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Measurement of quality and quantity of ground water in Belagavi city Karnataka state: An analysis

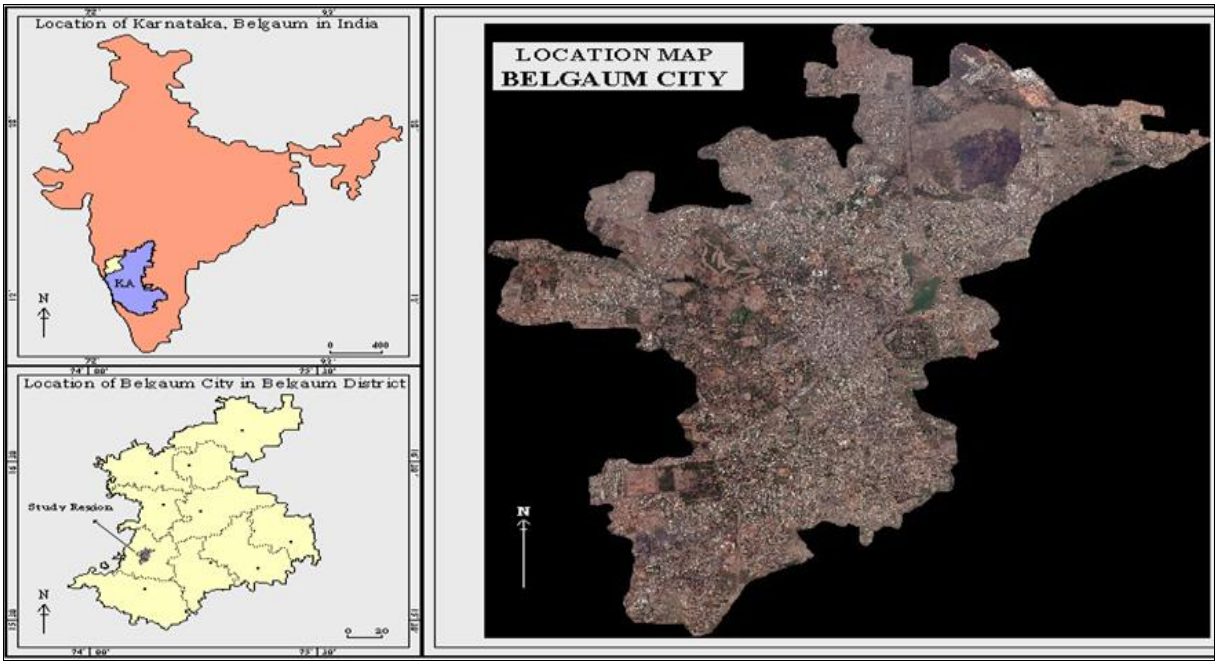
Dr. MS Kurani
Assistant Professor, Department of Geography, RPD College of Arts and Commerce, Tilakwadi Belagavi, Karnataka, India

Abstract
In recent years, the increasing threat to groundwater quality due to human activities has become a matter of great concern. A vast majority of groundwater quality problems present today are caused by contamination and by over-exploitation, or by combination of both. Rapid urbanization and industrialization in India has resulted in steep increase of generation of wastes. Due to lack of adequate infrastructure and resources the waste is not properly collected, treated and disposed; leading to accumulation and infiltration causing groundwater contamination. The problem is more severe in and around large cities as also various clusters of industries.
This paper attempts to analyse impact of urbanization and growth of industries on quality of ground water in Belagavi city due to the urbanization and and growth of industries in Belagavi city. The study area is located in south western part of Belgaum district and extended between 15 - 15' north latitude to 74 -31' east longitude at an height of 710 mtrs above the mean sea level. The total geographical area of the city is about 94.08 sq. kms, It is fifth biggest city among the cities of Karnataka state in terms of area and population and also district and divisional head quarters of the state.
The results indicates except Peeranwadi, all other hydrographic sations showing falling trend in the range from 0.25 to 9.50m.Ground water is acidic in nature with Ph of 4.41 and nitrates are beyond permissible limit at INDAL, Udyamabhag and Yamanapur areas.

Keywords: Ground water quality, industrialization, over exploitation, urbanization

1. Introduction
Groundwater plays a fundamental but often unappreciated role in the economic and social wellbeing of urban areas. Although there are no comprehensive statistics on the proportion of urban water supply derived from groundwater, it has been estimated (Foster *et al*., 1998) [10] that more than 1 billion urban dwellers in Asia and 150 million in Latin America probably depend directly on groundwater. Urbanisation as a driving force The increasing size and populations of cities and towns by natural growth and by migration from rural areas is a major driver of environmental change. During the twentieth century, the world's rural population doubled but the urban population increased more than tenfold (WWAP, 2006). In the second half of the twentieth century, most of the world's urban population growth was in low- and middle-income countries. By the year 2000, Asia alone had nearly half of the world's urban dwellers and more than half of the cities with one million people. Half of the world's population now lives in cities, compared to 15 per cent in 1900, and there are now almost 400 cities with more than
Urban areas affect the behavior and characteristics of ground water. The aquifers are not able to meet the quality and quantity of water needed by the growing population which is growing at the rate of 25per cent per annum. Urbanisation leads to decrease of recharge due to paving and soil compaction, progressive urbanization, Use of the flat areas for roads, motorways factories and new buildings reduce recharge. Due to tar dumping of plastic bags and covers leads to progressive inundation and flooding. Urbanization has a series of effects on ground water quality and quantity. A common result that it is an increase of dissolved nitrogen compounds, increase in total dissolved solid as a consequence of additional salts.

2. Study region
Belgaum is referred to as "venugram" (Bamboo village) in the early inscription of 12th and 13th centuries. It is located in sourth western part of Belgaum district and extended between 15 - 15' north latitude to 74 -31' east longitude at an height of 710 mtrs above the mean sea level. the total geographical area of the city is about 94.08 sq. kms, It is fifth biggest city among the cities of Karnataka state in terms of area and poplutation and also district and divisional head quarters of the state.



3. Objectives

The main objectives of the present study analysis are as follows

1. To highlight ground water regime condition in the study area
2. To analyse chemical constituents present in the ground water in Belagavi city
3. To examine impact of industries on quality of ground water in the study area

4. Data source and methodology

In this part of the study we have made an attempt to analyse impact of urbanization and industries on quality of ground water in Belagavi city **T**he required data for the present study analysis have been obtained from both primary and secondary sources The secondary sources of data has been collected from offices like CGWB Belagavi, Muncipal corporation, BUDA, CPCB Belagavi, Environmental survey, CPCB report etc. The field survey/observation has been made in selected wards and same has been incorporated in the present study analysis. The collected data have been classified, processed and presented in the form of different cartographical and GIS techniques

5. Ground water regime conditions

Ground water occurs in weathered zones, fractures and joints of these formations under phreatic and semi confined conditions. The occurrence and movement of ground water is controlled by vesicular and through secondary porosity developed by weathering joints and fractures and topographic configuration Because of heterogeneous nature of weathering and in consistent distribution of joint and fractures the rocks have varying yields ranging poor to moderate discharge. The depth of weathering varies from 1.0 to 12.0 meters. The laterites capping over weathered ones varies from 1.0 to 12.0 meters. The late rites capping over basalts extend up to the depth of 15m.

The depth of water level varies from 3.00 to 22.50 mbgl. Depending upon topographic set up, wells vary from 7.0 to 30.00 m bgl. The hydrogeological data of wells inventoried in and around Belgaum city is presented in the table no 1. The pre - monsoon levels varies from 1981.10 to 18.05 in Belgaum in and the post monsoon period around the city. The locations of these stations are shown in the hydro geological map of Belgaum city. The trend of water level of yamnapur, Nehrunagar, Kuduchi, Khasbag, Ganeshpur, Cantonment, Angol, Udyambag Tialakwadi Cross are shown in table while other areas show falling trend in the range from 0.25 to 9.75. The highest recorded is at Ganeshpur in the western part of the city. Ground water is presently developed through dug wells and bore wells. Dug wells are the most common ground water abstraction structures in the region. There is wide variation in yields (LIto 51 ps) of dugwells and borewells. Majority of Industries in and around the city are catering to their needs through bore wells.

Table 1: Water level trends of National Hydrography stations in Belgaum City – 2015

S. No	Location	Source	Use	Depth (mbgl)	DTW (mbgl)	Dia (m)	MP (magl)	Formation
1.	Yamnapur	Dug well	D	14.00	13.50	4.00	GL	B
2.	Nehru Nagar	Dug well	D	10.00	9.00	2.00	0.50	B
3.	Kuduchi	Dug well	D	7.00	3.00	1.00	0.60	L
4.	Khasbag	Dug well	I	12.30	8.00	1.20	0.60	B
5.	Ganeshpur	Dug well	D	30.00	22.50	1.20	0.60	L
6.	Cantonment	Dug well	D	14.25	13.00	2.00	0.50	L
7.	Shahapur	Dug well	D	11.00	7.00	2.00	1.00	L
8.	Tilakwadi	Dug well	D	17.00	15.00	2.00	0.60	L
9.	Udyanbag	Dug well	I	14.30	14.00	1.30	0.50	L
10.	Angol	Dug well	D	15.00	13.00	2.00	0.40	L
11.	Majagaon	Dug well	D	12.00	11.00	1.20	0.50	L

D=Domestic I=Irregation B=Basalt L=Laterite. ***Source*** = (District Geological Department)

6. Groundwater quality in Belgaum city

For evaluation of ground water quality 15 water samples were collected and their analysis has been presented in Table No.6.8. In major part of the city underground water is fresh and soft turned into alkaline Calcium, Mangnesium and Bicarbonate type, free from chloride and fluoride except at a few industrial locations. The range of chemical constituents present ground water is shown in Table No 1. PH is varying from 4.41 to 9.20 except at INDAL (Where ground water is acidic in nature with PH of 4.41) in other water samples it is alkaline in nature. EC I varying 80 to 5240 micro.-mhos cm at 25^0C high E.C values are recorded at INDAL.

Table 2: Range of Chemical Constituents in Ground Water Samples of Belgaum City.

Sl. No.	Chemical constituents	Range
1.	PH (ion Concentration)	4.41 to 9.20
2.	Ec (micro-mhos/cm at 25^0C	80 TO 5240
3.	Ca (in ppm)	10 to 204
4.	Mg (in ppm)	2 to 95
5.	Na (in ppm)	4 to 1200
6.	K (in ppm)	0.2 to 32
7.	Co_3 (in pm)	Nil to 530
8.	KCO_3 (in ppm)	12 to 1710
9.	Cl (in ppm)	14 to 567
10.	So_4 (in ppm)	2 to 1260
11.	No_1 (in ppm)	Nil to 112
12.	TH as Ca Co_1 (in ppm)	35 to 900
13.	F (in ppm)	Nil to 2.8
14.	SAR	1.37 to 223

***Source*:** Dr. D. R. Reddy Scientist 'B' State unit office central ground water Board, Belgaum.

6.1 Nitrates

The majority (87%) of water samples don't show the presence of higher concentration of nitrate. Normally the ground water when not polluted contains less than 45 ppm of nitrates. Nitrate hazards in ground water in the city are cause of concern. The slums and waste disposal areas cause nitrate pollution. Nitrates are beyond permissable limit at INDAL, Kuduchi and yamnapur. Sources of nitrates in surface and ground water are fertilizers runoff from agricultural land, decayed animal matter and vegetables, domestic effluents, sewage, sludge disposal on land and industrial discharges. Nitrate concentration of water source may result from a direct or indirect discharge. It may be due to the percolation (Seepage) over a period of time.

6.2 Flouride

In most of the surface and ground water, the concentration of F is approximately in the range of 0.5 to 1.5 mgl. Concentration of high F in streams due to soil and on some occasions because of through industrial discharges. Higher concentration of fluoride is observed at INDAL and Nanawadi.

6.3 Sulphate

Sulphate concentration varies from 2 to 1260 mg / lit Higher concentration of sulphates is recorded at INDAL. and Nanawadi.

7. INDAL (Indian aluminium company Ltd.) and its impact on ground water quality

It is situated in the northern part of the city. The plant has been processing bauxite of 587 KT to extract aluminum for more than 3 decades since 1970. The process for obtaining aluminium from bauxite is basically a chemical process, which involves many operations like steam generation, wet grinding, digestion, filteration precipitation and calcinations. Refined alumina generates dust and large quantity of alumina. Mud is pumped into ponds which may lead to contamination of ground water through the seepage and surface water by overflow of rainwater. The residual alkali content reduce these areas unsuitable for production use like agriculture. During fused salt electrolysis of alumina fluoride fumes gases particulate matter are, given out, which are harmful to vegetation animal and human health spent cathode lining is also a source of pollution because of various harmful elements in it. In the aluminium smelters, the common and most hazardous pollutant is fluride especially as gaseous fluoride in air, Soluble fluoride in water and fluoride in plant which function as a sink. The fluoride emission problem becomes more acute especially when smelters are located in the neighborhood of fertile agricultural land.

The environment issues associated with the INDAL plant are:

- High fluoride level in the effluent water, which is form smelting and cryolite recovery.
- The quality of surface and ground water near the plant is polluted.
- The ambient air quality deteriorated, due to SPM, RPM SO_2 and No_2, which are high in the vicinity of the plant and
- Effluent drainage water is collected at two places-lagoan and Kanabargi pond. These are domestic and industrial effluents and are being treated through recycling plant. The waste water generated from the colony is used for the irrigation of forests created by INDAL.

7.1 Water Pollution

Population pressure and growing food needs along with urbanization have created enormous environmental problems. Though urbanisation is considered to be a part of economic development, it causes much environmental degradation, which includes - mushroom growth of slums, lack of sewage and drainage facilities untreated industrial effluents, increasing number of vehicles. The water quality

varies from season to season and it would deteriorate in the pre-monsoon season. Both surface and ground waters is polluted with garbage, industrial hazardous wastes, industrial effluents, untreated wastes etc. Level of nitrates in the cities water is 3 times higher than the normal level. Land surfaces have been environmentally degraded and polluted and affected by industrial and toxic wastes, which are dumped. The use and throw culture has created large accumulation of garbage containing non-degradation substance like plastic.

The Bellary nala is polluted with sewage and garbage. Growth of slum in cities causes worst environmental problem, with the absence of basic amenities, like sewage, the slums are very unhygienic with filthy atmosphere. The squatter settlements in general have no facilities of sanitation, drainage and garbage disposal. Open untreated industrial effluence passing through the heart of the city through Bellary and Lendi nalas and Fort tank and Kapileshwar tanks are polluted by drainage water and garbage and giving foul smell in the city areas.

8. Suggestions

The measures suggested to Urban planning and development. And also to improve the quality of urban environment.

1. Overpopulation is the root of all pollution problems. The total impact on environment is simply proportional to total population. The population control is needed both in urban and rural areas. There is also need for checking rural to urban migration by providing employment opportunities and better civic amenities.
2. Industrial waste water is to be treated and reused on conservation of water and reduction of pollution of nearby surface water. Recycling of industrial wastes and treating of industrial effluents.
3. The indiscriminate exploitation of groundwater and other natural resources like agricultural, pastoral, grazing and forest lands also to be preserved. Provision of storage facilities for rainwater harvesting in each house, and making it mandatory by the corporation. Increase of percolation tanks in different parts of the city to augment the water levels in wells /tube wells with the supply of drinking water.
4. There is need of preservation of land for green areas, recreation, lakes and ponds and parks and playgrounds etc.

9. Conclusion

Urban growth has affected the quantity and quality of ground water. Rainfall is seasonal and large number of people concentrating is responsible for over exploitation of ground water, wells are becoming dumping pits and water from tube wells is not potable because of the presence of chemical pollutants like nitrates. At places where bore wells are adjacent to industrial effluents the ground water is highly polluted and is not fit for drinking purpose. Letting in of untreated sewages in to the waters hurt human health directly or indirectly and environment. There is need to change the life style and outlook of urban people. Every urbanite should think that it is his sacred and patriotic duty to preserve environment for the benefit of one and all. One should develop a consciousness of the preservation is considered to be fundamental duty of each and everyone.

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