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Biological assessment, Interpolation and Land use and Land cover changes : A case study of Ana Sagar Lake, Ajmer, Rajasthan, India.

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ABSTRACT

A lake can be adjectively stated as lentic. It is characterized by standing and calm water. The depth of the water reduces the movement of its constituents. This property of lake makes their strata clear. This paper focuses on the Ana Sagar lake of Ajmer district of Rajasthan in India. The lake has been reported of several events of dying of fishes. The paper concentrates on the biological assessment of the water. The parameter tested is total coliform count. Continuous disposal of 9 sewage lineshave been reported in the lake. The Water samples have been collected from 10 sampled sites and is tested for total coliform count. The intestinal tract of humans contains a massive population of rod-shaped bacteria which is collectively known as coliform bacteriaThe lake's total coliform count ranges from 76 cfu/ml to 314 cfu/ml. The lake has experienced an increase in its area from the year 1997 to 2018. The sewage disposal has continuously increased its area. The land use and land cover analysis of its 2 km buffer depicts a massive change in the landscape, creating an impact on the water quality.

KEYWORDS: Lake, total coliform count, faecal contamination, land use, Buffer

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INTRODUCTION

Water quality reflects the composition of water as affected by nature and human activities, which are expressed in terms of measurable quantities or narrative statements. The water quality is related to intended water use. For each use water quality may have different parameter. The pollution of water sources can be of two types, one is Human alteration i.e., alteration in the status of water body downgrading its integrity, the second is addition of allochthonous, originating from outside of the water body. Novotony, 2003. Activities in the catchment of the lake often cause the disposal of nutrients in the lake which causes intensification of the degradatrion process.Haack.et.al, 2003.Total coliform are the indicator organisms for the degree of pollution and also its sanitary quality. The sources of pathogens in the water are improperly treated sewage discharges, leaching of animal manure, domestic waste and lastly their runoff in the lakes or streams through precipitation. The discharge of wastewater from municipal sewers is one of the most important sources of coliform in the water. As per WHO 1973 standards in the 90% of the samples tested the coliform bacteria should be absent or MPN should be <1/100 ml and in addition to this, no sample should have coliform MPN greater than 10/100 ml. As per the Indian standards 1983, throughout any year 95% of samples should not contain any coliform organisms in 100ml and no sample should containE.coli in 100 ml. Maithi, 2011.

Coliform count is the indicator organism for drinking water, shellfish generating areas, agricultural irrigation, waste water effluent disinfection, saltwater recreation. The organism EschorichiaColi(E Coli) is found in the faeces of warm blooded animals is the indicator for total coliform test. These are more representative of faecal contamination.The faecal pollution introduces variety of intestinal pathogens.Dangi.et.al, 2017.Gopal.et.alin their work on evidence based holistic restoration of lake anasagar stated that nearly 11 nallas are depositing their sewage in the lake, namely Kazikanallah, Christianganj Nallah-1,Christianganj Nallah-2, ShantiperaNallah, AntendNallah(near old mittal hospital),ChaurasiawasNallah(Near new mittal hospital), Bandi River Nallah, Ram Nagar Nallah, Mahaveer colony Nallah, NagfaniNallah(Near Jain mandir), Nalla near Maheshwari Public School. The other causes of the water quality degradation are the attraction due to main tourist destination, Nearby food courts generating garbage and organic wastes, Encroachment in peripheral parts, Reduction of rainwater runoff and shrinkage, Input of detergents – cloth washing and bathing providing phosphorus to lake water responsible for eutrophication, Discharge of residual pesticides and fertilizers in the cultivation of *TrapaBispinasa*. The latitudinal and longitudinal extent of the lake is 26□27′ to 26□29′N and 74□36′ to74□37′E. it's an artificial lake built by *Anaji of Chauhan dynasty* during 1135-1150 A.D. It was once a source of water supply to Ajmer. The piped supply

started in 1884 to then population of 50,000. The lake has the catchment area of 1.99 km^2 and circumference of 12.88 km and is situated at an altitude of 491.44 meters above mean sea level.

EXPERIMENTAL SECTION

Total coliform count-The sampling techniques used is purposive random sampling concentrating on areas facing more tourist concentrations. Water is collected from 0.5 m below the surface at 10 sampled sites in sterilized bottles of glass or plastic of 250 ml capacity. The sample is then dechlorinated and further tested by most probable number test.

Interpolation- A point file is generated in Arc GIS 10.5 which is attributed with the values of total coliform count. The results are interpolated with the help of Arc GIS software through Indicator kriging and Inverse distance weightage method. Among the types of interpolation Kriging provides solution to the problem of estimation based on a continuous model among the stochastic ones. This technique makes the best use of existing knowledge by taking in account of the way a property varies in space. A kriged estimate at a place is simply a linear sum or weighed average of the data in the neighbourhood. The weights are allocated to the sample data of the points or the block in such a way to minimize the estimation. Kriging is most optimal in this sense Webster & Oliver 2007[6]. The IDW (inverse distance weighted) and Spline interpolation are deterministic interpolation methods because they based on specific mathematical formula that determines the smoothness of resulting surface. Such as geostatistical method Kriging based on the statistical method that includes autocorrelation among the measured point and it provides the accuracy of prediction.

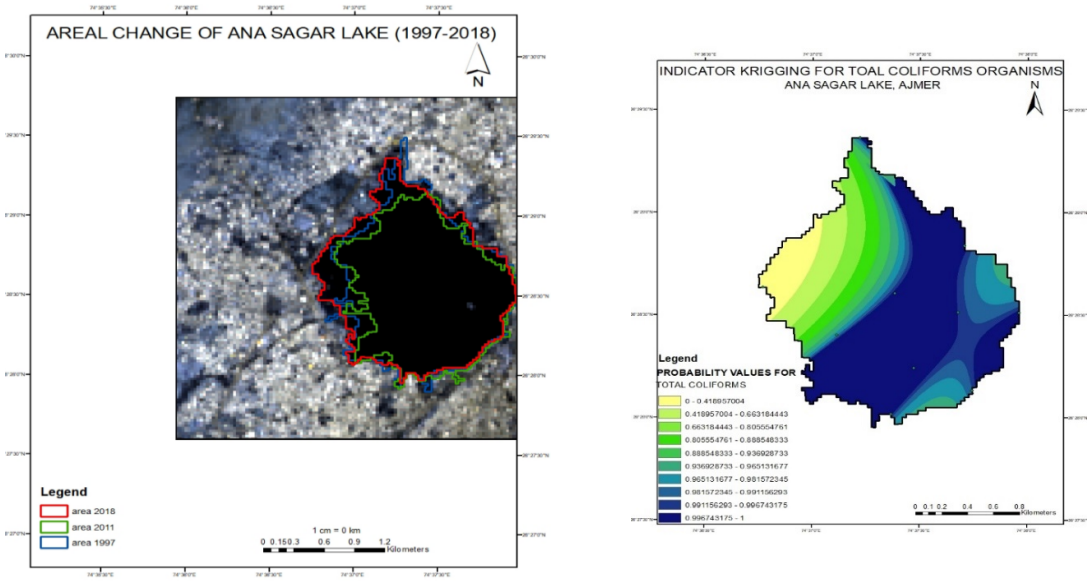
Areal change of lake and land use and landcover change analysis- the lake was digitized on the scale of 1:500 for the year 1997, 2011, 2018. The satellite images were of 30 x 30 resolution downloaded from earth explorer. A buffer of 2 km is created in arc GIS to indicate the land use change around the lake from the year 1997 to 2018. A subset is created for the buffer for two years 1997 2018 on LANDSAT data of United states geological survey. Supervised classification is used to create land use and land cover maps.

RESULTS AND DISCUSSIONS

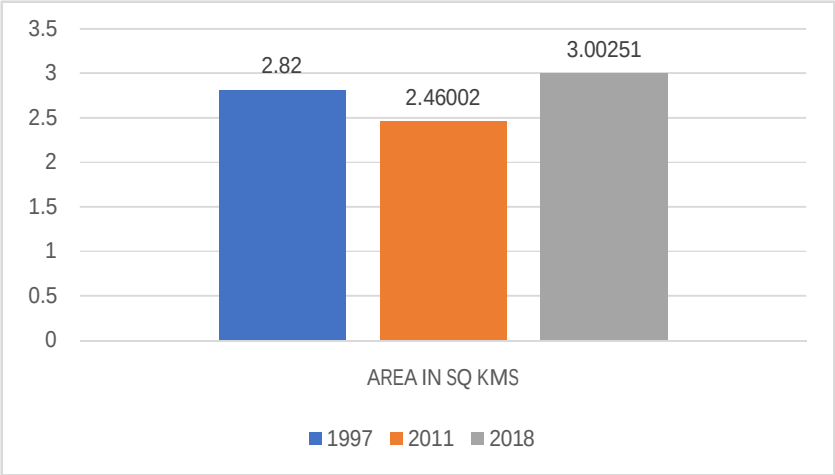
Areal change in the lake-

The image has been digitized on the scale of 1:500 for the year 1997, 2011,2018. The area of the lake was 2.82 km^2 in 1987 and then it decreased to 2.46 km^2 in 2011 and further increased to 2.87 km^2 in 2018. The increase in the area of the lake indicates the continuous disposal of the sewage.

This is rectified through the total coliform test of the lake water.



1.Areal Changeof Ana Sagar Lake (1997-2018)



2. Areal Change Of Ana Sagar Lake, Ajmer, Rajasthan (1997-2018)

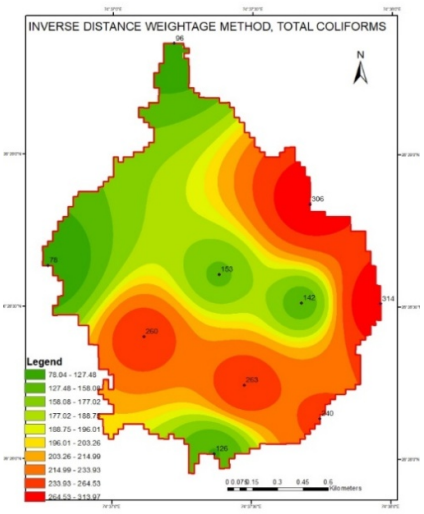
Total coliform count-

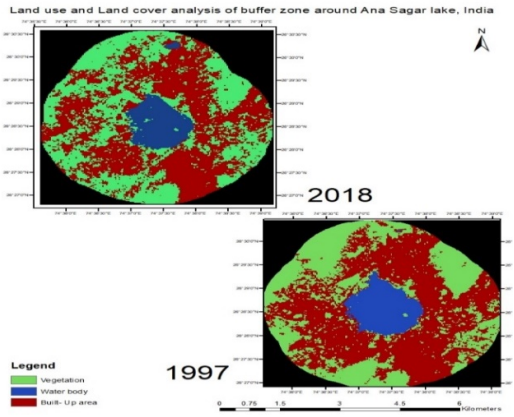
The total coliform count varies from 78 cfu/ml to 340 cfu/ ml, indicating a range of 236 cfu/ml. the eastern portion of the lake shows more coliform count due to numerous drains present. The western portion is more hill locked so the coliform count appears less. According to central pollution control board India, Class B category of water must have 5 most probable number. Fig 4 shows the interpolation of the total coliform through indicator kriging,

where 0 depicts the absence and 1 represents the presence of any phenomenon.

3. Interpolation through

IDW method, Ana Sagar Lake, Ajmer





4.Indicator kriging for Total Coliform Organism, Ana Sagar Lake, Ajmer

Land Use and Land cover change in the Lake buffer-

The supervised classification for both the years 1997 and 2018 shows a decline in the vegetation and water body and further increase in the settlement. Although Ana Sagarlake has experienced an increase in its area but the buffer also includes FatehSagar lake, hence concluding the overall decline in terms of the water body.

1.Land use and Land Cover change(1997-2018)

S.no	Type	1997 AREA(in km^2)	2018 AREA(in km^2)
1	Vegetation	13.57	11.65
2	Water body	3.83	3.12
3	Built-up area	14.99	17.87

5. S5.Supervised Classification-Land use and Land Cover change(1997-2018)

CONCLUSIONS

The image has been digitized on the scale of 1:500 for the year 1997, 2011,2018. The area of the lake was 2.82 km^2in 1987 and then it decreases to 2.46 km^2 in 2011 and further increased to 3.00 km^2in 2018.

The mean of total coliform count is 181.2 cfu/ml. Bacteriological analysis of the lake waters indicated that water was polluted by faecal contaminants to the extent that they were unpotable for drinking purposes and unsuitable for recreational activity. The land use and land cover analysis of

the buffer around the leave conclusions of a decrease in the area under vegetation from 13.57 km^2 to 11.65 km^2, decline in the area under water body from 3.83 km^2 to 2.87$km^2$and increase in the built-up area from 14.99 km^2 to 17.99 km^2.

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