Conserve and restore Chilika Lagoon ecosystem with its rich biodiversity and aquatic resources for the benefit of stakeholders, particularly local communities through participatory processes, research and ecologically sound management techniques for the present and future generations.

The Chilika Development Authority was created by the Forest and Environment Department, Government of Orissa vide Resolution No. 20369/F&E dated 20.11.1991. The Authority is a registered Society under the Orissa Societies Registration Act. The governing body consists of the Chief Minister of Orissa as the Chairman and the Minister of Environment, Science and Technology as the working Chairman. The members of the governing body are drawn from various State Government departments, NGOs and technical experts besides elected representatives.

To sustain and restore wetlands, their resources and biodiversity for future generations through research, information exchange and conservation activities worldwide.

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Hydrological Intervention for Restoration of Chilika Lagoon

Wetlands are essentially hydrological systems and are quite sensitive to the changes in hydrological regimes. Hydrology plays an important role in governing the ecological processes and functions of wetland. This is more pronounced in the lagoons, which are highly dynamic ephemeral aquatic systems, influenced by land as well as sea. Several examples throughout the world highlight the role of lagoons and other wetlands in protecting the coastline, maintenance of biodiversity, controlling floods, recharging groundwater and overall ecological and economic security of the coastal areas.

Chilika is a classical tidal lagoon, created by a beach barrier berm that developed by accretion of coastal sediments over a period of time. It differs from some lagoons because of the large influx of freshwater, particularly during the monsoon season which gives the lagoon brackish characteristics. The lagoon owes its existence to the occurrence of the weathered hills on the southwestern limit of the lagoon, Mahanadi delta and barrier berm.

Chilika lagoon is evolving towards an ultimate semi-terrestrial freshwater dominated end state due to both natural and anthropogenic pressures. If the lagoon is left to evolve into a freshwater system, it is likely that there will be a significant decline in the biodiversity as well as bioproduction upon which a huge population living in and around the lagoon depends for its sustenance. The lagoon area has been shrinking along with the reduction in cross section of the outer channel. The summer depth at Nagarmukhi, the gateway between the lake and the outer channel, has considerably reduced to 0.3 m resulting in reduced communication with sea. All these changes have resulted in the deterioration of the lagoon ecosystem. The significant changes observed during last few decades include drastic reduction in the salinity levels, increase in freshwater weeds, decline in fish landing and changes in floral and faunal diversity.

The State Government of Orissa has been greatly concerned about the deteriorating conditions of Chilika lagoon. Considering its significant value in ecological and economic security of the region, the Chilika Development Authority (CDA) was constituted in 1991 by the State Government to conserve and restore Chilika lagoon with its rich biodiversity for the benefit of stakeholders particularly local communities. The changes in salinity regimes due to heavy siltation and changes in hydrological regimes was identified as single most dominant factor governing the ecological functioning of the ecosystem. The State Government emphasized the need to develop strategies on scientific basis for restoration of salinity regimes along with species recruitment through natural processes. This necessitated the assessment of the feasibility of hydrological intervention and its implementation which is briefly discussed in the paper.

Coastal processes and issues

Chilika lagoon is marching fast in the process from marine to brackish to freshwater system. The rate of transition has increased due to landuse practices leading to increased erosion and sedimentation. The National Institute of Oceanography (NIO), Goa had estimated that the net coastal sediment transport is about 1.5 x 10^6 cu m per year with the maximum movement taken from March to October. A reversal in the direction of transport occurs from November to February. This northerly sediment transport when compared with other lagoons is quite high. It is estimated that the rate of siltation in Chilika Lake 735000 cu m annually. There are 42 point sources of sediment loading, five of which are large rivers or streams.

The inflow of the lagoon is the product of interaction between waves, currents and sediments. It is approximately the product of the surface area of the lagoon and tidal level fluctuation. The tidal fluctuation rate in Chilika lagoon is about 0.2 m during non-monsoon periods, driven by tide in the Bay of Bengal ranging from 0.9 to 2.4 m. Chilika lagoon also receives the benefit of the Fresh water flow from the Mahanadi River system and from other rivers and rivulets, in keeping the tidal inlet open. During the monsoon the lagoon level increases by 1 m or more. The location of the inlet migrates in the direction of long-shore transport of littoral sediments. Incident waves generate long-shore currents which convey sediments. The sediments lengthen the spit and encroach on the inlet channels. Sediments driven into the channel are either carried inshore to form a bar, or leads to siltation of the channel.

This is perhaps the reason that a long channel of more than 32 km has developed over a period of time. Quite often the inlet migrates the points where the flow ranging is too great and hydraulic forces act to open a new inlet with a shorter connecting channel.

The location of the inlet to Chilika lagoon exhibits the effect of prevailing northerly littoral sediment transport, and a large bar located offshore on the inlet. Historical records show the inlet has been located in the same general area, within about 10 km, since 1914. The historical records indicate that multiple inlets have opened and siltation has temporarily reduced the inlet cross section. The Inlet of the Chilika lagoon is not stable and it continuously migrates towards the north. It has been stable opposite to Arkhakuda since 1914 fluctuating in its position within 4.5 to 8 km northeast. In recent years it has shown tendency to move further north. The old mouth was quite narrow, with hardly 100 m width and a cross section area of 250 sq m.

Specific hydrological studies

The Government of India through the then Ministry of Parliament Affaire, Shipping and Transport constituted a committee to examine the problem of deterioration of outlet channel connecting Chilika lagoon with sea to restore the salinity regimes with the overall objective of enhancement of fisheries production. The Committee recommended undertaking specific studies. Subsequently, the Department of Science, Technology and Environment (DSTE), Government of Orissa formulated an integrated Action Plan for conservation and management of Chilika in 1987 that highlighted the need for hydrological intervention based on specific studies. The studies carried out in this regard so far are briefly outlined below:

Model studies

The CWPRS, Pune was engaged in seventies to study the prospect of desilatation of outer channel and opening of a mouth to optimize salinity regimes in Chilika lagoon. With the help of model studies a straight cut was proposed at Satapada. It was pointed out that in the existing conditions the tidal prism was of the order of 16 million cu m which could initiate...
considerable improvement in the salinity levels. The proposal was not, however, implemented. The matter was again referred to CWPRS, Pune in 1990 to develop a mathematical model to simulate the flow conditions and salinity distribution in the lagoon. With the help of a two-dimensional model, it was possible to conclude that the straight cut would be a viable solution for improving the lagoon salinity. It was felt necessary to improve this channel at Magarmukh where the flow is restricted due to deposition of silt brought by rivers.

**Long shore sediment transport and wave climate**

NIO, Goa was engaged to study longshore sediment transport, littoral drift, wave climate, tides and currents, during 1992-94. The study carried out by NIO, Goa highlighted the following:

- The longshore sediment transport rate is northward throughout the year with the maximum transport rate recorded at $19 \times 10^8 \text{ m}^3$ per month in May – June and the minimum at $0.6 \times 10^8 \text{ m}^3$ per month in December – January. As the sediment transport was predominantly northward throughout the year, there was no significant difference in the magnitude between the annual net transport and the annual gross transport rates. The annual net transport rate was $0.88 \times 10^8 \text{ m}^3$. The annual gross transport rate was $1 \times 10^8 \text{ m}^3$.

- Tides in the region are characterized by a mixed type; predominantly semi-diurnal. The average spring tidal range is about 2.39 m and neap tidal range is about 0.85 m.

- The channel with maximum depth was found at Mirzapur while the shallow portion is located between Satapada and Alupatna. Formation of large sand shoals along the channel was found to occur at many places causing considerable reduction in the tidal flow.

- The current is unidirectional flowing from the lake to the ocean during monsoon from June to October. The average freshwater discharge was estimated to be $978 \times 10^8 \text{ m}^3$s. Using the cross section of the inlet entrance measured in March 1990, the tidal prism is estimated approximately as $0.78 \times 10^8 \text{ m}^3$ during the non-monsoon period from December to May.

**Dredging strategy**

Based on the findings of the study of CWPRS, Pune, a dredging strategy was formulated. It was observed that the Magarmukh area, a strategic link between the lagoon and the outer channel, is heavily silted up and should be desilted to enhance communication with the Bay of Bengal. The Ocean Engineering Centre of Indian Institute of Technology and Management, Chennai prescribed a site specific dredger to undertake desiltation of outer channel. A dredge channel of 3.2 km length was proposed by CWPRS, Pune at Magarmukh. It was predicted that the proposed dredged channel will not only help to improve the water exchange and salinity flux, but also help in flushing out the sediments as well as migration of fish and other biological species.

A straight cut across the sand spit opposite village Sipakuda was undertaken on the recommendation of CWPRS. It was also recommended that the lead channel of 3.2 km length be developed near Magarmukh to facilitate proper exchange of water between the lagoon and sea through the outer channel. It was predicted by the CWPRS, Pune that the opening of the mouth at opposite to Sipakuda will improve salinity flux into the lagoon by 40% and the tidal flux by 45%.

**Opening of new mouth**

Two Crawl Cat dredgers with 1000 MTS disposal system were used, one for developing a lead channel of 3.2 km near Magarmukh involving 16 lakh cu m and the other dredger was used for opening of the new mouth opposite village Sipakuda at a distance of 8 km from Satapada by desiltting 2 lakh cu m.

An EIA study was carried out by NIO, Goa, to ensure that ecological character of the wetland is not altered. The disposal of the dredging material was done on an existing island to prevent back flow of dredged material. The island was planted with suitable species to provide perching ground for birds and stabilization of dredged out material.

The opening of the mouth was started in January 2000 and was completed on 23 September 2000 by use of an amphibian dredger. The width of the sand bar was 280 m with maximum height of 12 m.
Impacts of opening of the new mouth

The opening of the mouth is considered a significant hydrological intervention with the objective of restoration of lagoon ecosystem. CDA carried out monitoring of changes in the water quality and biodiversity due to opening of the mouth. The services of NIO Goa were commissioned for monitoring the lake ecosystem both pre and post opening of the mouth as well as the desiltation of the outer channel. NIO Goa in their interim report have mentioned that no adverse effects of dredging have been noticed by them on Chilika eco system. The significant changes which occurred are:

- Increase in the salinity level to 14 ppt in the month of December 2000, at Satapada against the average salinity of 3-4 ppt recorded during the same period observed for last one decade.
- A significant salinity gradient has developed within the lagoon facilitating the recruitment of fish and prawn species as well as crab juveniles.
- A comparative analysis of the fish, prawn and crab landing for the years 1999-2000 and 2000-2001 shows that there is an overall increase of fish, prawn and crab landings by 131%, 534% and 449% respectively in 2000-2001. A high proportion of the landing however is observed between the months from September 2000 and March 2001. This may be attributable to the opening of the new mouth.
- *Paenus indicus*, whose production had drastically declined over the last several years, has considerably recovered after opening of the mouth. During September to March the yield ranged from 19 – 433 MT during 2000-2001 against 11–20 MT recorded in 1989-2000.
- Fishermen of more than 40 villages, during the course of survey stated that they had earned an average of Rs. 5,000 to Rs. 10,000 during the month of June and July.
- The flushing of the sediment into the sea is now quite visible. The silt from the outer channel is gradually flushing out through the new mouth. Due to scouring, the depth of the channel has increased by 30-45 cm at some cross sections. The tidal fluctuation is now recorded to be about 30 cm.
- The migration of both catadromous and anadromous fish species has considerably improved in the lagoon due to shortening of the migration route between the lagoon and the sea.
- The substantial improvement in the efflux also indicates the possibility of decrease in the water level of the lagoon during the monsoon period. The inadequate efflux through the old mouth was one of the causative factors for water logging (50,000 hectares of Kharif paddy crop) in the peripheral villages of Chilika in Kanas and Brahmagiri Blocks, leading to substantial economic loss and suffering.

Future Strategies

Hydrological monitoring at the river basin level is key to the maintenance of appropriate hydrological regimes in order to harness the multiple benefits of the Chilika Lagoon ecosystem. This requires an assessment of allocation of freshwater with desired flow to flush out the sediments and stabilization of the mouth. The key factors determining the hydrological regimes need to be assessed and monitoring programmes developed for collection of data on a long-term basis.

Chilika Development Authority in collaboration with WIWA and other agencies at the national and international levels is developing strategies on scientific basis to ensure management of the lagoon with the objective to provide benefits to the wetland communities.

A. K. Pattnaik
Chief Executive
Chilika Development Authority

Integrated Water Resources Management of Chilika Lagoon: An Approach

Integrated water resources management is based on the concept of water being an integral part of ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its use (Agenda 21, United Nations, 1992). The 1997 publication of the United Nations Environmental Programme and Wetlands International – Asia Pacific on Wetlands and River Basin Management, documented experiences in Asia and the Pacific region for the potential of wetlands to serve as important elements within integrated river basin management. Several examples from Asia and Pacific have been provided in the publication highlighting the role of wetlands in controlling floods, protecting coastline, recharging ground water and maintaining water quality due to their natural functioning.

The successful water management emphasizes adoption of an approach, which considers interconnectedness of all activities instead of focussing on a small area with limited objectives. The river basin provides a natural unit for such an approach. The wetlands that include heterogeneous assemblage of habitats ranging from lakes, marshes swamps, floodplain, peat swamps, mangroves etc are organically interconnected with river system. They do not function in isolation but are influenced by processes taking place in river basin in which they are located. The recognition of this interconnectedness within river system is a key requirement for sustainable water resources management in the new millennium.

Wetlands provide a host of benefits that are valuable to human kind. These benefits result from their ecological & hydrological functions. The changes in hydrological regimes, particularly during last few decades seem to be the root-cause problem for the fast degradation of Chilika Lagoon. The degradation of catchment area and construction of hydraulic structures within the river basin are responsible for reduction in freshwater flow into the wetland. This has drastically changed the flushing pattern and contributed to the reduction and shifting of the lake mouth due to the sediment transport to the sea. The reduction in the velocity and volume of water has promoted siltation both within the lagoon and its confinement within the sea.

The importance of wetlands in flood control within river basins can be elucidated with the example of China where the reclamation of wetlands for agriculture and other activities in Yangtze, Songhua and Nenjiang Rivers was attributed as a causative factor for unprecedented floods in 1998. Dongting, Poyang, Zhalong, Xianghai Lakes located in the middle and lower reaches of Yangtze and Nenjiang River basins play an important role in the hydrological regimes of these river basins. The decrease in Dongting Lake by 1659 sq km during last 50 years has reduced water storage capacity of the lake by 11.9 sq km. Similarly, Poyang Lake, the largest lake in China, has shrunk by 1185 sq km. Wetland area of Songhua and Nenjiang has reduced by 45% of its original area. All these wetlands were responsible for absorption of huge amount of floodwater and thus control floods by their natural functioning. Realizing the importance of wetlands in the flood control, the Government of China has taken a major initiative at official levels for protection, rehabilitation and management of wetlands. The government has banned the conversion of wetlands for other uses and on priority basis has identified important wetlands for restoration.

Wetlands International - South Asia (WISA) has identified integrated river basin management as a key area for sustainable development of wetlands. Projects have been undertaken in the states of Manipur, Orissa, Gujarat and Punjab to integrate wetlands into conservation and wise use of wetlands into river basin management. The specific studies undertaken and their importance in the context are:

- Sustainable development of Loktak Lake falling within Manipur River basin emphasizes on optimizing the water level to harness multiple benefits such as generation of power, wildlife conservation, sustainable fisheries development, mitigation of floods and improvement of water quality. The project involves enhancing water holding capacity, improving water quality and flood mitigation and developing mechanisms for implementation of strategies for wise use of Loktak Lake based on specific studies. In order to achieve these objectives a rational stakeholder endorsed water management plan that addresses multiple values of Loktak Lake will be prepared.

- River basin approach was adopted to assess the current status of wetlands and identification of problem statements for prioritization of wetlands in Gujarat. The approach emphasized on linkages of hydrology and biodiversity with development activities within river basin to evolve strategies and
develop action plan for sustainable development of wetlands in Gujarat. Based on literature survey the root cause problem was identified as lack of planning and policy to ensure minimum flow within the river system and wetlands for maintenance of their ecological processes and functions. A critical analysis of flow regimes in some of the rivers indicated that diversion of water for irrigation and other human uses was responsible for drastic reduction in the discharge downstream by 45 – 84 per cent in Ambica, Sabarmati, Mahi, Narmada, Tapi and Kim rivers. This has led to the increase in salinity levels effecting the mangroves and other associated flora and fauna adversely.

- Harikot wetland in Punjab located at the confluence of river Satluj and Beas is one of the largest wetlands in northern India. The construction of a barrage in 1952 has seriously affected water regimes leading to the problems of weed infestation, sedimentation, pollution and loss of biodiversity. The capacity of the reservoir has reduced by more than 79% over a period of 40 years. The management of the wetland has to be undertaken as an integral part of two river systems which extend from Shivaliks in the Himalayas to the downstream of Harikot wetland. The approach for conservation as planned by WISA and Punjab State Council for Science and Technology is to enhance hydrological regimes and control soil erosion and pollution in the upstream for long term management of the wetland.

Chilika, that sprawls along the east coast of India in the Mahanadi delta is the largest brackish water lagoon in the country. The lagoon has been showing signs of degradation during last few decades.

The changes in hydrological regimes seem to be the root-cause problem for the fast degradation of Chilika Lagoon. The degradation of catchment area and construction of hydraulic structures within river basin are responsible for reduction in freshwater flow into the wetland. This has drastically changed the flushing pattern and contributed to the reduction and shifting of the lake mouth due to the sediment transport to the sea. The reduction in the velocity and volume of water has promoted siltation both within the lake and its confluence within the sea.

The choking of mouth and construction of dams and barrages in the upstream has considerably effected natural recruitment of biological species through its mouth and rivers flowing into the lagoon. The increase in human population and use of nets/gears with reduced mesh size and mechanized trawlers are probably responsible for a decreased biological productivity of the lagoon. The changes in salinity regimes have more on the effects rather than the causes.

An integrated approach linking lagoon catchment, water management and bio-resources within river basins needs to be adopted for sustainable development of the Chilika Lagoon which is one of the six Wetlands of International Importance designated by India under Ramsar Convention. The need to integrate wetlands into river basin management has been recognized by many organizations and global institutions.

The critical linkages between wetlands, water and river basin management is emphasized in the text of the Convention on Wetlands and in the decisions of the Contracting Parties to the Convention at the triennial conferences. The Operational Objective 2.2 of the Strategic Plan urges the Contracting Parties to integrate conservation and wise use of wetlands into national, provincial and local planning and decision making on land use groundwater management, catchment/ river basin and coastal zone planning and all other environmental management.

A range of resolutions and recommendations relate to the importance of integrating wetlands into river basin management. However, all these resolutions and recommendations do not give clear guidance to the Contracting Parties on how to do so. Realizing this, the Contracting Parties to the Ramsar Convention adopted the guidelines for integration of wetland conservation and wise use into river basin management.

WISA and CDA are evolving an approach for conservation and wise use of Chilika Lagoon in consultation with the stakeholders. A concept proposal has been formulated and discussed in a meeting organized by World Bank at New Delhi in which senior officials from Ministry of Environment and Forests and other concerned agencies participated.


- Identification of current and future demands of water within river basin
- Minimizing the impacts of land use and water development projects in Chilika
- Maintenance of natural water regimes within the lagoon to optimize functions, values and resources
- Protection and restoration of biodiversity
- Sustainable resource development and management
- Development and strengthening of policy and legislation for integrated water resource management
- Capacity building
- Involvement of stakeholders, community participation and public awareness

Dr. C. L. Trisal
Director
Wetlands International-South Asia
Catchment Area Treatment

An Action Plan for community participation and development for the catchment area was formulated by Wetlands International - South Asia and Chilika Development Authority based on a survey carried out in the catchment area on the western side of the Lagoon. A detailed survey was carried out in three villages, Mansinghpur, Harichandanpur, and Binjhala falling under Banapur block of Khurda district in February 2001. Dr. Prahlad Mishra from Xavier’s Institute of Management, Bhubaneswar was invited to provided technical support to conduct the survey. The components identified under the action plan included:

- Development of ecological, socio economic and institutional profile of the community in the catchment area.
- Identification of problems and their prioritization
- Providing for effective community involvement in the formulation and implementation of a resource management plan for the entire area.

Hydrological Monitoring

Data Collection:

Hydrometry: Hydrological stations have been established in and around Chilika Lake to collect data on inflow/ outflow of fresh and saline water. The data is being collected thrice a day for all the stream and sediment sampling (inflow) stations. In the stream gauging inflow/ outflow stations, data is collected once a day during low tide. Meteorological stations have also been established to collect data on various parameters viz. temperature, rainfall, humidity, wind speed & solar radiation. Details of the stations are as under:

- 11 stream gauging and sediment sampling stations (inflow) have been established at Balkati, Goardhanpur, Andarasungh, Samantarapur, Jankia, Chupuring, Tarimi, Baddha, Kumbhirapada, Chherapadara, & Langaleswar
- 4 inflow/ outflow monitoring stations have been installed in the outer channel at Magarmukh, Sipakuda, Palur and Arkhakuda
- 2 meteorological yards have been set up at INS premises and Satapada

Highlights of Activities

- Identification and prioritization of problems based on data analysis from PRA exercises and socio economic surveys
- Community participation and development through demonstration projects such as joint forest management, low cost sanitation, community based duckery and hatchery projects
- Micro planning with the communities for identification and developing mechanisms for usufruct sharing of the benefits of demonstration projects
- Institutional networking and development including capacity building, creation of self-help groups, empowerment of women and weaker sections of the society
- To provide additional / alternate income generation to the communities within the catchment area

Rain gauge stations have been installed at 3 locations at Balugaon, Kalijai and Krishnaprasad Garh.

Data on water discharge and sediment load is also being procured from a network of stations established by Water Resource Department, Govt. of Orissa to determine the impacts of water resources developmental activities within the river basin on Chilika Lagoon.

Water Quality: Data on water quality is being collected from 30 stations in the lagoon to monitor changes in the physico-chemical parameters of water. The monitoring is being carried out on monthly basis. The parameters being estimated among others are atmospheric temperature, water temperature, turbidity, total suspended solids (TSS), pH, conductivity, alkalinity, salinity, dissolved oxygen (DO), BOD, nitrate, orthophosphate, sodium and potassium.

A well-equipped laboratory has been set up in Bhubaneswar with facilities for water quality analysis, hydrological analysis, biological characteristics, fisheries assessment etc. In addition to this, an on-site laboratory has also been set up in Balugaon.

Preliminary analysis:

- As per the data collected during June – October 2000 a total discharge of 21869 cumec and a total sediment load of 329420 MT was recorded to flow into the Lagoon via the 9 rivers/ streams which are being gauged.
- Makara has the maximum discharge of 8055 cumec as well as maximum sediment load of 119919 MT
- The maximum discharge (6443 cumec) as well as maximum sediment load (113631 MT) was received during the monsoon month of August
plants species of the State of Orissa, which roughly comprises of 2700 species. **Fabaceae** is the most dominant plant family represented by 90 species followed by **Poaceae** (77 species), **Cyperaceae** (40 species), **Euphorbiaceae** (36 species), **Rubiacae** (26 species), **Acanthaceae** and **Convolvulaceae** (23 species), **Asteraceae** (21 species), **Malvaceae** (17 species), **Lamiaceae** (15 species) and **Scrophulariaeae** (13 species).

In the course of field explorations of different islands of Chilika Lagoon, it could be observed that there are certain species which are characteristic to a particular island and not known to occur in other islands. While **Cassipoura ceylanica**, **Capparis roxburghii** and **Andrographis elongata** were distributed in Badakuda and Sanakuda islands only, **Gyrocarpus americanus** and **Derris trifoliate** were found growing in Ghantasila island and occurrence of **Aegiceras corncutulum**, **Porteresia coarctata**, **Basella alba** and **Commiphora caudate** was restricted to Chadeiguda island. Few populations of **Myriostachya wightiana** were noticed in the margins of Kaliarai island. **Phragmites karka** forming large and pure populations in Nalabana, could also be seen in Ghantasila island along its muddy margins. Some valuable species like **Macrotyloma ciliatum**, **Colubrina asiatica** and **Heliotropium curassavicum** were collected from a small muddy island near Nalabana village.

**Biodiversity Assessment**

**Flora**

A survey of the vegetation on the islands inside the lagoon, shoreline and waterbody was carried out. Overall 706 species of flowering plants belonging to 488 genera and 119 families were identified. Interestingly this represents more than 1/4th of the vascular

**Cassipoura ceylanica**

a sudden spurt in the year 2000-2001. The catch of the prawn, *Peneaus indicus* and crabs have in particular increased. The prawn catch has increased from 204 MT in 1999-2000 to 1296 MT in 2000-2001. Likewise, the catch of crabs has also increased from 17 MT in 1999-2000 to 94 MT in 2000-2001.

**Community Participation and Development**

The following activities were undertaken by CDA to promote community development in the area in and around Chilika Lagoon:

- Six island villages, Mahisana, Brahmapura, Tua, Gambhari, Jahnkuda, and Sipakuda have been provided with solar street lighting system through OREDA. 70. A total of sixty-five units have been installed in these six villages. Solar lighting has also been provided at Kaliarai Island.

**Fisheries**

The data on fisheries landing from the years 1986 – 2001 show that from 1988 to 2000 there has been a sharp fall in the fisheries production from the Lagoon. The landings declined from 8926 MT in 1987 to 1276 MT in 1996. However, the fish landing of Chilika increased from October 2000 after opening of the Chilika mouth. This is clearly visible in the chart presented alongside which shows

**Ferry Service in Chilika**

**Boat Jetty**
Two jetties have been constructed at Berampura and Mahisana to provide fish landing facilities to the villages. Further two more jetties are under construction at Satapada and Jahnukuda.

Two waiting cum auction halls are under construction at Kalupada Ghat and Sorana, which are the two prime fish landing centers of Chilika.

A ferry service between Puri and Krishnaprasad blocks is being developed by CDA through technical assistance from Ocean Engineering Center, IITM, Chennai. Once completed, this service shall benefit more than 70,000 people of Krishnaprasad block, who, at present, do not have any communication facility. Another ferry craft is being launched between Jahnukuda and Satapada.

A landing ghat for the convenience of fishermen and local boat commuters has been constructed at Mahisana, an island village. This shall facilitate landing of boats in all weathers.

Environmental Education and Public Awareness

The activities which have been undertaken by CDA for the environmental education and awareness about the Lagoon ecosystem are:

- Establishment of a Visitor Interpretation Centre at Satapada.

A visitor interpretation centre is being developed at Satapada with technical inputs from Ramsar Center Japan, WWF-India and Center for Environmental Education- Ahmedabad. The center is being equipped with an auditorium with the facility of multi media presentation, aquarium, laboratory and an observatory with telescopes.

The civil works involved in the construction of the centre have been completed. CDA has entered into a Memorandum of Undertaking with the Centre for Environment and Education, Ahmedabad (CEE) for installation of all the gadgets, exhibits and for the interior furnishing of the centre on a turnkey basis. CEE has also been entrusted with the task of developing a complete interpretation programme for Chilika. The initial survey work for the purpose has already been initiated.

Besides conducting awareness generation programmes for the tourists and local communities, the centre shall also conduct regular grass root level trainings and workshops on environmental education for school children.

- Establishment of Wetland Research Centre at Balugaon

The construction of the Wetland Research Centre at Balugaon is nearing completion along with the twelve rooms of scientist's hostel. The image processing hardware and software as well as other necessary equipment have been procured for installation in the centre.

- JFGE Project on Environmental Education and Awareness

A project on Environmental Education and Awareness has been initiated with financial support from Japan Fund for Global Environment. Under this project, Pallishree, a local NGO, has adopted twenty villages of Krishnaprasad CD Block for environmental education and awareness. During the first phase, the local stakeholders are being sensitized about the content and methodology of the programme.

Database

The Chilika Development Authority is in the process of developing a comprehensive database on Chilika. This database is being designed to encompass both spatial and non-spatial information related to Chilika. Information in this regard is presently being collected from the government departments, universities and research institutes besides from other literature available. The database will also include satellite imagery such as from LISS-III, and OCEANSAT-1 on Chilika and its catchment captured at strategic periods on an annual basis. Suitable hardware and software to undertake such image processing and GIS based analysis is already available with the CDA.

**AEHMS ECOFORUM MEETING**

Aquatic Ecosystem Health and Management Society (AEHMS) organized a meeting of AEHMS Ecoforum at WISA office in New Delhi on 19 February 2031. The meeting was attended by scientists from Canada, Austria, Nepal and India working in the South Asia region. The objective of the Ecoforum was to promote research on aquatic ecosystem and management and build a network of experts to facilitate exchange of information. The meeting deliberated on the following:

- Aquatic Ecosystem Health: status, scope and objectives
- Conservation and management of wetlands in India
- Bioconservation of fishes
- Current status of health of the Ganges ecosystem
- Insect macroinvertebrate freshwater fauna: origin and distribution within catchments of Ganges
- Environmental aberration on fishery
- Surface water quality assessment in the Hindu Kush Himalaya
- Conservation and management of Chilika Lagoon

NEWS BRIEFS

Release of Chilika Newsletter

The first issue of Newsletter 'CHILIKA' published jointly by Chilika Development Authority (CDA) and Wetlands International - South Asia (WISA) was released by the Hon'ble Chief Minister of Orissa, Mr. Naveen Patnaik on 26 September, 2000 at Orissa Secretariat. The Hon'ble Minister of Tourism, Government of Orissa, Mr. Bijoyshree Rout Roy and several secretaries of the State Government departments were present at the function. The Newsletter highlighted progress of activities carried out by CDA on conservation and management of Chilika Lagoon and a broad outline of the concept proposal submitted to World Bank for financial assistance.

Celebration of World Wetlands Day 2001

CDA in collaboration with a local NGO, Pallishree organized World Wetlands Day at Satpada. The Hon'ble Union Minister of Steel, Mr. Braja Kishore Tripathi was the chief guest in the function. He released a poster on Chilika, a Newsletter entitled 'CHILIKAR DARPANA' (Mirror of Chilika) and an environmental educational kit on Wise Use of Lagoon. A boat rally was also organized during the function in which 200 boatmen with traditionally decorated boats participated.

The World Wetlands Day function was also attended by a visiting team from Japan, which included Dr. Tsuji, Wetlands International - Japan, Dr. Yoshi, Fishery Expert, Ms. Reiko Nakamura and Mr. T. Musha, Ramsar Centre Japan.

Governor's visit to Chilika

His excellency the Governor of Orissa, Mr. M. Rajendra visited Nalabana Bird Sanctuary on 3 February, 2001 to assess the progress of activities carried out by CDA for conservation and management of Chilika Lagoon. He expressed his satisfaction regarding the measures taken by CDA and control of poaching of birds in Nalabana. The Hon'ble Governor was pleased to learn about enhancement of fish landing after opening of new mouth.

Chief Minister's Review of CDA Activities

The Hon'ble Chief Minister reviewed the activities of CDA on 8 January, 2001. He expressed his pleasure over the progress of CDA activities particularly opening of the mouth which has visible impacts on lagoon ecosystem as evinced by enhancement of fish production, reappearance of prawn species and increase in salinity levels after opening of mouth. The Chief Secretary and the Secretary, Forest and Environment departments were also present during the review meeting.

Workshop on Sustainable Development and Biodiversity Conservation of Chilika Lagoon

A two day workshop on Sustainable Development and Biodiversity Conservation of Chilika Lagoon jointly organized by CDA and WISA was held from 9-10 Feb., 2001 at Bhubaneswar. The workshop was attended by representatives from Ministry of Environment & Forests and state government departments of soil conservation, forestry, wildlife, tourism and fisheries. The scientists from Central Water & Power Research Station, Pune, Zoological Survey of India, Patna University, Utkal University and other concerned agencies also participated in the workshop. The workshop deliberated on issues relating to catchment area treatment, water resources management, biodiversity conservation and sustainable resources development and management. The proceedings of the workshop is under compilation.

International Expert Meeting

An International Expert meeting of the project on Environment Education and Awareness supported by JFGE on Chilika Lagoon was held on 28 September 2000 at Bhubaneswar. The meeting was attended by Dr. C.L. Trisal, Director, WISA, Dr. Chen Kelin, Director Wetlands International China programme, Mr. Reiko Nakamura, Secretary General Ramsar Center Japan, Mr. Mashor Mansor, Deputy Dean, School of Biological Sciences, University Sains Malaysia, Mr. Sanwar Hussain, President, Bangladesh POUSH. The experts visited the project site and interacted with the school teachers regarding the approach and the achievements made so far. They appreciated the biodiversity of Chilika Lagoon and the rules and regulations adopted by the island villagers for conservation of the lagoon. The findings and recommendations of the PRA exercises carried out in the 20 project villages were analyzed by the experts and the achievements were found to be satisfactory.
Other Activities of Wetlands International – South Asia

Ecotourism at Harike

Harike Lake, at the confluence of River Sutlej and Beas, is one of the largest habitats for waterfront in northern India supporting more than 200 avian species including migratory waterfront. Wetlands International – South Asia has formulated a management plan for ecotourism development of Harike wetland with the main objective of biodiversity conservation while providing economic benefits to the local communities. The ecotourism development broadly includes plan of action for recreation, revenue generation and public awareness. The various activities include setting up of interpretation center, infrastructural facilities for bird watching at the identified locations of touristic interest. The plan also envisages assessment of supportive and assimilative carrying capacity of the ecosystem and to develop measures for mitigation of impacts.

Integrating floodplain wetlands of River Yamuna in Delhi stretch into River Basin Management

Wetlands International – South Asia in collaboration with Delhi University and Guru Gobind Singh Indraprastha University has initiated a study to assess the role of floodplains of river Yamuna in Delhi stretch in determining the hydrological and ecological functions of the river stretch. The specific aspects under study include identification of floodplain areas using hydrological and ecological parameters; determining distribution, production and role of vegetation and pollution abatement; assessment of floodplains in recharging of aquifers and flood control; and evaluating the impacts of development on biodiversity. Based on the analysis of data collected, strategies will be formulated to integrate the floodplains with the river system with a view to improve the water quality within the river channels, conserve biodiversity and maintain hydrological regimes.

Project on Sustainable Development & Water Resources Management of Loktak Lake

• A bathymetric survey of Keibul Lamjao National Park was undertaken to determine the depth profiles and their relationship with flora, fauna and water quality. A report on the status of the Keibul Lamjao National Park is under preparation.

• A survey of fish migration in the downstream of Ithai Barrage was carried out by a multidisciplinary team including experts from fisheries, limnology, sociology, hydrology, and remote sensing to assess the impacts of Ithai barrage and suggest immediate measures. The results of the survey have been compiled.

• Training workshops on Logical Framework Analysis and Results Based Management were conducted at Imphal by Wetlands International – South Asia and Loktak Development Authority.

• A low cost sanitation project has been initiated at Karang Island through efforts of the SDWRLM project team to improve the sanitary conditions in the villages and to reduce the amount of waste flowing into the lake.

• A community owned mini Chinese hatchery has been constructed at Toubul having a production capacity of 1 million fingerlings per annum.