"ENVIRONMENTAL IMPACTS ON ECOLOGY AND SPECIES DIVERSITY OF LAKE CHILIKA" -A RETROSPECTIVE

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Abstract: Among hundreds of fresh and salt water lakes in India, Lake Chilika stands soaring due to its natural habitats, ecology and biodiversity. It is indeed the largest lagoon in Asia and chronicled as one of the preeminent biodiversity hotspots.

India stood second in the world in its fish production contributing about 5.6% of the global production-extending livelihood to approximately 14 million people. Whereas the fish landing in most of the Lakes had decreases considerably. It was observed that the fish and fishery products of the Lake Chilika had marginally improved as well as the socio-economic condition of local community. The biotourism had got wings and grown to several thousands of foreign exchange with infrastructural development in and around the Lake. Nevertheless, the natural and usual ecology of the Lake had lost its glory due to unnecessary anthropogenic interference resulting into loss of natural habitats, biodiversity and ecosystem as a whole.

Present study is a retrospective of several other researchers carried on Lake Chilika along with research conducted by group of students between November 2009 to March, 2012. The statistical data collected was based on the secondary data available in several international and national journals, FAO database, Government gazettes, annual reports and information gathered from authorities in and around the Lake. However, the scientific data and erstwhile information was based on personal questionnaires, laboratory analysis and local literature related to ecology and species diversity.

Keywords: *Aquaculture, Ecosystem, Fish and fisheries, Lagoon, Lake Chilika, Species diversity*

Introduction: Under the leadership of **Annandale** who became the first Director of the Zoological Survey of India in 1916, number of expeditions were conducted on hydro-biological conditions of different water bodies in British India. Several prominent native Indian scientists were associated with Annandale during that period. Practically all kinds of habitats such as lakes, swamps, ponds, thermal springs, streams, torrents, rivers, coastal lagoons and estuaries of about 269 were surveyed (Annandale *et al*, 1921) followed by the Sunda Expedition of 1928, (Brij Gopal & Zutshi, 1998). The Yale North India Expedition in 1932 strengthened the foundations for detailed limnological studies as eleven high altitude lakes in the Ladakh-Tibet region and several lakes in Kashmir were investigated (Hutchinson, 1933). By the early 1940s, hydro-biological studies were already gaining momentum through their diversification into newer areas (Ganapati, 1947).

Both Indians as well as Foreigners conducted several studies in the past on Lake Chilika. Prominent among them were Jhingran (1985); Mohanty (1988); Biswas (1995); Panigrahy (2000); Ghosh and Pattnaik (2005). The origin and geology of the Lake was studied by Phleger (1969); Venkatarathnam (1970); Khandelwal *et al* (2008). Ecology of the lake was studied specifically by Panigrahy (2000); Ghosh and Pattnaik (2005). The fish and fisheries of Lake Chilika was broadly studied by Hora (1923); Banarjee and RoyChoudhury (1966); Jhingran and Natarajan (1969); Pattnaik (1973); Patnaik and Sarkar (1976); Mohanty (1981); Misra *et al* (1988); Raman *et al.* (1990); Biswas (1995); Ghosh (1998); Nayak *et al.* (2004); Ghosh and Pattnaik (2005); Mohapatra *et al.* (2007), Mishra and Griffin (2010); Kumar and Pattnaik (2012); while on the avifauna studies were made by Dev in 1992.

The origin of Lake Chilika dates back to more than a million years (suposed to be in Pleistocene period) before the Begining of Common Era (BCE). Originally part of the beautiful Bay of Bengal (BOB), The Lagoon is separated from the sea by sand dunes. Human interaction with the lagoon appears to be very old that dates back to few thousand years if we consider descriptions in the ancient Hindu religious texts and epics related to local legends (Das 1977, Pattnaik 1979). Patra *et al.*, portrayed the existence of maritime trade activities, and boat building in Chilika as far back as 2300 BCE (Sinha, 2000). Up to the mid seventies in the twentieth centuary, the Lake used to have two mouths but later on only one remained with rudimentary inlet ("Magarmukha"). The Lagoon was under the verge of ecological complexity with detoriating species diversity at once in want of rejuvination.

The Chilika Lake is the largest brackish water lagoon in Asia, situated between the latitude 19° 28′–19° 54′ N and longitude 85° 05′–85° 38′ E covering about 100,000 ha of land on the east coast of peninsular India, one of the six Indian wetlands listed in the Ramsar convention of 1982. The water spread area is estimated at 704 km² during the summer and 1,020 km² monsoon seasons respectively as against an earlier estimate of 905 km² and 1,165 km² (Annandale,1915). About 132 villages surronded by 277

hemlets comprising of about 0.25 million people live and depend in and around the Lake. The lake encompass a combination of fresh water, brackish and marine ingredients. It is inundated by several fresh water streams and rivers drained from northern and central sectors.

For conviniance the Lake chilika is devided in to three major sectos, north, central and southern. The physico-chemical as well as biodiversity composition of all these three sectors also vary slightly. Chilika has very rich ecological diversity with over 400 vertebrates of both brackish and freshwater species with the total number of fish species is reported to be more than 225. The species diversity has several endangered, threatened, and vulnerable species including the Barkudia limbless skink. A phytodiversity survey done by Pattnaik (2003) has identified 710 plants that includes over 350 species of non-aquatic plants along with a variety of phytoplankton, algae, and aquatic plants in Chilika. As per the Zoological Survey of India (1985-87) the fauna recorded are over 800 species in and around the lagoon. The lake predominantly also home to hundreads of Irrawaddy dolphins (*Orcaella brevirostris*) attracting tourists from different corners. Some of the most common varieties of crab species found in Chilika Lake are*: Scylla serrata, Neptunus pelagicus, Varuna litterata, Ocypoda Sp.,* and *Paratelphusa Sp*. *Scylla serrata* Commonly known as "Tiger Crab" is the most important invertebrate species along with the “tiger shrimp” *Penaes monodon* occurs in greater numbers than all other species combined togather and are commercially significant for the socio-economical condition of local population. The shell fishery is basically dominated by five species three shrimps and two prawn varieties. They are: *Penaes monodon, P.indicus, Metapenaes monoceros, Macrobrachium affins,* and *M.dodsoni*. The fast-growing prawn industry and over exploitation of "Tiger Prawn", *P.monodon* by the nearby hatchery farms are causing lot of disturbance to the ecology and biodiversity of the lake.

Over a million migratory waterfowl and shore birds gather there during winter. It is the largest wintering hinter ground for migratory waterfowl found anywhere on the Indian subcontinent. About 150 species of birds including the dowitcher, one of the least known Asian shorebirds, and the spoonbill sandpiper, one of the rarest are also found in the Lake. Birds from the Caspian Sea, Lake Baikal, Aral Sea, Russia, Mongolia, central and southeast Asia, great Himalayas and Ladakh migrate covering thousand of miles to reach at a place in the Lake called “Nalabana”, declared as a“bird sanctuary”in the year 1973 under the Indian Wildlife (Protection) Act 1972.

In addition to its impact on fishing, weed growth has contributed to drastic reductions in these bird populations, particularly noted near the Nalabana bird sanctuary. Also noted is a decline in the quantity and variety of fish on which these birds prey. Deforestation in the Chilika basin and hunting, to the tune of almost 15,000 to 20,000 birds every year are also contributing to this decline. This decline, in turn, has resulted in a substantial decrease in international tourists and ecotourism, which used to contribute greatly to the local economy.

The ecological problems: With the growth and development of aquaculture, fish born industries, tourism- both biological and food, use of motor boats and expansion of agricultural lands the ecology and biodiversity of the Lake also undergoing change alarmingly. The anthropogenic interferance in the lake ecosystem has resulted in to the loss of several rare species as well as causing the decrease of existing. The frequency of fish species have descended to around 65 from 126 in the 1920s (Annandale, 1915). The lake once used to be home to a variety of marine animals such as crocodile, green sea turtles, and gharials now locally extinct. The decrease of plant species to about fifty percent and luxirious growth of some eutrophic species is an indication that the lake needs more attention.

The ecological, geological, and physico-chemical parameters of the lake has also undergone severe changes during the years. The influx of silt is the chief cause of lake shrinkage. The progressive increase in silt has reached a rate of almost 13 million tons annually brought into the lake by rivers, predominantly due to deforestation in the drainage basin. The long and slender lake mouth narrowing the sea inlet has also resulted in to siltation. Since the Lake becomes more shallow and its sea outlets fill in with sediment increased flooding occurs in mansoon. Formation of creeks inside Chilika leading to blockage of water along side with decrease in depth of water in the Lake are of most cocern level.

The average salinity has progressively decreased from around 22.3 ppt in 1957-58 (Jhingran) to present levels of 3.6 ppt (about 7 times) is another serious ecological concern. Declining salinity is mainly due to the increasing flow of fresh water from the north rivers and the slender lake mouth. The growth of chemical-based industries in the catchment areas, agricultural intensification in the Lake basin and, most importantly the spread of prawn-culture ponds since have increased pollution and eutrophication of the lake. The frequent use of plastic bags, nylon nets and dumping of domestic garbage has resulted into alterations in water texture and quality. The presence of toxic heavy metals including mercury, lead, copper, chromium, and nickel in the lake has been

reported. The net effect of eutrophication has caused many fish diseases, low production and excessive weed growth, because of the high influx of rich organic silt and sedimentation over the years as well progressive decline in salinity. The decline fishing poppulation, over weed growth has contributed to drastic reductions in avifauna (the bird population), particularly in the Nalabana bird sanctuary. Deforestation and hunting underlying almost 15,000 to 20,000 birds every year are furthermore contributory to this decline.

With the growth of human settlements and agriculture fields, municipal sewage, fertilizers and pesticides too overspill the Lake causing algae blooms suphocating the young and juvenile. The human behaviour of throwing dead fish back into the water contaminate the Lake causing pathological problems. While tourism is providing salutation income to local communities, yet adversely impacting the environment as a whole. The motoer boats and vehicles causing air and noise pollution along side contributing water pollution by the unused spitting of diesel oil in to the lake.

Towards solution: The ecosystem of Chilika Lake can be understood by conducting studies on following components

1. The hydrography to know the water quality,
2. Species diversity and abundance of Fish and fisheries (Don't think of the monoculture or poly culture systems for commercial growth and development)
3. Biodiversity composition in terms of species richness and
4. The overall interaction, energy flow, trophic diversity and species distribution in the lake

Together all these factors signify the ecosystem characteristics of the Lake valued as positive (fish production and tourism) and represent the threats (e.g., overfishing and illegal aquaculture, pollution, and sedimentation) contributing negative. For the sustainable growth and development, there is need for urgent industrial and commercial development of lakes into centers of amuzement and food parks; by rising bio-tourism, aquaculture farms, food industries, food exportation but.., but..not at the cost of nature, ecology, deforestation and biodiversity.

The water clarity is a gauge to know how much light penetrates though the water column by knowing the trasperancy that establish the phytoplankton distribution and their abundance. The Dissolved oxygen content mostly generated by aquatic plants is important for aquatic respiration. The amount of dissolved oxygen needed varies from species to species but must for survival of aquatic life. Prominent phytoplankton levels (the total chlorophyll content is a measure of phytoplankton biomass) can reduce water clarity and decomposing phytoplankton can reduce dissolved oxygen levels (UNEP/GEF project and CDA, 2008). To preserve the ecology and biodiversity of Lake Chilika, following steps should be considered for implementation.

a. The traditional practices for fisheries be given more emphasis
b. Over exploitation of fish and fishery be avoided
c. Proper maintenance of fishery by products and fish related waste materials
d. Well developed management practices for tourism be developed
e. Biodiversity hotspots, bird sanctuaries and selected islands be made free from tourism and human intervention
f. Fisheries to certain lake areas be restricted
g. The sea and lake mouth be widened.
h. Afforestation in the catchment areas and barren islands.
i. Monoculture and controlled culture practices should be banned within the lakes.
j. The industrial, municipal as well as other polluting materials should be properly treated before culmination in to lake.
k. Urbanisation and industrialisation should be controlled around the lake
l. Conversion of lake area in to agriculture land be regulated
m. Changing Aquaculture practices
n. Responsibility of the state and stakeholders in terms of political, legal and Institutional should be understood.

The Chilika Development Authorty (CDA) did some commanding job to make the lake more living by initiating several steps to stop unnecessary interferance by man and to interface the ecology as well as biodiversity of the lagoon. But yet the outcome outspeaks the need to do more to preserve the beauty and ecosysytem of the Lake. What matters for a biologist more is the expediency of faunal species in their, abundance and richness, fixed primary productivity, well organised food chain and food web, dynamic trophic hierarchy, community and appropriate balance among species composition; not the overproduction and abundance of selected catagory of species and their seasonal distribution. Presence of excess algal growth in any aquatic ecosystem indicates presence of more microbial communities that inturn result in to over growth of phytons leading to over production of zooplanktons. Unless and untill this chain is conserved the energy cycle can not go hand in hand. The life line of millions of people rests in the hand of biologists who have to take care of every little change in nature, if ignored can lead to greater ecological disasters. This is the truth that not only holds good for only Lake

Chilika, but also to most of the great Lakes such as Pullicate and Kolleru.

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