

## **INTEGRATED MANAGEMENT OF CHILIKA LAGOON, INDIA, CASE #268**

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This case describes ecological restoration of a coastal wetland and the challenges and benefits in relation to local community participation.

### **ABSTRACT**

#### **Description**

This case study describes a framework for integrated lagoon basin management including interventions in both the coastal processes and the river basin itself for restoration of a severely threatened lagoon with an ecosystem approach. Application of GIS and remote sensing tools have been useful tools for monitoring and assessment of the lagoon. The outcome has been a significant improvement of the ecological health of the lagoon, including a substantial per capita income of the fishing community due to the restoration of the lagoon.

Key lessons learned have been on the implementation of a flexible, pragmatic and non-bureaucratic management set-up with high-level political support. Committed leadership and true participatory involvement and stewardship of local communities were another key to success. Finally, a sound and holistic understanding of the ecosystem processes of the Chilika lagoon has been essential.

After the reception of the Ramsar Wetland Conservation Award in 2002, the case has received international recognition, and the experiences demonstrate the promising potentials in reforming the management frameworks of the numerous important coastal wetlands in the Asian region.

#### **Lessons learned**

The extraordinary implementation success of Chilika Development Authority (CDA) can be related to the non-bureaucratic organizational setup, which actually has no formal legal mandate. Supported by a high-level Governing Body with strong political backing and with full access to government funding, the CDA combines the stability of a government authority with the implementation flexibility of the private sector, avoiding the constraints of the normal bureaucracy. The management philosophy of CDA is pragmatic and outcome-focused, implemented by innovative leadership and a strong and committed core team

Management steps by the CDA are widely debated, researched and implemented, and this extensive consultative approach has contributed significantly to the success of the management actions undertaken. The CDA is also actively involved in local socio-economic activities in support of local communities. It is also backed by a strong outreach programme with active participation of the local communities, NGOs and the community based organisations. The hydrological interventions for the restoration of the lagoon have resulted in considerable improvement of its fishery resources, water quality and a positive impact on the biodiversity of the lagoon. Consequently, this has significantly contributed towards the increase in the per capita income of the community who depend on the lagoon for their livelihood. The increase in the

productivity level both in the wetland as well as the watershed due to the good environmental practices facilitated the poverty alleviation of the community.

The community participation and stewardship, linkage with the various national and international professional institutions, intensive monitoring and assessment system are some of the uniqueness of the management practices adopted by CDA for restoration of this wetland. At the same time, time is now ripe to start a process to establish a participatory and a self-sustainable mechanism for conservation and wise-use of the resources of the lagoon on a long-term basis.

### **Importance of case for IWRM**

This case study demonstrates how a clear understanding of the coastal process and the river basin is essential for restoration of a coastal wetland. The intervention for improvement of the hydrological regime and the participatory management of the watershed resulted in the enhancement of the productivity thereby increase in the per capita income of the community. The intensive monitoring and assessment system, linkages between the scientific studies and the management interventions are some of the uniqueness of the management practices adopted by CDA for restoration of this unique wetland. This has also facilitated the self-initiated good practices by the community. It can be replicated in many other coastal wetlands facing similar problems.

### **Main tools used**

B1.1 Reforming Institutions for Better Governance  
B1.9 Civil Society Institutions and Community Based Organisations  
C1.3 Modelling in IWRM

### **Keywords**

Lagoon basin management, coastal wetlands management, GIS application and tools for monitoring lagoons, Ramsar Convention, participatory approaches, livelihood and fishing in lagoons

### ***MAIN TEXT***

### **Problems**

Chilika is the largest lagoon along the east coast of India, situated between latitude 19<sup>0</sup> 28' and 19<sup>0</sup> 54' N and longitude 85<sup>0</sup> 05' and 85<sup>0</sup> 38' E. (fig-1).

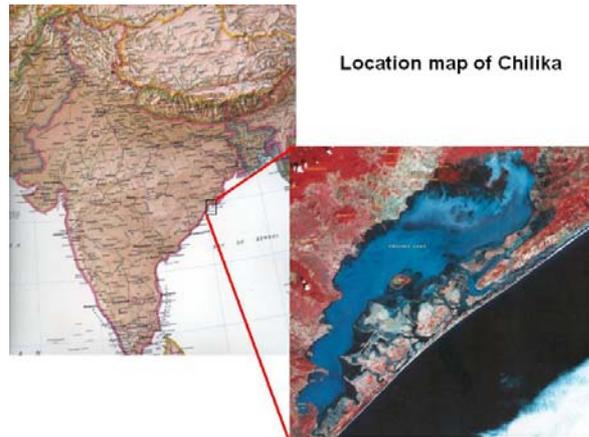


Figure 1.

The lagoon is a unique assemblage of marine, brackish and fresh water eco-systems with estuarine characters. It is one of the hotspots of biodiversity and shelters a number of endangered species listed in the IUCN red list of threatened species, and also is a designated Ramsar site. It is an avian grandeur and the wintering ground for more than one million migratory birds. The highly productive lagoon eco-system with its rich fishery resources sustains the livelihood of more than 0.15 million-fisher folk who live in and around the lagoon.

Hydrologically, Chilika is influenced by three subsystems: i) The Mahanadi river delta, ii) minor rivers flowing in the lagoon from the Western catchment and iii) the tidal outlet to the Bay of Bengal (fig-2). Construction of major hydraulic structures upstream in the Mahanadi has altered the flow pattern into Chilika. The long shore sediment transport along the coast of Bay of Bengal estimated to be 0.1 million metric tones annually tend to shift lagoon mouth opening to the sea every year thus adversely affecting the tidal exchange.

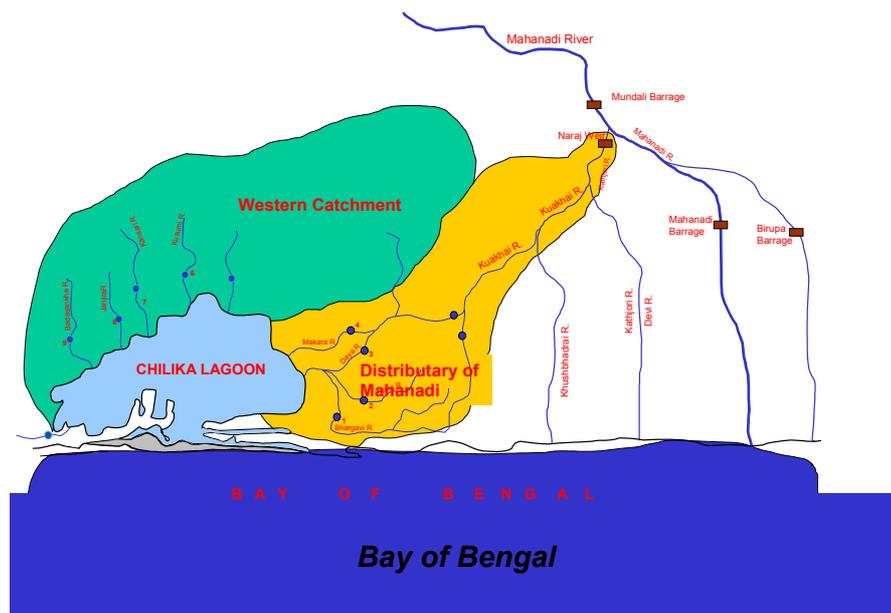


Fig-2 Hydrological set up of the lagoon

This changed flushing pattern significantly affected the salinity regime, and consequent natural recruitment of biological species. The spatial and temporal salinity gradients due to the freshwater flow from the riverine system and the seawater influx; gave it the unique characteristics of an estuarine eco-system, exercising a continuous and selective influence on its biota. The hydrological alterations leading to the transformation of the lagoon towards a fresh water ecosystem was considered as a potential threat to the biota of this unique ecosystem. This could be broadly attributed to the change in the flow pattern from the lagoon basin and the changes in the coastal processes. Due to the depletion of the health of the lagoon, it was added to the list the Montreux Record (threatened list of Ramsar sites) in 1993. The lagoon encountered a combination of increased siltation, as well as partial closure the outlet channel connecting the sea. The consequent decrease in salinity caused proliferation of invasive species, increased turbidity, shrinkage of area, loss of biodiversity, depletion of the fishery resources. The overall decline in the productivity adversely affected the livelihood of the local community.

### **Actions taken**

Being concerned with this the Orissa State Government created Chilika Development Authority (CDA) in the year 1992, for the integrated management of the lagoon. CDA adopted a holistic approach of integration of coastal processes and lagoon basin in the management planning. For a clear understanding of this complex system, the services of the premier institutes of the country like National Institute of Oceanography (NIO) was commissioned by CDA to carry out a detail study of the coastal processes and the hydrological set up of the lagoon. Hydro-biological monitoring of the lagoon in collaboration with the Wetlands International South Asia (WISA) is being carried out to understand the changes in the hydrological regimes, water quality and biota in reference to the changes in the flow pattern into the lagoon from the catchments. Based on the output of these studies, the Central Water and Power Research Station (CWPRS), Pune, carried out a two dimensional numerical model studies. The studies concluded that the tidal influx into the lagoon was considerably reduced because of the shoal formation along the lead channel and continuous shifting of the mouth that resulted in significant hydraulic head loss.

Based on the findings of the numerical model studies, CWPRS inferred that the salinity flux and tidal flux into the lagoon would not improve unless the location of the opening of the inlet was moved closer to the central parts of the lagoon. Following the recommendations of the CWPRS, an artificial mouth was opened on 23<sup>rd</sup> September 2000 which reduced length of the outflow channel by 18 km. Dredging of the lead channel was also completed before opening the new mouth. The environment impact assessment was carried out by National Institute of Oceanography, Goa, before and after the opening of the mouth.

### **Outcomes**

#### ***Impact of the hydrological intervention on the lagoon ecosystem***

The opening of the artificial mouth and the desiltation of the lead channel not only rejuvenated the ecosystem of the lagoon but also immensely benefited the community

depending on the lagoon whose average annual income increased by more than US \$ 1040 approx. per family.

There have been significant improvements of the salinity gradient after opening of the mouth. Before the opening of the new mouth, the salinity level of northern sector of the lagoon used to remain zero through out the year. There used to be an abrupt change in the salinity level of the central and outer channel with onset of monsoon. After the hydrological intervention the salinity level of the northern sector improved as measured during May 2001 (figure 3) against the average salinity level during the same period for the past one decade. For an ecosystem with a seasonal and the sectoral characteristics as indicated above, an appropriate salinity gradient with gradual decrease from the lagoon mouth towards the lagoon proper is desirable. Ideally the seasonal changes in salinity gradient should not be abrupt, as it is considered, harmful for the biota and it should be as flat as possible. The change in salinity regime of the lagoon was abrupt in the outer channel and the central sector prior to opening of the mouth. After opening of the new mouth less fluctuation of the salinity gradient is observed.

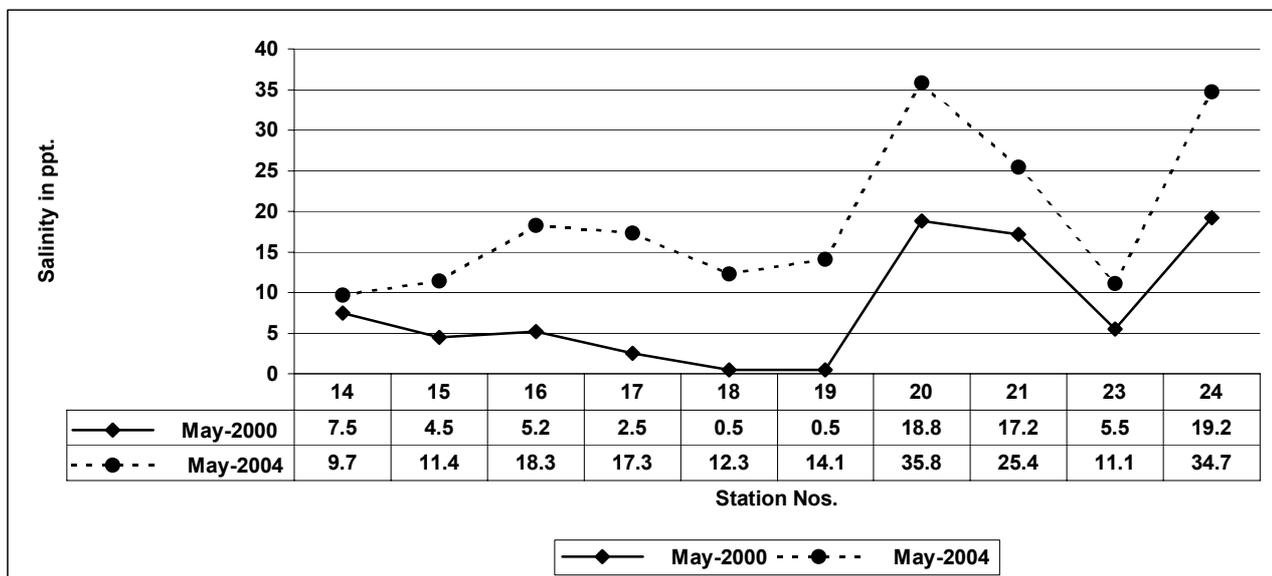


Figure 3 Variation of salinity in the Northern sector during May 2000 and May 2004

The gradual reduction in the salinity from the lagoon mouth to the lagoon interior after the opening of the mouth is providing the desirable sense of direction for the euryhaline forms to enter into the lagoon from the sea. This is facilitating the auto-recruitment of the fish, prawn and crab juvenile into the lagoon. As against the annual average fish (fish and prawns) landing of 1600 metric tons recorded during the past six years, the fish landing during the year 2000-2001 improved to 4889 metric tons (figure 4). From April 2003 to March 2004 the fish landing is recorded to be 14,000 M.T, thus the average productivity during the current year has shown about 8 times increase in comparison to the average yield prior to opening of the mouth. Based on the average weighted price, the total financial return from the fisheries for the financial year 2001-2002 is estimated as Rs. 800 million INR (nearly 17 million US\$). The crab landing of the lagoon which had declined from 79 metric tons during

1985-86 to the lowest ever, 3 metric tons during the year 1994-95, touched 93.5 MTs in 2000-2001, and it improved to 111 M.T during 2001-2002 (figure 5). After opening of the new mouth six species of fish one species of shrimp of commercial importance reappeared which were thought to be disappeared from the lagoon. The increase in the fishery resources facilitated the community to adopt self-initiated good practices, like regulation of the mesh size, refrain from the juvenile poaching etc.

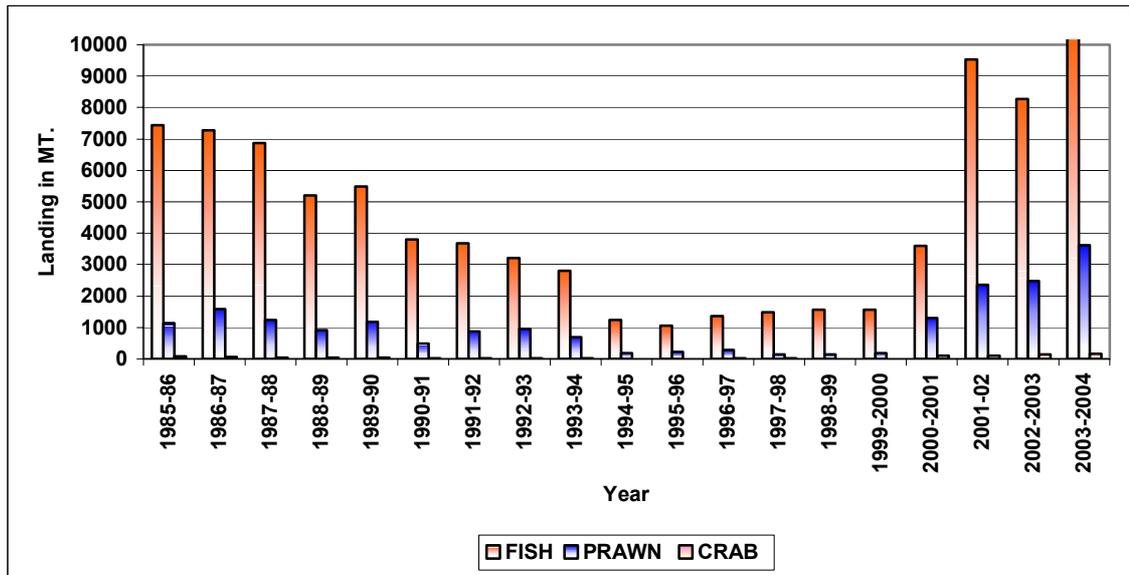


Figure. 4 Fish, prawn and crab landings of Chilika Lagoon during the years 1985-86 to 2003-04

The declining salinity level triggered proliferation of the fresh water invasive species. The weed spread area (figure 5 ) which was only about 20 sq.km in 1972, increased to 523 sq.km by October 2000, leaving a weed free area of bare 334 sq.km. After the opening of the new mouth, the weed free area assessed by use of the image-processing tool found to be in the order of 506 sq.km (May 2001), an increase by about 172 sq km.

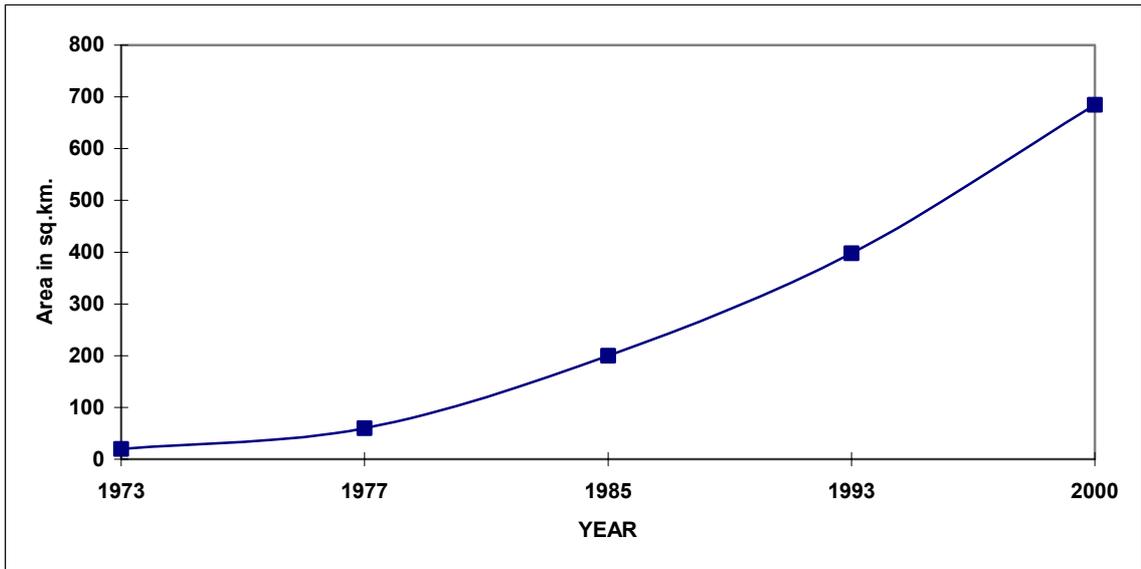


Figure 5 Increase in weed spread area form the year 1973 to 2000 in the Chilika Lagoon

Better flushing of the sediment to the sea through the outlet channels along with significant improvement in the water level variation (figure 6) during the tidal cycle is being observed after opening of the new mouth. This has set the lagoon in to a **pulsing** mode; which helps in making a wetland more productive by nourishment with additional nutrient and flushing out of the detritus and waste products.

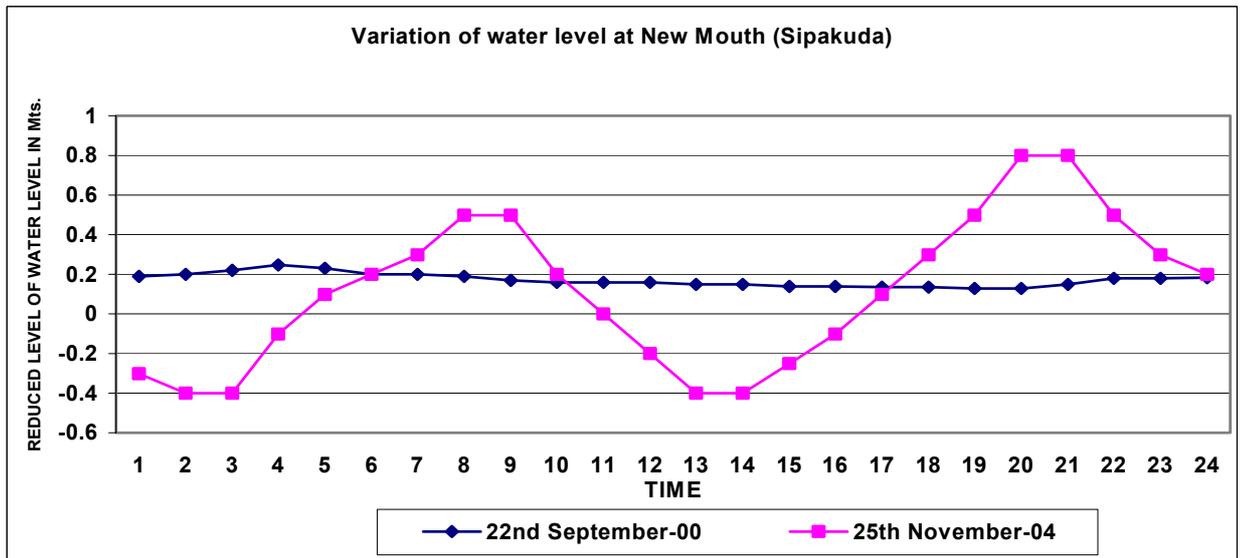


Figure 6 Variation of water level at New Mouth (Sipakuda)

### ***Community based management of the lagoon hinterlands***

The other major component of the restoration plan is the community-based management of the lagoon basin, on a micro watershed basis. The treatment of the catchment on a micro watershed basis is being done in a participatory manner with an objective to facilitate a community based co-management strategy for an integrated terrestrial and aquatic resource management within the watershed. Through a series of training program and exposure visits, the capacity building of the watershed community is accomplished, which paves the way for preparation of the micro plan blended with indigenous knowledge, for optimum utilization of the natural resources. The watershed community also shares a part of the cost of the management of the lagoon basin. This is also creating an enabling environment for the local community to take decision and participate in the management.

More than 0.20 million fisher folk directly depend on the lagoon, and about 0.80 million people live in the catchment of the lagoon. So while formulating the management plan, stakeholder consultations were done by holding village level meetings. And the outcome of the meeting in the form of suggestions and recommendations are incorporated into the management action plan. The linkages with the community through the village level institutions, women self help groups, community based organizations, networking of the NGOs is a mandate of the CDA . A network of the NGOs and the Community Based Organisations (CBOs) working in and around the lagoon has been established. A bi-monthly newsletter in local language is published in collaboration with a local NGO. The basic objective of the newsletter is to keep the stakeholders update with the management programme. The village schoolteachers and the natural leaders who are encouraged to come up with local issues contribute most of the articles of the newsletters. A section of the newsletter is also dedicated to the articles on wise use and good practices.

### ***Ecological outcomes***

Considering the sensitive ecosystem of the lagoon, a close monitoring of the lagoon is carried out to assess the impact of various management interventions on the lagoon. This is carried out from 30 fixed stations covering all the four ecological zones, and data collected at 30 days intervals. The remote sensing GIS tool is used for assessment of the spread of the aquatic macrophytes in the lagoon, their distribution pattern, abundance and seasonal variation. The monitoring result indicated that after opening of the mouth there is expansion of the sea grass meadows and their species diversity has also improved. The expansion of the habitat of the endangered species of Irrawady dolphin is also observed.

A clear understanding of the hydrological process i.e. integration of the coastal processes and the river basin provided the clue for the restoration interventions and its sustainability. Community participation is crucial for sustainability of the restoration and management of the lagoon. Capacity building of the watershed community facilitated the formulation of the micro plan at the grass root level blended with the indigenous knowledge, a bottom up approach. The micro plan not only envisaged the appropriate land use and soil moisture conservation measures but optimum utilisation of all the natural resources including the human resources in a sustainable manner.

An exercise for environment flow assessment is also now in progress. Chilika was removed from the Montreux record by the Ramsar bureau with effect from 11th November 2003. The prestigious Ramsar Wetland Award 2002 is also conferred on CDA for the impressive way in which the restoration was carried out with the active participation of the community.

### **Lessons learned**

The extraordinary implementation success of CDA can be related to the non-bureaucratic organizational setup, which actually has no formal legal mandate. Supported by a high-level Governing Body with strong political backing and with full access to government funding, the CDA combines the stability of a government authority with the implementation flexibility of the private sector, avoiding the constraints of the normal bureaucracy. The management philosophy of CDA is pragmatic and outcome-focused, implemented by innovative leadership and a strong and committed core team

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## Links to further information

1. Chilika Development Authority website: [www.chilika.com](http://www.chilika.com)
2. "Chilika" is a jointly published newsletter of Chilika lake Authority and Wetland International South Asia. Editorial Panel: Dr. L.C. Trisal, WISA and Dr. A.K. Patnaik, CDA. For subscription contact CDA at [www.chilika.com](http://www.chilika.com) or WISA at <http://www.wetlands.org/aboutWI/offices/IndiaStaff.htm>
3. A.K. Pattnaik (2003) Integrated management of Chilika Lagoon; Restoration of a coastal wetland with community participation. Proceedings, First S. E. Asia Water Forum, Chiang Mai, Thailand. Global Water partnership SE Asia Technical Advisory Committee and Thailand Water Resources Association, Bangkok, Thailand.

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