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Anthropogenic Activity-Induced Water Quality Degradation in Girital Lake, Uttarakhand

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Abstract - *Girital Lake is situated in the district of Kashipur, Uttarakhand. Few decades back, Girital lake was a pilgrimage place and was generally full of tourist and visitors. It was a beautiful location and an important source of water for domestic uses. Due to anthropogenic activities in the surroundings areas of this lake, the water quality has severely affected. Also, water spread area of this lake has great fluctuations. Five sample locations in Girital lake has been marked and water quality of these samples were tested laboratorially. The results suggested that the pH values, Electrical conductivity (EC), turbidity, Nitrate and phosphate concentration were far more than the permissible limits of EPA and CPCP. Due to high concentration of nitrate and phosphate, eutrophication has taken place. Water hyacinth, a aquatic weed has covered the length and breadth of Girital lake.*

Key Words: **Girital lake, water spread mapping, water quality, aquatic weed**

1. INTRODUCTION

In Indian civilization, lakes and rivers have great importance in terms of water uses and also a source of cultural thinking. These lakes and rivers supply water both in rural and urban areas. The water quality of lakes and rivers is generally influenced by the human induced agricultural as well as industrial activities. The consequence is that most lakes and reservoirs in various part of India and the world have varying degrees of environmental degradation. In general, lakes serve the purpose of water demand for agriculture and domestic water supply in developing towns and cities. Due to increasing population close to lakes, the waste water after domestic uses flow towards the lakes. This is one of the major reasons behind the pollution of lakes. Due to anthropogenic activities, water qualities of water body is continuously exceeding the permissible limits ([1], [2],[3],[4],[5]).

Pollutants may enter into lakes through fixed point sources. Due to use of cosmetics, pharmaceutical products, domestic wastewater contain nutrients and toxic organic and inorganic pollutants. Also industrial effluents are continuously have a outflow in rivers or lakes ([6],[7],[8]). Pollutants may also enter in lakes through non-point sources. Due to excessive use of fertilizers in agricultural fields, through agriculture runoff and contamination percolation, pollution in rivers is increasing. Due to human settlements along the periphery of the lakes and reservoirs, the contamination is increasing in water bodies ([9],[10]). Due to excessive use of pharmaceutical products now a days, its excessive concentration is also observed in water sources such as lake, river and also in groundwater ([11]; [12]). [13] studied on seasonal nutrient enrichment in lake. Due to increase in concentration of heavy metals such as lead, chromium, mercury etc. in water bodies, chronic poisoning in aquatic animals has been observed. Also, harmful algal blooms were becoming increasingly common in freshwater ecosystems globally. [14] studied water quality parameters of Shahpura lake of Bhopal, India. The results suggested that the lake was highly eutrophic. The phosphate concentration of the lake water studied was found in the range of 6.05 to 9.21 ppm. The nitrate content of the water was found to be in the range 2.02 to 15.22 ppm. [15] studied water and sediment chemistry of the Nainital, Bhimtal, Naukuchiyatal and Sattal Lakes of Kumaun. The results from this study suggested that the water of these lakes are alkaline and that electrical conductivity, total dissolved solid and bicarbonate were much higher in Nainital than in the other three lakes. [16] Investigated on the concentrations of three heavy metals chromium, cadmium, lead in water, sediment and green algae which were collected from six different stations at Pulicat lake, which received effluents from industries located in North Chennai coastal region. The results suggested that concentrations of Cadmium (Cd) and Chromium (Cr) were found to be high in sediment. [17] has studied and analyzed various physicochemical parameters of water quality of Triveni Lake, Maharashtra, for the period of one year during December 2010 to November 2011. Physicochemical parameters were studied. The results revealed that there was significant seasonal variation in some physicochemical parameters. The

objective of this study is to assess the variation of water spread area of Girital lake, kashipur, Uttarakhand and water quality assessment of Girital Lake.

2. Materials and Methods

2.1 Study Area Description

In the present study, Girital lake of Kashipur, Udham Singh Nagar, Uttarakhand has been selected for water quality analysis. Near this lake there are three famous temples, namely, Chamunda, Santoshimata and Mansa Devi. The Girital Lake is one of the famous lake in kashipur. In the past few years, due to excessive layout of built up area, the water quality has sharply affected in adverse way. Nearby houses daily dump impure water in the lake. The lake is full of weed and it also spread bad smell in the surroundings. In this study, by studying the water spread area of water and water quality analysis, the extent of problem has been tried to visualize.

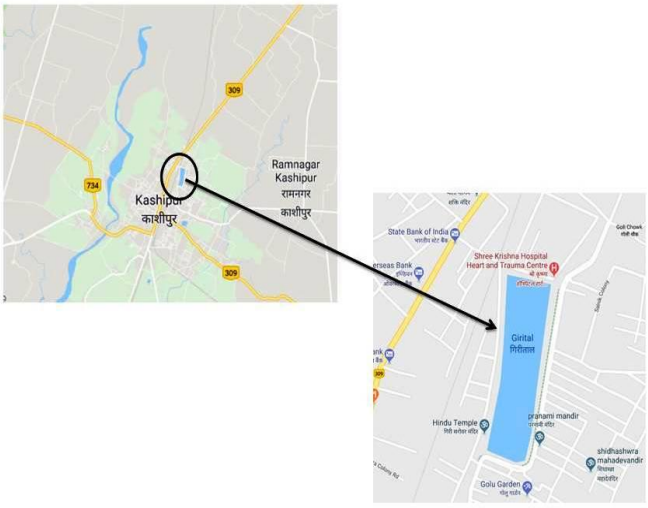

Chart -1: Locational Map of Girital Lake

2.2 Instruments Used for Water Quality

Table 1 depict the instruments used for water quality analysis. Multimeter and spectrophotometer has been used for analysis of selected water quality parameter.

Table -1: Instruments for water quality analysis

S. No.	Water Parameters	Instrument Used
1	pH, Electrical conductivity (EC), turbidity, total alkalinity and total hardness	Multimeter
2	Nitrate, phosphate, chlorine	Spectrophotometer

The samples for water quality assessment has been collected from selected locations as shown in Chart 2. The sample locations has been marked as S1, S2, S3, S4 and S5 whose coordinates were 29°13' 8.81'' N, 78° 58' 9.10'' E; 29°13' 16.28'' N, 78° 58' 11.27'' E; 29°13' 51.21'' N, 78° 58' 14.22'' E; 29°13' 9.78'' N, 78° 58' 13.56'' E and 29°13' 4.39'' N, 78° 58' 9.64'' E respectively.

Chart -2: Sampling Locations at Girital Lake, Kasipur

3. Results and Discussion

For studying the water spread area, the images acquired on the platform of Google Earth has been used in this study. The images acquired and analysed were for the dates of 05/10/2013, 15/12/2014, 15/12/2015, 09/10/2016 and 15/12/2017 (Date/month/Year). The tools available for the analysis are taken from the same platform. The water

spread area has been shown in Table 2. From Table 2, it can be depicted that water spread area for this lake was maximum in the October month of 2016, while it was minimum for the month of December 2014. No fixed pattern of variations of the water spread area has been observed, since the water spread area depends on the rainfall pattern of this area. As compared to December 2016, there was 22.6 % decrease of water spread area on December 2017. The average water spread area for the periods shown in Table 2 was 37043.4 m^2. The demarcation of water spread area for the Girital Lake is shown in Chart 3. The images have been collected from Google earth.

Table -2: Water Spread Area of Girital Lake on Various Periods

Date of Image Acquisition	Perimeter of water Spread(m)	Area of water spread (m^2)
05/10/2013	994	37778
15/12/2014	900	28998
15/12/2015	958	36245
09/10/2016	1041	46081
15/12/2017	913	36115

For water quality assessment, various parameters has been tested in laboratory and its results are shown in Table 3. As per EPA water quality criteria for fresh water lake, the pH values should have a range of 6.5 to 8. It has been found that at locations S1, S2, S3 and S5, pH value was greater than 8 which was more than the permissible limits. As per EPA standards, Electrical conductivity (EC) of freshwater should be usually between 0 and 1,500 µS/cm. It is clear from Table 3 that EC values were far more than the permissible limit. The EC values in the sample locations were about 440% more than the maximum permissible limit. As per drinking water standards of CPCB (Central Pollution control Board), the turbidity should be less than 5 NPU. The turbidity of Giritl Lake is shown in Table 3 for all sampled locations. At all sampled locations at Girital Lake, the turbidity was more than permissible limit. Hence, the water can't be used for drinking purposes. Alkalinity varies greatly due to differences in geology; there aren't general standards for alkalinity. Levels of 20-200 mg/L are typical values for fresh water. The total alkalinity at different locations at Girital lake is shown in Table 3. The alkalinity were well within permissible limits.

The permissible limit for Nitrate concentration in fresh water lake as per EPA standard should be less than 10 ppm. But, from Table 3, it could be depicted that the concentration of nitrate was greater than permissible limit. High level of nitrate has increased the eutrophication process in the lake and has also increased the algal and weed population in the lake. The permissible limit for phosphate concentration in fresh water lake as per EPA standard should be less than 0.05 ppm. But, from Table 3, it can be depicted that concentration of phosphate was greater than permissible limit. Due to high level of phosphate, eutrophication process in the lake has increased tremendously.

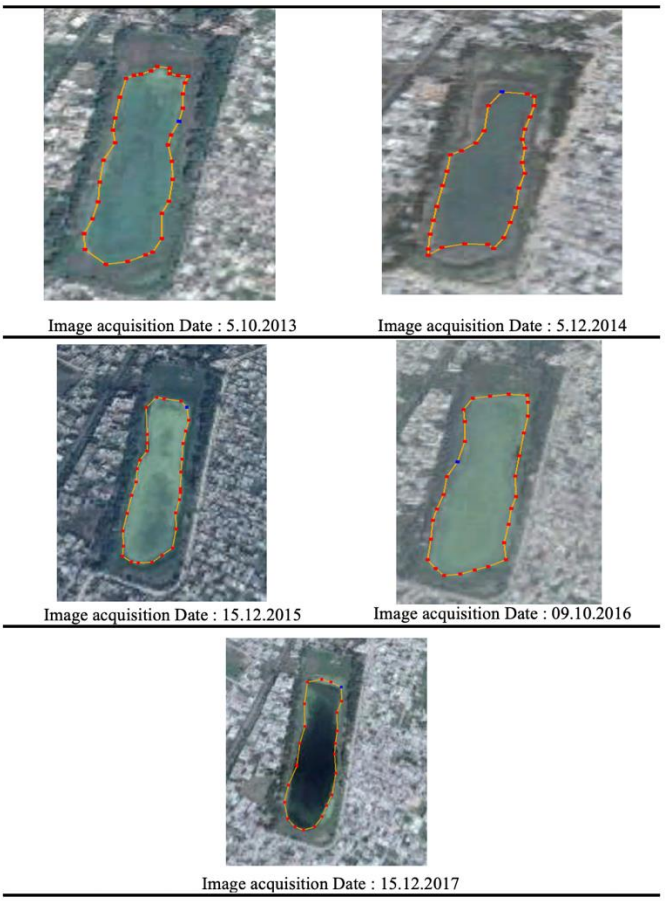

Chart -3: Google earth Image of water spread area of Girital Lake for various periods

Due to presence of high concentration of phosphate and nitrate in Girital Lake, eutrophication has taken

place. The weed present in excess amount in this lake is shown in Chart 4. The weed is commonly known as water hyacinth. Its Kingdom is *Plantae*, Family is *Pontederiaceae*, Genus is *Eichhornia* and Species is *Eichhornia crassipes*.

Table -3: Water Quality at sampled locations of Girital lake

Sl. No	Samples Location	pH	EC (µs/cm)	Turbidity (ntu)	Total Alkalinity (ppm)	Nitrate (ppm)	Phosphate (ppm)	Chlorine (ppm)
1	S1	8.23	6578	6.3	138	73	53.5	12.4
2	S2	8.1	6324	6.5	142	69	48	12
3	S3	8.12	6412	6.5	140	65	45	14.1
4	S4	7.9	6120	6	140	70	44.7	10
5	S5	8.33	6469	6.3	145	72	45	11.6

Water hyacinth is a free-floating perennial aquatic plant (or hydrophyte) native to tropical and sub-tropical South America. With broad, thick, glossy, ovate leaves, water hyacinth may rise above the surface of the water as much as 1 meter in height. The Girital lake was full of water hyacinth.

Chart -4: Water hyacinth weed in Girital lake

4. CONCLUSION

In this study, water quality assessment of Girital Lake which is situated Kashipur, Uttarakhand has been done. Due to anthropogenic activities in the surroundings areas of this lake, the water quality has severely affected. A study on the water spread area of this lake has also been done by using google earth images. Five sample locations in Girital lake has been marked and water quality of these samples were tested laboratorially. The avarage values of water quality parameters suggested that pH values, Electrical conductivity (EC), turbidity, Nitrate and phosphate concentration were far more than the permissible limits of EPA and CPCP. Water hyacinth was also covered the Girital lake and it has mainly due to eutrophication.

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