, are used when the ETP is under maintenance. During Khan's visit, many of the ETPs were out of order or under maintenance.

The most significant point that emerged during the survey and inspection of effluent points is that even if effluents are treated and all prescribed parameters followed, the treated effluent thereby being considered harmless for domestic use, it may still remain harmful for aquatic organisms. For instance, ash slurry, coal dust and other inert suspended materials are not toxic to fish, but they

destroy fish by choking their gills, damage the spawning and nursing grounds and retard plankton production. Some chemical pollutants cause fish kills, while others get absorbed in the body, disturbing the metabolism, damaging the nervous system and destroying the flesh and the keeping quality of captured fish. Mercury, for example, at the prescribed limit of 0.01 mg/litre, is probably harmless to fish, but since mercury is bioaccumulative and tends to get deposited in fish muscles, liver and brain, it is, ultimately, a threat. The survey revealed that both the public as well as the industrial community have become more environmentally conscious. Industrial groups are now more eager to take pollution control measures and invest money in elaborate effluent treatment systems. The private sector industries are more concerned about environment conservation than public sector units.

43.4 Agriculture . Consumption of chemical fertilizers in Orissa

Orissa, a predominantly agrarian state, had a population growth rate of 19.5 per cent in 1981-1991. There is, therefore, pressure on farming activity to increase production. During 1991-1992, 8,490,300 ha were under cultivation (Statistical Abstracts, 1991). About 30 per

Year	Quantity of consumption ('000 t)			Total
	Nitrogen	Phosphate	Potassium	
1984-85	70	27	16	113
1985-86	87	33	20	140
1986-87	91	38	24	153
1987-88	88	39	25	152
1988-89	123	48	31	202

cent of this land was for high yielding varieties, HYV, which,

for successful yields, require large amounts of fertilizers, pesticides and insecticides. The consumption of chemical fertilizers is shown in the table above.

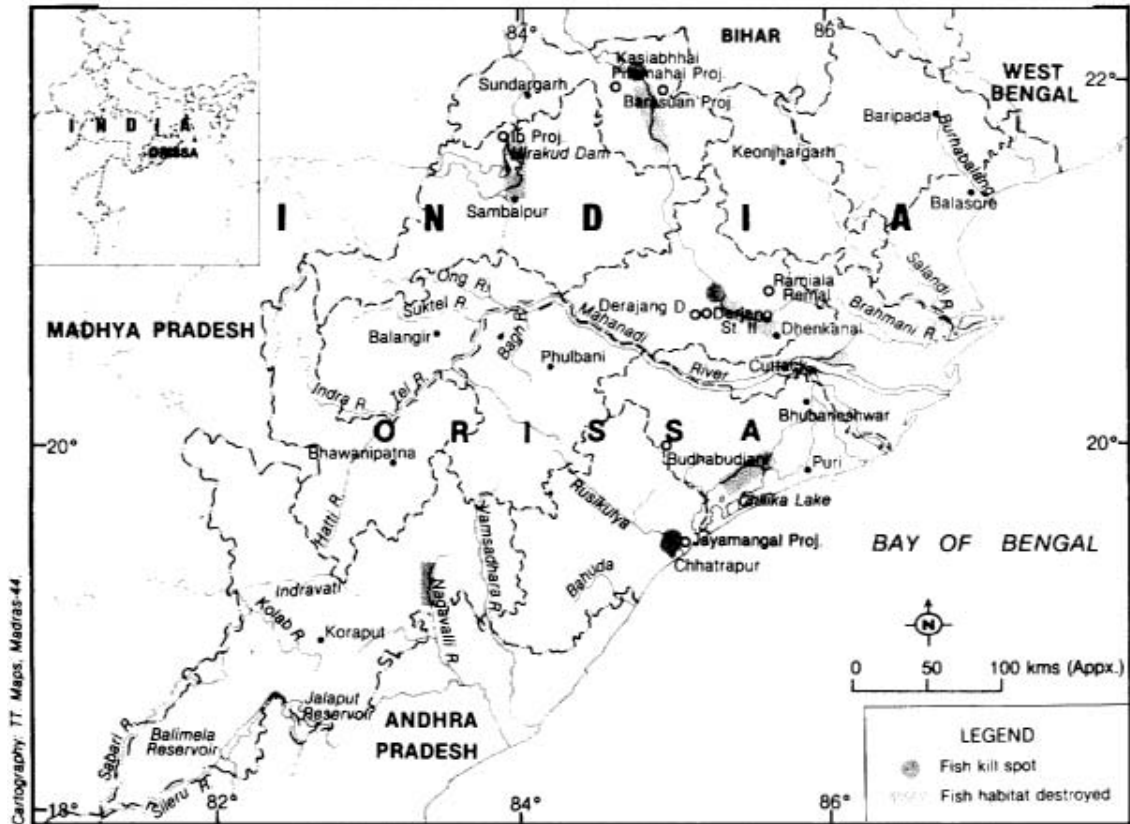
(Source : Statistical Abstract, 1991)

44. EFFECTS OF POLLUTION

Detrimental effects of pollution have not been recorded in a major way in coastal areas. However, river pollution is much more evident. Since river water finally reaches the sea, and since many fish spend a part of their lives at sea and a part in the rivers, river pollution is also relevant when discussing the marine environment. Among the observed effects are :

- **Biovacuum zones:** A total destruction of all forms of life, as in parts of the Nandira and Ib Rivers, near Brajrajnagar has been reported.
- **Reduction of fish catch and quality quantum:** This has been noted in the Brahmani, Mahanadi and Rusikulya Rivers.
- **Path-blockages for fish migration**
- **Effects on plankton:** Plankton occurring in the unpolluted zone of Nandira River has diminished with the proportionate increase in pollution load (Tripathy *et al.*, 1990).
- **Depletion of fishery:** The *Hilsa ilisha* and mullet fisheries have been totally destroyed in the Rusikulya estuary. (Commentaries on water, air pollution and environment protection laws, 1990).
- **Bioaccumulation of heavy metals in fish:** Reported from the Rusikulya estuary and Ib River.
- **Destruction of spawn collection grounds in rivers:** Riverine spawn collection was a thriving industry which attracted a large number of collectors. Spawn collection has now been completely wiped out from the Brahmani River and, to a certain extent, from the Mahanadi River.
- **Freshwater prawn fishery destroyed:** The fishery for *Macrobrachium malcolmsonii* has been destroyed in the Brahmani River (fishermen's report)

Fig. 31. Map of Orissa showing identified area of fishkills and habitat destruction



- **Fish kills** : These have been reported from the Nandira section (Brahmani), Ib zone (Hirakud reservoir) and Rusikulya estuary. Fish kills are also regularly reported each year from the Raurkela and Taicher regions (Brahmani). Figure 31 shows fish kill spots and areas where the fish habitats have been destroyed.
- **Effect of general water quality:** Surface drinking and irrigation water has been destroyed, in some areas, as in the Nandira River, for instance.

45. USE OF INDUSTRIAL/DOMESTIC WASTES

If the cost of effluent treatment could be partly recovered, it would provide an inducement to industries to go in for proper effluent management. At least some industries in Orissa have the potential for this. Examples are

- Use of rice mill effluent in pond fertilization. A rice mill diverts its waste water tanker to a Sambalpur fish farm. The results are very positive: the cost of pond fertilization is reduced without any environmental repercussions.
- Use of sewage and domestic waste. Sewage from city municipalities is used for fish culture in many places, e.g. in West Bengal, which has 130 sewage-fed farms, and in Tamil Nadu.
- Use of pulp and paper mill effluents for irrigation. A paper mill in Orissa has tested irrigation of crops like sugarcane and paddy with paper mill effluents. No adverse effects were reported (Reddy, 1981).
- Use of paper mill sludge. This can be utilized as liming material in agricultural lands and fish ponds.
- Use of sludge from chemical plants. It can be used as binding material in cement manufacturing.
- Use of sludge from sewage. Successful trials have been carried out using sludge as fertilizer at the Berhampur state fish farm.
- Use of fly ash from thermal plants. This can be utilized in brick and cement manufacture etc.

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APPENDIX XXII

Institutions engaged in environmental research, monitoring and enforcement

GOVERNMENT

State Prevention and Control of Pollution Board, Orissa (SPCP), A/118 Nilakantha Nagar. Unit-VIII, Bhubaneswar - 751 012.

This is the organization most actively involved in the study of pollution in Orissa. It has a wealth of information on aquatic pollution. The SPCP Board was established in 1983 to enforce the provisions of the Water (Prevention and Control of Pollution) Act, 1974, and Air (Prevention and Control of Pollution) Act, 1981. Subsequently, the Board was entrusted with the responsibility of enforcing certain environmental provisions which come under the Pollution Act, 1986.

Regional Research Laboratory (Council of Scientific and Industrial Research), Bhubaneswar 751 013.

This laboratory of the Council of Scientific and Industrial Research (CSIR), Government of India, devotes itself to aspects of research connected and concerned with technological problems of industrial development. It has undertaken marine pollution monitoring along the Orissa coast as a Department of Ocean Development (DOD) unit for Coastal Ocean Monitoring and Predictive Systems (COMAPS). Its aim is to study various pollution parameters along the Orissa coast, from Digha in the north to Kalingapatnam in the south.

Orissa Remote Sensing Application Centre (ORSAC), Bhubaneswar.

The Oceanic Remote Sensing Centre for the east coast, which preceded ORSAC, was set up in Bhubaneswar in 1987-88 with DOD assistance. In 1991-92, it was taken over by the State Government and ORSAC formed. ORSAC carries out studies on different environment aspects in coastal/oceanic waters. It has worked on aspects of environment degradation relating to Chilika Lake, mangroves and coastal waters.

Department of Fisheries, Government of Orissa, Dry Dock, Jobra, Cuttack 753 007.

The state Fisheries Department is basically concerned with the development of fisheries resources for the socioeconomic upliftment of the people of the state. It covers freshwater, inland, brackishwater and marine fisheries. The Department is not directly concerned with study of environmental pollution and degradation. However, it takes up local production-related problems for study and has, therefore, indirectly worked on a few aspects of pollution, including the use of industrial and sewage wastes.

Chief Conservator of Forests (Wild Life), Orissa, BBSR.

The Wild Life Department, an offshoot of the Forest Department, is concerned with the preservation of wild animals and the enforcement of the Wild Life Protection Act. Certain sections of Chilika Lake have been declared bird sanctuaries under the Act. Furthermore, selected marine and estuarine animals, like crocodiles and turtles, are also covered under the Wild Life Protection Act. Estuarine and coastal water pollution, which affects these animals, are also brought under this legislation.

OTHERS

- Central Rice Research Institute, Bidyadharpur, Cuttack District 753 006
- Central Institute of Freshwater Aquaculture, Kausalyagang, Bhubaneswar, Puri District 751 002

UNIVERSITIES

A number of universities have been working on fisheries-related pollution studies. These include the following:

- Utkal University, Vani Vihar, Bhubaneswar, Puri District.
- Berhampur University, Bhanja Bihar, Berhampur, Ganjam, District 760 007. (Department of Marine Science).
- Sambalpur University, Jyoti Vihar, Burla, Sambalpur District
- Orissa University of Agriculture and Technology, Bhubaneswar, Puri District.

APPENDIX XXIII

Legislation against threats to the marine environment

The Union Government's first Act on environment protection, called the Water (Prevention and Control of Pollution) Act, 1974, was adopted by the Orissa State Assembly in April 1983. The second Act, namely the Air (Prevention and Control of Pollution) Act, 1981, since amended, was adopted by the State at the same time. The Environment (Protection) Act, 1986, has also been adopted by Orissa State (Source: SPCP Board).

The consolidated Orissa Forest Act, 1972, which received the assent of the President of India in 1972 provides for environmental protection against degradation and pollution, particularly in forest areas and includes mangroves. (Source: Orissa Forest Manual).

The Orissa Forest Act, 1972. makes ample provision for protection against such types of environment degradation as tree-felling and shifting cultivation, which cause both soil erosion and water degradation.

Apart from the protection of reserved forests, the Orissa Forest Act provides for control of forest and land which are not Government property or in which the authorities have a joint interest. Section 39 of the Act provides as follows:

The State Government may notify, regulate or prohibit the following in any forest or waste land:

- a. the breaking-up or clearing of land for cultivation;
- b. cattle pasturing; or
- c. setting fire to or clearing of the vegetation, when it appears necessary for any of the following purposes, namely:
 - i. for protection against storms, winds, rolling stones, floods, avalanches;
 - ii. for the preservation of soil on the ridges and slopes and in the valleys or hilly tracts, the prevention of landslips or of the formation of ravines and torrents, or the protection of land against erosion or sand deposits, stones or gravel;
 - iii. for the maintenance of water-supplies in springs, rivers, tanks, reservoirs and irrigation projects;
 - iv. for the protection of roads, bridges, railways and other communication infrastructure;
 - v. for the preservation of public health and places of worship. (Source: Orissa Forest Act, 1972).