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A Study on Water quality and Sediment characteristics of Gudavi wetland in Central Western Ghat region, Shimoga(Dist), India

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***Abstract*– The Study was conducted to investigate the status of the water quality and sediment characteristics in the Gudavi wetland. In the present study Gudavi, located in SorabaTaluk of Shimoga District in Karnataka, one of the most picturesque wetland and well-known bird sanctuaries of India; the one identified under National Wetland Conservation programme is selected and monitored for a period of six months. This wetland 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 lies between Lat.14º25'59"-14º26'41"N and Long. 75º6'43"-75º25'28"E. Parameters were selected to study the water quality viz,, temperature, turbidity, pH, salinity, TDS, total alkalinity, conductivity, chloride, dissolved oxygen, calcium, hardness, magnesium and nitrate,. The study revealed that the parameters examined were well within the permissible limits of WHO. Sediment quality parameters such as pH, electric conductivity, organic carbon, nitrogen, phosphorus and potassium, were analyzed. Although the water and sediment quality parameters were in the suitable range, the overall results suggest that better management techniques should be practiced in order to overcome impact on wetland ecosystem.**

Keywords*– *Water quality, salinity, sediment quality, magnesium, potassium

INTRODUCTION:

Wetlands although they account only for about 4% of the earth's ice-free land surface plays a crucial role in the hydrological cycle, the most productive ecosystems of the world and a potential source of carbon sequestration, (Panigrahy*et al.*,2012*)*.There are several kinds of wetlands such as Marshes, Lagoons, Bogs, Fens, Open water bodies and Mangroves. India has wealth of wetland ecosystems distributed in the different geographical region. Wetlands occupy 18.4% of the countries area (excluding river) of which 70% are under paddy cultivation. In India, it has been estimated that 4.1 million hectares are wetlands (excluding paddy fields, rivers, and streams), whereas 1.5 million hectares are natural and 2.6 million hectares are manmade (Ramamurthy. 2014).

Hydrological processes occurring in wetlands are the same processes that occur outside of wetlands and collectively are referred to as the hydrologic cycle. Major components of the hydrologic cycle are precipitation, surface-water flow, ground-water flow, and evapotranspiration.(Acreman*et al.*, 2005) Wetlands and uplands continually receive or lose water through exchange with the atmosphere, streams, and groundwater. Both a favorable geologic setting and an adequate and persistent supply of water are necessary for the existence of wetlands.(Kim *et al.*, 2012).Physico-chemical properties of water are very important as they serve as the medium for living of all aquatic organisms. The physical and chemical reactions take place in the aquatic environment with the biotic communities both individually and synergistically. A shift in the desired level of physico-chemical properties affects the productivity chain adversely and as a result, the entire aquatic productivity equilibrium is disrupted. Bottom sediments and water are an important factor for its fertility and productivity. The Soil is a major component of any aquatic environment, which not only holds water for aquatic animals but also enriches the water body with the various nutrients required for biological production. (Abu *et al.*, 2015).

Climatechange is recognized as a major threat to the survival of species and integrity of ecosystems worldwide. The ecological and hydrological impacts expected to result from climate change has grown considerably over the past decade.(Hollis G E ., 2009) Pressures on wetlands are likely to be mediated through changes in hydrology, direct and indirect effects of changes in temperatures, as well as land use change. Examples of impacts resulting from projected changes in extreme climate events includechange in base flows; altered hydrology (depth and hydro period).Under currently predicted future climate scenarios, the spread of exotics will probably be enhanced, which could increase pressure on watersheds and ecosystems(Erwin., 2008). Climate change will affect the hydrology of individual wetland ecosystems

mostly through changes in precipitation and temperature regimes with great global variability. Aquatic biotic communities associated with watersheds with high agricultural and urban land use are generally characterized by lower species diversity, less trophic complexity, altered food webs, altered community composition, and reduced habitat diversity. High nutrient loads in coastal ecosystems result in increased algal blooms, increased low dissolved oxygen events, alterations in the food web, and declines in valued aquatic species. Sediment and contaminant loads are also increased in watersheds dominated by agricultural and urban development mainly due to storm-water runoff .These declines have been attributed primarily to increased eutrophication and toxic substances. Concentrations of dissolved oxygen and nutrients in the water column; concentrations of chemical contaminants in the sediment; and measures of human activity in the watershed, such as population density, land use, and loadings of nutrients and toxics.(Dauer*et al*.,2000).

Materials and Methodology

STUDY AREA

Gudaviis a wetland and a bird sanctuary conserved under National Conservation Programme, with notification. It is located at 13 km away from Soraba city and 0.5 km away from Gudavi village. This wetland occupies the water-spread 73.68, out of the total 73.68 ha.it includes marshy areas, inland and moist deciduous forest interspersed with grassy patches. The minimum and maximum temperature recorded in the wetland is 18°□C and 36°□C respectively. The source of water impounding the sanctuary's water tank is from the monsoonal run off from the surrounding catchments areas. The average annual rainfall in the area is about 1500 mm. The wetland lies between Lat.$14^0$25'59"-14^0 26'41"N and Long. 75^0 6'43"-$75^0$25'28"E. The wetland is a particularly important wintering habitat for migratory birds have been observed here.

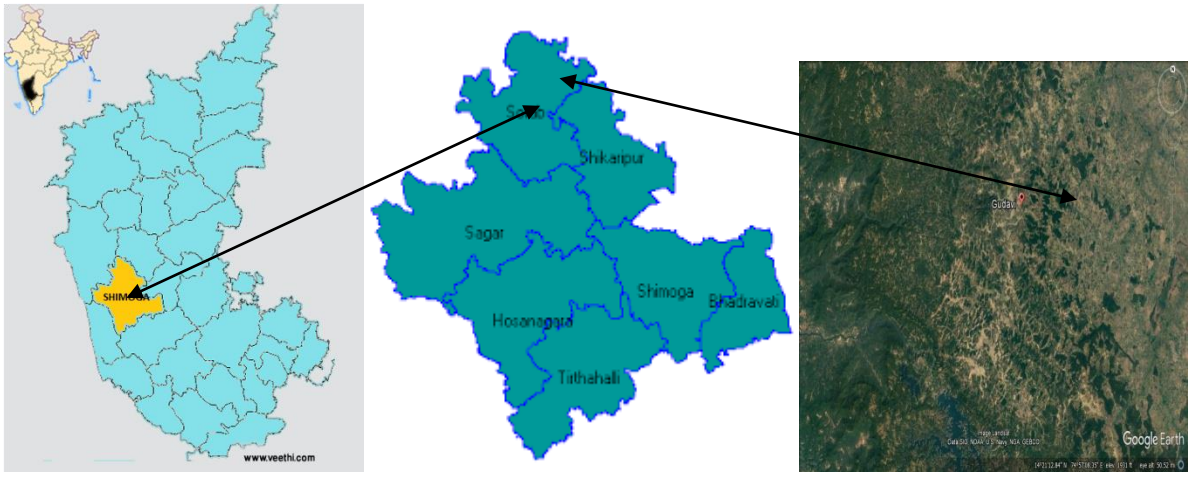

Fig 1: Map representing Study area.

Sample Collection.

Water and sediment samples were collected at three different sites on monthly intervals for a period of six months during(Nov 2015-April2016) to study the Physico-chemical characteristics. Water samples were collected using horizontal water sampler at the depth of 1m, and preserved in polythene bottles for the study of water chemistry. The physico-chemical parameters of water such as surface water temperature, pH, conductivity, total dissolved solids(TDS), total alkalinity, nitrate, phosphate, chloride, dissolved oxygen, calcium, hardness, magnesium, turbidity, and salinity was analyzed. The sediment samples were taken at a depth of nearly 5 cm using sediment corer and placed in polythene bags and stored at 4°C (Heyden and New ., 2003). The sediment samples were dried, powdered and sieved for the chemical analysis(Shiji*et al*., 2015**).** The sediment properties included pH, organic carbon (%), phosphorous (%), potassium (%) was analysed. Sample collection, preservation, physic-chemical analysis was carried out using standard methods described by(APHA, 1998; Adoni*et al*., 1985)

Physico-chemical parameters	November 2015	December 2015	January 2016	February 2016	March 2016	April 2016
Water temperature(°C)	20.66±6.42	17.16±3.88	18.33±1.52	25.33±2.51	25.66±2.081	24.16±1.25
Air temperature(°C)	24.66±3.05	18.66±4.04	24.66±3.05	27.66±1.52	34.5±2.29	35.83±0.76
Conductivity(mS)	8.16±0.55	8.2±0.26	8.66±0.76	5.16±1.52	5.83±1.04	4.66±1.04
Total dissolved solids(mg/l)	0.17±0.01	0.26±0.02	0.35±0.05	0.32±0.03	0.35±0.02	0.24±0.015
Turbidity(NTU)	115.33±1.57	113.16±5.575	119.33±6.027	131.66±3.51	139.33±5.13	123.16±5.34
pH	14.36±3.30	8.6±0.78	10.33±0.76	18.83±1.52	18.06±0.60	15.33±3.21
Dissolved oxygen(mg/l)	14.16±0.32	11.03±0.55	11.16±2.84	12.33±1.52	13.56±0.80	13.26±1.92
Total alkalinity(mg/l)	42.33±2.08	79.66±1.52	55.66±4.04	39.66±3.511	47.33±5.03	53.16±8.31
Total hardness(mg/l)	76.83±4.25	75.16±4.0	73.66±11.06	82.33±1.52	74.16±13.76	98.33±20.20
Chlorides(mg/l)	24.09±2.447	28.79±4.28	22.65±1.36	43.35±1.085	44.31±0.598	48.56±9.71
Calcium(mg/l)	22.84±1.276	22.42±4.81	27.76±10.29	31.83±0.763	52.5±0.5	42.25±2.50
Magnesium(mg/l)	13.78±0.255	10.96±0.45	7.81±2.30	18.18±7.15	10.78±3.12	10.59±3.98
Nitrate(mg/l)	0.09±0.01	0.38±0.076	0.14±0.13	0.53±0.305	0.43±0.152	0.56±0.41
Phosphate(mg/l)	0.6±0.1	0.7±0.2	0.7±0.2	0.73±0.15	1.36±0.208	1.53±0.208

Table 1: Mean Values (Mean±SD) of physico-chemical parameters of water monitored at Gudavi wetland during the study period (from November 2015- April 2016)

Water quality and sediment analysis.

water temperature was recorded using a thermometer. The water pH value was determined by a digital pH

meter and pH of the sediment was measured by a glass electrode pH meter. Conductivity and total dissolvedsolids (TDS) were measured through a conductivity meter. Surface water temperature, pH,conductivity, total dissolved solids (TDS) were recorded.(Abu *et al*., 2014) Determination of nitrate-N, phosphate-P and were performed by (UV Spectrophotometer) in the laboratory. The percentage organic carbon ofsediment was determined volumetrically by wetoxidation methods of Walkley and Black (1935). Totalnitrogen of sediment was estimated by Kjeldahl method. Exchangeable-K was estimated with the help of flame photometer following the method describedby Jackson (1962).

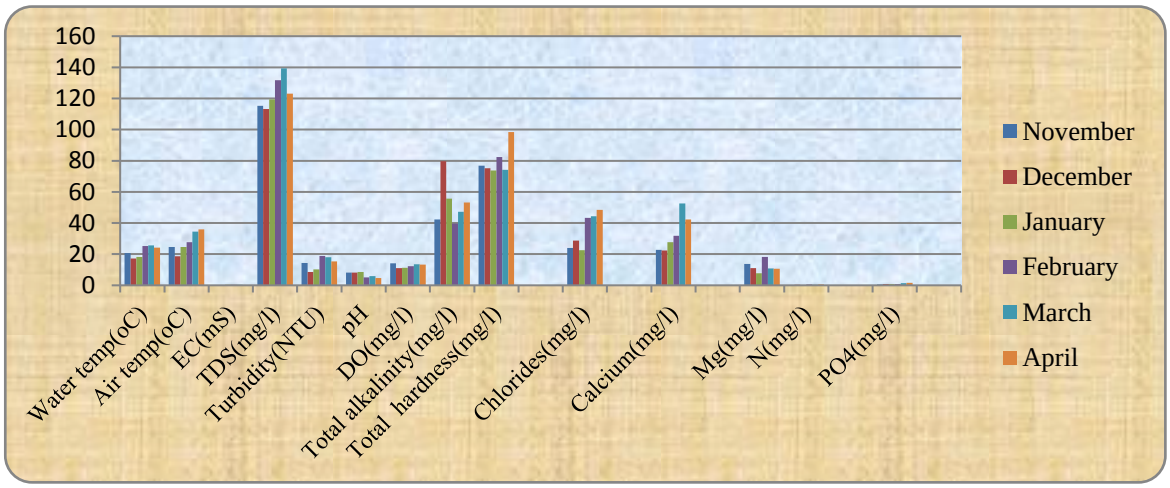

Fig 2: Mean values of Physico-chemical parameters represented by graph

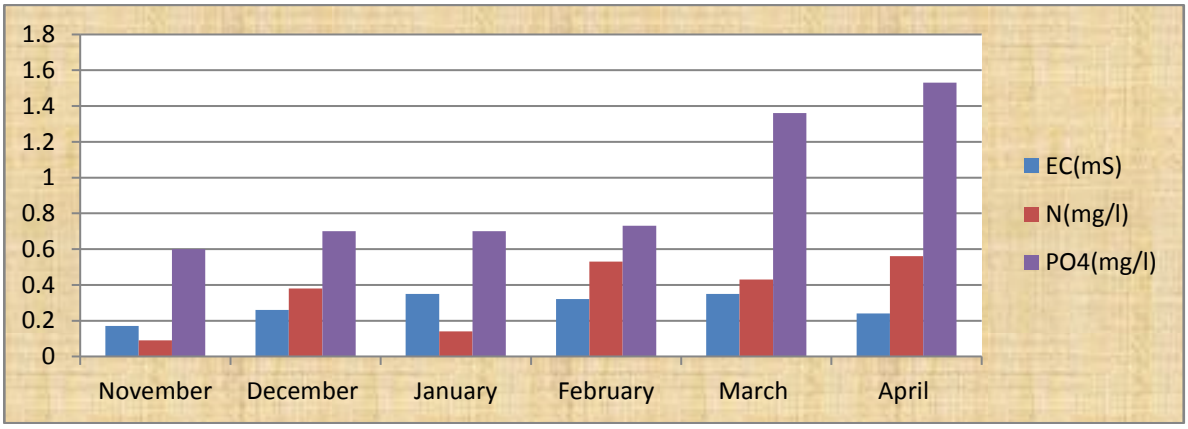

Fig 3: Mean values of EC=Electric conductance, N=nitrate, PO_4=Phosphate representing graph.

Table 2 Mean values of Gudavi wetland sediment quality parameters during the study period (from November 2015 – April 2016)

Sediment Parameters	November 2015	December 2015	January 2016	February 2016	March 2016	April 2016
pH	5.44±0.38	5.75±0.66	4.96±0.80	4.56±0.56	4.79±0.03	4.36±0.15
Electric Conductivity. dSm^{-1}	0.65±0.08	0.76±0.13	0.75±0.1	0.64±0.11	0.74±0.11	0.61±0.21
Organic Carbon. (%)	0.82±0.12	0.73±0.07	0.78±0.20	0.83±0.07	0.65±0.09	0.73±0.10
Total Nitrogen (%)	0.43±0.06	0.56±0.05	0.29±0.05	0.73±0.05	0.72±0.05	0.81±0.04
Phosphorus (%)	0.63±0.08	0.66±0.02	0.74±0.05	1.16±0.09	2.18±1.03	2.7±0.11
Potassium (%)	1.68±0.76	2.17±0.30	2.58±0.56	3.25±0.42	3.18±1.03	3.96±1.30

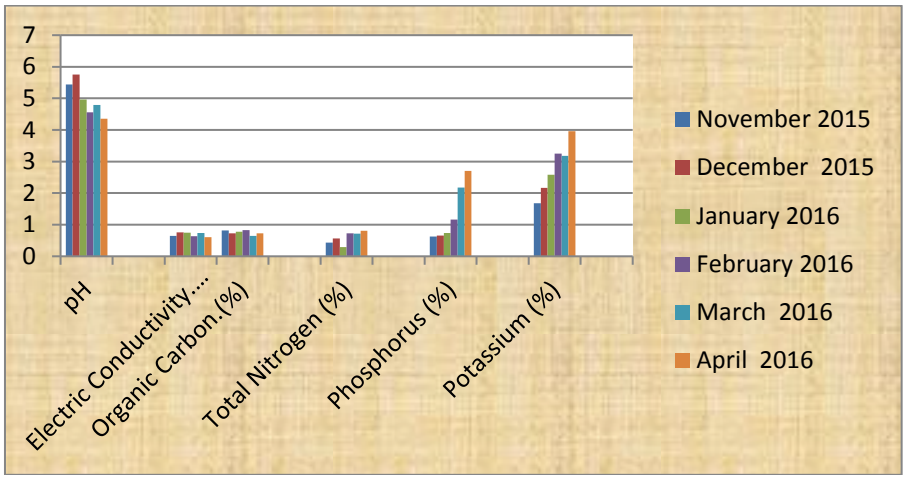

Fig 4:Mean values Sediment characteristics represented by graph.

RESULTS AND DISCUSSION

Physico-chemical quality of water.

Physico-chemical parameters of water and sediment was determined. The seasonal change of parameters at selected sites during winter and pre-monsoon seasons (November 2015 – April 2016) and their data is presented in Table 1 Fig 2 &3. The average temperature of water in the study sites over the period from November 2015 to April 2016 was found to vary from 17.16±3.88° C to 25.66±2.08°C. The highest air temperature (35.83° C) recorded in April, whereas the lowest temperature (18.66°C) was observed in the month of December. pHrecorded at the different sites in the Gudavi and surrounding wetland varied seasonally(Table 1). The maximum water pH value was recorded at the Gudavi in January. Fluctuating trends of pH in different sites of the Gudavi wetland indicated that pH value gradually increases after November and continues up to January.Boyd (1982) concluded that animal species grow well at pH 6.0 to 9.0; they cannot survive at pH 4.0, therefore the present study shows pH of water is acidic in nature which effects the growth of aquatic species. The pH of water as shownfluctuated within a narrow range and rarely remained neutral to slightly acidic. The values of total alkalinity also recorded from the Gudavi wetland were found to varied from 39.66±3.51mg/L to 79.66±1.52 mg/L. The maximum value of total alkalinity (79.66±1.52 mg/L) was recorded from the Gudavi wetland during December. Conductivity of the water at the different sites of Gudavi observed from 0.17±0.01 to 0.35±0.025mS/cm during the study period. The highest value of conductivity (0.35±0.02 mS/cm) was recorded in March. The values of total dissolved solids (TDS) at the different sites in the Gudavi Wetland were within the suitable range which showed significant difference. It recorded between 99.33±5.13 mg/L and 131.66±3.51 mg/L and exhibited more or less similar trend at selected sites .The nutrient concentrations, as nitrate-N, recorded between 0.09±0.01 mg/L and 0.56±0.41 mg/L at the wetland sites. The highest nitrate-N concentration (0.56±0.41 mg/L) was found in April and lowest one (0.09±0.01 mg/L) observed in November. The nitrate content indicates that Gudavi wetland is high in productivity. The values of Phosphate ranged between 0.6±0.1 to 1.53±0.20 mg/L at the Gudavi site. The highest concentration (1.53±0.20 mg/L) of phosphate-P was recorded in august at the sampling site. The average concentration of phosphate of water during summer season remained high due to agriculture run off and decaying of allochthonous materials.

Sediment Characteristics.

Sediment is a major component of any aquatic environment, which not only holds water for aquatic animals but also enriches the water body with various nutrients required for biological production. However, the exchange rate of nutrients from bottom soil to water depends upon temperature, pH, and nutrients, the results presented in table-2, Fig 4 in the water. The pH value of sediment is an important factor for regulating water quality for aquaculture. The pH values of sediment at different sites shown acidic in nature, pH mean values indicated 4.36±0.15 to 5.75±0.66 and differed significantly among the sites and more or less similar values were observed throughout the study period. The highest acidic content in sediment pH (4.36±0.15) was recorded in April, which might have been due to decomposition rate is high. Available organic carbon is recorded from 0.65±0.09% to 0.83±0.07% in Gudavi, which differs significantly at different sites, again it is due to decomposition of organic matter in nature. The

observed concentration of nitrogen in the Gudavi wetland sediment at different sites varied from 0.43% to 0.81%. The values for phosphorous ranges from 0.63±0.085% to 2.7±1.035 %.Concentration of potassium in sediment at different sites recorded (from 1.68±0.76 to 3.96±1.30%), which differs significantly increasing in summer season. The obtained results indicate that continuous accumulation of nutrients in the bottom sediment system, which is associated with the sedimentation of suspended solids carried by agriculture run off.

CONCLUSION:

The Gudavi wetland located in a natural forest area is surrounded by agriculture activities. The physicochemical properties of water indicate acidic pH, high TDS and rich in nitrates and phosphates. Similarly sediment pH also acidic in nature, organic carbon, nitrogen, phosphorus also shows increasing trend during February and April. Gudavi wetland is a good habitat for birds due to rich growth of aquatic fauna and flora, Thus care must be taken not to destroy the natural ecosystem and disturb the ecological balance by huge agricultural development in this area. Finally, it is imperative that efforts must be taken to develop ecosystem-based management strategies with inputs from scientists, resource managers, policy makers, government and non-government organizations and other stakeholders, with the objectives of enhancing production, maintaining biodiversity in a sustainable manner and improving the Gudavi bird sanctuary as an internationally recognized wetland area.

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