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RESEARCH ARTICLE

ANTHROPOGENIC ACTIVITIES ON SHORELINE ENVIRONS – A PROFILE OF BYRAMANGALA RESERVOIR, KARNATAKA, INDIA

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ABSTRACT

Environment designations provide 'The framework for implementing shoreline policies and regulatory measures specific to the environment designation'. In view of this, the efforts were made to document the major problems associated on lake shores in peri- urban areas which constitutes the transitional zones between urban and rural areas are subjected to rapid changes to the time frame due to anthropogenic activities including the management let-downs. The Byramangala reservoir is situated near to Byramangala village which is a rapidly growing area in concerned with the Industries of Ramanagara district, Karnataka. The inventory was carried out using Vermont Agency of Natural Resources of United States (2012) and Shoreline Master Program (SMP) Guidelines (2012) for a fixed period (January, 2014 to December 2014). It was found that, the degree of anthropogenic activities of Byramangala reservoir shore was significantly influenced and reduced the quality of littoral habitat and altered aquatic, animal communities. These concerns have been challenging to document because of increasing effects of continued development in and around the reservoir. However, the management of shores should be effective in saving the environs of Byramangala reservoir.

INTRODUCTION

The reservoir-shore or lake-shore is the interface between water and land. This is often a region of dynamic physical processes, and high biodiversity and productivity, serving as a crucial habitat for terrestrial and aquatic plants and many invertebrates, fish and birds during all or part of their life cycles. The littoral zone – the region inhabited by benthic-rooted aquatic plants, is often the first part of a lake to suffer the effects of human activity. Humans have damaged many lake ecosystems due to developmental activities (Kelly and Stinchfield, 1998). The anthropogenic alterations has a cumulative effect on water quality and biota of lake ecosystems (Engel and Pederson, 1998) and human influences on lake ecosystems resulting nuisance conditions of algal blooms and abundant aquatic macrophytes. Byramangala reservoir was built by the British in 1942 as a result of impoundment of Vrishabhavathi stream flowing in the southern part of Bengaluru. Until in the late 1960s, the Byramangala reservoir water quality was of the highest purity. Since then the water quality has been receding to a point where nowadays the reservoir is highly polluted as it receives both industrial effluents and untreated sewage from various domestic sources from southern part of Urban Bengaluru. The present aim of the study is to document the major problems associated with Byramangala reservoir shore line due to anthropogenic activities and management let-downs.

MATERIALS AND METHODS

Study area: Byramangala reservoir is located at $12^0$52'32"N and $77^0$20'12"E of Ramanagara District with average annual rainfall of 850-900mm. The reservoir is located at 38km away to the north-west of Bengaluru, Karnataka. The gross storage capacity of the reservoir is 24.1 Million Cubic Meter (MCM) with a length of 2286 meter and maximum height above foundation was 22.85 meter (Water Resource Information System, 2010). The reservoir water is being utilized for agriculture, fisheries and for other various vegetation purposes. About 1,600 hectares of the surrounding agricultural areas is being irrigated by the same water from this reservoir. The main source of water to the reservoir is the part of domestic sewage from southern part of Urban Bengaluru which joins the river through a Vrishabhavathi river. The villages neighbouring the lake are Anchipure, Bannigere, Maregowdama, Doddi, Byramangala, Shanmangala, Kuntanalialli Parasamapalya,

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METHODOLOGY

The methods below indicated were followed as prescribed by Vermont Agency of Natural Resources of United States (2012) and Shoreline Master Program (SMP) Guidelines (2012) to bear out the objective:

Reservoir Survey - In this portion, lake residents/researchers boat around the shore and make notes about conditions in the water such as areas of attached algae growth, sediment accumulation, and aquatic plants growth. These conditions can help pinpoint where nutrients and sediments are entering the reservoir. These shorelines conditions are "early warning signs" that appear before the overall nitrate and phosphate concentrations of the reservoir changes.

Shore land Survey - Observations were made of shore land development types and locations, and other conditions that might have an effect on the reservoir, particularly in areas of concern as noted in the In-lake survey. Things such as vegetation density and types (trees, shrubs, lawn etc), artificial structures (retaining walls), shoreline erosion, driveway erosions and human based activities were noted.

Watershed Survey - In the watershed portion of the survey, the land area that drains to the reservoir is studied. Observations were made about erosion, stream conditions, and land-use types and locations.

Outlining physico-chemical characteristics: The water sampling and analysis of physico-chemical parameters were carried out for a fixed period (January 2014 to December 2014) using the Standard Methods for the Examination of Water and Waste Water (APHA, 2005).

Figure 1&2 Observation and Sample collection of water sample from Byramangala reservoir

RESULTS AND DISCUSSION

Byramangala reservoir shore is on the horizon in increase of water quality problems such as extreme algae and bush growth and mortification of reservoir and shore land habitat. Higher of this development pressure takes the form of restoration of reservoir, whereas the agricultural land are converted to Industrial area and overcrowd in villages as due to migration of individuals. This trend impose on the quality on land, water and air environs. Anthropological actions such as those listed below in the study area, often contribute to or accelerate the natural shoreline, exacerbating the negative effects.

Artificial hardening: The shorelines of reservoir are not only important habitats for seasonal and nesting birds, as well as flora and fauna, but they also affect the aquatic habitat of reservoir. Shorelines also act as natural filters of pollutants. Urban development reduces the habitat for these species. The artificial hardening, is caused by pavement and urban development and involves alteration of the reservoirs natural cycles of deposition and erosion by man-made structures in and around Byramangala reservoir majorly by the industrial developments. These alterations had great importance in turn with point and non-point sources of pollutants in Byramangala reservoir.

Figure 3&4 Open spaces of reservoir shore used as play ground and soil is removed for brick making

Foams: The foam formation near the reservoir out-lets is usually natural. Wind-driven currents frequently create parallel streaks of foam in open water that accumulate along windward shores. Foam is created as decomposing plants and animals release organic compounds into the water. The compounds reduce the surface tension of water, causing bubbles to form. The foam formation in the Byramangala reservoir may be due to detergents and organic matter which are from point source discharges like domestic sewage and industrial effluent.

Minnesota Shore land Management (2014) also facts out shoreline foam on detergents, but detergents do not create long-lasting foam since they quickly lose their lather ability. Industrial pollution effluents may have been a more common source of foam on surface water.

Figure 5 Irrigation canals of the reservoir carrying polluted water and foam

Uprooting Natural Vegetation: Natural vegetation is important as it possess protection to stabilization of reservoir Environs. Due to expansion of roads, and expanding agriculture area, uprooting the natural vegetation is increasing around Byramangala reservoir.

Figure 6&7 Uprooting natural vegetation for road expansion near the outlet of Byramangala reservoir

Aesthetics: Total maximum daily load to the lake can express the water quality of Byramangala reservoir. High cloudiness of water can significantly reduce the aesthetic quality of reservoir having a harmful impact on recreation. Natural sources can include erosion from upland, riparian, stream bank, and stream channel areas; however, this is difficult to measure due to agriculture and development activity. Human activities can accelerate erosion. Tannic acids often associated with peat and bog areas cause water to be coloured resulting in turbidity.

Figure 8& 9 Unaccountable sewage and impact of eutrophication on the aesthetics of reservoir

Point Source of Pollution: In Bengaluru city, storm-water runoff is combined with domestic sewage in a common system. The increased water volume leads to reduced treatment. Combined sewer overflows occur when water flow exceeds treatment plant capacity, resulting in untreated sewage being discharged and reaches to Byramangala reservoir.

Open spaces: It is evident from the study that shoreline development do have impact on reservoir water quality associated with the anthropogenic activities, even though having more vegetation around the vicinities of reservoir. But lack of shoreline management as buffer zoning lead to pollution load on the reservoir.

Figure 10&11 Construction waste at the outlet of reservoir

Figure 12&13 Industrial Fibre wastes dumped on shores of reservoir

Figure 14& 15 Chemical wastes dumped at the shores of reservior

Figure 16& 17 Laboratory and dispensary glass bottles disposed at the shores of reservior

Non-Point source of pollution: Enters to the reservior from a source that cannot be traced to any single site of discharge. Byramangala reservior is threatened by non-point source of pollution from agricultural field that use chemical fertilizers around the shore clusters as it is revealed when the reservoir water is subjected to physicochemical analysis.

Figure 18&19 Agriculture expansions and Commercial Plantations in the vicinities of Byramangala reservior

Identifying non-point source of pollution can be an expensive and often frustrating approach as it suffers from comprehensive management.

The National Wildlife Federation (2001), also reports these sources including Agricultural fields and grazing lands as runoff carries chemical fertilizers, pesticides and nutrients are harmful to aquatic life, in the absence of soil protection, logging leads to increases in erosion affects the turbidity which in turn decrease dissolved oxygen, poor erosion controls, soil and construction wastes enter waterways harming wildlife and lowering water quality and paving over natural land, the amount of runoff greatly increases and toxic chemicals, oils and paints affects the aquatic biota. The Zoning regulations were clearly omitted by the individuals for shore area and the buffer zone of the lake.

Figure 20& 21 Constructed huts and ground water pump house at shores of reservior.

Fishing, Grazing and Nursery: Fishing is an enjoyable sport for those looking for outdoor activity, food source as for living communities and more importantly used as commercial purposes. Fishing in this reservoir was undertaken by the Cooperating Society and Department of Fisheries, Karnataka. Due to overload of pollution, fish culture is stopped by the cooperating society.

The Indigenous fishes are taken over by African cat fish. However, in view of the commercial purpose, the fishes were captured and sold by the individuals without any safety plans even though the water is heavily polluted and wastes are accumulated.

Figure 22& 23 Fishing at the weir outlet of the reservoir

Figure 24&25 Command areas used for animal husbandry and commercial plantations

The command areas are well grown with the nutrient rich water. The commercial crops were grown in the downstream of the lake viz, maize to make the food products, coconut and sapota plantations. The animal husbandry which includes the cattle's and sheep's were also affected by the polluted water.

Figure 26&27 Nursery activities at the outlet of Byramangala reservoir.

In the nurseries, the siblings were formed to plants using this water and the groundwater at the shores of this lake. However, these plats may also affect through the pollution with higher concentrations of heavy metals and damages the resistivity of the plants.

Vegetation in and around the Byramangala reservoir within 50m vicinity were documented and are tabulated in the table 1. Vegetation found in and around was categorised into trees, shrubs, herbs and aquatic plants. It was observed that, the various decaying weeds in the reservoir formed floating vegetation which deteriorate quality of water and also interfere with activities of lower aquatic organism.

Table 1 Flora identified in and around Byramangala reservoir

Aquatic	Trees	Shrubs	Herbs
Jussiaea spp., *Asteracantha longifolia* *Eichhornia crassipes* *Cyperus distans* *Lemna minor*	*Pongamia pinnata* *Albizia saman* *Peltophorum* spp., *Ficus religiosa* *Azadirachta indica* *Madhuca longifolia* *Terminalia arjuna* *Syzygium cumini* *Ficus virens* *Cocos nucifera* *Manilkara zapota*	*Calotropis gig antea* *Nerium oleander*	*Bacopa monerri* *Chenopodium album* *Parthenium argentatum* *Mimosa pudica* *Aloe vera* *Cardiospermum halicacabum* *Ocimum americanum*

Water quality is undoubtedly important when it comes to all kinds of aquatic life. The diversity of the fishes mainly depends upon the biotic and abiotic factors and type of the ecosystem, age of the water body, mean depth, water level fluctuations, morphometric features and bottom have great implications. The hydro-biological features of the collection centers also play an effective role in fisheries output to a greater extent. The fish species identified were tabulated in the table 2.

Table 2 Important fauna - Aquatic (Fishes) identifiedin Byramangala reservoir

Salmostoma clupeiodes (Bloch) – Chalake *Chela (Chela) cachius-Silver hatchetchela* (Borle menu) *Esomus danricus* - Hamilton-Buchanan (Meese Pakke)	*Cirrhinus mrigala* (Mrigal) *Catla catla* *Labeo rohita* (Rohu) African catfish	*Cyprinus carpio communis*-Common carp (Samany agende) *Mystus cavasius* - Gangetic Mystus (Girlu) *Channa punctatus*- Spotted snake –head (Korava)

The magnitude of anthropogenic activities along Byramangala shorelines showed that, the pollution load are greatly increased and reduces the reservoir water quality. This consequence have been challenging to document because of increasing effects of continued development. The physico-chemical and heavy metal concentration of Byramangala reservoir water samples are tabulated in the table 3.

Table 3 Annual mean concentration of physico-chemical and heavy metal inwater samples of Byramangala reservoir

Parameters	IS 2296-1982(Class-E)	Mean concent-rations
Physico-chemical parameters		
pH	6.0-8.5	7.62
Total Alkalinity	-	176.2
Electrical Conductivity	2250	1412
Turbidity	-	12
Total Dissolved Solids	2100	885
Dissolved Oxygen	-	1.1
Biological Oxygen Demand	30	12.6
Chemical Oxygen Demand	-	82
Total Hardness as $CaCO_3$	-	210
Calcium Hardness	-	82
Magnesium Hardness	-	3.66
Chlorides	600	182
Fluorides	-	0.32
Nitrates*General Standards	10	41.6
Phosphates	5	16.2
Sulphates	1000	112
Sodium	-	164
Potassium	-	18
Heavy Metals		
Cadmium	0.01	0.07
Cobalt	-	BDL
Manganese	0.5	0.082
Chromium	0.05	BDL
Zinc	15	0.046
Nickel	3	0.03
Copper	1.5	0.04
Lead	0.1	0.002
Iron	0.3	0.172
Mercury	0.001	BDL

Note: All values are in mg/L; except pH, EC (µmhos/cm), Turbidity (NTU); BDL-Below Detected Level

CONCLUSION

The impact of all human pressure on shores of the Byramangala reservoir showing under continual stress and it is much needed situation for reservoir shore land management. Habitat and reducing pollution from anthropogenic activities from agricultural, industrial, recreational, entering of sewages, dumping of wastes including hazardous wastes in the vicinity of reservoir is deteriorating the quality of water. The non-point

source pollution particularly phosphorous and sediment harm habitat and weaken shoreline banks.

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