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Original Article

Analysis and Assessment of Land-use and Land cover and Water Quality of the Chikkamadhure Lake and Obanaikanahalli Lake using Remote Sensing and GIS, Karnataka, India

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Abstract *- For the present study, we considered the 2 Lakes such as Chikkamadhure Lake and Obanaikanahalli Lake. These are the oldest Lakes From past 1989 to the present in Bangalore rural, with their source being rainwater. Hence there is a need to study, restore and protect this Lake. The present study deals with studying and analyzing the Physico-chemical parameters of these lakes at different sampling points at different locations and land use, and Landcover changes around the lakes. The following parameters were analyzed in KSPCB Lab using different analytical methods, i.e. Turbidity, Total Dissolved solids, pH, Total hardness, chloride, calcium, fluoride, P alkalinity, Total alkalinity, Electrical conductivity, magnesium, sodium, potassium, COD, BOD, Nitrate and sulphate. And also, heavy metals are conducted, such as Nickel, cadmium, iron, lead, zinc, chromium and copper, to know the appearance of aquatic animals and plants. From the analysis, the result shows that for all the Lakes, the parameters like Turbidity, pH, Total alkalinity, Electrical conductivity, Chemical oxygen demand, P alkalinity and magnesium were well within the permissible limit. The heavy metals like Nickel, cadmium, lead, manganese, copper and chromium were below the detection level for Obanaikanahalli Lake, except the Chikkamadhure Lake has manganese (0.060mg/l). The BOD exceeded the permissible limit as per the standards; it is within 5 mg/l, so the lakes are moderately polluted. The other parameters like total hardness, chlorides, calcium, fluorides, potassium, sulphate, nitrate, total dissolved solids, zinc and iron for two lakes are not meeting the permissible standards. It was concluded that the lake water could be used for domestic purposes, irrigation and also for drinking purposes with proper treatment. The LULC changes in this presents the analysis and qualitative assessment of Bangalore rural lakes; the analysis shows that the lakes ecosystem is modernly polluted using different lulc classes. Around the lakes buffering of about 1000 m from the centre of the lakes is taken and mapped using ArcGis software and assessment on land-use and Land-cover area from 1989 to 2021, around 42 years shows that The results show that for the Obanaikanahalli Lake and Chikkamadhure Lake all the Landuse and Landcover parameters are increasing in the area, but for the Chikkamadhure Lake the water bodies are decreasing in area. In the future, Lakes ecosystem will be vigorously changed by other land-use and land cover changes, so to control this, proper remedial measures and management should be taken to safeguard the lakes.*

Keywords *- Surface water (Lake), Conductivity, Total hardness and P[H].*

1. Introduction

Water is now recognized as a fundamental right of human beings. In addition, a visual assessment of water infrastructure was also conducted to determine the condition of wells that residents use as water resources. In societies like India with developing economies, the optimum development, efficient utilization and effective management of their water resources should be the dominant strategy for economic growth. The suitability of water depends on various constituents, such as suspended particles and dissolved inorganic, organic, radiological and biological constituents.

Surface water and groundwater are both important sources of community water needs. Groundwater is a common source for single homes and small towns, and rivers and lakes are the usual sources for large cities. Although approximately 98 percent of liquid freshwater exists as groundwater, much occurs very deep. This makes pumping very expensive, preventing the full development and use of all groundwater resources.

Heavy metals can contaminate private wells through groundwater movement and surface water seepage and runoff. People that consume high levels of heavy metals risk

acute and chronic toxicity, liver, kidney, and intestinal damage, anemia, and cancer.

Surface water is any body of water above ground, including streams, rivers, lakes, wetlands, reservoirs, and creeks.

The ocean, despite being saltwater, is also considered surface water. Surface water participates in the hydrologic cycle, or water cycle movement of water to and from the Earth's surface. Precipitation and water runoff feed bodies of surface water. On the other hand, evaporation and seepage of water into the ground cause water bodies to lose water. Water that seeps deep into the ground is called groundwater. Surface water and groundwater are reservoirs that can feed into each other. Man-made surface water is found in artificial structures like dams and constructed wetlands. Since surface water is more easily accessible than groundwater, it is relied on for many human uses.

It is an important source of drinking water and is used to irrigate farmland. Wetlands with surface water are also important habitats for aquatic plants and wildlife.

Lake assessment is important as it helps determine the impact of human activities and climate change on surface water availability. Keeping track of vegetation around bodies of surface water is also important. The removal of vegetation, either through natural means such as fires or through deforestation, can have a negative impact on surface water. Lakes also play a major role in regulating the microclimate of any urban centre and hence act as ecological barometers of the health of such places. Freshwater lakes also play a vital role in various natural processes occurring in the environment like the hydrological cycle, climate change adaptations, biochemical cycle etc. In the current scenarios, globally, not only lakes rather all freshwater ecosystems are facing great degradation pressure and the threat of eutrophication or extinction because of heavy loads of pollution and contaminations from multiple sources like rapid industrialization, exponentially growing populations pressure, fast developing urbanization, modern agricultural practices and other anthropogenic activities, saltations, discharge of domestic sewage, immersion of idols and other religious activities and lakes are the worst sufferer because of low surface velocity, along water retention time and isolation from all other terrestrial and aquatic ecosystems.

2. Study Area

The experiment was conducted in the Bengaluru rural district, located at 13.2847 º N Latitude and 77.6078º E longitude about 40 km North West of Bengaluru. The Lake water samples are collected the around the different locations of Bengaluru.

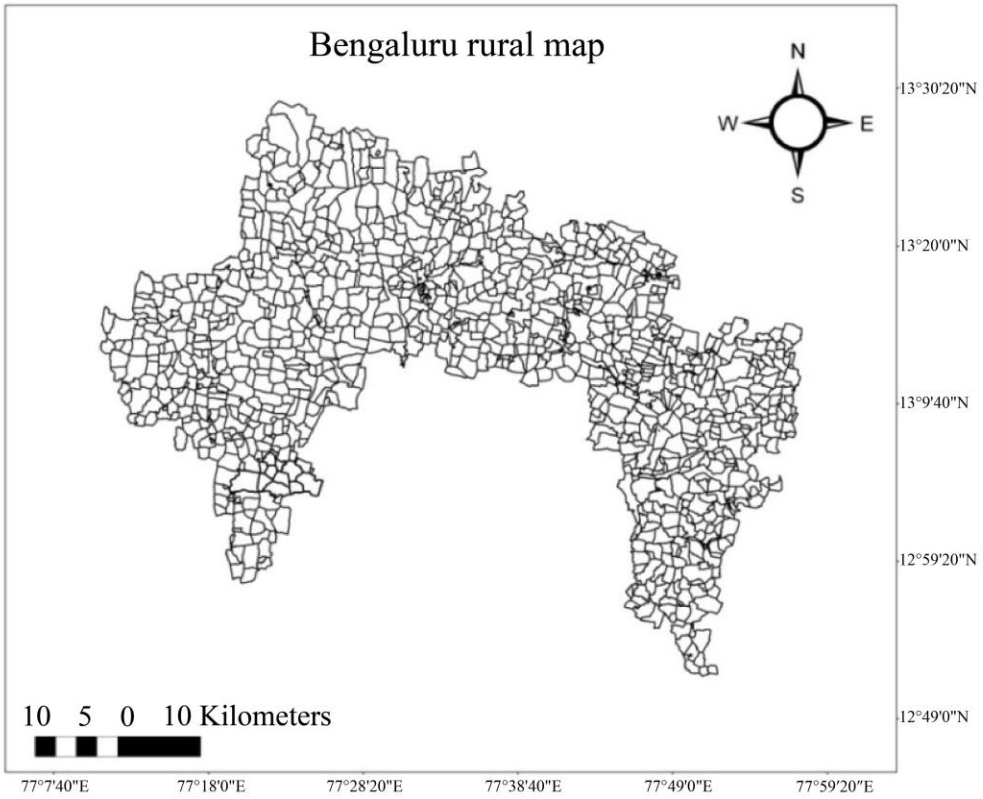

Fig. 1 Study area of Bengaluru rural map

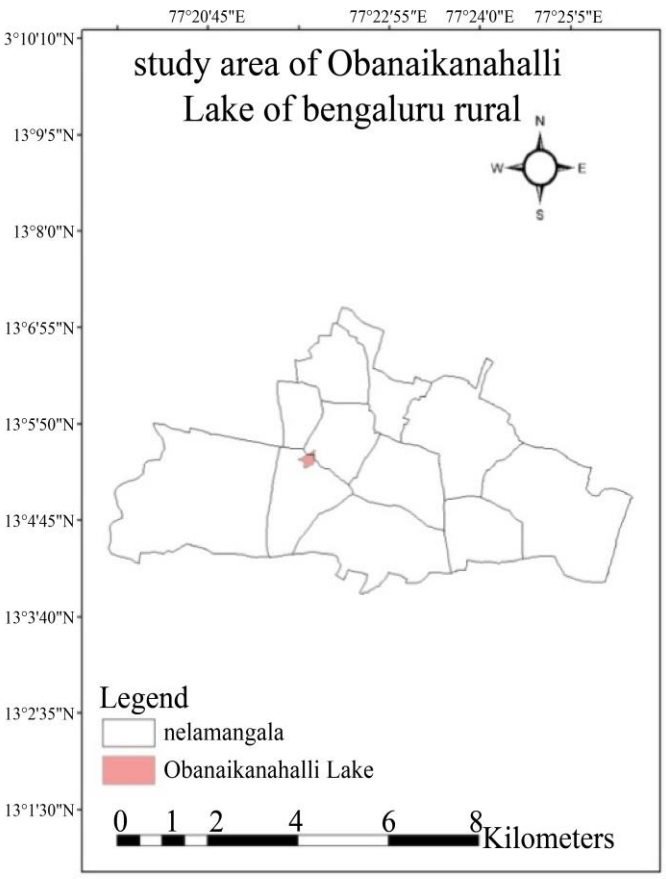

Fig. 2 Study area of Obanaikanahalli Lake

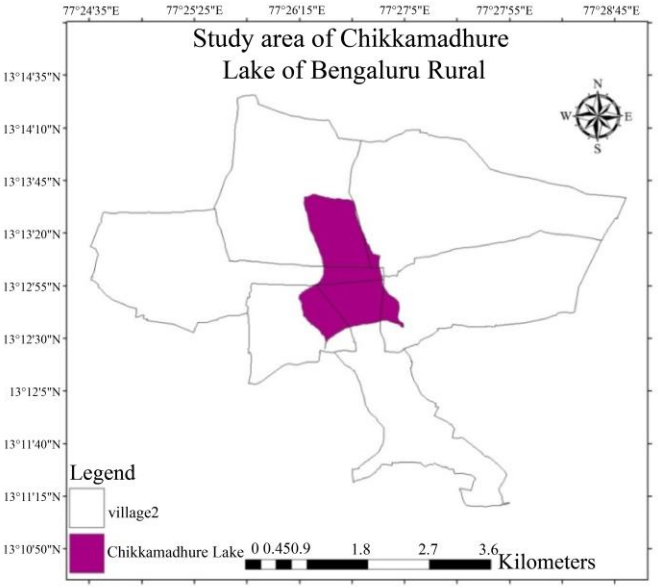

Fig. 3 Study area of Chikkamadhure Lake

2.1. Field Visit Photos

Fig. 4 Obanaikanahalli Lake

Fig. 5 Chikkamadhure Lake

3. Objectives

The main objectives of lake water analysis are as follows:

- Mapping of different Lake Waters.
- Analysis and assessment of physical and chemical parameters.
- Analysis of heavy metals for the Lake water to know habitats for aquatic plants and animals.
- Analysis and assessment of LULC for different lakes.
- LULC mapping for different lakes for different years.

4. Materials and Methods

4.1. Sampling of Lake-Water

In an effort to study the extent of the Lake water contamination

- Sampling of Lake Water is collected in the Bengaluru Rural using "grab sampling".
- The samples of Lake water from various points were collected in 2 litres of plastic cans.
- The samples which were collected were tested at KSPCB Lab Bangalore, as per IS STD of water analysis, and results are presented in the form of a Table as shown below.
- To find out the presence of hazardous materials in Lake water.
- To gain awareness of the effect of water pollution on the environment.

4.2. Software used for Mapping of Lake-Water Samples

- ArcGIS10.1.
- Google earth pro.
- Erdas Imagine 2014.

5. Results and Discussion

5.1. Physical and Chemical Analysis of Lake Water

From the sample 1 analysis, the result shows that for all the Lakes, the parameters like Turbidity (1.8), pH (6.9), Total alkalinity (104mg/l), Electrical conductivity (318), Chemical oxygen demand (36mg/l), P alkalinity (Nil) and magnesium (48mg/l) were well within the permissible limit but calcium (52 mg/l) is below the permissible limit. Heavy metals like Nickel, cadmium, lead, manganese, copper and chromium were below the detection level. The BOD exceeded the permissible limit as per the standards; it is within 5 mg/l, so the lakes are moderately polluted.

The other parameters like total hardness (100mg/l), chlorides(12mg/l), calcium(52mg/l), fluorides(0.32), potassium(1.0mg/l), sulphate(1.0mg/l), sodium (80mg/l), nitrate(0.7mg/l), total dissolved solids(216mg/l), zinc(0.041mg/l) and iron(0.271mg/l) for this lakes are not meeting the permissible standards.

From the sample 2 analysis, the result shows that for all the Lakes, the parameters like Turbidity (2.0), pH (6.8), Total alkalinity (128mg/l), Electrical conductivity (615), Chemical oxygen demand (40mg/l), P alkalinity (nil) and magnesium (60mg/l) were well within the permissible limit. Heavy metals like Nickel, cadmium, lead, manganese, copper and chromium were below the detection level. The BOD exceeded the permissible limit as per the standards; it is within 5 mg/l, so the lakes are moderately polluted. The other parameters like total hardness(124mg/l), chlorides(40mg/l), calcium(64mg/l), fluorides(0.11mg/l), Sodium(39) is exceeding the permissible limit, potassium(6.5mg/l), sulphate(5.0mg/l), nitrate(1.2mg/l), total dissolved solids(258mg/l), zinc(0.040mg/l), magnesium(60) and iron(0.164mg/l) for these lakes are not meeting the permissible standards.

Note

BDL: Below Detection Level in mg/l.
Copper: 0.05 Total Chromium: 0.2 Nickel: 0.1 Cadmium: 0.04 Lead: 0.2
Manganese: 0.04

Table 1. Physical and chemical analysis of lake water

Parameters	UNIT	Sample-1 Chikkamadhure	Sample-2 Obanaikanahalli
PH Value	------	6.9	6.8
Turbidity	NTU	1.8	2.0
Total hardness as caco3	mg/l	100	124
Chlorides	mg/l	12	40
Calcium	mg/l	52	64
Fluorides	mg/l	0.32	0.13
P-Alkalinity	mg/l	NIL	NIL
Total Alkalinity as caco3	mg/l	208	112
Electrical Conductivity	µs/cm	318	440
Magnesium as mg	mg/l	48	60
Sodium	mg/l	18	39
Potassium	mg/l	1.0	6.5
Sulphates	mg/l	1.0	5.0
Chemical oxygen demand (C.O.D)	mg/l	36	40
Nitrate	mg/l	0.7	1.2
Biological oxygen demand (B.O.D)(3 days @27C)	mg/l	3.4	4.0
Total dissolved Solids	mg/l	418	258
manganese	mg/l	0.060	BDL
lead	mg/l	BDL	BDL
Total chromium	mg/l	BDL	BDL
copper	mg/l	BDL	BDL
cadmium	mg/l	BDL	BDL
nickel	mg/l	BDL	BDL
zinc	mg/l	0.041	0.040
Iron	mg/l	0.271	0.164

5.2. Analysis of Landuse Landcover of Lakes

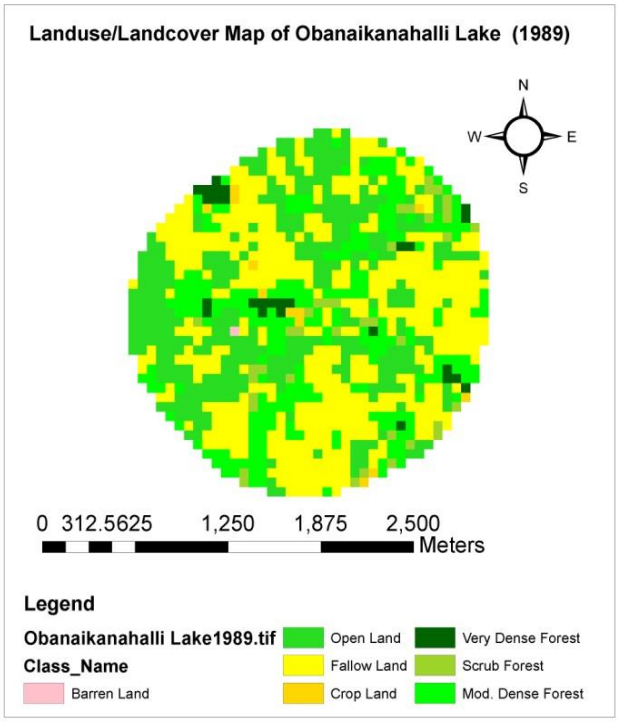

Fig. 6 LULC map of Obanaikanahalli Lake (1989)

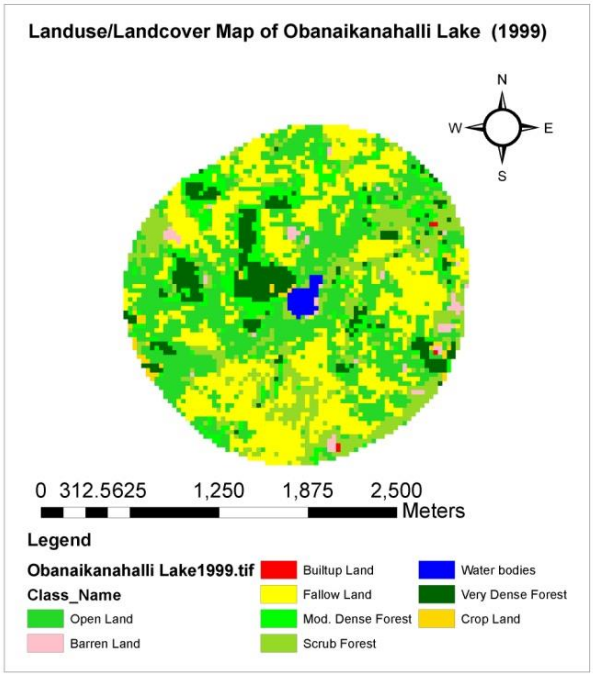

Fig. 7 LULC map of Obanaikanahalli Lake (1999)

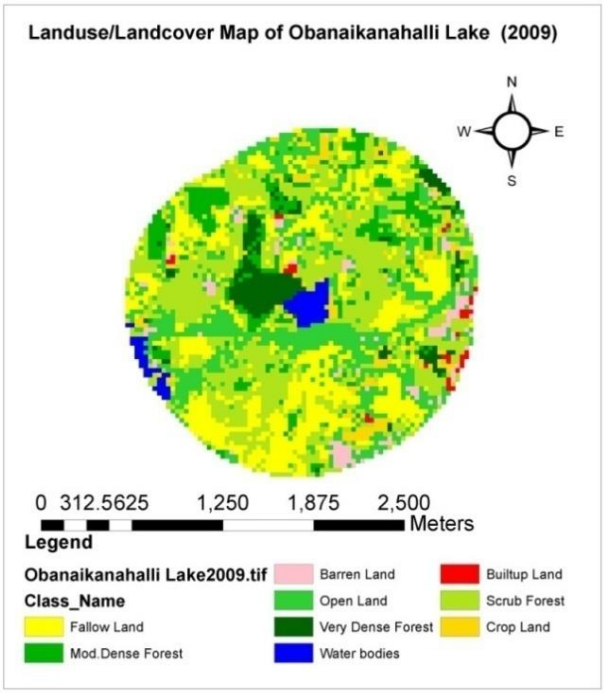

Fig. 8 LULC map of Obanaikanahalli Lake (2009)

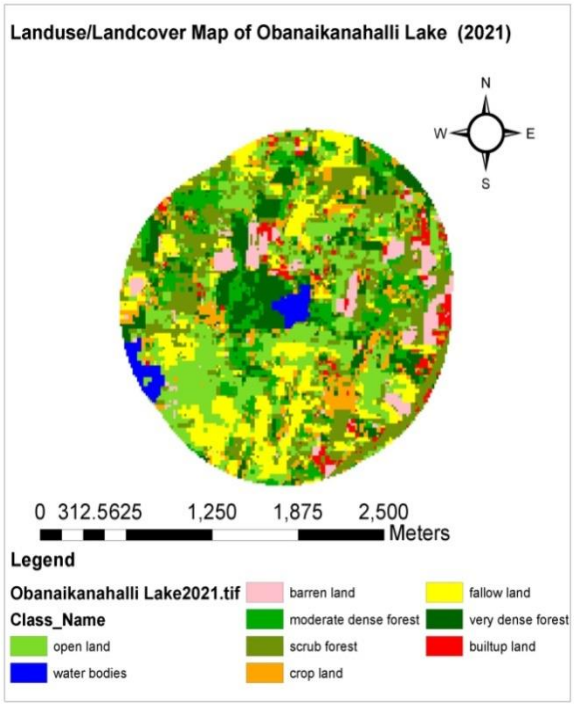

Fig. 9 LULC map of Obanaikanahalli Lake (2021)

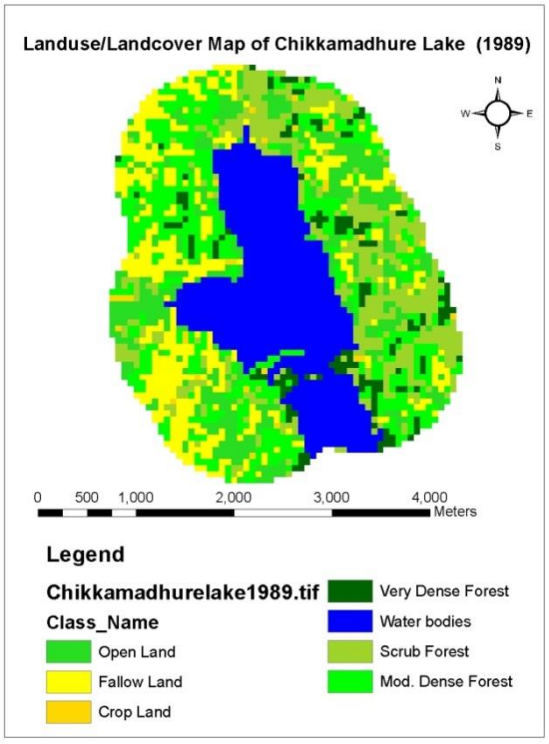

Fig. 10 LULC map of Chikkamadhure Lake (1989)

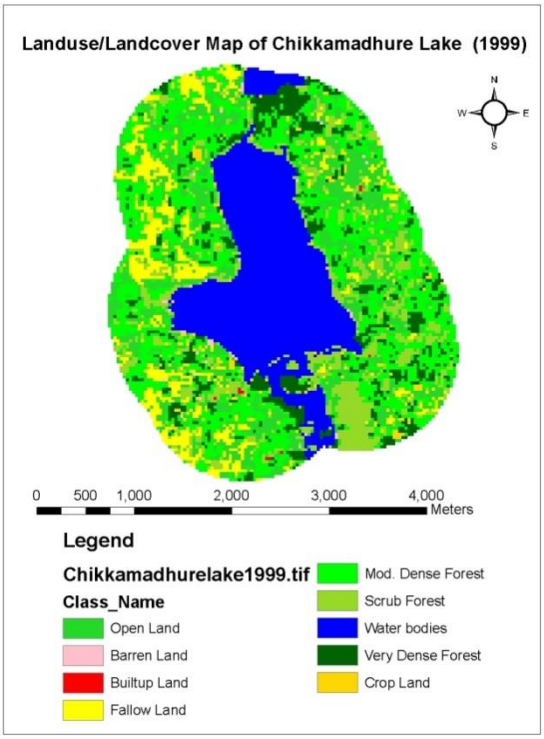

Fig. 11 LULC map of Chikkamadhure Lake (1999)

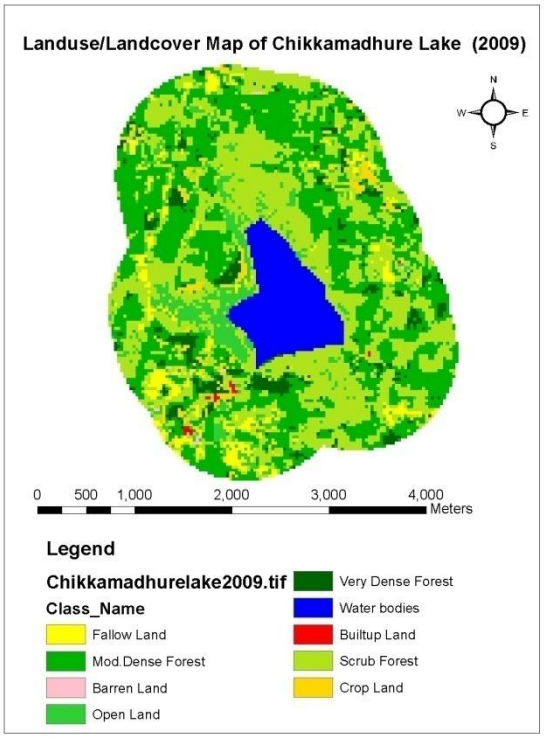

Fig. 12 LULC map of Chikkamadhure Lake (2009)

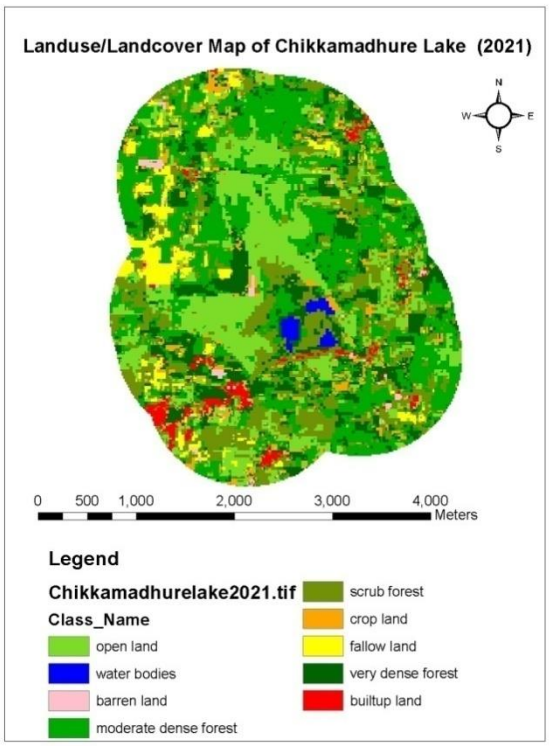

Fig. 13 LULC map of Chikkamadhure Lake (2009)

Table 2. Land use and land cover Area (hectares) analysis for obanaikanahalli lake from 1989 to 2021

LULC PARAMETERS	1989	1999	2009	2021
Open Land	125.64	133.83	83.61	351.63
Fallow Land	178.2	132.57	92.88	245.25
Crop Land	4.32	4.14	21.15	133.38
Very Dense Forest	9.72	32.13	21.15	197.19
Scrub Forest	14.04	71.19	133.92	376.65
Mod. Dense Forest	87.84	34.65	39.78	185.94
Barren Land	0.36	6.21	13.68	98.01
Built-up Land		0.45	3.42	52.74
Water bodies		4.14	9.72	36.9

Table 3. Land use and land cover area (hectares) analysis for chikkamadhure Lake from 1989 to 2021

LULC PARAMETERS	1989	1999	2009	2021
Open Land	164.88	190.26	75.6	888.57
Fallow Land	182.52	99	46.8	195.12
Crop Land	12.24	14.31	37.89	226.26
Very Dense Forest	58.68	110.52	54.81	643.14
Water bodies	282.96	261.63	89.64	36.18
Scrub Forest	174.24	133.47	397.89	926.91
Mod. Dense Forest	228.96	289.17	395.91	1351.98
Barren Land	-	3.69	2.43	42.93
Built-up Land	-	0.9	1.98	100.62

Table 4. Change detection of land use and landcover

LULC PARAMETERS	1999-1989	2009-1999	2021-2009
Open Land	25.38	-114.66	812.97
Fallow Land	-83.52	-52.2	148.32
Crop Land	2.07	23.58	188.37
Very Dense Forest	51.84	-55.71	588.33
Water bodies	-21.33	-171.99	-53.46
Scrub Forest	-40.77	264.42	529.02
Mod. Dense Forest	60.21	106.74	956.07
Barren Land	3.69	-1.26	40.5
Built-up Land	0.9	1.08	98.64

6. Conclusion

On the basis of the findings, it was concluded that the drinking water of the study areas was all Physicochemical parameters. From the analysis, the result shows that for all the Lakes, the parameters like Turbidity, pH, Total alkalinity, Electrical conductivity, Chemical oxygen demand, P alkalinity and magnesium were well within the permissible limit but except the Francis Lake has calcium (60 mg/l) is below the permissible limit. Heavy metals like Nickel, cadmium, lead, manganese, copper and chromium were below detection level, except the Chikkamadhure Lake has manganese (0.060mg/l). The BOD exceeded the permissible limit as per the standards; it is within 5 mg/l, so the lakes are moderately polluted. The other parameters like total hardness, chlorides, calcium, fluorides, potassium, sulphate, nitrate, total dissolved solids, zinc and iron these lakes and are not meeting the permissible standards. It was concluded that the lake water could be used for domestic purposes, irrigation and drinking purposes with proper treatment.

Analysis of the lakes by buffering around 1000 m from the centre of the lakes, mapping and assessment on land-use and Landcover area from 1989 to 2021, around 42 years. Change detection analysis is carried out to know the changes from the past 42 years for lakes. The results show that for the Obanaikanahalli Lake and Chikkamadhure Lake, all the Landuse and Landcover parameters are increasing in the area, but for the Chikkamadhure Lake, the water bodies are decreasing in the area. The paper presents a qualitative assessment of Bangalore's rural lakes. In the future, proper remedial measures and management should be taken to safeguard the lakes.

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I would like to express my special thanks of gratitude to my teacher (C. Sadashivaiah, HOD of the civil department) as well as our principal, who gave me the golden opportunity to do this wonderful project on the topic (“Analysis and

Assessment of Land-use and Land cover and water quality of the Chikkamadhure Lake and Obanaikanahalli Lake using remote sensing and GIS"), which also helped me in doing a lot of Research. I came to know about so many things. Finally, I would like to express my sincere gratitude to the Deputy scientific officer (Shivakumar) and the staff of CPCB Bengaluru. And as well as our final year civil engineering students (Prajwala T, Mallikarjuna, Darshan CJ, and Mahesh)…

References

[1] B.S. Badmus, "Leachate Contamination Effect on Ground Water Exploration," *African Journal of EnvironmentalStudies*, vol. 2, pp. 38-41, 2001. [Google Scholar]

[2] Verma Pradeep et al., "Water Quality Analysis of an Organically Polluted Lake by Investigating Different Physical and Chemical Parameters," *International Journal of Research in Chemistry and Environment*, vol. 2, no. 1, pp. 105-111, 2012. [Google Scholar] [Publisher Link]

[3] A.S. Oyewumi et al., "Assessing Groundwater Quality In Katsina State, Nigeria," *SSRG International Journal of Geoinformatics and Geological Science*, vol. 6, no. 2, pp. 45-57, 2019. [CrossRef] [Google Scholar] [Publisher Link]

[4] Qureshimatva Umerfaruq M, and Solanki HA, "Physico-Chemical Parameters of Water in Bibi Lake, Ahmedabad, Gujarat, India," *Journal of Pollution Effects & Control*, vol. 3, no. 2, 2015. [CrossRef] [Google Scholar] [Publisher Link]

[5] N.C. Kankal et al., "Water Quality Index of Surface Water Bodies of Gujarat, India," *Asian Journal of Experimental Sciences*, vol. 26, no. 1, pp. 39-48, 2012. [Google Scholar] [Publisher Link]

[6] Poojashri R Naik et al., "Water Quality Assessment of Hebbal Lake inBangalore City," *International Journal of Innovative Technology and Exploring Engineering*, vol. 8, no. 11, 2019. [CrossRef] [Google Scholar] [Publisher Link]

[7] Heru Ismanto et al., "The Accuracy of Remote Sensing Image Interprepation on Changes In Land Use Suitability In Merauke Regency Papua," *International Journal of Engineering Trends and Technology*, vol. 68, no. 10, pp. 42-47, 2020. [Publisher Link]

[8] Rohit Sharma et al., "Analysis of Water Pollution Using Different Physicochemical Parameters: A Study of Yamuna River," *Frontiers in Environmental Science*, vol. 8, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[9] Kouedjou Idriss Landry, Ndjeuto Tchouli Prosper I, and Tchotsoua Michel, "Quantification And Characterization of Changes in Land Use Types in the Menoua Watershed Between 1974 and 2018," *International Journal of Geoinformatics and Geological Science*, vol. 8, issue-no. 2, pp. 1-8, 2021. [CrossRef] [Publisher Link]

[10] M. Pramod Kumar et al., "Land use and Land Cover Analysis using Remote Sensing and GIS: A Case Study in and around Bramhamgarimatam, Kadapa District, Andhra Pradesh, India," *SSRG International Journal of Geoinformatics and Geological Science*, vol. 6, no. 1, pp. 16-20, 2019. [CrossRef] [Publisher Link]

[11] Aniekan Eyoh, and Francis Okeke, "Evaluation of the Relationship between Land Use/Land Cover Dynamics and Land Surface Temperature across the Niger Delta Region of Nigeria," *SSRG International Journal of Geoinformatics and Geological Science*, vol. 4, no. 3, pp. 1-12, 2017. [CrossRef] [Google Scholar] [Publisher Link]

[12] AM Dewan, Y Yamaguchi, "Land Use and Land Cover Change in Greater Dhaka, Bangladesh: Using Remote Sensing to Promote Sustainable Urbanization," *Applied Geography*, Elsevier, vol. 29, no. 3, pp. 390-104, 2009. [CrossRef] [Google Scholar] [Publisher Link]

[13] Pravin V. Desai, and Suresh K. Ukarande, "Modeling of Soil Erosion using SWAT and Linking Land-Cover Pattern to Soil Erosion in Upper Krishna Sub-Basin," *International Journal of Engineering Trends and Technology*, vol. 70, no. 5, pp. 159-172, 2022. [CrossRef] [Publisher Link]

[14] KP Sharma, SC Jain, and PK Garg, "Monitoring Landuse and Landcover Changes Using Landsat Images," *Journal of the Indian Society of Photo-Interpretation and Remote Sensing, Springer*, vol. 12, pp. 65-70, 1984. [CrossRef] [Google Scholar] [Publisher Link]

[15] Chen Liping, Sun Yujun, and Sajjad Saeed, "Monitoring and Predicting Land Use and Land Cover Changes Using Remote Sensing and GIS Techniques —A Case Study of a Hilly Area, Jiangle, China," *Plos One*, 2018. [CrossRef] [Google Scholar] [Publisher Link]