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Conservation of Chilika Lake, Orissa, India

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ABSTRACT

The Chilika lake of Orissa coast is a natural brackish water lagoon of marine origin and is designated as a Ramsar site since 1981.The water spread area of the lagoon varies between 1165 sq. km. in monsoon to about 906 sq. km. in pre-monsoon. It's pear shaped, semi-enclosed nature formed by a recurved barrier spit on a gently sloping coast. The lake harbours over 150 migratory and resident species of birds and 225 species of fish including Irrawady Dolphin (*Coryphaena* sp.) and Sea cow (*Dugong dugong*). The lagoon had been facing multidimensional ecological and anthropogenic pressure, leading to an overall loss of biodiversity and productivity, adversely affecting the livelihood of the local community. A constant inflow of 13 MT per year of silt, due to soil erosion in the catchment area, is choking the lake mouth. Satellite images indicate that 46 sq. km area has been silted and infested with weeds and grasses.

A new artificial mouth was dredged in 2000 to reduce the length of the inlet channel, by 18 km for salinity restoration. The other components of the restoration plan were integrated watershed management with community participation, monitoring and assessment, improvement of socio- economic conditions of the local communities, shared decision making, improvement of communication network, fish stock enhancement, development of a visitor centre, wetland research and training centre etc.

After opening of the new mouth there is a marked improvement in the exchange of water between the sea and the lagoon facilitating auto-recruitment and free breeding migration of the fish, prawn and crab juvenile into the lagoon leading to a significant improvement of the fishery resources. Chilika is a perfect example of how the restoration of a wetland with most appropriate strategy can not only restore the ecological integrity of a wetland, but also, can contribute significantly towards the improvement of livelihood of the local community due to increase in productivity.

Keywords: Brackish, lagoon, spit, dolphin, sea cow, wetland, catchment, Ramsar.

INTRODUCTION

There is no specific definition for lakes in India. The word "Lake" is used loosely to describe many types of water bodies – natural, manmade and ephemeral including wetlands. The Chilika lake of Orissa coast is a natural brackish water lagoon of marine origin and is designated as a Ramsar site since 1981.The water spread area of the lagoon varies between 1165 sq. km. in monsoon to about 906 sq. km. in premonsoon. It is pear shaped; along NE-SW , it is 64 km. long and has a variable width, from maximum of 20 km. on its northern edge to a few kilometers across its southern edge. It's pear shaped, semi-enclosed nature formed by a recurved barrier spit on a gently sloping coast and known as the beauty queen of Orissa's natural heritage for its scenic beauty, migratory birds and rich fishery resource.

STUDY AREA

Chilika lake features in Puri, Ganjam and Khurda districts of Orissa between latitudes $19^0$28' to $19^0$54' N and longitudes $85^0$05' to $85^0$38'E. The geomorphological map of Chilika lake is given in figure-1. The lake is connected to the Bay of Bengal through a tidal inlet about 35km. long but very narrow. The mouth of the inlet is at present located near village Arkhakuda. Hydrologically, Chilika is influenced by three subsystems viz. distributaries of Mahanadi river system, Western catchment and the Bay of Bengal. The surface water temperature of Chilika lake varies from 17.5 to 32^{o}C. Salinity varies from traces to 36ppt. pH varies from 7.6 to 10. Chilika receives fresh water through Daya, Bhargavi, Nuna and Makra rivers, the distributaries of Mahanadi and many other small streams. It is connected to the Bay of Bengal through a 25km long, outer channel. The lake is very shallow with an average depth of 1.5m in its northern side and about 2.5-3m. on its southern side. It is bordered by hills and hillocks of Eastern Ghat rocks, which at places project into the lake as promontories. There are a series of coastal islands in between the barrier spit and the lake which are separated by interconnecting channels. The different islands are Kalijai, Somota, Nalaban, Breakfast, Birds island and many others. The northern side receives uninterrupted freshwater flow,

whereas the southern side is almost free from such influence.

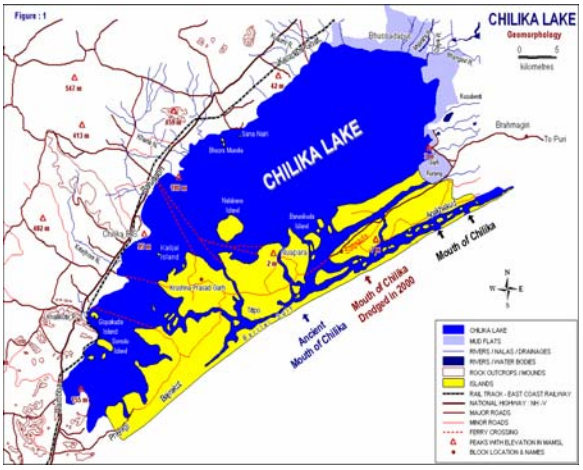

Figure 1:

METHODOLOGY

Detailed field studies were carried out to assess the present status of Chilika lake, and to know the ecological and anthropogenic pressure and its remedial measures. Different available literature regarding Chilika lake was consulted for clear understanding of the problem. Chilika Development Authority (CDA) was also contacted to get the latest status of the lake. During the field studies village people around the lake was consulted to know their problems and its remedial measures.

RESULTS AND DISCUSSIONS

Geomorphology

The area under study represents various kinds of geomorphic processes and landforms. The important geomorphic units can be classified into structural, denudational, fluvial, fluviomarine and aeolian. Visual interpretation of IRS 1C & 1D (Panchromatic) data was done to interpret various kinds of geomorphic units. These are denudational hills, pediment, buried pediment, piedmont zone etc.

Deltaic Plain

This geomorphic unit represents a part of lower delta of Mahanadi river and extends upto Chilika embodying Daya and Bhargavi rivers. It is found towards northeast of the study area.

Mud flat

This mud flat unit is seen lying around the confluence of Daya, Bhargavi, and Nuna rivers with Chilika. In the satellite imagery, it is recognized by typical dark grey colour, reticulate drainage pattern, numerous mud cracks and backswamps. Existence of this mud flat indicates that in the geological past, the expansion of Chilika waterspread was upto its northern limit, and distributaries of Mahanadi river were debouching into it at the limit which is situated at about 30km. north-east of present location. Total area of this mud flat is 480 sq.km. which was included in the past in the water spread of Chilika.

Coastal Plain

In areas around Bajrakot, Satpada and Mathasahi, there exists a flat terrain alongwith beach ridges and coastal sand dunes. This plain is developed by marine deposition being exposed during the last marine regression. There are a number of islands in between Chilika and sea water which might have been deposited by fluvio-marine processes.

Barrier Spit

The easternmost part of the study area between Palur and Arkhakuda is represented by a long linear barrier spit which has been responsible for origin of Chilika. The length of the spit extends over 60km. from its point of origin at Palur hill to the lake mouth near Arkhakuda. The barrier spit is curvilinear with concavity towards sea, and has been recurved many times indicating different stages of growth.

Coastal Sand dunes

To the east of Chilika lake, nearer to the shore, a series of sand dunes are found with two distinct alignments, i.e. one set being parallel and the other transverse to the shoreline. On the barrier spit region, they areas high as 15m above the ground but the width is less, minimum being about 50m. in area nearer Arakhakuda, transverse dunes are found with maximum width of 6km. these sand dunes are rich in heavy minerals.

Flora and Fauna

The lake is an important habitat and breeding ground for both resident and migratory and aquatic birds, most notably flamingos. Migratory birds arrive in October from as far away as Siberia, Iran, Iraq, Afghanistan and the Himalaya, and generally stay until March. Part of the lake is protected by the Chilika Lake Bird Sanctuary, which harbours over 150 migratory and

resident species of birds. The Nalaban Island within the lagoon is classified as a Bird Sanctuary under the wildlife protection act.

The lake is also home to a diverse range of aquatic life, including 225 species of fish. Chilika lake is designated a wetland of international importance under the Ramsar Convention, since over a million migratory waterfowl and shorebirds winter here and many vertebrate species have been recorded here. As an estuarine lagoon, it supports a unique assemblage of marine, brackish and freshwater species and, since several rare and endangered species are found in the region. Dolphin (Coryphaena sp.) and Sea cow (Dudong dugong) are also present.

Shifting of channel and mouth

It is studied from landsat TM imagery that there have been three shifts of the channel mouth. The earlier location being near Taltala, Krishnaprasadgarh and Tichhini. Presence of Jahnikuda – Nuapara and Barunkuda islands also trifurcate the present configuration of the channel. It is reported that the opening mouth of the channel was near Arkhakuda, during 1914 (Annadale and Kemp, 1915). Now this has been shifted by 6 kms NE of the said point. The satellite image also shows the earlier spread of the lake to north east from which it has shrunk to its present position.

Enviornmental Degradation

Chilika lake is presently showing many symptoms of environmental degradation. A constant inflow of silt, 13 million tones per year, due to soil erosion in the catchment area, is choking the lake mouth. Satellite images indicate that 46sq.km area has been silted up and this area is now infested with weeds and grasses. The shrinkage has been calculated at 1.5sq.km 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 lagoon had been facing multidimensional ecological and anthropogenic pressure, leading to an overall loss of biodiversity and productivity, adversely affecting the livelihood of the local community. Two lakhs people of 1542 villages are dependent on Chilika for their livelihood. Constructions of major hydraulic structures on the major river systems and the change in the land use pattern in the catchments are also responsible for the alteration in the flow pattern into the lagoon that is significantly affecting the hydrological set up of the lagoon. Ramsar Bureau added it to the list of the Montreux record (threatened list of Ramsar site) in 1993 due to the changes in its ecological characters. Being concerned with this, the Government of Orissa created Chilika Development Authority (CDA) in 1991, for the restoration and management of the lagoon. The root cause of the degradation of the lagoon were identified as siltation, shifting of the inlet channel and shoal formation along the outer channel, fall in salinity, decline in fish landing, proliferation of fresh water weed and invasive species, poor discharge of flood water leading to water logging in the peripheral crop land, unauthorized shrimp culture.

Restoration of Chilika lake

For a clear understanding of this complex and sensitive ecosystem and the root cause of the degradation of the lagoon ecosystem, CDA commissioned the services of the premier institutes of the country like National Institute of Oceanography (NIO) and Central Water and Power Research Station (CWPRS), Pune. Based on the findings a historical hydrological intervention was carried by CDA by way of opening of an artificial mouth of 200m length, 200m. width and 2.5 m depth below the lowest lake water level is dredged near Magarmukh on September 2000, which reduced the length of the inlet channel, by 18 km. The other components of the restoration plan are integrated watershed management of the lagoon with active participation of local community and Non Governmental Organisations on a micro watershed basis, monitoring and assessment, improvement of socio economic conditions of the local communities, shared decision making, improvement of communication network, fish stock enhancement, development of a visitor center, wetland research and training center etc. As there is no catchment in the islands he runoff directly goes to he sea. The irrigated land in Krishnaprasad block is still zero. So rain water harvesting in ponds, tanks and development of minor irrigation is the only solution for freshwater in he area.

The opening of the artificial mouth and the desiltation of the lead channel yielded encouraging results by way of not only rejuvenating the ecosystem of the lagoon but also immensely benefited the local community, whose average per capita income improved substantially. After opening of the new mouth there is a marked improvement in the exchange of water between the sea and the lagoon facilitating auto-recruitment and free breeding migration of the fish, prawn and crab juvenile into the lagoon leading to a significant improvement of the fishery resources. The annual average fish (fish and prawn) landing, which had declined to as low as 1600 metric tons prior to the opening of the new mouth, increase to 14,000 MT during the financial year 2003-04. After opening of the new mouth, six species of fish, which had disappeared from the system, reappeared; similarly 48 species of

fish, 4 species of prawn and 6 species of crab were recorded for the first time in the lagoon. Due to fall in salinity, there was large scale proliferation of the fresh water invasive species. The weed spread area which was merely 20 sq.km. in 1972, increased to about 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 as assessed through remote sensing tool was found to be in the order of 506sq.km.(May2001), i.e. an improvement of 172 sq.km. of weed free zone. Due to the increase in the velocity of water and better flushing of the sediment and water to the sea through the lead and outlet channels, the depth of the channel from Satpada to the new mouth is improving progressively. There is a significant improvement in the water level variation during the tidal cycle leading to pulsing, which helps in making a wetland more productive by nourishment with additional nutrient and flushing out of the detritus and waste products. The other performance indicators have been; increase of the sea grass meadows from 24.8 sq. km. to 86.84 kms and improvement of their species diversity, expansion of the habitat of the Irrawady Dolphins.

Chilika is a perfect example of how the restoration of a wetland with most appropriate strategy can not only restore the ecological integrity of a wetland, but also, can contribute significantly towards the improvement of livelihood of the local community due to increase in productivity. The community participation, linkage with the various national and international institutions, intensive monitoring and assessment system are some of the uniqueness of the management practices adopted by CDA for restoration of this unique wetland. Chilika is removed from the Montreux record by the Ramsar bureau with effect from 11th November 2003 for the improvement of the ecosystem of the lagoon after the restoration initiatives by the CDA. It is the first Ramsar site from Asia to be removed from the Montreux record (threatened list of Ramsar site). The prestigious Ramsar Wetland Conservation Award and the Indira Gandhi Paryavarn Puraskar are conferred on CDA for the impressive way in which the restoration was carried out with the active participation of the community.

Hydrogeology

Krushnaprasad block having an area of 328.73 sq.km. is surrounded by Chilika lake is underlain by alluvium of Quaternary age consisting of sand, pebble, clay and silt. The Eastern Ghat group of rocks comprising granite gneiss, khondalites and anorthosites are exposed in the northern part. Mud flat, sand dunes forming ridges are very common in the area.

The Central Ground Water Board has conducted exploration upto 500m. in Brahmagiri, Puri Sadar of Puri district. The wells could not be constructed due to nonavailability of required thickness of freshwater zones.

The DANIDA drilled 15 medium deep tube wells within the Chilika lake area to depths ranging from 154 to 230m. and 13 shallow tubewells down to depths from 10-15m. The drilling results brought out the following conclusions:

1. In the south western part at Bajrakot the basement occur at a depth of 118m. having a top fresh aquifer down to 20m. Below 20m. only two major aquifers between 40-60m. and 100 to 118m. are inferred to be saline from geophysical logging.
2. Within the southern parts, the six tube wells at Moroda, Ora, Sial, Kumpuri, Annua and Gillinasi tapped the aquifers within the depths from 102 to 209 mbgl and chloride concentrations varies from 290 to 430 mg/l. The quality of ground water is found to be slightly brackish.
3. In the central parts no fresh water zones are encountered within the drilled depth of 200m excepting around Krushna Prasadgarh where a thin aquifer zone at around 100m. is reported in the PHED tubewell.
4. Around the mouth of the Chilika lake the tubewell at Dahikhiya yielded brackish water with chloride concentration of 310mg/l between 154 to 195m. The other three tubewells in this area yielded saline water.
5. The bottom aquifers are under confined conditions and the tubewells registered artesian flow butit is brackish in nature.

The salinity problem extends further to north-eastern parts into Brahmagiri, Kanas, Balugaon NAC and Khalikote blocks adjoining Chilika Lake. There are also cases of saline water auto flow wells in the Raibidar Gram Panchayat of Brahmagiri block. Wells drilled adjoining to the Chilika in Khalikote block yielded saline water. This type of haphazard drilling will not only contaminate the available freshwater aquifers but also spoil the cultivated lands. In these circumstances it is needed to delineate the freshwater aquifer and assess safe yield to prevent groundwater contamination. The state Govt. should examine the critical areas and caution the public of the possible hazards. The critical area for notification is shown in the enclosed map.

CONCLUSIONS

Siltation is the main problem the lake is facing and it is calculated to be 1.5 sq. km. per year. Due care must be

taken to reduce this load by suitable plantation and watershed development programme in the catchment areas. A detailed study is required to be taken up for identifying critical areas. Due to the decrease in salinity and the excess nutrients (from the silt) weeds have spread over approximately one- fourth of the lake. Opening of an artificial mouth on September 2000, reduced the length of the inlet channel, by 18 km. The lake can be restored by integrated watershed management of the lagoon with active participation of local community and Non Governmental Organisations on a micro watershed basis and improvement of socio economic conditions of the local communities, shared decision making, improvement of communication network, wetland research and training center etc. Awareness programme are to be conducted to caution the public about the possible hazards.

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