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Prediction of water quality index of Gudavi wetland, Karnataka, Central Western Ghats

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Abstract:
The present study was planned to analyse Water Quality Index (WQI) of Gudavi wetland, a bird sanctuary in Shimoga district, Central Western Ghats, Karnataka in order to establish the tool Water Quality Index (WQI) to evaluate the quality of water and restoration of wetland. This study helps to deal with impact on environmental parameters on the water quality of wetland. The WQI was studied for whole seasons, i.e. pre-monsoon, monsoon and post-monsoon. During the study WQI was resolute on the basis of various parameters like pH, EC, TDS, T alkalinity, T hardness, T suspended solids, calcium, magnesium, chloride, nitrate and dissolved oxygen(DO). The values found were compared with the recommendations suggested by the Bureau of Indian Standard (BIS). A relative weight was given to each parameter range from 0.1 to 66.64, based on its range where dissolved solids in pre-monsoon showed high. The WQI values range from ∑Wnqn=62.75 to ∑Wnqn =113.73 where indicates high nutrient load. The application of WQI is necessary for proper management of the Gudavi. Water quality condition was slightly accumulated with inorganic nutrients from the runoff was found in the selected study area, which was evidenced from WQI (∑Wnqn =113.73) and growth of aquatic vegetation. The dense growth of Salvinia molesta is used as the water quality key indicator, and it exists where there is a high nitrates in water quality condition. The nitrates and chlorides negatively influenced the aquatic macrophytes. Therefore, there is a need for some adaptation measure to maintain the better water quality for the avian fauna diversity.

Keywords*: Water quality index, Wetland, chloride, conservation.*

Introduction.

In the global natural condition, wetlands provide essential habitat for many wildlife on the earth such as fish species, aquatic macrophytes, plankton diversity, animals, birds, amphibians and mammals even in crucial ecosystem. (Hernandez and Mitsch 2007; Palit and Mukherjee 2012; Ramesh kumar et al., 2019).Wetlands are the important component in biological diversity, vegetation and ecosystem function, performance varied by the hydrological and ecosystem variable functions (Banner and Mac Kenzie., 2000). Water quality index is the method that provides a ranking of the complex effect of individual parameters of water quality to the weight of overall water quality which is affected by physical, chemical and biological causes (Ichwana et al., 2016).The term WQI was developed as an effective tool to give an indication of how suitable the water is for human consumption, aquatic biodiversity, sustainable management and wetlands restoration. (Yisa and Jimoh., 2010; Sajitha andVijayamma. 2016). This method certifies the quality of water easily that can respond to changes in the basic characteristics of water. Water quality index was developed by the National Sanitation Foundation (NSF), provides a regular method for comparing the

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relative quality of various water bodies. Wetlands, valued for their water resources, ground water restores and habitats of a widespread variety of fauna and flora, are facing various degrees of pressures,rise in population and extension of economical projects resulted in consequent fall in the ecological services and undeniably leads to swelling demand of water use for various purposes. (Chandra et al., 2009; Hameed et al., 2010). The biological estimation of water quality index has been executed from many years complementing the physical-chemical indicators, with the benthic macro invertebrate groups, responses to different degrees of environmental stress from the anthropogenic pressure throughout the season (Custodio et al., 2018). In the present study Gudavi is a wetland and a bird sanctuary conserved under National Conservation Programme. This wetland occupies the water-spread 73.68, out of the total 73.68 ha. In the recent years the invasive species salvinia molesta is covered fully and supressedthe other aquatic vegetation, in this connection to know the weight of nutrient load. The source of water impounding the Gudavi wetland is from the monsoonal run off from the surrounding catchments areas. The Gudavi wetland, having the largest water spread area among the Soraba taluk wetlands. The Gudavi wetland, is known to attract several migratory birds, recorded 217 avian species belonging to 48 families were recorded at the Gudavi sanctuary. (Dayananda., 2009).

Materials and Methods:

Study area:

Gudavi wetland is one of recognized bird sanctuary, conserved under nation wetland conservation programme from the year 2000. It is the main source of water for avifaunal diversity and many nearby villages where they do seasonal fishing. Geographically, Gudavi is located at latitudes (Lat 14025'59"-14026'41"NLong.7506'43"-75025'28"E) in Soraba taluk, Central Western Ghats, and elevated 565m above sea level (Figure 1). It includes marshy areas, inland and moist deciduous forest interspread with grassy patches. This sanctuary occupies the water-spread area of about 33 ha, in rainy season, out of the total 73.68 ha. Remaining area is moist deciduous forest interspread with grassy patches.The wetland has encroachments of connecting paddy fields and villages on the bund. Seasonally, the wetland is covered with dense *Salvinia molesta* (Figure 2). The minimum and maximum temperature recorded in the wetland is 18^0C-36^0C respectively and precipitation of 1500-1800mm.

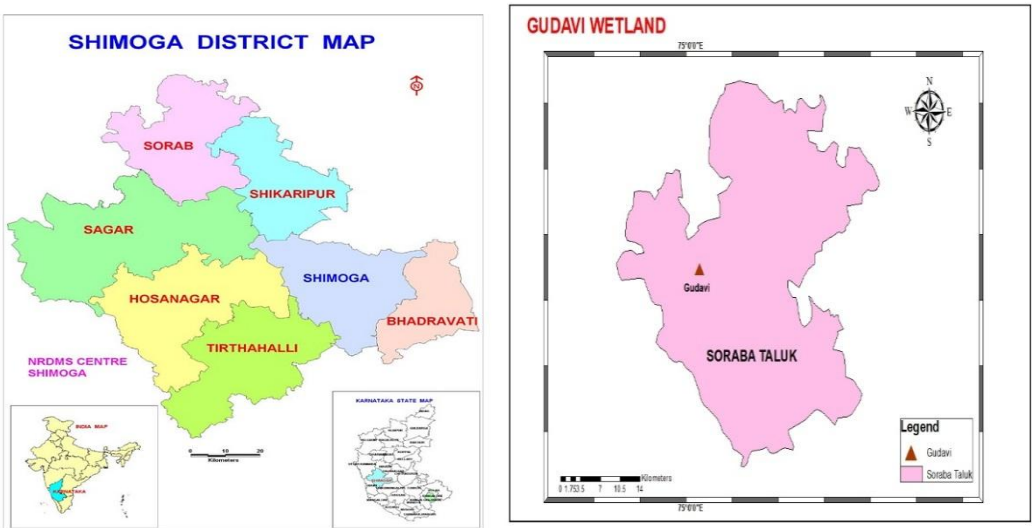

Figure 1: GIS Map showing the wetland study site

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Fig 2: Seasonal changes of Gudavi wetland and dense growth of Salvinia molesta.a) Pre-monsoon with the mat of *Salvinia molesta*, b) Monsoon season, c) Post-monsoon

Water sampling:

Water samples were collected at monthly intervals and studied the seasonal variations for a period of one year during (Nov 2017-Oct 2018) to know the physico-chemical status and Water Quality Index. Water samples were collected using beta horizontal water sampler at the depth of 1m, and preserved in polythene bottles for the study of water chemistry. The concordant samples were prepared by the three replicates from three different sampling points.The physico-chemical parameters of water such as temperature, pH, conductivity, total dissolved solids using TDS pen, turbidity, T. alkalinity, nitrates, chlorides, dissolved oxygen by Wrinklers method, T. hardness, magnesium and calcium hardness. Sample collection, preservation, physic-chemical analysis was carried out using standard methods described by APHA, 1995.

Water quality index (WQI):

Water quality index of wetland water is calculated by adopting Chaterjee and Razuddin (2002), Ramesh kumar *et al.,* 2019, method, and the formula is given below.

WQI=∑ q n Wn/ ∑Wn

where *qn* = 100 [*Vn* − Vio]/(*Sn* − V10)], *qn* quality rating forthe ith water quality parameter; *Vn* estimated value of the *i*th parameter at a given sampling station; *Sn* standard permissible value of *i*th parameter; Vio ideal value of *i*th parameterin pure water (pH 7, DO = 14 mg/L and for other parameter= 0); *Wn* unit weight for ith parameter; *Sn* standard valuefor *i*th parameter; *K* constant for proportionality.

Results and Discussion

Water Quality Index (WQI):

Electrical Conductivity is the key factor that regulates the quality of water which measures purity of water. The EC value in the present study ranged between 0.19 mS to 0.4 mS being maximum (0.4 mS) in summer season and minimum (0.19 mS) in winter season. The WQI of EC varied from 0.02 to 0.048 where the WQI is high during the rainy season due to addition of salts by runoff. The results of total dissolved solids in 2016-17 highest in the location that is 121.66 ppt and the lowest is 87.75 ppt. TDS concentration increased, the diversity and abundance of aquatic species declines. The high TDS values may results in eutrophication in the wetland. The WQI of dissolved solids showed highest in summer, ie WnQn=0.09 in the month of April. (Ichwana et al., 2016)In the evaluation of water quality, the turbidity ranged 3.05 NTU to 16.0 NTU respectively, higher in monsoonal season. The WQI of turbidity showed high during summer ie. WnQn=66.64.The turbidity formed from clay sediment with the eroded soil during runoff in catchment area where water is rich in organic matter and clay particles.(Dhanalakshmi et al.,2013).pH is termed as one of the most dominant water quality parameter because most of the aquatic species are adapted to an average pH. The pH values during the pre-monsoon, monsoon and post monsoonseasons were 8.86, 8.075 and 7.78 respectively. The WQI showed WnQn=20.80 and WnQn=33.86. Higher value of pH in pre monsoon season is due to increase of concentration of carbonates and low water level (Sahni and Yadav. 2012).

The presence of Dissolved Oxygen to regulate and maintain the higher forms of aquatic vegetation and its biological life, proper stability of various pollutions thus making the wetland bodies healthy. The chemical and biochemical method enduring in water body are largely contingent upon the presence of DO. In Gudavi wetland the DO showed 6.125 mg/L and 7.6 mg/L, where in

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pre-monsoon the DO reached high due to decline of aquatic vegetation and agriculture run off. The permissible value suggested for DO is above 5-9.5mg/L for aquatic species as per UNECE 1993. The WQI is measured and results showed WnQn=19.37, WnQn=15.60 and WnQn=14.99. Study area indexed high in summer which may be due to the increased solubility of oxygen at higher temperature. (Sajitha V., Smitha Asok Vijayamma., 2016).Alkalinity in wetlands is due to dissolution of rocks and sediment, plant actions and agriculture waste water discharges are also accounting for alkalinity. (Upadhyay & Chandrakala., 2016) Alkalinity remarks water buffering capacity and holds ability to withstand changes in pH. In this study the observed values of alkalinity showed the seasonal variations ie., 42 mg/L to 51.33mg/L. Water Quality Index of alkalinity measured and tabulated ie., $W_nq_{n=}$0.66 in pre-monsoon , $W_nq_{n=}$0.36 in monsoon and $W_nq_{n=}$0.52 in post-monsoon.Hardness concentration values ranged from 90.75mg/L to 93.33mg/L in the Gudavi wetland. According to BIS 2012, the permissible limit for T hardness is 300 mg/L. Compared to the desirable limit, the values of the samples is found lower than the limit. (Sajitha and Vijayamma., 2016).

The water quality index of total hardness showed within acceptable value and tabulated the result, W_nq_n =0.18.Chloride ranging between 42.25 to 66.33 mg/L of which increased value (66.33 mg/L) was observed in pre-monsoon season and the minimum value in post-monsoon season. The high absorption of chloride is an indicator of higher pollution due to high organic waste and high temperature, which is observed in the work of Sahni and Yadav. 2012. The WQI is also justified and analysed, WQI=0.19 and fluctuated throughout all the season. Calcium is found in abundance in all natural water source and its main basis is weathering of rocks from which it leaches out. Calcium was found higher (42 mg/L) in summer season and lower (27.66 mg/L) in winter season. Indexed W_nq_n = 0.92 to W_nq_n = 1.4 and weighed high during summer. The main source of calcium is being leaching of rocks in the catchment area. The maximum level of calcium hardness during the summer season may be due to evaporation of water, addition of calcium salts and domestic usage (Chaurasia and Pandey, 2007).Magnesium is the source of mineral salts associated with calcium in all kind of water, but it concentration remain generally lower than the calcium(Kumar et al., *2014).*

In Gudavi wetland the amount of magnesium recorded ranges between 9.75 mg/L to 13mg/L. The maximum amount of magnesium in the water was recorded during winter season and minimum amount was recorded during summer season. The water quality index ranged 1.9 to 2.6 in the weight, nitrate are natural ions that are part of nitrogen cycle. However, the nitrate value varies from 1.37 to 2.1 mg/L. Although all the sample are within the permissible limit, and ranges high in summer, due to leachates from plant debris, over usage of inorganic nitrate fertilizers for paddy fields. The index calculated and weight for the nitrate recorded W_nq_n = 0.12 to W_nq_n = 0.20. High nitrates load also leads to eutrophication which resulted in the dense growth of invasive species Salvinia molesta. (Yisa and Jimoh., 2010).

Conclusion:

The Water Quality Index was calculated for all the seasons (Table 2) and was found to be $\sum W_nq_n$ =113.73, 62.75 and 65.41. The highest weight of water quality of overall parameters showed high in pre-monsoon and lowest in post–monsoon season. The present study conducted on the Gudavi wetland water reveals that, the quality of the water is changing with its increasing nutrient load from agriculture runoff which resulted in the dense growth of aquatic vegetation. Gudavi wetland is a chief source for migratory birds, hence it should be free from the impurities. The water quality characteristics directly affect the aquatic vegetation, which was evidenced from the water quality index of the wetland. Also, the status of water quality varied due to usage and topography. Moreover, this study concludes that dense growth of Salvinia molesta in pre-monsoon and post-monsoonal season indicating the low dissolved oxygen, high dissolved solids and absence of transparency. From all these evaluation of water quality and index needed to take some adaptation measure to maintain the water quality and adoptive ecosystem for migratory birds.

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