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Characteristics of Surface Water Quality- A Case Study in Coimbatore City Corporation, Tamil Nadu



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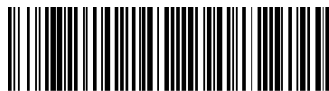
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ABSTRACT

Spatial variations in Surface water quality in Coimbatore City have been studied using Geographical Information System (GIS). GIS, a tool used for storing, analyzing and displaying a spatial data to investigate surface water quality. For this study, the water quality data were collected and analyzed for Physio – Chemical parameters like TDS, TH, Cl⁻, NO₃⁻ etc., using spatial interpolation technique in ArcGIS 9.1. The analysis of surface water quality has helped in the identification of the area having potable or non-potable water for drinking purposes in Coimbatore City.



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INTRODUCTION

Water is important for all living things on the earth. A water molecule contains one oxygen and two hydrogen atoms connected by covalent bonds. It covers almost 71 percent of the earth's surface. 96.5 percent of the water is found in sea and oceans. 1.7 percent in ground, glaciers and ice caps and 0.001 percent of water is found in the air as water vapor and clouds are in solid or liquid state.

AIM AND OBJECTIVES

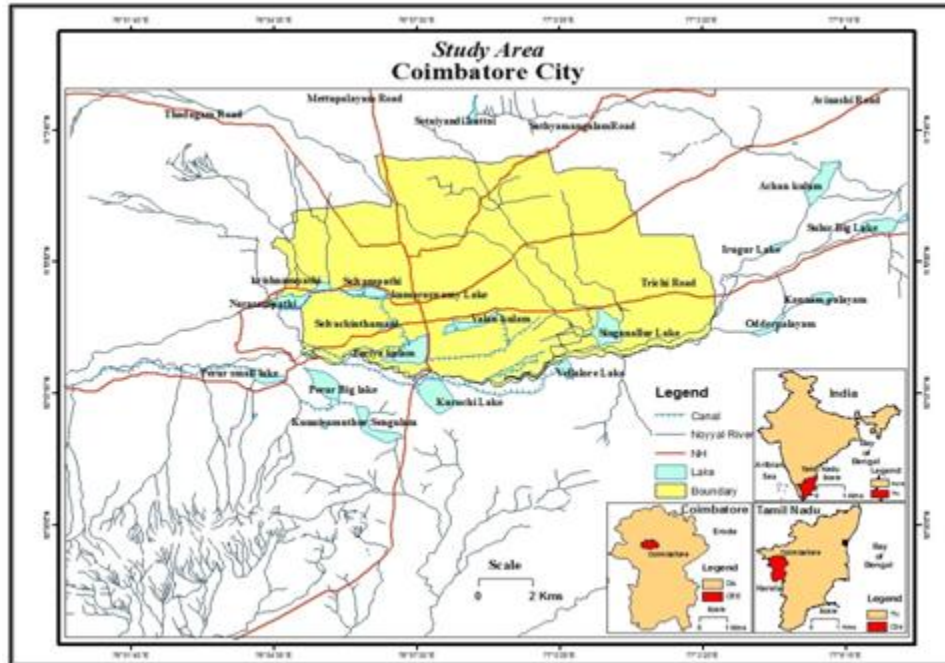
The prime aim of the study is to identify the area having potable water in Coimbatore City using remote sensing and GIS.

The major objectives of the study are to

- i. analyze surface water samples collected in Coimbatore City,
- ii. map the chemical parameters covering the entire study area and
- iii. Identify the area having potable water lie with the permissible limits of chemical by the national and international agencies.

Study Area

The study area, Coimbatore city is one of the metropolitan cities in the state of Tamil Nadu, India. It lies between $76^{\circ} 55' 00''$ and $77^{\circ} 3' 20''$ East Longitudes and $10^{\circ} 58' 20''$ and $11^{\circ} 32' 00''$ Latitudes. The study area is located in the plateau region. The maximum and minimum temperature is 39.4°C in summer and 26.7°C in winter. The geographical area of Coimbatore city is 112.53 sq.km. The normal annual rainfall over the city is about 700 mm ^[18]. The study area enjoys a tropical climate. The region is bounded by Kerala and Nilgiris District on the west, and is surrounded by Tirupur district, Nilgiris district and Erode district on the east.

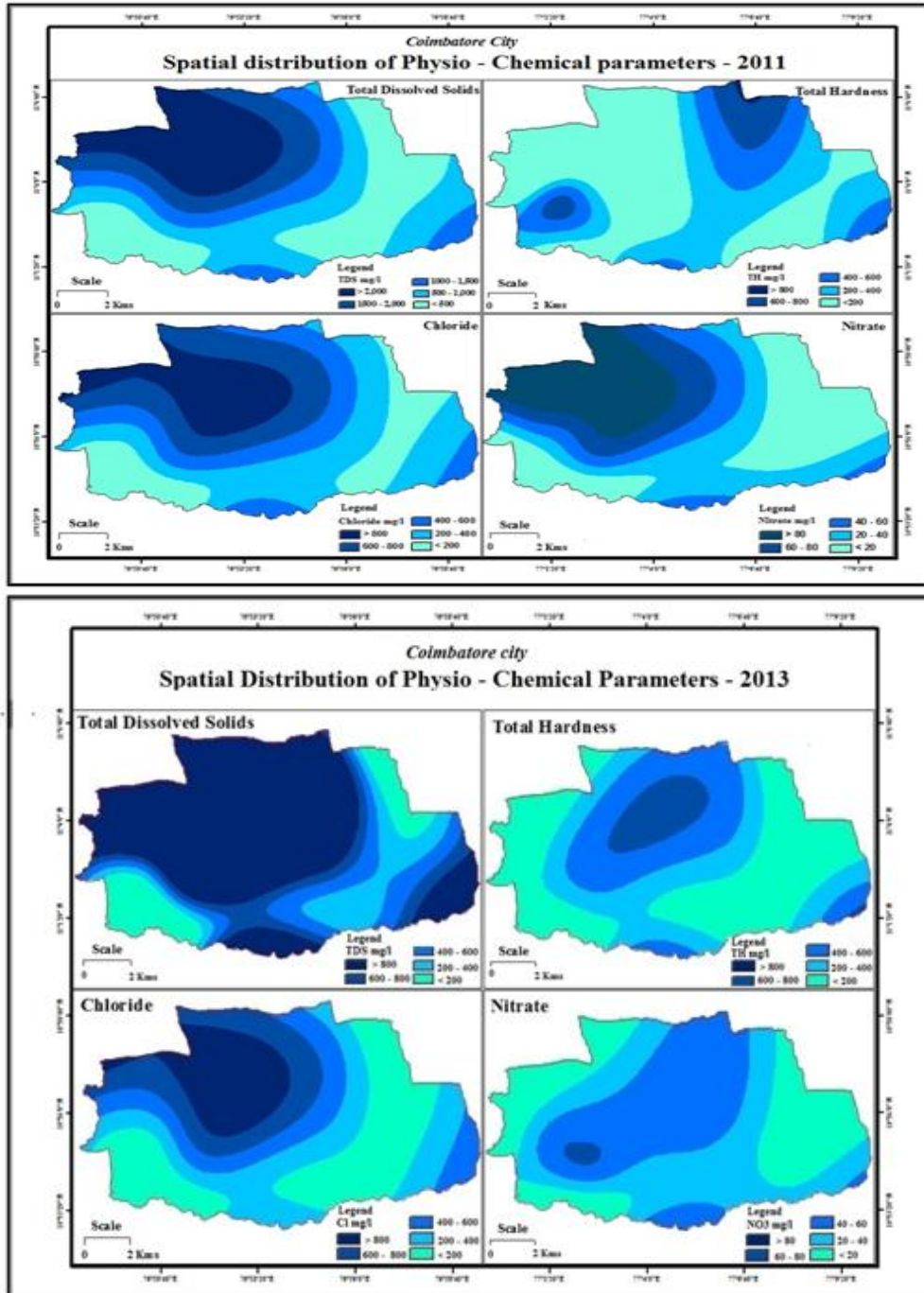


The study area has 28 lakes are Ukkulam, Pudukulam, Kolarampathi lake, Narasampathi lake, Krishnampathi lake, Selvachinthamani lake, Selvampathi lake, Kumaraswamy lake, Sottaiyandi kuttai, Ganganaryansam Udham, Perur Big lake, Kuniyamuthur Sengulam, Perur small lake, Coimbatore big lake, Valamkulam, Kurichi Kulam, Vellalore lake, Singanallur lake, Odderpalayam lake, Kannampalayam lake, Irugur lake, Neelambur lake, Sulur big lake, and Achan Kulam etc.

METHODOLOGY

Coimbatore City map in 1:20,000 scale was used in the present study. It was published by the TTK healthcare private limited, Chennai. Map shows all the basic information about the Coimbatore city. The Coimbatore city was digitized with the help ArcGIS 9.1 software. The map was updated with the help of Google Earth satellite images .The Toposheet bearing numbers 58 A / 10 / SE, 58 A / 16 / SW, 58 E / 4 / SW, 58 B / 13 / NW, 58 C / 13 / NE in 1:25,000 scale were used in present study. They were mosaiced using ERDAS Imagine software. The entire study area falls within these six toposheets; extended toward Boluvampati range on the western side, Sulur on the eastern side, Thadagam on the Northern side and Mettupalayam on the Southern side. The Toposheet represent the all geographical features for e.g. rivers, roads, railways, contour lines, vegetation and forest etc. the 28 lakes have been digitized as a polygon feature in

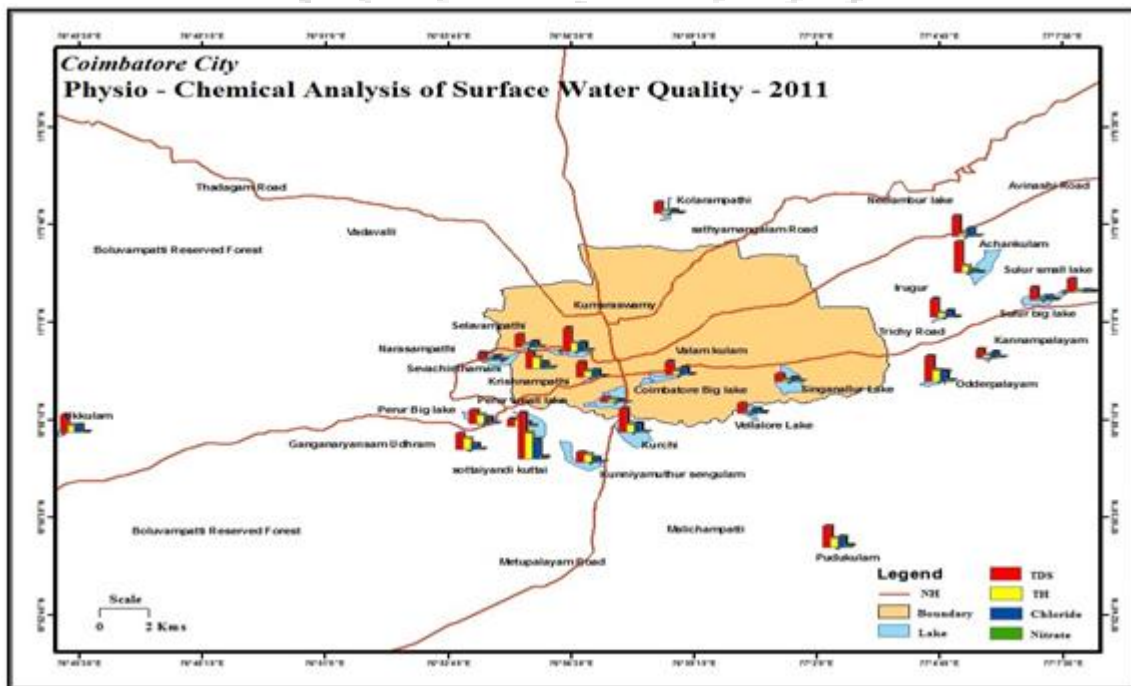
ArcGIS 9.3. The data has been collected from the Environs Chemical Lab Pvt. Ltd., Coimbatore. It is an ISO 9001 – 2008 organization. The water samples were collected and tested by them for 28 tanks / lakes in Coimbatore city. The data were purchased for two particular dates (11.11.2011) and (13.7.2013).



Total Dissolved Solids (TDS)

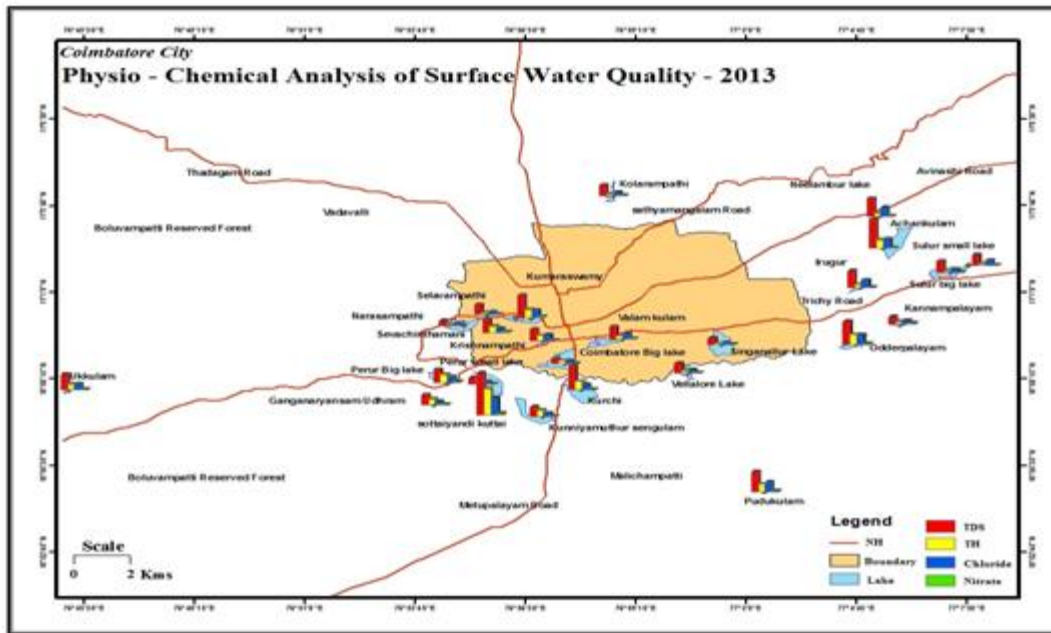
The solid particles, which are dissolved in water is referred to as TDS. In natural water, TDS is usually less than 500 mg/l when it exceeds 500 mg/l water is unfit drinking purposes. When the TDS is less than 300 mg/l the water is desirable for dying of clothes and manufacture for plastics, pulp paper etc. When the TDS is 1000 mg/l the water becomes tasteless. The maximum level of TDS tolerance limit is 2000 mg/l. In the present data, the maximum concentration of TDS is 1653 mg/l and the minimum concentration of TDS is 396 mg/l in the year 2011. In 2013 the maximum level of TDS concentration is 2480 mg/l and the minimum level of TDS concentration is 311 mg/l. The tolerance limit of TDS is mentioned in table 1. The majority of water samples are fall within the permissible limits for both the years, expect Sottaiyandi kuttai because TDS value exceeds the tolerance limits 2438 mg/l in 2011 and 2480 mg/l in 2013 is unfit for drinking purposes and the water in other lakes are fall within the permissible limits, so water is suited for drinking purposes.

Map: 2



Total Hardness (TH)

The presence of Calcium and Magnesium mostly causes the hardness of water. The TH can be divided into two type carbonate or temporary and bi – carbonate or permanent hardness. When the Calcium and Magnesium can be virtually removed by boiling water called permanent hardness. When the hardness is less than 75 mg/l is considered as soft, when the hardness is range from 75 to 150 mg/l is unsafe for drinking purposes. The present data show the maximum and minimum level of hardness is from 12 to 1382 mg/l in the year 2011. In 2013 the hardness is ranging from 40 to 1531 mg/l. Here the data reveals that all the values are above the permissible limits hence it is unfit for drinking purposes, according to the national and international standards.



Chloride

Chloride is a minor constituent of the earth's crust. The Chloride in water has originated from natural resources and rain water. The natural water contains 100 mg/l of Chloride when it becomes less than 100 mg/l is saline in taste. Suppose its contamination high the water is used for agriculture purposes. The human can tolerate up to 300 – 400 mg/l of Chloride content in water. The maximum level of concentration of Chloride is 1035.14 mg/l in 2013 and 1020 mg/l in 2011. The minimum level of concentration of Chloride is 141 mg/l in 2013 and 113.44 mg/l in 2011.

2011. The data show that the values fall within the permissible limits, except in a few lakes like Ukkulam, Pudukulam, Irugur, Sottaiyandi Kuttai, Neelambur etc. are not suitable for drinking purposes for both the years according to national and international standards.

Nitrate

The main source of Nitrate in water is from atmosphere, plant debris and animal waste or excreta. When the water contains more than 100 mg/l of Nitrate, it is bitter in taste. Normally the natural water contains only 10 mg/l of Nitrate content. The maximum concentration of Nitrate in water is 5.60 mg/l in 2011 and 9 mg/l in 2013. Almost all water samples fall within the permissible limits, except Sottaiyandi kuttai and Pudukulam Lake because the water has more Nitrate content, taste of water is brackish.

RESULT AND DISCUSSION

The 28 lakes supply drinking water to Coimbatore city. These 28 lakes are interconnected with tributaries/streams of Noyyal River. The major sources of water to these lakes are rain water and underground drainage system and in a few areas, the canals were built to connect these lakes.

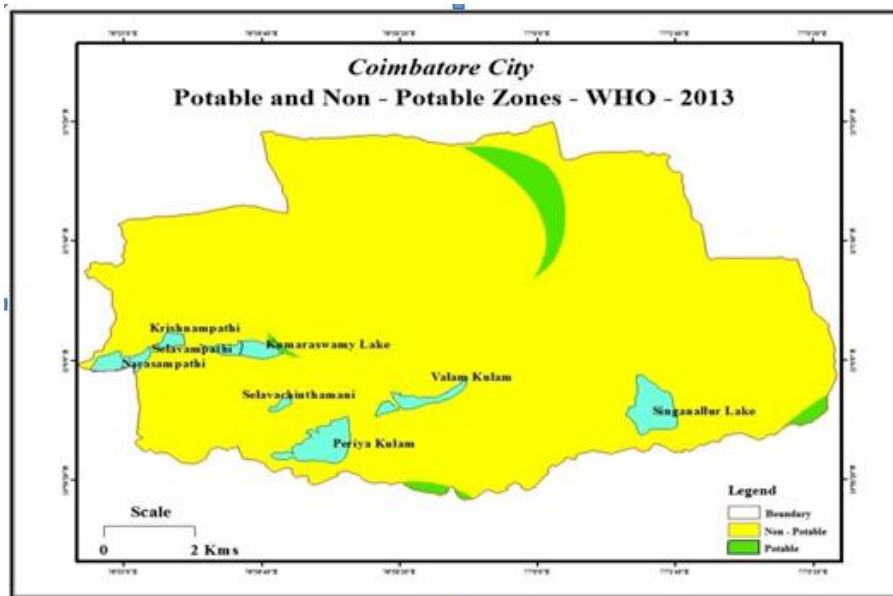
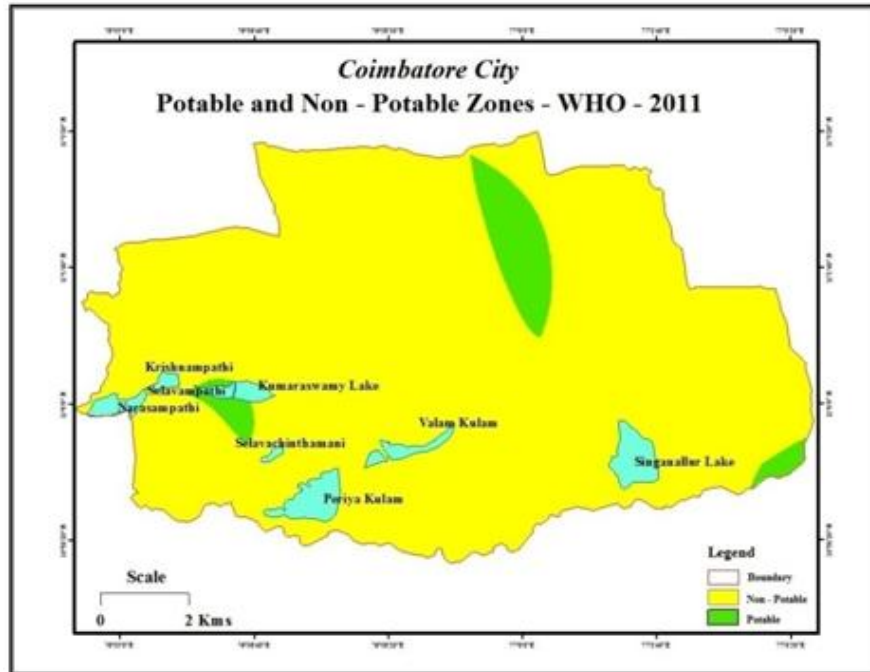
Table: 1 Coimbatore city: Area under Potable Water 2011 – 2013

Area in sq units⁷

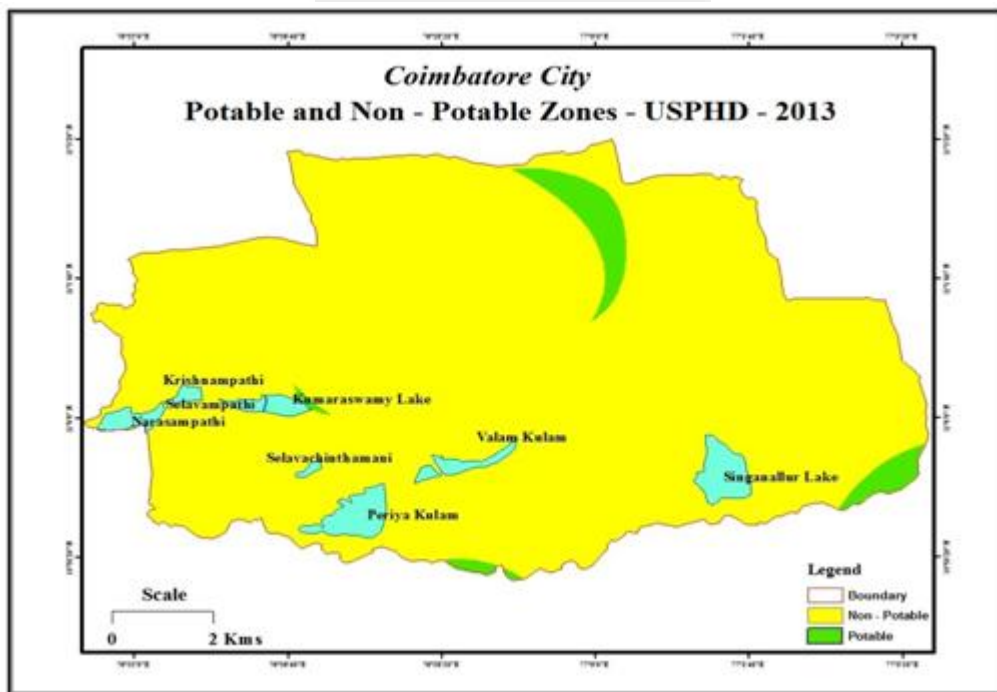
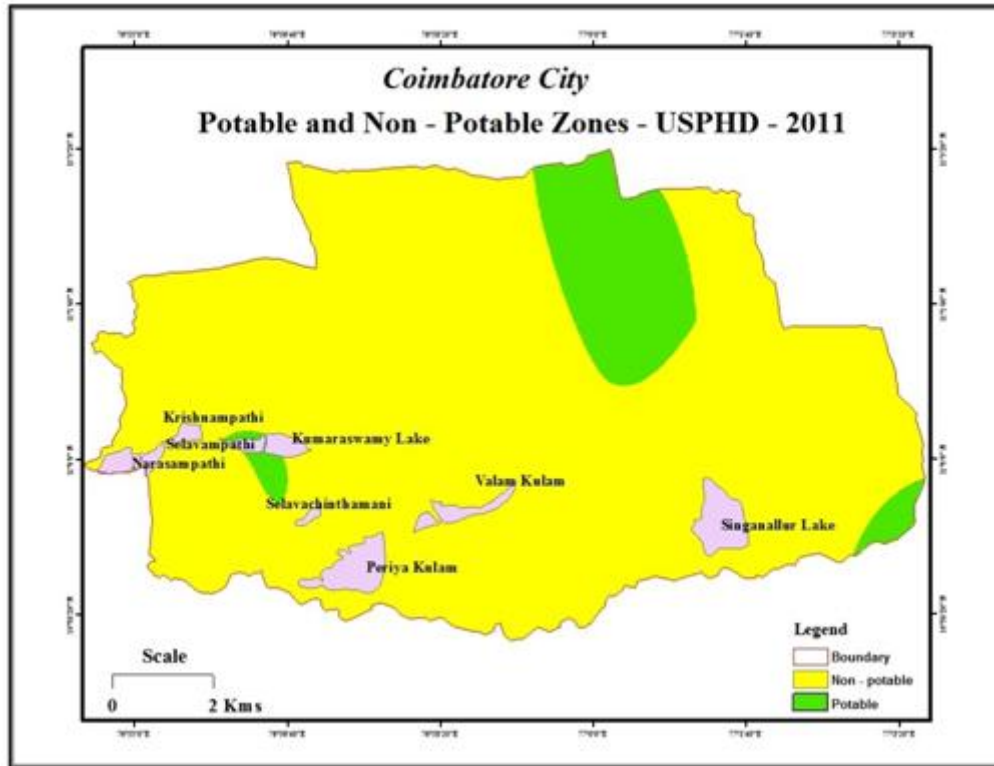
Year	WHO		USPHD		ISI		ICMR	
	2011	2013	2011	2013	2011	2013	2011	2013
Potable	5.46	2.73	11.46	3.33	1.19	0.04	25.41	20.41
Non – Potable	107.07	109.80	101.08	109.21	111.35	112.49	87.12	92.12
Total	112.53	112.53	112.53	112.53	112.53	112.53	112.53	112.53

The standards of permissible limits have been specified by national and international agencies such as WHO, USPHD, ICMR, and ISI.

In the study area the level of water used for drinking purposes decreased over a period of one year. The important physio – chemical characteristics of analyzed water samples are TDS, TH, Chloride, Nitrate etc. Values are compared with national and international standards namely WHO, USPHD, ISI and ICMR. The potable water area is sq.km observed for the year 2013, as per WHO is 2.73, USPHD 3.33, ISI 0.04, and ICMR 20.41. The total area of the Coimbatore city is 112.53 sq.km.

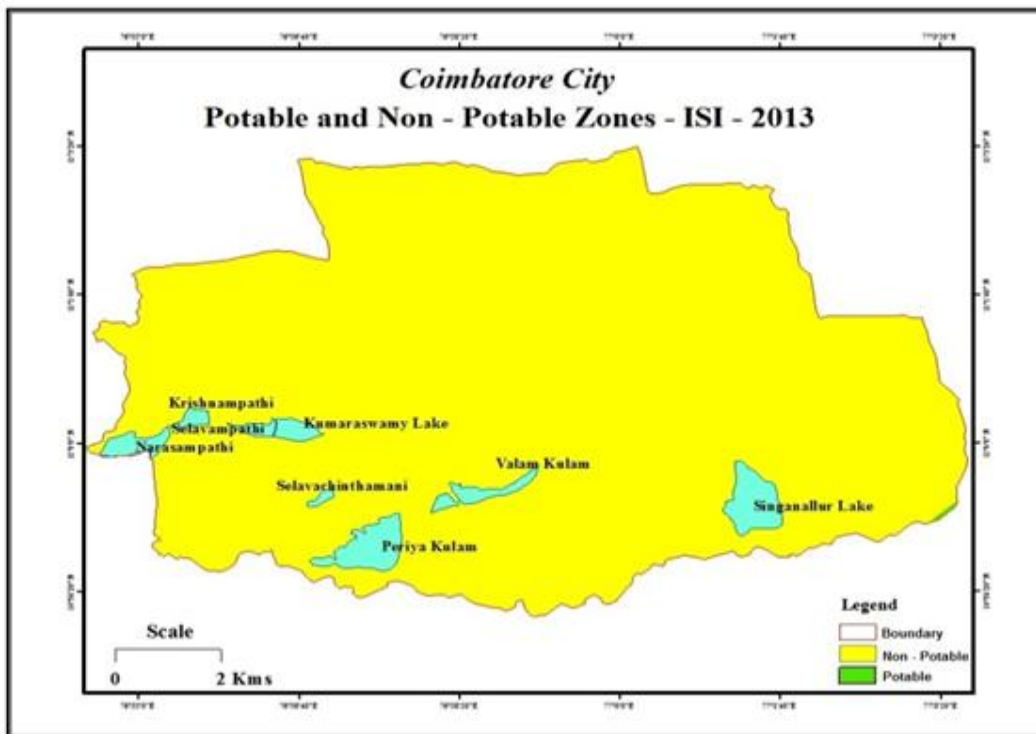
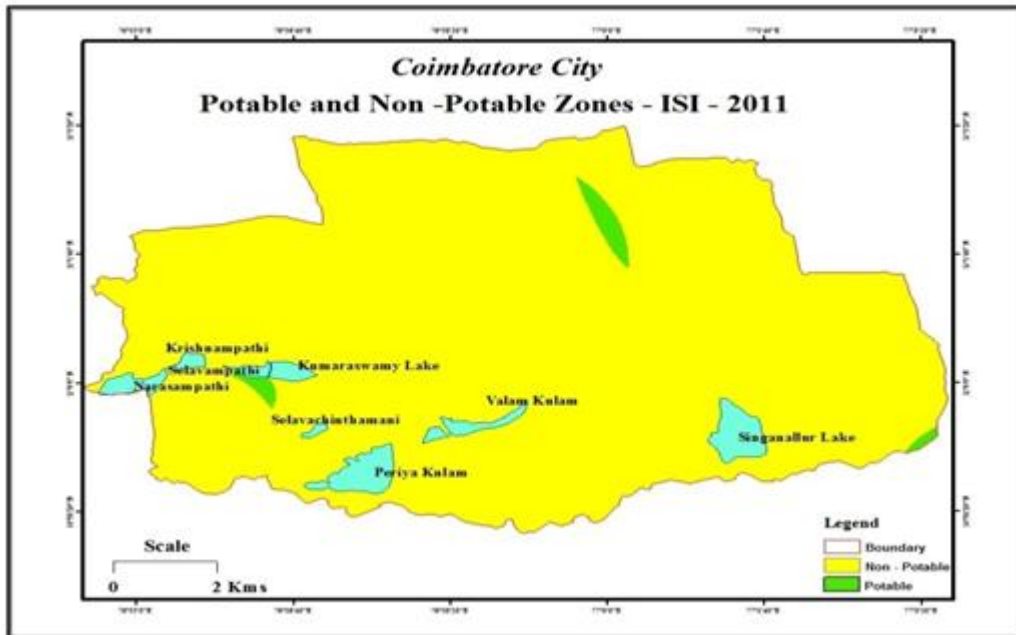


5.46 and in 2013 is 2.73 sq.km. The map 7 shows the decrease in the area of potable water in the city. Area having potable water is located in the northeastern side, western side and southern side of the study area as shown in map 6 and 7.



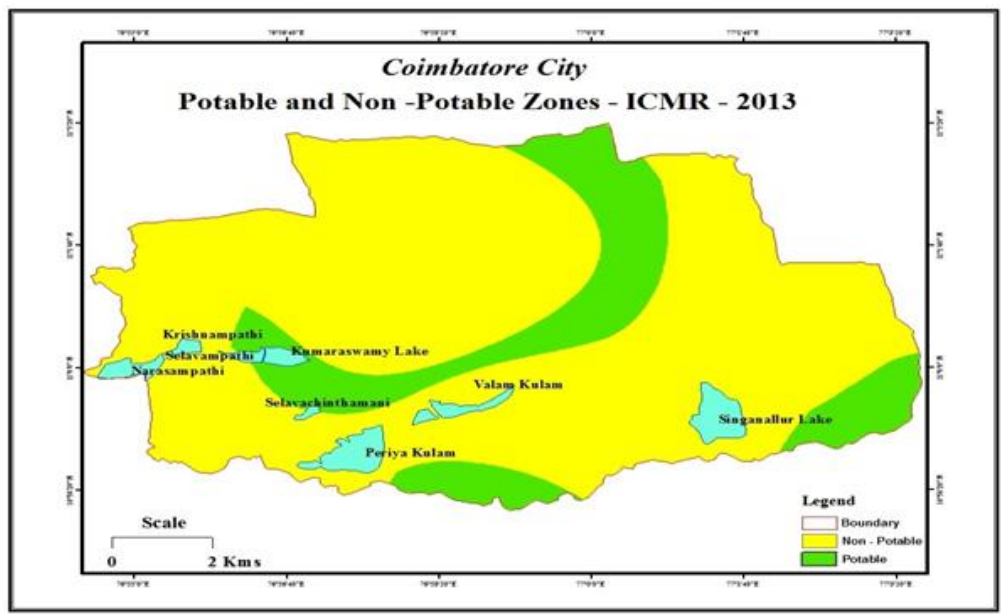
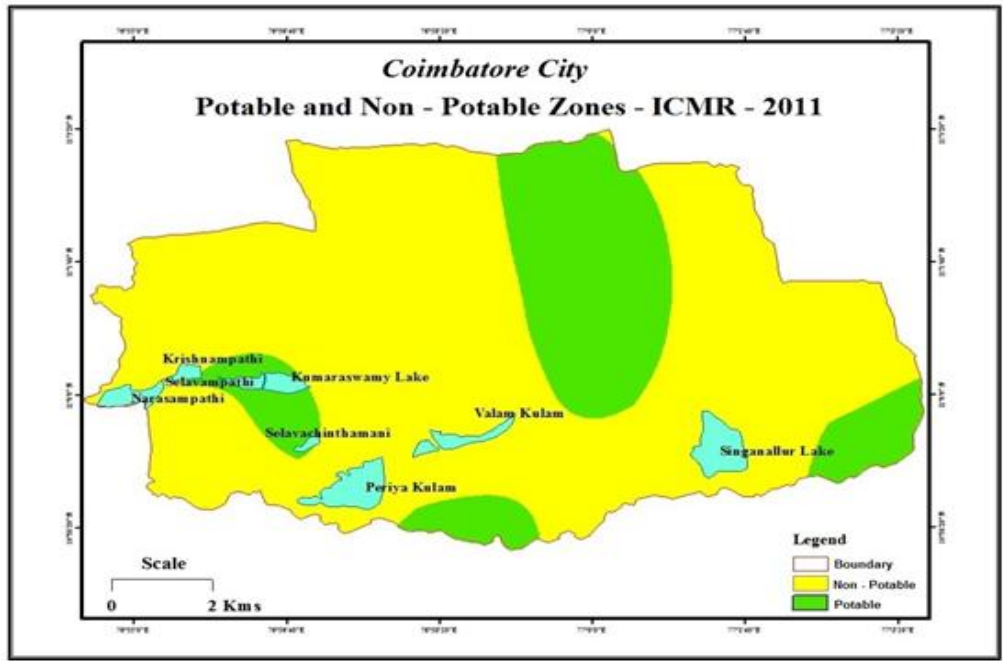
14. IUSPHD

The level of potable water is 11.46 sq.km in 2011 and 3.33 sq.km in 2013. These maps show decline in area under potable water in the city. The area having potable water is located in the northeastern side, western side and southern side of the study area as shown in the map 8 and 9.



ISI

The level of potable water is 1.19 sq.km in 2011 and 0.04 sq.km in 2013. The area under the potable water has decreased. The area has potable water located in northeastern side, western side and southeastern side of the study area. In the year 2013 map shows the level of potable water is located only in southeastern side of the study area as shown in the map 10 and 11.



ICMR

Area having potable water is located in northeastern side, western side, and southeastern side of the study area. The area having potable water has decreased from 25.41sq.km in 2011 to 20.41 sq.km in 2013 as shown in the map 12 and 13.

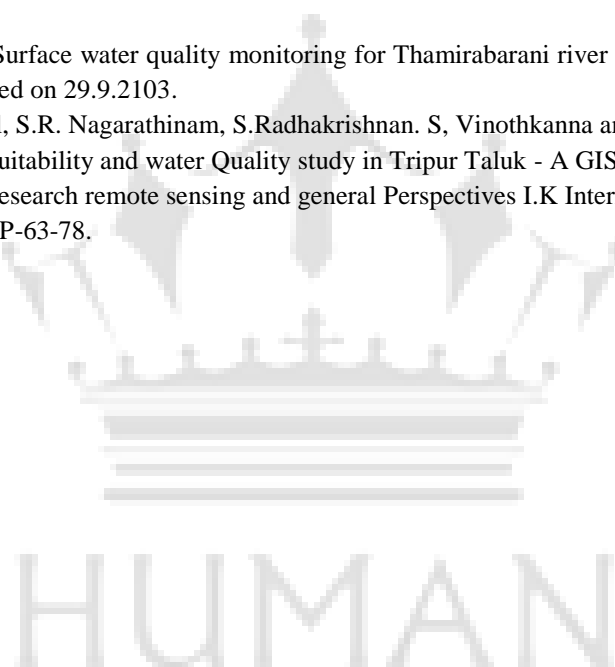
CONCLUSION

Surface water is one of the major sources of drinking water. It is now facing threats due to rapid growth of population, urbanization and industrial activities effluents, and wastes from urban infrastructure, agriculture, horticulture, transport and discharges from abandoned mines and deliberate or accidental pollution. The water quality is equally important as that of quantity. The present study has been undertaken to analyze the spatial variation of major water quality parameters such as TDS, TH, Nitrate and Chloride using GIS technology. GIS can be used as a tool for arriving at solutions related to water quality, determining water availability, understanding the natural environment and managing water resources on a local or regional scale. The water quality of 28 sample lakes was tested in Coimbatore District of Tamil Nadu State for the present study. The spatial variation maps on these water quality parameters were prepared and finally all these maps were integrated. The water quality has been classified as potable and non-potable depending on the final maps. The integrated map shows the area is Singanallur, Pesaripalayam, Ratinasabathi puram, Racecourse, Ramanathapuram, Nanjunda puram, Sivananda colony, Ganapathi, Siddhapudur and Gandhipuram possessing potable water as per the tolerance limit set by the national and international agencies. This study helps to understand the quality of the water in Coimbatore city.

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