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Prediction On Groundwater Qualityand Its Impacts On Urbanization Using Remote Sensing And Gis

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Abstract
Water assets, environmental quality, for example vegetation, greenery fauna, and geo-morphological attributes are a portion of the significant components of a watershed. Watershed wellbeing can be gotten through a portion of the aberrant measurements, for example, an adjustment in precipitation spillover reaction, exhaustion of groundwater, groundwater contamination and geomorphological degradation attributes. In the present study, the application of remote sensing and Geographic Information System (GIS) technologies have been demonstrated for assessment urbanization and its impact on groundwater quality over a period of the last 30 years (1995–2017). Investigation includes estimation of urbanization due to land use/land cover changes around the basin by knowing groundwater level, groundwater quality and rainfall. Remote sensing images of 1995, 2005 and 2016 have been used for extraction of land use/cover and urban growth. Groundwater analysis has been carried out in GIS to determine the change in groundwater and rainfall level and quality for a period of 1995, 2005 to 2017. Based on GWI, in both pre monsoon and post monsoon the groundwater was not polluted in upstream areas of the study area and it was vigorously dirtied simply subsequent to entering the Sarkar Samakulam zone of Coimbatore locale and proceeds till the finish of the investigation territory.
KeyWords : *Urbanization, Groundwater Quality Index (GWI), Land Use Land Cover, Rainfall, Water Level*

INTRODUCTION

Assessing land use/land cover change is necessary for conservation, safeguarding and managing water resources to fulfill the expanding need for human needs and government assistance without negotiation of water quality (Ang Kean Hua 2017). While the process of urbanization has important implications for changes in demographic characteristics and transformation of the physical landscape, unplanned, unsystematic and rapid urbanization can cause profound impacts on various environmental components, especially on land and water. A detailed comprehension of the elements of urbanization incited land-spread change is, thusly, vital for adapting to ecological changes and encouraging maintainability (Suman Patra et.al, 2018). This is so particularly because most of the urban areas in the world have experienced considerable land-cover changes over the years. There are several studies which related to environmental problems and degradation of ecosystems through pollution of air, water and land (Wang et al., 2016, Battista and de Lieto Vollaro, 2017, Rubia Khan 2018), urbanization and LULC changes (Sajjad and Iqbal, 2012, Alqurashi and Kumar, 2017), urbanization and changes in groundwater level (Khazaei et al., 2004, Wakode et al., 2018) and LULC changes in the watershed (Butt et.al.,2015, Boori and Vozenilek 2014, Wright and M. C. Wimberly2013). Urbanization and industrialization in groundwater (Gumma et al., 2011) withdrawal of groundwater in most of the States in India for both agricultural and industrial use has been more(Jat et al. 2005). Therefore, it is essential to assess the impact of urbanization on the quality and quantity of groundwater for its optimal utilization and sustainable environment. The current investigation is valuable in recognizing the expected dangers to groundwater of zone, and to create a water asset information base for general advancement on a manageable premise, which can support metropolitan organizers and choice settles on for the approach choices.

Stream Noyyal is a feeder of Cauvery that lies in the territory of Tamil Nadu and it is an occasional waterway that has great stream just for brief periods during the upper east and southwest storms. The stream length of the waterway bowl is 180 Kms with a wide of 25 km. Geographical Position of the waterway bowl is from North scope 10° 54' - 11° 19' 03" to East longitude 76° 39' 30" - 77° 05' 25 and the total area is 3,510km^2 with a agriculture Area of 258,834 hectares (including a groundwater irrigation area of over 30,000 acres). Annual average rainfall is in the basin is 700 mm. Noyyal is very urbanized with a complete population of forty two lakhs, over seventy five percentage of resides in eighty six urban settlements, with the remaining twenty five percent residing in two hundred and forty three villages (Census of India, 2011). Total population within the basin doubled in 20 years, from 19.5 to 42 lakhs from the year 1991 to 2011 respectively. As a result of heavy urbanization, land use within the basin has moved far away from agriculture towards urban and industrial uses, reflecting the changing nature of occupations.

METHODOLOGY

The watershed approach has been used in the present study for the estimation of changes in groundwater contamination and to study the impact of urbanization on groundwater quality. To identify the changes in groundwater quantity, land use/ land cover, rainfall, water level were used and boundaries of the river basin are digitized using SOI toposheets for the scale of 1:50,000. Land use and land cover map was prepared by using Multi-spectral satellite imagery of the Landsat 8, Indian Remote Sensing (IRS 1D) LISS-III and LANDSAT, for the years 2017, 2005 and 1995 respectively by using ERDAS imagine software. The secondary data like rainfall and water level data were collected from state ground and surface water resource data centre, Tamil Nadu, for the year 1995, 2005 and 2017 and were plotted on a topographic base map. To study the impact of urbanization on groundwater quality, 63 samples were collected in the month of January and June for the years 2005 and 2017 and for the year 1995it was collected in the state surface and groundwater resource data centre. Totally eleven physicochemical parameters were analysed in that Seven parameters recommended by WHO for drinking water quality were used for calculating GWI and they are Cl-, Na, Ca2, Mg_2, SO_4-, TDS and NO_3. Finally, all layers are integrated together to assess the impact of urbanization on groundwater in terms of land use/ land cover, rainfall, water level and GWI, spatially and temporally using simple overlay analysis in GIS.

RESULT AND DISCUSSION

Land Use /Land Cover

Land use land cover change of the study area has been done by using ERDAS Imagine 8.4 based on supervised classification using National Remote Sensing Agency (NRSA 1995) classification system for the years 1995,2005 and 2017 detail of satellite images are shown in table 1and land use classification are shown in fig 1,2 and 3. The interpretation of the images was done by its characteristics such as shape, size, shadow, pattern, tone, texture slope, association and location. The classification was based on the recommendations given by the NRSA, Department of space, Government of India. Based on the visual interpretation and the available collateral data the land use /land cover for the study area was made into 10 categories.

Table 1 Detail of Satellite Images

S.No	Data type	Sensor	Date of acquisition	Resolution
1	LANDSAT_8	LISS IV	29.03.2017	30m x 30m
2	IRS ID	LISS III	13.02.05	23.5 x 23.5 m
3	LANDSAT TM	Grid N-44-10	11.3.1995	30m x 30m

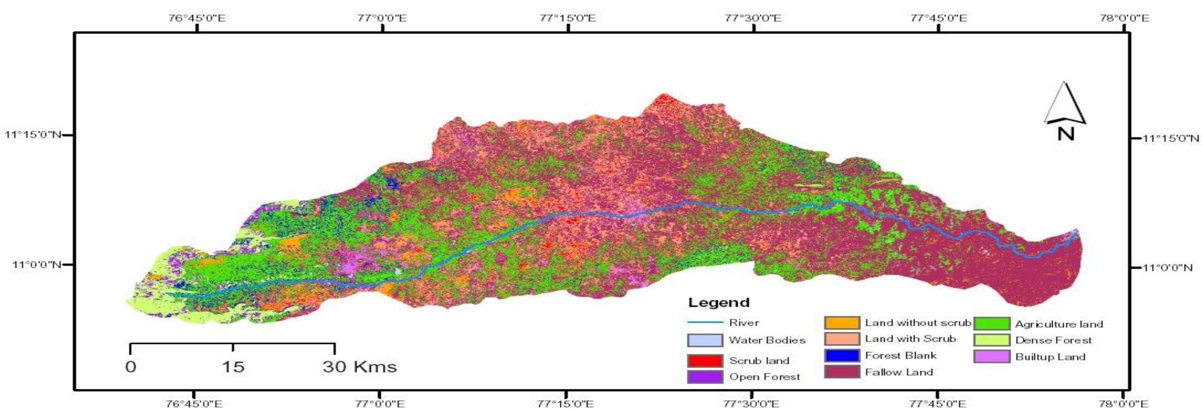

Figure 1 Land Use Classification of 1995

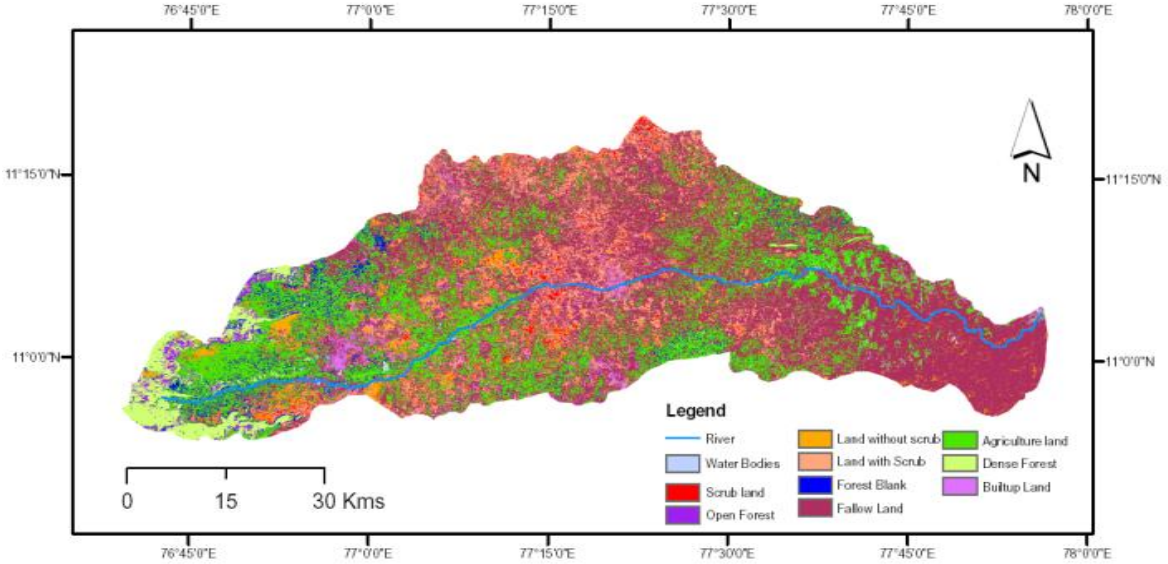

Figure 2 Land Use Classification of 2005

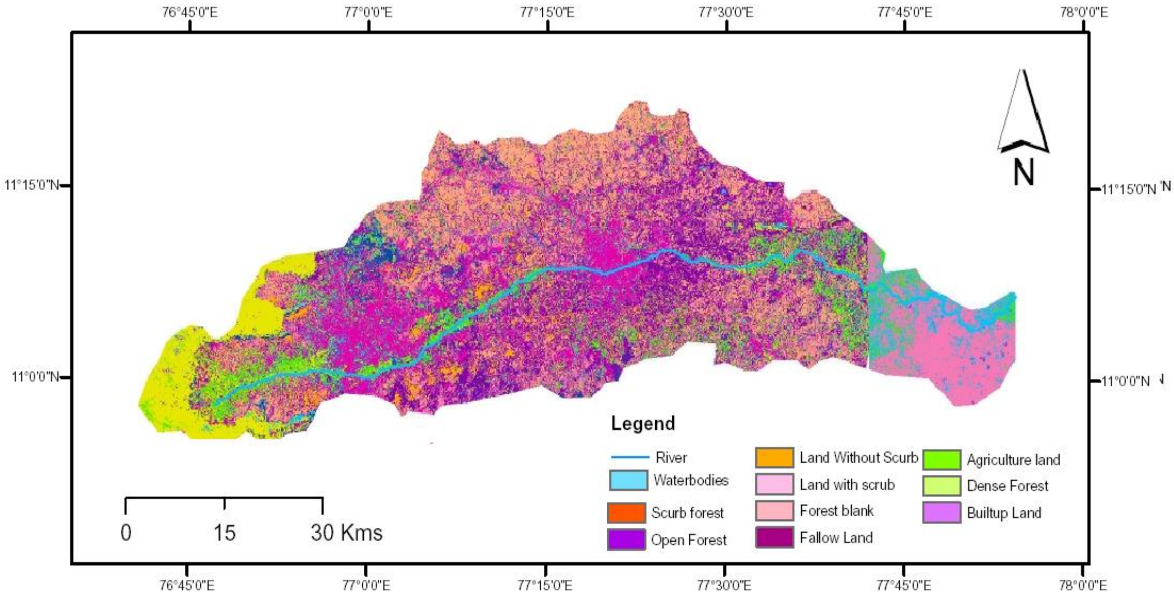

Figure 3 Land Use Classification of 2017

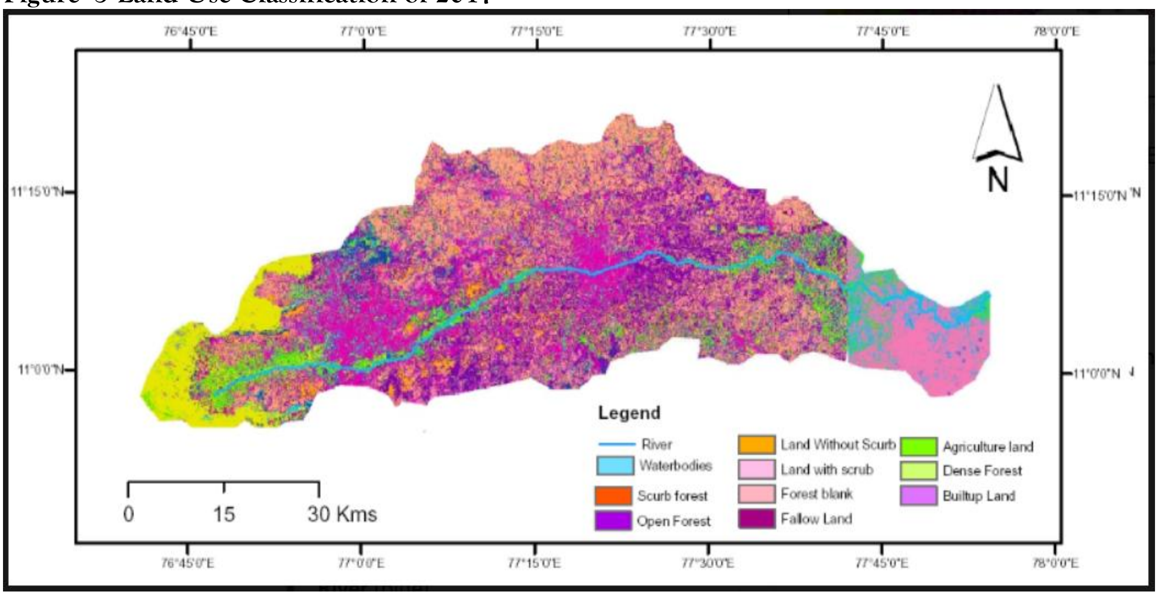

Figure 4 Land Use Classification of 2025

Table 2 Land Use Statistics for the Year 1992, 2005 and 2017

Description	1995		2005		2017	
	Area in Sq.Km	% of Area	Area in Sq.Km	% of Area	Area in Sq.Km	% of Area
Built up land	2	3.24	316.57	9.02	629.19	17.9
Fallow land	1631.55	46.48	107.04	3.05	564.52	16.1
Land with scrub	400.72	11.42	1073.32	30.58	733.32	20.9
Land without scrub	120.42	3.43	661.87	18.86	67.23	1.9
Water bodies	12.68	0.36	17.94	0.51	12.4	0.4
Agriculture land	891.8	25.41	431.27	12.29	265.13	7.6
Dense forest	130.03	3.70	75.25	2.14	355.8	10.1
Scrub forest	56.72	1.62	633.95	18.06	12.13	0.3
Forest blank	110.07	3.14	107.04	3.05	186.82	5.3
Open forest	42.18	1.20	85.28	2.43	683.21	19.5

From the table2 and figure 4 , it,s shows that, the built up land has increased from 113.84 sq.km, 316.57 sq.km to 629.19 sq.km from 1992, 2005 to 2017 respectively with a percentage change of 3.24 to 17.9 from 1995 to 2017 with an average increase of1.06 sq.km. The study shows that there is a remarkable growth in and around the river basin between 1992 to 2017 because of agricultural land and scrub land has been lost to built-up land during this period. Fallow land of the study area has been reduced by 43.43% between 1992 to 2005 and again it was increased by 13.05 in 2017 and converted either as agriculture land or forest land. Land with scrub and Land without scrub is increased in 2005 compared to 1995 from 400.72 and 120.42 to 1073.32 and 661.87 sq.km respectively with a percentage increase of 19.16 and 15.43 and again it was decreased in 2017 at a percentage of 9.68 and 16.69 due to change of fallow land and buildup land. The negative changes were observed in agriculture and it decreased about 891.8 sq.km to 265.13 sq.km at a percentage of 17.9 due to industrialization and urban development and it causes severe losses. The water bodies are a little bit changed from 1995 to 2017 may be due to the discharging of industrial and domestic effluent. Dense forest and forest blank were an increase in 2005 and 2017 compared to 1995 at a percentage of 10.5 and 5.1respectively. The open forest was continuously increasing from 1995 to 2017 at a percentage rate of 18.3 due to converting agricultural land, land with or without scrub. For identifying the change of water quality, land use/ land cover was classified into three categories as Good (Crop land, Fallow land, Water bodies, Land without scrub), Moderate (Scrub forest, Land with scrub) and Bad(Built up land, Forest blank).

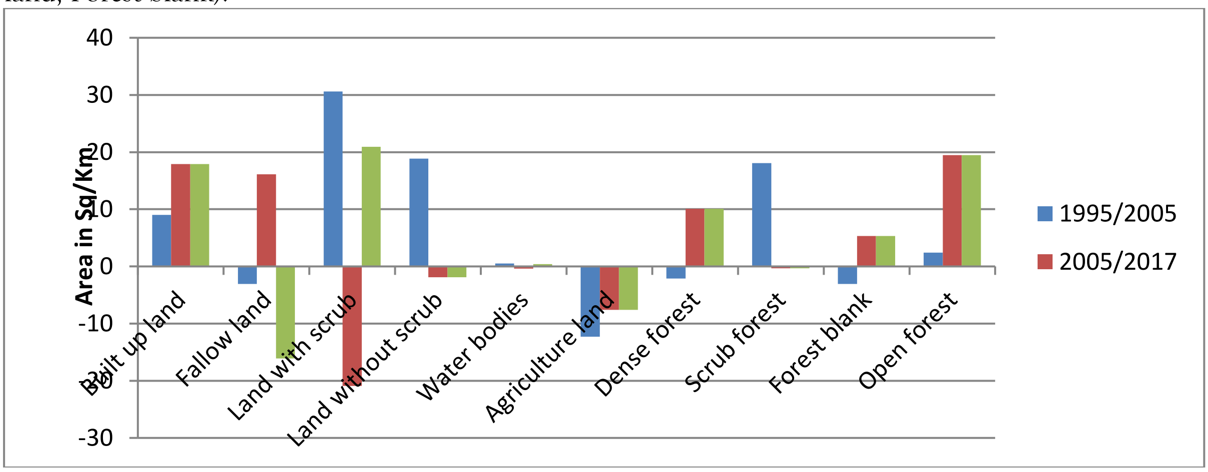

Figure 5 Land Use Statistics for the Year 1992, 2005, 2017 and 2025

Conclusion

The land use and landcover considerable changes shows the expansion of nearly three to four times at the area of build up land, land with scrub, dense forest and open forest . As regards the land use classes, over the past 22 years, an urban built-up area has increased by 3.24 to 17.9 from 1995 to 2017 with an average increase of1.06 sq.km In 1995, fallow land and agriculture and it was changed as build up land, land with scrub, dense forest and open forest in 2017 were the dominant types of land use land cover, and most of the urban settlements were concentrated in the centre part of the river basin. Furthermore in 1995 to 2017, the total area of Fallow land reduced from 46.48 to 16.1, Agriculture land 25.41 to 7.6, Scrub forest from 1.62 to 0.3%. The GQI of pre monsoon and post monsoon samples state that 15% and 27% of the total groundwater samples are good, 12 and 20 % are poor and 75 and 53% are moderate quality for the year 1995. GQI of pre monsoon and post monsoon samples state that 9% and 19% of the total groundwater samples are good, 12 and 34% are poor and 79and 47% are moderate quality for the year 2005. GQI of pre monsoon and post monsoon samples state that 11% and 8% of the total groundwater samples are good, 22 and 43% are poor 67and 49% are moderate quality for the year 2017. There is no remarkable change in the correlation pattern among pre monsoon water quality parameters and among the post monsoon water quality parameters. It can be concluded that the cause for groundwater quality difference between the seasons is the dissolution of chemical concentration of the water solution due to rainfall and water level. Spatial distribution of groundwater quality changes shows that the area of distribution of excellent groundwater is more in pre monsoon season and less in post monsoon season. It is also found that that 15%, 12% and 60% of the total area were contaminated 1995,2005,2017 and 2025 respectively. Impact assessment of land use on groundwater quality, rainfall and water level revealed that the contamination is expanding is having most extreme impact from land-use conditions, likely on the grounds that the developed land open woodland are abundantly spread over the whole area. Settlements, in any case, show a more prominent worldly inconstancy of groundwater quality.

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