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EUTROPHICATION ASSESSMENT OF THE KELEGERI LAKE USING GIS TECHNIQUE

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Abstract - *Water is one of the most precious resources necessary for the survival of all living organisms. Due to rapid use of chemicals and fertilizers in agricultural, discharge of sewage and domestic activities in and around the lake decreases the water quality of lake. The study was carried out on the assessment of trophic state of Kelegeri Lake by using GIS technique. A representation of the spatial distribution was developed using inverse distance weighted interpolation method. The eutrophication level of the lake was determined with the help of Carlson's scale. Based on trophic state index calculations and spatial distribution by Geographic information system technique. The lake was found to be in oligotrophic condition in February and April, mesotrophic condition in March. In the study period, the lake was found to be almost in moderately upper mesotrophic condition*.

Key Words: **Eutrophication**, **Geographical Information system (GIS), Trophic State Index (TSI), Spatial distribution, Ecosystem.**

1. INTRODUCTION

Lakes are not only significant source of precious water but also provide valuable habitats to the biological world[2].Pollution resulting from increased human activities is threatening the lakes and its effects being characterized by serious eutrophication. The total output of the eutrophication is loading of lake with phosphate and nitrates. These 2 elements basically increase the fertility of lake water and lead to growth of water hyacinth and floating micro algae. Eutrophication refers to continuous enrichment of water by addition of substances that provide for the increasing growth of aquatic life. Eutrophication is the process of enhanced trophic status due to increased nutrient inputs[3].The recent issue of " The Water Wheel"(water research commission of south Africa 2008) reported that 54% lakes and reservoirs in Asia are impaired by Eutrophication. In Europe it is about 53%, In North America it is about 48%, In South America it is about 41%,and in Africa it is about 28% [23]. Water eutrophication breaks the equilibrium of aquatic ecosystem and gradually leads to the damage of water ecosystem and degeneration of its functions. It also affects the water quality and transparency of water. Water eutrophication breaks the equilibrium of flu aquatic ecosystem and gradually leads to be damage of water ecosystem and degeneration of its functions. It also affects the water quality and transparency of water. The aim of the study is to analyse eutrophic status of the lake by calculating trophic state index by identifying the physico-chemical characteristics of the lake water and estimation of rate of eutrophication along with creation of spatial variations using Geographic Information System technique.

1.1 SCOPE OF PRESENT STUDY

The water is the most fundamental element of all living organisms. Due to reckless use of chemicals in the agricultural fields and in daily activities. Phosphorous and nitrogen is the main chemical responsible for the water quality degradation. So the study of some of the physico – chemical parameters of the lake to consider whether this can be used for drinking purpose are not. The application of Carlson's trophic state index for the lake under study to categorize the lake for its trophical status. The use of GIS in every field is increasing day by day so the application of GIS knowledge in analyzing the trophic condition of the of the lake. The spatial variation of the lake physico chemical parameters can be easily plotted by using GIS software. This study also insists upon the nutrient concentration in the lake.

1.2 OBJECTIVES

The main objective of the study is to analyse eutrophic status of the lake by calculating trophic state index by identifying the physico-chemical characteristics of the lake water and estimation of rate of eutrophication along with creation of spatial variations using Geographic Information System technique.

The specific objectives are;

- To know the physico – chemical characteristics of the lake water.
- To know the nutrients level in the lake
- To classify the lake using Carlson's trophic state index
- To study the application of GIS in anaysing the trophic status of the lake.

2. MATERIALS AND METHODOLOGY

2.1 STUDY AREA AND THE SAMPLING LOCATIONS

Dharwad district with on area of 4263km2 (15º 17' N 75º 3' E) is situated on the edge of Western Ghats. It is an average altitude of 750meters above the sea level. The kelegeri lake (fig2.1) which was constructed by Sir M.Vishweshwaraiah in march 1911 is geographically located at latitude 15º27'N & longitude 15º27'E. The catchment area of the lake is 6.36sq miles and the lake lies on the outskirts of the city. This lake was owned by Dharwad agricultural university this was one of the drinking water supply source to the Dharwad city at one point of time. The lake was getting contaminated from sewerage water, defiling by cattle and cloths washing, garbage dumping in the lake area.

To determine the variation of the physico – chemical parameters the samples were collected monthly from February 2019 to April 2019. The samples were collected in polythene bottle of 2 litre capacity at seven sampling stations in the lake and were stored in dark coloured bottles at 4ºC. The collected samples were analyzed for the water quality parameters in the laboratory. The physical parameters such as Temperature, Transparency, pH, were measured at site itself. The chemical parameters which were supposed to be like COD, BOD, DO and Nitrates and Phosphates. Considering the standard and the major methods which will taken for the examination of water and also as well as the waste water according to the American Public Health Association also known as the APHA a well known organization and American Water Works Association which is also termed as in short AWWA in the year of the 1980 as well as the Mackereth (1963) were used.

Fig 2.1 the study area and the sampling point.

Sampling stations	Lattitude	Longitude
S1	$15^0$45'53.7"N	$74^0$97'64.2"E
S2	$15^0$45'74.6"N	$74^0$97'57.5"E
S3	$15^0$45'9.6"N	$74^0$97'45.6"E
S4	$15^0$46'24"N	$74^0$97'50.6"E
S5	$15^0$46'15.7"N	$74^0$97'50.6"E
S6	$15^0$46'13.2"N	$74^0$97'13.6"E
S7	$15^0$46'01.3"N	$74^0$97'13.6"E

Table1 GPS Point Locations.

2.1 ASSESSMENT OF TROPHIC STATE INDEX

Trophic state index is a type of classification system that is used to rate bodies of water based on the nutrient level in the water body. The level of productivity in lake is measured with reference to nitrogen, phosphorous & transparency. There are 29 different methods to calculate the major Trophic State Index known as the TSI of the surface water bodies. One of the best methods among all the methods is the Carlson's Trophic State Index. The Carlson's trophic state index has scale of 0-100 and the scale divides the trophic state of the lake as

Scale	Trophic levels
0-30	Oligotrophic
30-40	Lower mesotrophic
40- 50	Mesotrophic
50-60	upper mesotrophic
60-70	Eutrophic
70-80	Hyper eutrophic
80-100	Extremely hyper eutrophic

Table 2.1 Classification of trophic levels

Carlson's trophic state index can be calculated using the below equations

1. TSI for SD (Secchi Depth) in meter

$$60 - 14.41\ln(SD)$$

2. TSI for TP (total phosphorous) in mg/l

$$14.42 \ln (TP) + 4.15$$

3. TSI for TN (total nitrogen) in mg/ l

$$54.45 + 14.43\ln (TN)$$

3. RESULTS AND DISCUSSION

The basic parameters which shows the contamination level and the nutrient level in the lake are measured and the variations are are plotted in the form of graphs. The parameters and the variation of each parameter were discussed below. Temperature mainly influences the change in water quality and also as well as the aquatic environment. Transparency is measured in the form of turbidity. Higher the transparency higher the level of turbidity of lake. Higher turbidity affects the life indirectly by cutting the light to be utilized by the phytoplankton growth. pH is the parameter which is used to know the alkaline condition and acid base equilibrium. The main consideration of the dissolved oxygen which will be an most important source of also as important for the aquatic body and then also considering the photosynthetic process that will undergo in the green plants which will be then also known to be determining factor termed in to the water quality that will be over the surface

water ecosystem. COD is the amount of oxygen consumed for the degradation of total organic load include biodegradable and non-biodegradable organic matter which will be under the using strong which is and chemical oxidant likewise also taking the potassium dichromate by acidic conditions. It is the amount of oxygen utilized for biological oxidation of organic matter under aerobic condition for a period of 5 days at 20ºC. the major values of the demand for oxygen is and the important factors of the proportional to the amount which will be of organic waste to be that will be going to be considered in the degraded by aerobically. Phosphorous is the main constituent for the eutrophication of the fresh water resources. The total phosphorous is essential for the advance of bacilli and it is a comestible that banned the primary abundance of the lake water. Inorganic phosphorous plays a activating role in amphibian ecosystem and it present in low concentrations. The main sources for the phosphorous input to the lake is agricultural runoff. In the present study the phosphorous is less in quantity but this less amount of phosphorous will be leading to great effect of eutrophication. The nitrogen is present in the atmosphere is converted nitrite and nitrate required for the plants is provided by nitrogen fixation by some micro – organisms and some aquatic plants

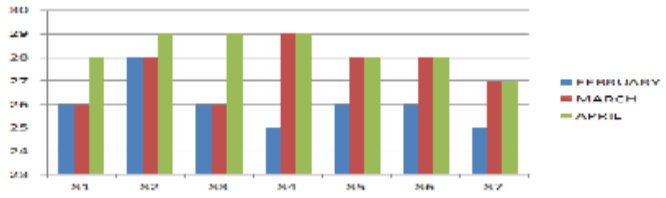

Fig 1 shows the variation of temperature at site

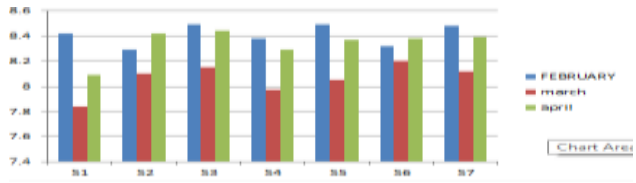

Fig 2 shows the variation of pH at site

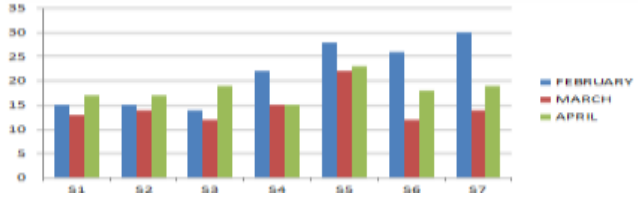

Fig 3 varaiation of the turbidity

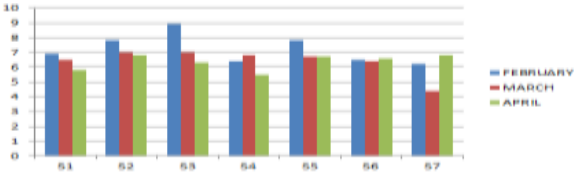

Fig 4shows the varaition of DO

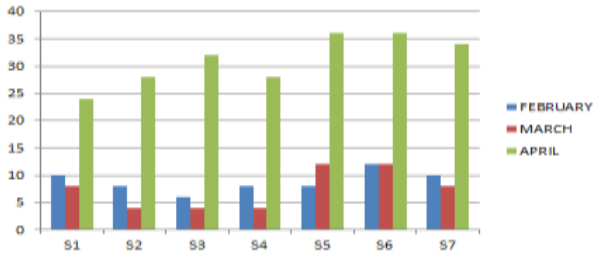

Fig 5 shows the variation of COD

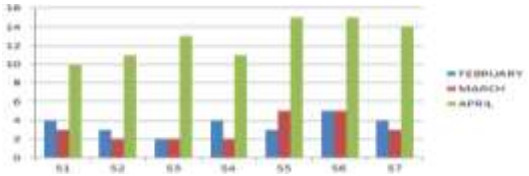

Fig 6 shows the varaition of BOD

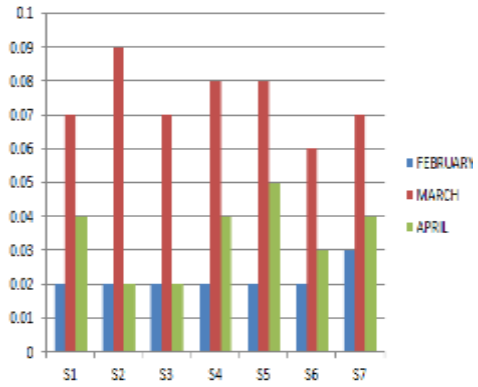

Fig 7 shows the variation of total phosphorous

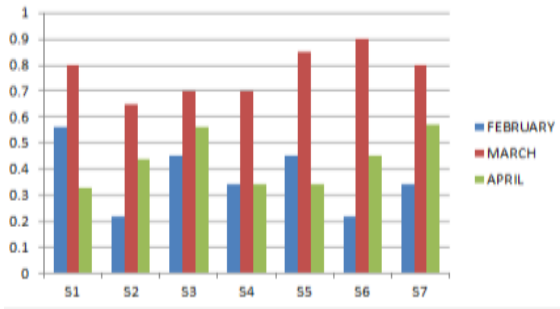

Fig 8 shows the variation of total Nitrogen

3.1 SPATIAL ANALYSIS OF THE RESULTS

The variation of the parameters that are responsible for the process of eutrophication are considered and the thematic maps were generated. These thematic maps provide the spatial distribution of the data. The thematic maps shows the concentration of the parameter at particular station. In this study we have considered only the nitrogen, phosphorous and secchi depth for the calculation of Carlson's trophic state index and the distribution of the same for the 3 months during the study period. The concentration of the nitrogen is

higher compared to the concentration of phosphorous in the lake. The secchi depth is measured to know the transparency and it is found to be almost uniform in the lake. The thematic maps of the parameters were represented in the form of maps are shown in the following figures

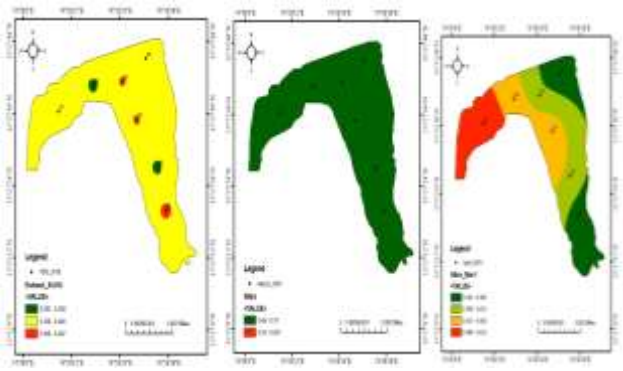

Fig 3.1.1 spatial variation of the total nitrogen during the 3 months

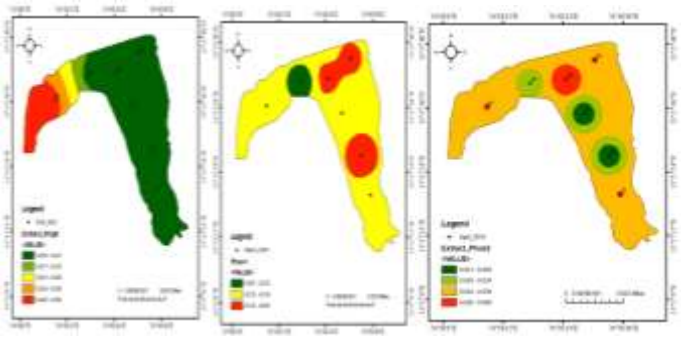

Fig 3.1.2 spatial variation of the total phosphorous during the 3 months.

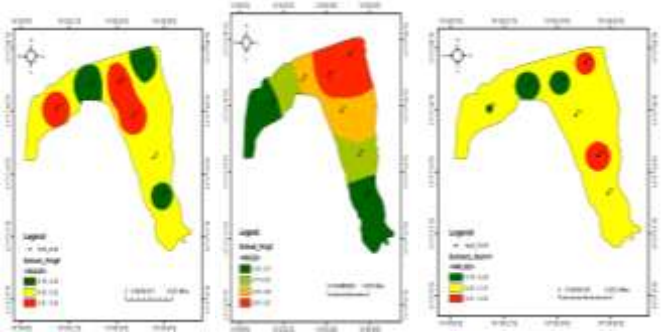

Fig 3.1.3 spatial variation of the secchi depth during the 3 months

3. CONCLUSIONS

The following are some of the concluding points

- Based on the Carlson's TSI calculations the kelegeri lake has been classified in the mesotrophic condition
- By analyzing the physico – chemical parameters it can be concluded that the lake is polluted due to agricultural run-off and the domestic activities in and around the lake.
- Based on the analysis of DO level at different points of the lake ,the DO is found to be good for the aquatic life to survive
- The algal growth is increasing day-by –day and aesthetic appearance of the Kelegeri Lake is reducing.
- Due to higher level of turbidity of water and runoff from agricultural sediments the water holding capacity of the lake is decreased.
- The GIS manages the spatial and attribute data in addition to manipulate and display the results of the TSI calculations.

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