Water Quality Assessment through GIS: A Case Study of Sukhna Lake, Chandigarh, India

Kaiser Manzoor[1], Pushkar Raj[2], Rohit Sheoran[3], Swastik Dey[4], Er. Jotesh Gupta[5], Dr. Bushra Zaman[6], Dr. Chhotu Rao[7]

[1,2,3,4] *Students, Dept. of Civil Engineering, MM University, Sadopur, Ambala.*
[5] *Assistant Professors, Dept. of Civil Engineering MM University, Sadopur, Ambala.*
[6] *Adjunct Professor, Utah State University, Logan, Utah, USA.*

Abstract - *The Sukhna Lake of Chandigarh City is a delightful artificial lake but now is fighting for survival. The water quality has become critical for flora and fauna of Sukhna Lake. Stream of sewage from close-by towns (Kansal) in the catchment is the primary reason for low water quality of the lake. The investigation was done out to assess the water quality of Sukhna Lake. Topographic sheets from Survey of India and ArcGIS 10.4 software was used for making interpolated maps. Water samples were gathered from eight different locations across Sukhna Lake in month of Sept 2017. Water samples inspected for physicochemical parameters, for example, pH, temperature, TDS, Total Suspended Solid (TSS), Phosphorous, BOD, Nitrate Dioxide, Dissolve Oxygen, and COD. The estimations of a large portion of the perimeters were less than limits set by Central Pollution Control Board (CPCB) and BIS limits for a freshwater lake reasonable for delight exercises and development of fisheries and natural life.*

Key Words: **Sukhna, Physicochemical Parameters, ArcGIS**

1. INTRODUCTION

1.1 General Introduction

A lake is an area packed with water, localized in a valley, which is neighboring by land, apart from any natural drainage. Wholesome lakes and their shores not only provide us with a number of environmental advantages but they influence our quality of life. Lakes are also used as to recharge groundwater and protect the biodiversity and ecosystem of the area. Religion in India is an indispensable aspect. Similarly, the lakes in India are considered religiously important. The multiple geographical structure and huge river line forms innumerable lakes in the country. Throughout, some of them are artificial, but they are transcended and many of the natural lakes are in purity and attractiveness. Rajasthan and Himachal Pradesh which are North-Western state and Northern state of India are doubtless in cover of larger number of lakes throughout the country.

1.2 Sukhna Introduction

Sukhna Lake is a wonderful lake which lies in the foothills of Shiwalik hills in the north-east corner of UT, Chandigarh. The remarkable thing about Sukhna is that it is artificial lake. The founders of Chandigarh have offered this lovely lake to the residents of the new city with the goal that they may get away from the monotonous of the city life and appreciate the excellence of nature in peace and silence. It is a 3-km long lake that was built in the year 1958. It was finished by constructing the Sukhna Choe, which a non-perpetual stream which is streaming down from the Shiwalik slopes. The lake is 1.52 km in length and 1.49 km wide. Sukhna lake water is contributed by two occasional tributaries Kansal and Saketri. After finish in 1958, the watershed area of the lake was 188 hac and the average depth was 15.38 feet which has been reduced to the depth of to 8.5 feet due to heavy siltation.

Source: www.tripadvisor.in
Fig -1: Sukhna Lake

2. Objective and Scope

The objective is to examine the Sukhna Lake in present condition on the basis of its water quality. In this we have to collect water samples of Sukhna Lake from different location throughout the lake. We examine the sample on the basis of different parameter of water quality with the help of physical chemical and biological test and compare the resultant parameter with the standard limits of lake water.

Scope**:** Water quality management is for good cause, controlled by approval of releases of unsafe substances for which checking of discharge, effluents and affected surface water. Water quality observing of existing water quality is

evaluated and compared with the standard quality limits and gaps are distinguished. On the basis of the distinguished gaps the water body or its part is categorized as moderately or highly polluted.

3. Material and Methodology

3.1 Water sampling sites

Eight sites were selected in Sukhna Lake to cover the maximum area. The eight sites were named as sampling site 1, 2, 3 , 4, 5 ,6, 7 & 8. The fig.-2 below shows the sampling sites location in Sukhna Lake.

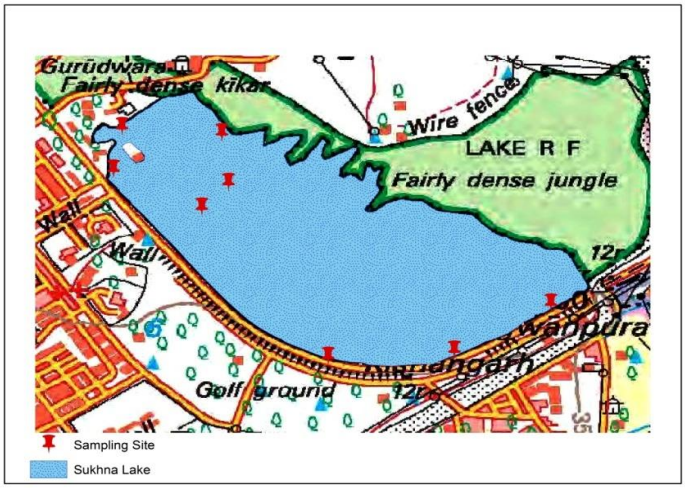

Fig -2: Sampling locations

3.2 Collection of water samples

Water samples were gathered from the inspecting destinations in the month of September. 2-liter plastic sterile containers were utilized for gathering the samples. BOD bottles were used for taking water sample for biological perimeter testing. Samples were taken from a depth of 30 cm underneath the water surface using water bottles. Bottles were tightly packed so no air pockets can happen inside the container.

3.3 Analysis of Physicochemical perimeters

The temperature of surface water for all sites was recorded on their separate spots while sample gathering with a thermometer. pH of water tests was measured utilizing a pH meter adjusted promptly in the wake of conveying the water samples to the laboratory. The colour of water tests was checked with bare eyes. TDS were investigated by Gravimetric technique. DO was measured by Winkler' method. BOD was figured by 5-day BOD test. COD of water was measured by potassium dichromate test

3.4 Analysis of Bacteriological perimeters

After conveying the water samples to the laboratory, total count as colony forming units per milliliter of bacteria was analyzed by Membrane filtration method. Bacteriological water investigation is a method for analyzing water to estimate the number of microorganism's exhibit and, if necessary, to discover what kind of microorganisms are present.

3.4 ArcGIS

ArcGIS is geographic information system for working with maps and geographic information. It is utilized for making and utilizing maps, ordering geographic information, examining mapped data. The maps from SOI were first projected in GIS and the lake was digitized. Location of sampling sites and the value of perimeters was imported and interpolated by Kriging method.

4. RESULTS

The samples taken from eight different locations in Sukhna Lake were checked and the value of perimeters for physicochemical and bacteriological given in table below

Table -1: Water Quality Perimeters

Peremeters	Unit	Site 1	Site2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Odour		NO	YES	NO	NO	NO	YES	YES	YES
Temperature	ºC	29	29	29	29	29	29	29	29
Turbidity	NTU	20	15	16	17	16	18	16	17
TDS	mg/l	97	87	87	87	87	87	87	87
CaCo3	mg/l	50	40	40	40	40	40	40	40
Ca	mg/l	8	8	8	8	8	8	8	8
Mg	mg/l	7.2	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Cl	mg/l	10	10	10	10	10	10	10	10
So4	mg/l	5	5	5	5	5	5	5	5
pH	mg/l	7.2	7.1	7.1	7.1	7.1	7.1	7.1	7.1
No3	mg/l	0.07	0.06	0.06	0.05	0.06	0.05	0.06	0.05
DO	mg/l	2.2	2.5	1.8	2	2.3	2	2.7	3.2
COD	mg/l	5	10	20	20	10	12	7	7
BOD	mg/l	3	5	8	7	4	5	3	3
NO2	mg/l	3	3.33	6	2.6	3.6	7	5	2.9
Phosphorus	mg/l	1.33	0.63	0.49	0.50	0.69	0.59	0.34	0.58
Total Coliform	CFU/100 ml	400	400	400	400	400	400	400	400

The appearance of water samples taken was not clear and looks light yellowish. The odor was normal at site 1,3,4,5 but was odorous at site 2, 6, 7, 8. The temperatures were around 29°C. Average surface water temperatures for all the six sites were similar and consistent. The turbidity is between 15-20 NTU and was high at Site 1 at the front of lake where boats stands. The allowable Turbidity esteems for drinking water is around 1 mg/l (BIS 10500, 1991, specification) which suggests that water of Sukhna Lake is not potable. The U.S. Environmental Protection Agency (USEPA) has determined a turbidity limit of 5 NTU for any lake to be utilized for swimming and recreational purposes (EPA 2006). Qualities for TDS in all the six destinations were under 100mg/l, proposing that the lake goes under the class of new water lake. The TDS value was high for Site A (97mg/l). Site A is the lake front (traveler spot) and Lake club site. Sukhna Lake gets measure of sediment and disintegrated minerals from the catchment areas.

pH recorded for all the six locations were between 7.0 - 7.1. The standard of pH set by the CPCB is 6.5-8.5. The pH recorded for the lake were well inside the limits and essentially neutral to somewhat basic in nature

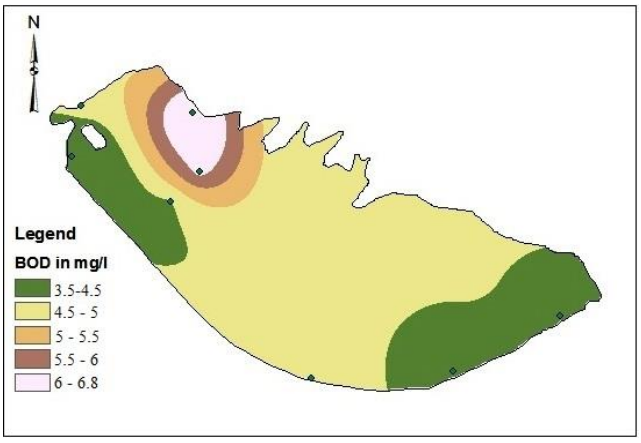

Fig -3: Map showing variation of BOD in lake

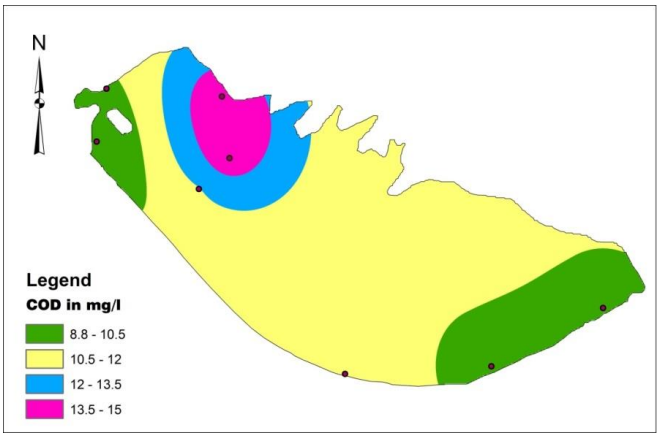

Fig -4: Map showing variation of COD in lake

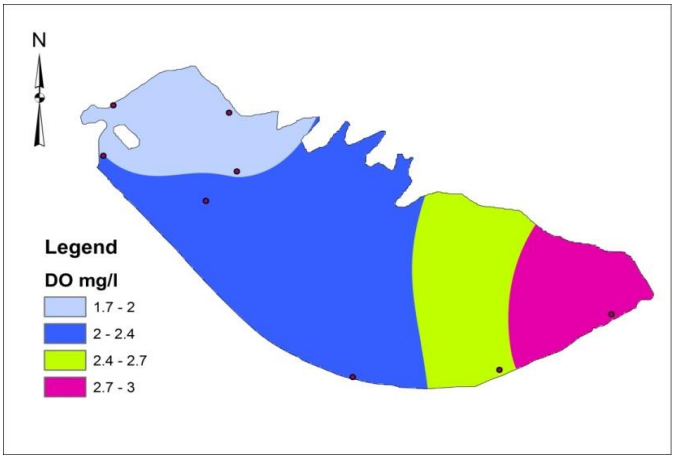

Fig -5: Map showing variation of DO in lake

BOD levels between 3-6mg/l come under the class of moderately polluted and BOD under 3mg/l is considered be relatively clean (Bharadwaj, 2005). The standard limits of BOD are 3mg/l or less for fresh water for outdoor bathing (CPCB, 2007). BOD is between 3-6mg/l except site 3 and 4 which demonstrates the lake is moderately polluted. COD values when considered alongside BOD are valuable in knowing the harmful conditions and biologically resistant organic substances. The value went from at least 7mg/l for site 7 and 8 to a highest of 20 mg/l for site 3 and 4. As per CPCB (2007) the quality criteria of fresh water for the propagation of fisheries requires the DO of water to be 4mg/l or more. Since the entire DO values are underneath 4mg/l, lake water poses danger to aquatic life in and around the lake. The reduction in DO level might be a reason for dying of fishes.

The calcium carbonate is more at Site 1 with a value of 50mg/l and same at other locations with 40mg/l value which is inside standard limits. The major ions Ca, Mg, CO3, HCO3, Cl, SO4, NO3, NO2 are inside standard limits and are same for all locations indicates water isn't greatly contaminated

Total Coliform is 400 CFU per 100 ml of water sample for all locations. The standard limit of TC are 300MNP/100 ml or less for fresh water for drinking water and under 500 MNP/100 ml for outside washing (CPCB, 2007), which indicates lake is not highly polluted

4. CONCLUSIONS

Sukhna Lake is famous as a spot for open air amusement and tourism in north India. The Chandigarh organization is spending a significant portion of the yearly spending plan on keeping it in a good condition. Because of inflow of untreated sewage from adjacent towns, basically during rainy season and disintegrated soil accompanying runoff from catchment range is dirtying the waterway. In spite of the fact that TDS, pH, major ions, TC were still in permissible limits for a Lake implied for recreational purposes but the turbidity is high

and BOD is between 3mg/l to 6mg/l and DO values are underneath 4mg/l, lake water poses danger to aquatic life in and around the lake. The decrease in DO level might be an explanation behind dying of fishes. Diverting of waste water, a long way from the lake in close-by towns or by setting up a sewage treatment plant and forcing a restriction on new improvement in the catchment range is a necessary step for keeping up the immense soundness of the water body

REFERENCES

[1] S S Shrimalil, S P Aggarwalz and J S Samral, Prioritizing erosion-prone areas in hills using remote sensing and GIS - a case study of the Sukhna Lake catchment, Northern India: JAG, Vol. 3(1),2001

[2] Singh, Y, Geo-ecology of the Trans Satluj Punjab-Haryana Siwalik Hills, NW India. Himalayan Ecology and Development: Envis Bulletin, 9(2), 2001

[3] Yadvinder Singh, Siltation Problems In Sukhna Lake In Chandigarh, Nw India And Comments On Geohydrogical Changes In The Yamuna-Satluj Region: ENVIS Bulletin: Himalayan Ecology and Development, 10(2), 2002

[4] Bhardwaj R. M. Water quality monitoring in India: achievements and constraints. (2005) Intl Work Session on Water Stats. Vienna.

[5] Central Pollution Control Board: Guidelines for water quality monitoring. (2007). MINARS/27/2007-08.

[6] Simerjit Kaur and Annamma C.I., Water quality analysis of Sukhna Lake, Chandigarh, International Journal of Advances in Engineering Research, (IJAER), 2011, Vol. 2 (3).

[7] P.Chaudhry, M.P. Sharma, R. Bhargave, S. Kumar and P.J.S.Dadhwal, Water Quality Assessment of Sukhna Lake of Chandigarh City of India, Hydro Nepal. Issue N0. 12 (2013)

[8] Siddiqui R., G. Mahmood and S.R. Ali, Analysis of sustainability of Sukhnalake and determination of hydrodynamics of Watershed of Sukhna lake with special reference to urbanization impact assessment. Intl J Innov Res Dev. 2:3, 2013

[9] JyotiDadwal, AchalBhatnagar, Sandeep Kumar, Assessment of Physicochemical and Bacteriological Parameters of Sukhna Lake in Chandigarh, India, International Journal of Science and Research (IJSR), Vol. 3 (9) 2014.

[10] YangchanJ, Jain A.K., Tiwari A.K, Sood A, Morphometric Analysis of Drainage Basin through GIS: A Case study of Sukhna Lake Watershed in Lower Shiwalik, India, IIJSER Vol. 6(2), 2015

[11] Survey of India, Chandigarh

[12] https://www.tripadvisor.in/LocationPhotoDirectLink-g297596-d1204434-i172300486-Sukhna_Lake-Chandigarh.html

[13] http://www.sunday-guardian.com/news/uk-report-finds-sukhna-highly-polluted