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Conservation of Lake Kolleru: Status Report

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A B S T R A C T

Kolleru, the largest fresh water lake in India, falls in the West Godavari and Krishna districts of the state of Andhra Pradesh. The catchment of the lake extends up to 6121 km^2, of which 4763 km^2 comprise of upland, and 1358 km^2 deltaic. Considering that the lake functions as a flood moderating reservoir between the Krishna and Godavari deltas and that it supports several vulnerable species and a variety of resident and migratory birds, the Kolleru wetland was declared as a Wildlife Sanctuary, a RAMSAR site and also as an Important Bird Area (IBA). In 1999, 308 km^2 of the Lake falling below +5 feet above MSL contour line was declared as Kolleru Wildlife Sanctuary (KWS). Even after the declaration, ecologically not-so-benign activities and encroachments continued unabated in the area. Kolleru lake system represents one of the largest and oldest natural wetland eco systems in the country. During the last couple of decades, the changing socio-economic and political milieu of the state in general and the region in particular brought enormous alteration to the lake area and consequent strains on this wetland ecosystem. The lucrative business of aquaculture made far reaching consequence on the habitual land use in the Lake area.

Introduction:

Kolleru Lake the largest fresh water lake in India falls in the West Godavari and Krishna districts of the state of Andhra Pradesh. The catchment of the lake extends up to 6121 km^2, of which 4763 km^2 comprise of upland, and 1358 km^2 deltaic. Considering that the lake functions as a flood moderating reservoir between the Krishna and Godavari deltas (Fig-1) and that it supports several vulnerable species and a variety of resident and migratory birds, the Kolleru wetland was declared as a Wildlife Sanctuary, a RAMSAR site and also as an Important Bird Area (IBA) During the last couple of decades, the changing socio-economic and political milieu of the state in general and the region in particular brought enormous alteration to the lake area and consequent strains on this wetland ecosystem. The lucrative business of aquaculture made far reaching consequence on the habitual land use in the Lake area.

Hydrology of the Lake:

The lake receives water from several sources of these; the streams Budameru, Tammileru (East and West branches), Ramileru, Gunderu and Bulusuvagu are natural and foremost in terms of water input. Minor streams, Jayanthi, Kattaleru, Ippalavagu, Telleru, Ballaleru and Nadimeru flowing through several mandals also join the lake Kolleru (Table 1). The rest of inflow drains are largely manmade and contribute lesser inputs. The estimated total inflow via the sea sources is about 9.6 TMC (Thousand million cubic feet per annum. The Budameru flows through the Mandals of Vijayawada, Gannavaram, Gudivada and Kaikaluru, while the rest of the streams flow through the West Godavari district. Tammileru originating from Bethupalli in Khammam district reaches Kolleru Lake after passing through Nagireddygudem reservoir in Chintalapudi Mandal. The lake Kolleru debouches into the Bay of Bengal, at Peranatalakanuma through the channel called Upputeru

which is about 65 km long the channel is under strong tidal influence and turns brackish especially towards the downstream stretch.

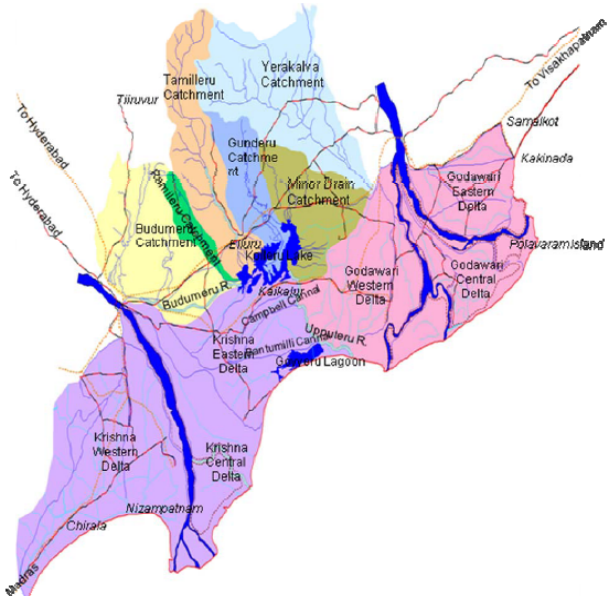

Fig: 1. Kolleru Lake between Krishna and Godavari rivers.

The Lake Kolleru is largely a freshwater body, except towards its south eastern portion where the water may turn brackish particularly during summer months due to salt water ingression through Upputeru. Around 26% of the lake area in eastern zone gets affected by high tides, particularly in summer (Amaraneni *et al.,*2004).

Water quality:

Kolleru lake system is located amid the deltas of the rivers Godavari and Krishna and the lake is fed directly by several seasonal rivulets and is also linked to the Krishna and Godavari systems through several inflowing drains and irrigation channels. The lake is not directly connected with either Krishna or Godavari rivers. Nevertheless, the Kolleru wetland receives huge quantity of nutrient rich sediments from the flood plains of these rivers.

Meteorology:

Meteorologically the Kolleru basin falls under semi-arid climate class, with three seasons, namely summer, monsoon and winter. The basin enjoys rainfall from both southwest as well as northeast monsoons. The rainfall was found to vary widely across the years. The normal rainfall in the area is about 715 mm. Not much variation is seen in temperature across the seasons winter last for a period of three months (December – February) followed by summer, which lasts till June to mid-July. Dry situation have been reported frequently in the uplands of the basin due to failure or delayed monsoon. Similarly flood due to depression (in the Bay of Bengal) induced rainfall / storms are frequent in the basin generally during August to November.

Land use changes and associated threats to the kolleru ecosystem:

In reality, the lake system has been subject to severe pressure in recent years from anthropogenic activities. It is stated that, if human induced degradation continues the lake will soon vanish (Jayanthi *et al.,* 2006, Nageswara Rao *et al.,* 2004). Land use changes associated with the aquaculture boom during the last couple of decades, industrial development and contemporary chemical intensive agriculture practices in the wetland area are some of the troubles affecting the well being of the ecosystem and its functions. Rao *et al.,* (2000) analyzed the land use changes that happened in the lake during 1989-1999; Nageshwara Rao *et al.*, (2004) analyzed land use pattern for the year 2001; Jayanthi *et al.,* (2006) examined it for the 1967 to 2004 period; Nagabhatla *et al.,* (2009) analyzed the land use land cover (LULC) during the period 1977-2007; Nageshwara Rao *et al.,* (2010) reported the land-use changes during 2004-2008 and Pattanaik *et al.,* (2010) examined land- use changes for the period 1977-2000. While no land was under aquaculture in 1977 it reached 15854 hectare in 2000. The 'Operation Kolleru' that demolished aquaculture farms in encroached areas in 2005 is reflected in the drastic decline of area under aquaculture in 2007. During the same time the area under aquatic vegetation and open water showed an increase. The lucrative business of aquaculture made far reaching consequences on the habitual land use in the lake area. Encroachment in the wildlife sanctuary and conversion of rice paddies to aquaculture farms appears to be a common story in the Kolleru region.

Drainage and channelization:

The entire drainage system of the lake has developed in view the water retention capacity of the lake. As mentioned earlier, some rivulets and several drains empty into the lake and the lake waters gradually flow into the sea through Upputeru. The natural drainage pattern, design and mechanism has been grossly interfered by constructing high bunds around the fish farms, unauthorized and illegal encroachments along the outlet channels. The Wetland International (2008) has found the need to erect 339 vents to facilitate water flow. The elevated water level will remain for a longer period as it is to be drained only by one outlet, the Upputeru that

as of now is ill equipped to convey all the waters. On the other hand Upputeru water may backflow entering Kolleru Lake (Venkata Rao and Malleswara Rao, 2009) and drains joining it because of the low effective hydraulic heads. The loss of gradient in Upputeru and minor drains is evident from reducing velocities of their flows resulting in longer periods for recession of floods.

Pollution:

The major sources of pollution are agricultural run-off containing residues of several agrochemicals, fertilizers, fish tank discharges containing antibiotics, pro-biotics, food wastes and others, industrial effluents containing chemical residues and organics of different types and municipal and domestic sewage. As a result, the water of the lake turned more alkaline in nature, turbid, nutrient rich, low in dissolved oxygen (DO) and high in biochemical oxygen demand (BOD). Changes in total dissolved solids (TDS) and salinity imbalance in the lake has been reported (Rao *et al*., 2006). Annually around 116800 tons of inorganic fertilizers are used there, of which about one fourth ends up in the lake via run-off and leaching (Gopalakrishnayya, 1999). Besides, natural nutrients from the vast catchment, from the natural levees of Godavari and Krishna rivers, drift down to the lake taking along 68,000 tons of cattle manures as deltaic area is dense with cattle population. The vegetation along the river banks also contributes substantially to the nutrient load, while their litters decay. In addition, about 7.4 lakh ducks (Gopalakrishnayya, 1999) also was known to enter the lake adding on their excrements. High levels of organic pollutants are also reported from the Kolleru Lake (Rao and Pillala, 2001). The total organochlorine pesticides used in and around the lake area is estimated to be about 1600 tons / year. Residues of methyl parathion used in the first cropping season find its way into the lake, and is another major source of pollution threatening the biota with residual effects. The study conducted by the School of Chemistry, Andhra University concluded that the contamination of pesticide in the ambient air of the lake may be due to uncontrolled use of pesticides in agriculture and aquaculture (Sreenivasa Rao and Rama Rao, 2000). Poly cyclic hydrocarbons are also reported from sediments of Kolleru Wetland (Amaraneni, 2004).

Untreated municipal sewage from Vijayawada, Gudiwada and Eluru and domestic sewage from other human habitations on the sides of the inlets, flows into the lake. It is reported that the Eluru Municipal Corporation alone discharges around 24 MLD (Million liters/day) untreated sewage to the lake. Organic rich wastes cause various changes in water quality including depletion of oxygen levels leading to fish kills and bacterial contamination. Fecal waste in water leads to the proliferation of pathogens such as *Salmonella, Escherichia coli* and *Vibrio cholerae*. High phosphate input from the wastes leads to eutrophication. Fish which are exposed to the effluents coming from various sources experience hypoxic stress and oxygen deficiency. Depletion of DO deprives aquatic species of vital oxygen resulting in their death, perhaps one of the reasons for increasing number of air breathing fishes. It was reported that Effluent Treatment Plants (ETP) are functioning and, even so, it is doubtful whether the effluents at the final outlet of ETPs meet the statutory standards.

The lake's eutrophication and deterioration in ecological health has occurred steadily and consistently. Kolleru Lake receives large quantity of nutrients, leading to eutrophication. Eutrophication is known to cause wide changes in structure and function of aquatic systems (Smith et al., 1999). Rise in turbidity, increase in phytoplankton biomass, blooms of toxic or in edible phytoplankton and gelatinous zooplankton, decline in the biomass of benthic and epiphytic algae, changes in macrophyte species composition and biomass, fall in dissolved oxygen, fish kills, change in species composition of fish and other fauna, reductions in harvestable fish and shellfish and fall in aesthetic value of the water body are some common consequences of eutrophication. Variations in water level, human pressure on land and increasing landscape modification have added to further deterioration of the lake. Huge quantities of inorganic fertilizers are used in the catchment area for agriculture which is likely to increase with augmented irrigation as and when the Polavaram right canal becomes functional. As a result of leaching and run-off, it is estimated that about one fourth of the fertilizers will end up in the lake (Gopalakrishnayya, 1999). The expanding rooted and floating weeds aid trapping suspended sediment sand other materials, and reduce the flow of water augmenting further eutrophication of the lake.

Flora & fauna:

The Kolleru Lake is rich in floral biodiversity. But the land use changes in water quality and other environmental changes is reflected in floral composition as well. Invasive species such as *Eichhorrnia crassipes*, *Pistia stratiotes* and *Salvinia molesta* have spread over the lake, clogging many areas and filling several open water areas. The spread of floating weeds would have serious impacts on the submerged, algal and epiphytic flora as well. However, such changes in Kolleru so far remain largely un-documented and needs further investigations. *Phragmites karka* seems to have invaded all the exposed areas in the lake especially towards the lower ends.

The Lake Kolleru has been habitat for a variety of waterfowl; resident, migratory, rare and endangered

species since time immemorial. It acts as a staging post and refueling station for migratory birds on their onward journey. Bird watchers have been conducting bird census in January of every year in different parts of the lake. The data available on bird census is shown Red Data Book. Rose and Scott (1994) while reporting Spot billed pelican population in South and South East Asia to be around 11500 noted a perceptible trend of decrease in its population. The species is considered a "Globally threatened species" under the category "vulnerable". The changes in the flora and environment had apparent impacts on the faunal forms of the lake". Species such as apple snail has reduced considerably. Apple snail is one of the important food species for storks. Similarly several fish species have reportedly disappeared and the fish species composition has changed after establishment of shrimp farms, Apple snail (*Pila virens*), the staple food of Asian Open billed stork (*Anastomus oscitans*), was being collected for feeding tigershrimp (*Penaeus monodon*) to fatten it. Consequently large-scale commercial exploitation of this snail in and around Kolleru has led to 60% destruction of its population (Seshagiri Rao and Varhala Raju, 1996).

According to the study conducted by the Regional Ayurvedic Research Centre, Vijayawada there are about 30 medicinal plant species in the lake area which can be another source of livelihood. A strategy for sustainable and ecologically benign harvesting, value addition and marketing has to be developed for these.

The lake can be developed as a major tourist destination and that will create direct and indirect employment for the people of the area. The lake harboring rare and endangered species of migratory birds has high potential to develop into a major attraction for general tourists, students, researchers and other special interest groups. Ecotourism should be targeted at socio-economical development especially of the local communities and should be community based. These activities should be aimed at developing soft and hard infrastructure and all infrastructure development should be environmentally sensitive and culturally sound, keeping local landscape in mind and should at all times involve the local community. Benefits of ecotourism must go only to the local stakeholders with minimum investment from outside agencies. Appropriate means such as Eco-development committees (EDC) may be formed to implement such programs.

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