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Original Article

GEOSPATIAL MAPPING AND ASSESSMENT OF GROUNDWATER DEPLETION DUE TO URBANIZATION IN COIMBATORE DISTRICT

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ABSTRACT

Urbanization is the term for the complex phase of population growth in towns and cities. As a result, the ratio of the renewable and non-renewable resources has changed. Water depletion is a major problem in developing countries like India, and water conservation is seen as a risky endeavor. The groundwater level has been depleted as a result of rapid urbanization. Groundwater depletion is regarded as one of the most pressing issues in this fast-paced country. In this concern, this study was carried out in the Coimbatore district to understand groundwater depletion from 2000 to 2015. For the period 2001 to 2016, the LULC changes were examined utilizing remote sensing and GIS technology. The study revealed a significant decrease in barren land and forest areas, as well as an increase in area under a water body, agricultural, and settlement. Furthermore, in 2015, the depth to water level slightly declined during the pre-monsoon period and increased during the post-monsoon period.

KEYWORDS: Urbanization, Depletion, GIS, Remote Sensing & LULC (Land use Land Cover)

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INTRODUCTION

Groundwater is one of the most important natural resources available on the planet. Nearly 3.9 billion people or 54% of the world population lived in cities in 2014, and by 2050, two–thirds of the global population would be living in cities, resulting in a 55% increase in global water demand (Arfanuzzaman & Atiq Rahman, 2017). Urbanization growth and urban development have a significant impact on many environmental issues, including contamination of surface water and groundwater depletion (Kalhor & Emaminejad, 2019). Urbanization is the source of groundwater depletion and severe environmental concerns in both developed and developing countries.

According to Gideon (2020), the Composite Water Management Index (CWMI) developed an index after studying the intensity of water in 24 Indian states, estimating that 54% of India's groundwater wells are dwindling and cities will be water-stressed by 2020. According to a survey by Central Ground Water Authority, only 8% of wells had water below 4m depth in 2004. However, it became 16% and 26% in2013 and 2014 (Tnn, 2016). Groundwater levels in the Coimbatore district have dropped 5 meters as a result of the monsoon failure in 2012, especially in a few places (northern and eastern pockets) (Madhavan, 2016). This paper aims to investigate trends of groundwater depletion during the period from 2000-2015, for Coimbatore District of Tamil Nadu, which is a fast-growing urban center in India.

OBJECTIVE

- To map the urban growth of the Coimbatore district by analyzing the land use and land cover status in

2001 and 2016.

- To investigate the connection between groundwater depletion and land use land cover changes.

Study Area

In 2011, the population of the Coimbatore district increased by 18.56 %, making it Tamil Nadu's second most urbanized district in Tamil Nadu after Chennai (Census of India, 2011), and is known as “Manchester of South India". It is located between 10º 13’15” to 11º 24' 26” N Latitudes and 76º 58’52” to 77º 06’28” E Longitude in the extreme west of Tamil Nadu near Kerala State and has an area extent of 4693.1sq.km. The Coimbatore district, an upland plateau area, is bordered by several hill ranges, hill rocks of the Western Ghats, and the undulating topography with plains on the east. Coimbatore has favorable climate conditions and attractive mountains. It has a subtropical climate, warm weather, and rainfall from both the southwest and northeast monsoons. The mean maximum and minimum temperature vary between 35˚C to 12˚C severally. Although the study area is located on the banks of the Noyyal River, it lacks a significant perennial source of surface water. The water level fluctuates up to 5 m during the post-monsoon and pre-monsoon seasons, with a depth of 12.43m.

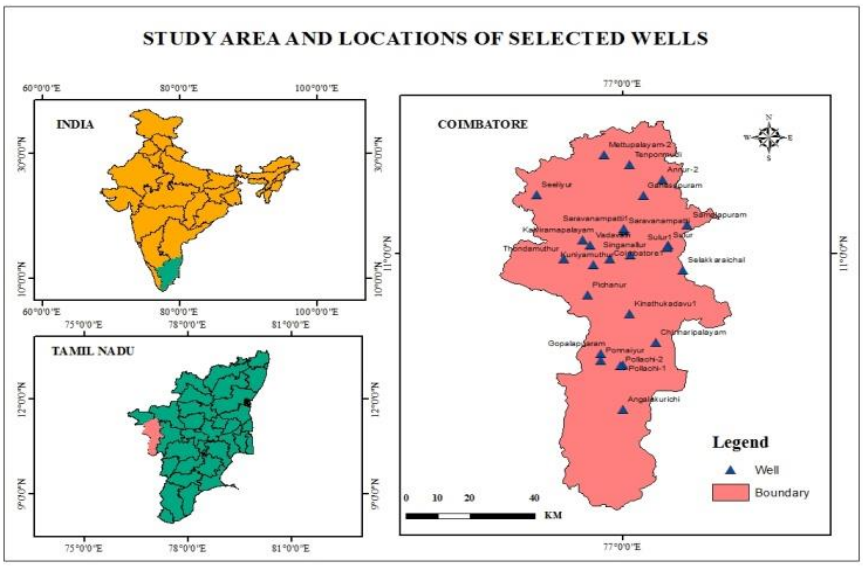

Figure 1: Location Map Of Coimbatore District.

DATA USED AND METHODOLOGY

The database for this study is the data provided mainly by the Central Ground Water Board (CGWB), Government of India. Depths to groundwater level data were collected from 2000 to 2015 based on a 5 years interval to find the seasonal change between pre-monsoon and post-monsoon. The IDW (Inverse Distance Weighting) interpolation method was used to determine the difference between seasons. Landsat 7 ETM+ and Landsat 8 OLI/TIRS images (30 – meter spatial resolution) were used to identify LULC between2001 and 2016. NRSC level-1supervised classification was used for LULC classification using GIS and Remote sensing techniques. Erdas imagine and ArcMap 10.5 was the software used to prepare maps and was integrated with GIS for the analysis.

The limitation of the study is that satellite data was used based on the availability of cloud-free images from Landsat Data. Hence the land use analysis was done only for these two periods.

RESULT AND DISCUSSIONS

Ground Water plays a vital role in the environment, sustaining life, and also the economy of a country. Although water demand has increased, recharging of the groundwater sources has decreased as a result of anthropogenic activity such as concrete construction, roads, and deforestation. Problems such as water shortage and depletion are becoming more prevalent in urban areas as they pump water from the underground sources when there is not enough surface water availability. The analysis was done using data from the Pre-monsoon and Post-monsoon seasons to get a clear picture on the groundwater table levels in the Coimbatore district.

Ground Water Level in Pre-Monsoon

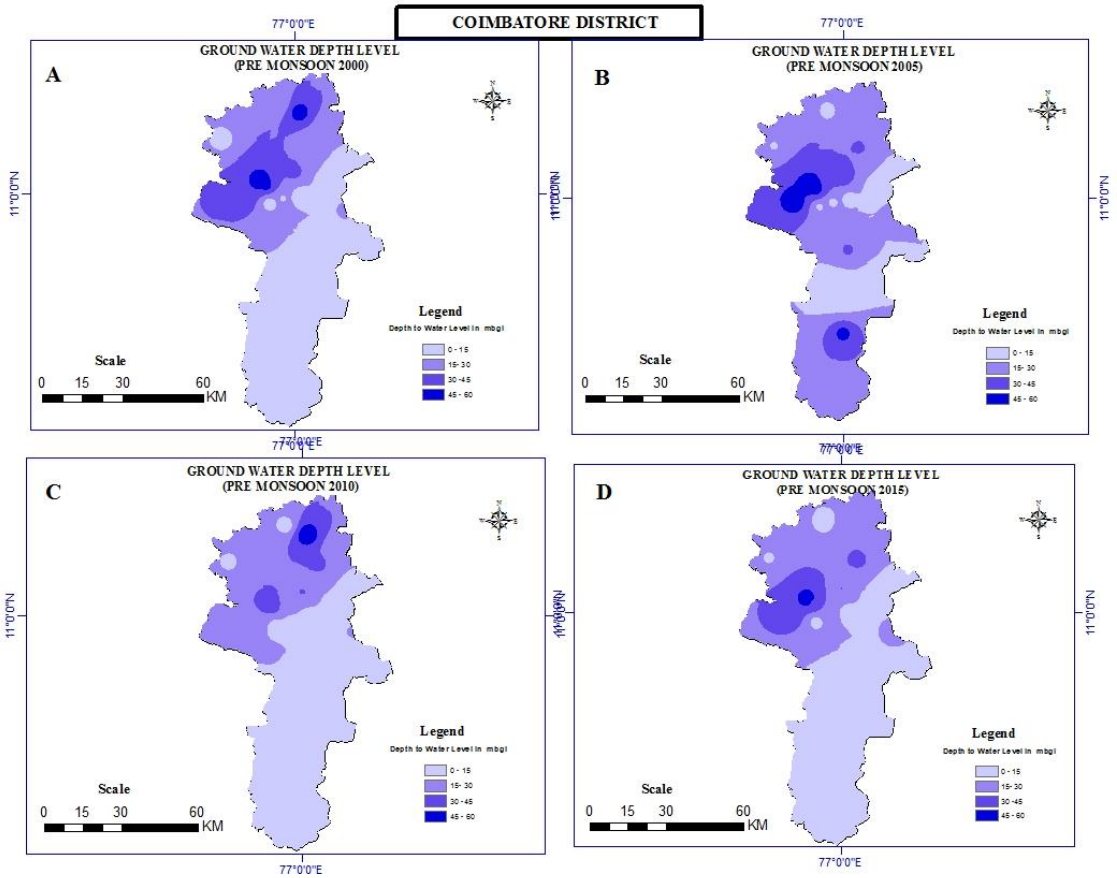

Figure 2: Groundwater Depth Level in Pre-Monsoon.

The depth of water from the surface is referred to as groundwater level. In the year 2000, the depth of the water level in the Coimbatore district during the pre-monsoon period in the southeastern region ranged from 0-15m, as shown in Fig. 2(A). Whereas the Northern part of the District especially areas like Pichanur, Annur-2, Ganesapuram, and Saravanampatti recorded 15-30m depth. 30- 45m was observed over Vadavalli, Tenponmudi, while 45-60m was recorded only in Kalvirampalayam. The Angalakurichi area showed a decline of the water table from 0-15m to 45-60m in Fig. 2(B). Overall, the area below 0-15m was significantly reduced in Fig.2(B). Based on previous observation water level 0-15m was slightly increased in the middle and southern part of Coimbatore district as in Fig. 2(C). In Fig. 2(D), the 0-15m depth

to water level was retaining same in the southern part and it has been slightly declined in the middle part of Coimbatore district.

Ground Water Level in Post-Monsoon

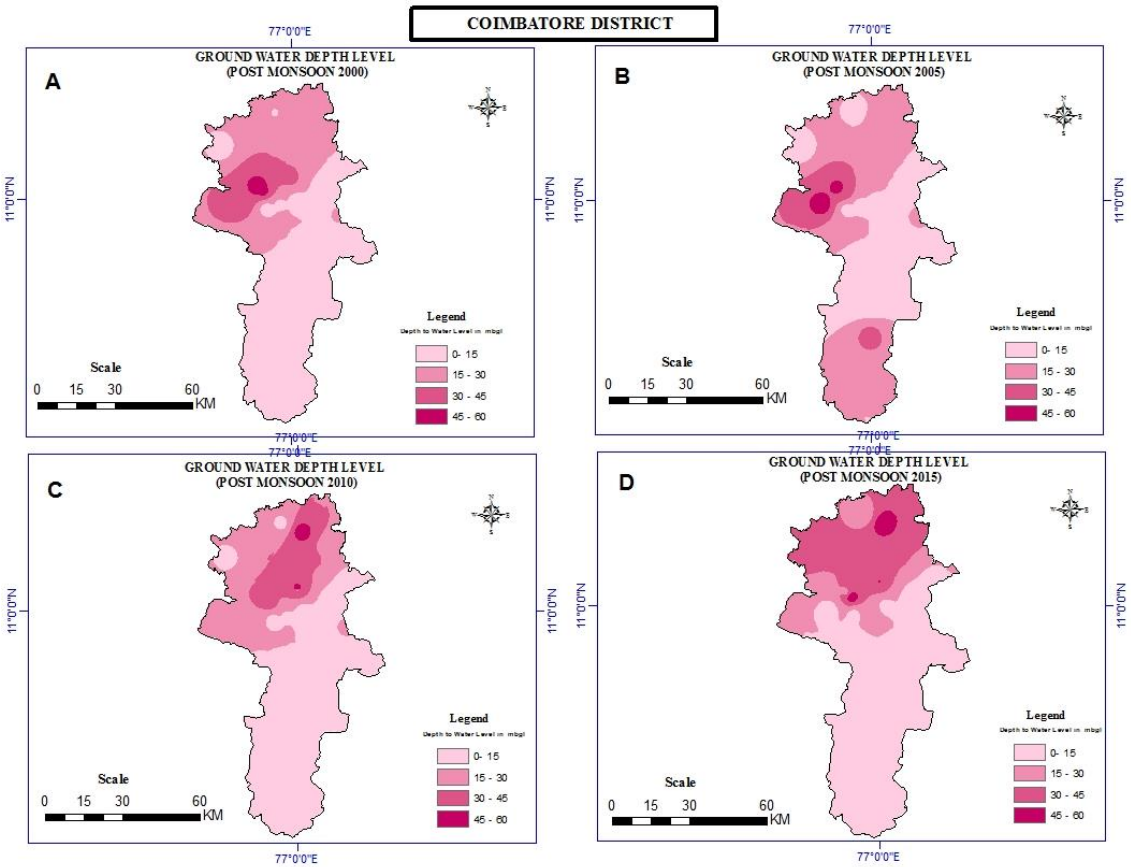

Figure 3: Groundwater Level in Post – Monsoon.

The depth of the water level in the post-monsoon period was analyzed from 2000 to 2015. Fig.3 (A) revealed that the depth to the water level in Kalvirampalayam ranges between 45-60m. 30-45m observed in Vadavalli and Thondamuthur. 15-30m was observed over Saravampatti, Ganesapuram, Tenponmudi, Pichanur, and Annur-2. Fig. 3(B) shows that there has been a major decline in the level of water in the southern part of Coimbatore district, especially in Angalakurichi and its surrounding areas. In Kalvirampalayam and Vadavalli water table has been declined. Fig. 3(C) reveals that the major parts of the southern region have retained the same as in Fig.3 (A). The water level at Kalvirampalayam ranges from 30-45m and in Thondamuthur 15-30m in Fig.3(D). The water level 0-15m has been slightly increased in the middle part of Coimbatore district.

The comparison of Pre-monsoon and Post-monsoon from 2000 to 2015 revealed that the decline in the water table was drastic by the end of the year 2005. The rainfall data clearly shows the decrease in the annual amount of rainfall received from the year 2005 onwards, which substantiates the lowering of the water table from 2005. However, from 2011 onwards, the district shows a slight increase in the amount of annual rainfall received, that is 1103.5mm in 2011 and 107mm in September 2014. This high rainfall has contributed to the increase of the water table in 2015. The analysis reveals that the depth to water level decreased by 3.6 m during the pre-monsoon period and increased by 11.13 m during

the post-monsoon period in 2015, when compared to 2000 data.

The depth to groundwater level has a direct relationship with the amount of rainfall and also to what land use the land is put to. The study reveals the fact that though the amount of rainfall increased the water table level in the areas Pollachi-1 & 2, Angalakurich, Ponnaiyur, Chinnaripalayam, Gopalapuram and Kinathukadavu. Water level has remained the same or even declined in the urbanized areas of Coimbatore city like Singanalur, Kuniyamuthur, Thondamuthur, Vadavalli, Sulur, Mettupalayam, and Annur, due to increasing population pressure and urbanization trends.

Land use Land Cover

In order to analyze the relationship between the usage of land and the decline of water table land use analysis of the study area was carried for a period of 15 years**.**

The study shows significant changes in Land Use from 2001 to 2016 which is explicit in Fig.4, 5, Graph.1, and Table.1. The area under water bodies increased from 0.54% in 2001 to 0.62% in 2016. The percentage of land used for agriculture also increased from 18.06 % to 32.15% in 2016. The land use under barren land shows a decreasing trend from 40.98%to 28.49% in 2016. The area under forest cover was reduced from 29.72% to 24.17%. The settlement was increased by 10.70% to 14.56%.

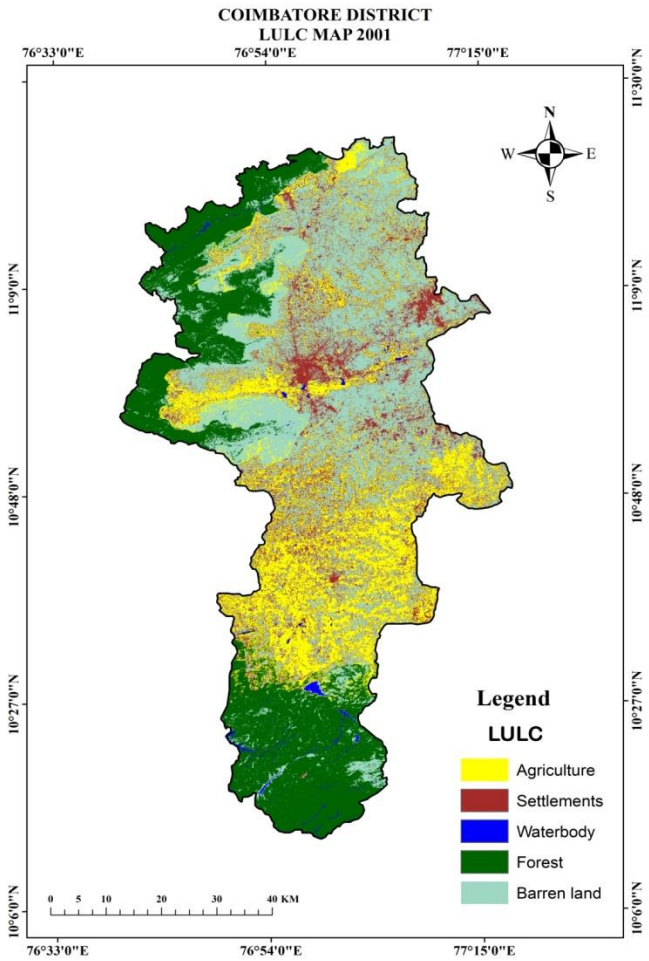

Figure 4: LULC 2001.

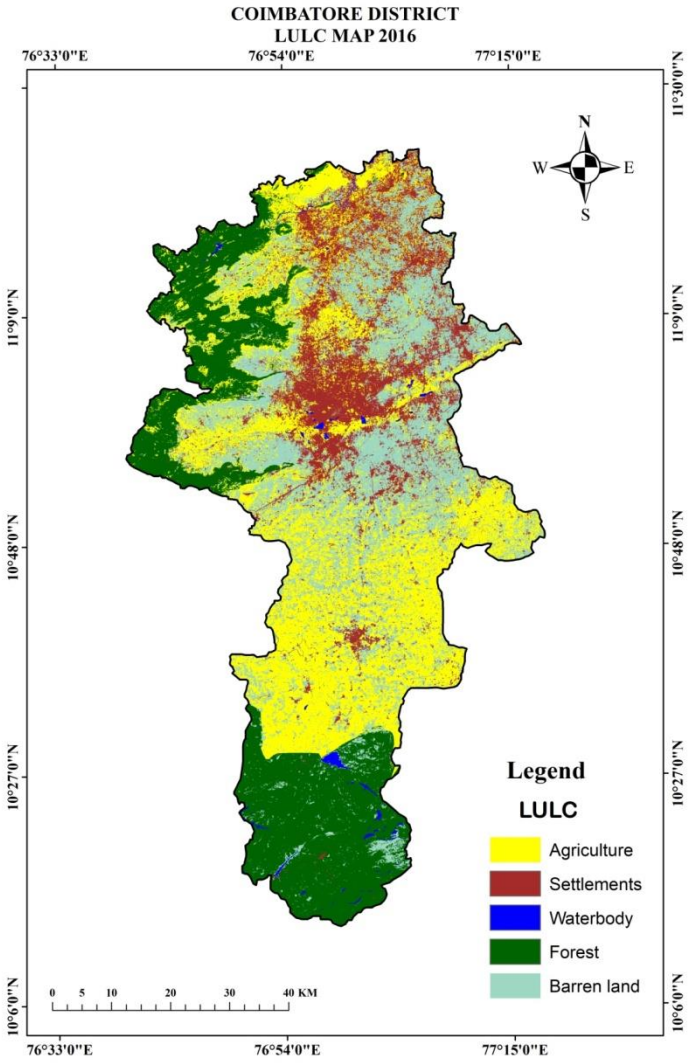

Figure 5: LULC 2016.

Table 1: LULC Changes from the Year 2001 to 2016

Feature	Area in sq km (2001)	Percentage of Land Area in 2001	Area in sq km (2016)	Percentage of Land Area in 2016
Waterbody	25.43	0.54	30.08	0.62
Agriculture	847.37	18.06	1551.53	32.15
Forest	1394.67	29.72	1166.70	24.17
Barren land	1923.40	40.98	1375.12	28.49
Settlement	502.16	10.70	702.65	14.56

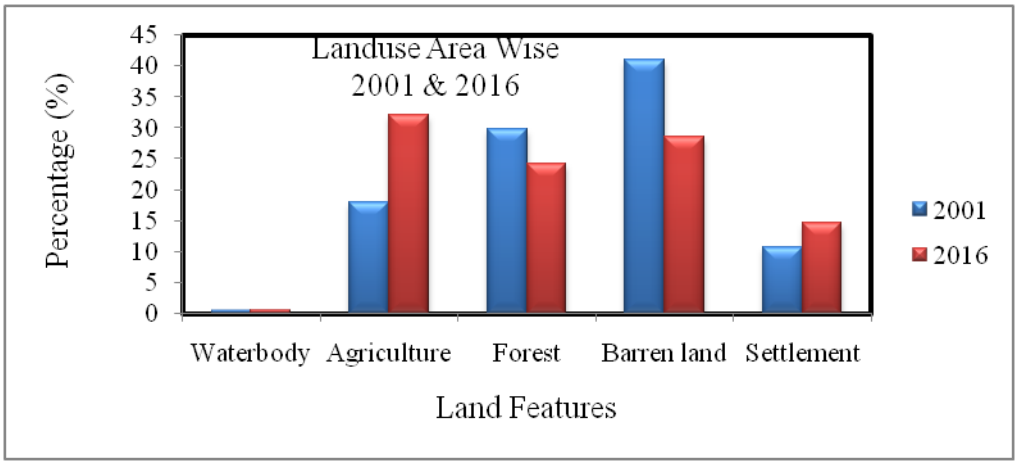

Figure 6: Area in Percentage under Different Land use Land Cover from 2001 to 2016.

CONCLUSIONS

The analysis reveals that the urbanization pressure on land use, barren land and forest areas have increased over the time period from 2001 to 2016. The built up area of Coimbatore City has expanded generally to all directions and specifically to the northern and northwestern part of the city, which implies the trend of urban sprawl. Because of the proximity to two industrialized districts (Tirupur and Erode) and one tourist hub (Nilgris), settlements in the center, northern and northwestern parts of this area have increased. Railways and National Highways such as NH 67, NH 209, and NH47 are well-connected. The construction of flyovers has also contributed significantly to the increase in the roadside settlement. The depth to water level was slightly increased post-monsoon. These positive changes can be credited to the increase in rainfall and availability of groundwater along the tanks by the efforts of Siruthuli, an NGO (which works towards protecting the water bodies of Coimbatore) started in 2003. The depletion of ground water during the pre-monsoon period in 2015 can be attributed to the pressure due to increase in agricultural land and settlement. So, water conservation and management is a pressing need, to avoid, a multitude of problems during our lifetimes and those of future generations. This study and the findings could assist planners in promoting water conservation strategy in a sustainable way.

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