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# Geomatics for Land Use/Land Cover and Water Quality Changes

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## ABSTRACT

Water is essential to people and the largest available source of fresh water lies underground. Increased demands for water have stimulated exploration of underground water resources. Water resources get polluted due to rapid industrialization, advancement in agricultural techniques, increasing population and other adverse impacts of environments. All these factors may result in changing the hydrological cycle. The urban environmental quality always depends on the usage of land. The quality of the environment is determined by studying the land use features and their impacts are analyzed. In present study an attempt is made to evaluate the impact of landuse / landcover on ground water quality of Zone VII under Greater Hyderabad Municipal Corporation (GHMC) area. Various thematic maps are prepared from the toposheet on 1:50000 scale using ArcGIS Software. The landuse / landcover map of the study area is prepared from the linearly enhanced fused data of IRS-1D PAN and LISS-III satellite imagery by using Visual Interpretation Techniques.

Ground water samples were randomly collected at pre-determined sampling locations based on satellite imagery of the study area. All the samples were analyzed for various physico-chemical parameters adopting standard protocols for the generation of attribute data. Based on the results obtained maps showing spatial distribution of selected water quality parameters are prepared for the study area.

The variations in the concentrations of water quality parameters indicated high concentrations of Alkalinity, TDS, Fluoride, Hardness, Nitrates are exceeded the permissible limits while other parameters like Sodium, Sulphate and Chloride were within the permissible limits except in few areas like Golnaka, Imlibun, Kamalanagar etc., which may be attributed to seepage of domestic wastes through open nallahs and industrial wastes. The water quality index (WQI) in the study area is calculated to determine the suitability of ground water for drinking purpose. Different ratings of water quality have been observed which indicated deteriorating quality of ground water. Control and remedial measures for the improvement of ground water quality in the study area are suggested.

**Keywords:** Water Pollution, Land Use/ Land Cover, Remote sensing, GIS, Spatial Maps.

## I. INTRODUCTION

Hyderabad city, the capital of the state of Telangana is located at the heart of the Deccan plateau of the Indian sub-continent. Hyderabad urban agglomeration area covers one fifth of the total urban area of Telangana state. The increase in population and built up area, the pressure has increased on the civic amenities and is directly affecting the quality of environment. The two main reasons of the study are rapid growth in population, uncontrolled industrialization and unchecked immigration. Study area is shown in Figure 1.

Ground Water Contamination: Many human activities such as urban development, industrial processing,

agricultural practices, chemical spills, commercial/domestic wastes and household septic systems cause significant ground-water contamination in areas that previously had clean, potable ground water.

## OBJECTIVES OF THE STUDY AREA:

1) Assessment of impact of Landuse / Landcover on ground water quality in the study area
2) To analyze the estimated ground water quality and its suitability for drinking purpose.
3) Determination of water quality index by using statistical approach.
4) To create spatial maps for water quality and highlight the areas under environmental stress.

## II. MATERIALS & METHODOLOGY

Source of Data Products: Satellite data from National Remote Sensing Centre (NRSC) (IRS-ID LISS-III + PAN), Toposheets of 1:50,000 scale from Survey of India (SoI), water samples are collected from the study area.

The methodology considered for the analysis of environmental impacts on urban conglomeration of part of Hyderabad City i.e. Zone-VII (study area) is basically a five steps process. They are as following.

(i) Spatial digital database and Attribute digital database creation.
(ii) Integration of spatial database and Attribute database.
(iii) Estimation of Ground Water Quality and Water Quality Index.
(iv) Preparation of Spatial distribution maps for the study area using water quality data.
(v) Comparison of Land Use/Land Cover and Ground Water Quality changes.

## III. RESULTS

1. Land Use / Land Cover Map: Comprehensive information on land use / land cover is the basic prerequisite for land resources evaluation, assessment, utilization and management (Figure 2). Today, with increasing population pressure on land and the resulting changes in the land use pattern and processes, a considerable degree of land transformation and environmental deterioration is being witnessed (Table 1). Therefore it is important to understand the cause and effect of the changes through scientific studies.

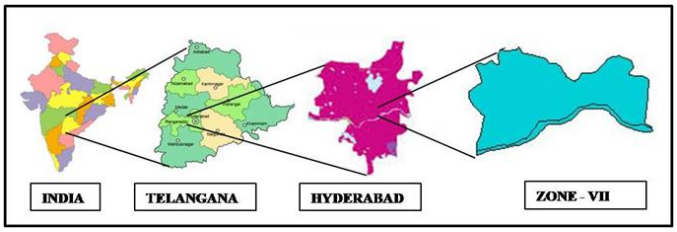


**Figure 1.** Location Map of the study area

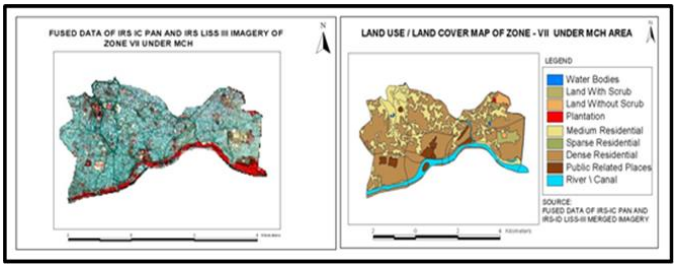


**Figure 2.** Satellite imagery and Land use / Land cover classified map of the study area

**Table 1:** Existing Landuse Pattern of the study area

| LAND USE class | AREA in Sq.Kms |
|---|---|
| Water Bodies | 7.053 |
| Land with scrub | 10.678 |
| Land without scrub | 9.505 |
| Plantation | 0.303 |
| Barren sheet area | 9.36 |
| Medium residential | 36.103 |
| Sparse residential | 16.691 |
| Dense residential | 77.986 |
| Public related places | 1.74 |
| Quarries | 0.3 |
| Agricultural land | 1.605 |
| Rivers | 3.422 |

| | |
|---|---|
| Industries | 1.213 |
| Parks | 2.834 |

1. **Estimation of Water Quality Index (WQI) for the study area:** A total number of nine water quality parameters are estimated from 43 water samples randomly collected at different locations in the study area. These water quality parameters are estimated based on the standard methods of water quality analysis. Spatial distribution of each one of the water quality parameter is generated on ArcGIS software. These maps are generated based on the integration of spatial and attribute database. The spatial distribution maps may gives a clear assumption of the water quality in the study area. The nine water quality parameters pH, alkalinity, chlorides, sulfates, nitrates, sodium, total hardness, TDS and fluorides are considered for the estimation of water quality index for this zone.

**Water Quality Index Computations:** Water Quality Index can be computed using the method proposed by Tiwari and Mishra, 1995.

## IV. DISCUSSION

The water quality Index can be a very special and efficient tool for communicating the information on overall quality of water. in present study the water quality rating in MCH Zone VII varied from good, poor, very poor to unfit for human consumption. The water quality of a place may be related to land use in that area. The more landuse more will be environmental degradation. From the Land use / Land cover and water quality index obtained in the present study. It is observed that water quality deteriorated. Residential and commercial areas are reasonably good except Golnaka which showed high value of fluoride. However water quality is poor in some residential and commercial areas like Narayanaguda, Begumbazar, Nimboliadda and in Amberpet where small-scale industries like flourmills and papermills are located. Very poor water quality is found in dense residential areas like Police Academy, near L.B. Stadium, Bazarghat, Navbath Rahar etc, which may be due to seepage of domestic sewage. In areas like Golnaka, Zindathnagar, Koti, Hyderguda, Goshamahal, Imlibun, Sewerage treatment plant at Amberpet the WQI showed that the water is not fit for human consumption. This can be attributed to high concentrations of Fluoride, TDS, Nitrates and Alkalinity observed in the above areas. Fluoride and hardness showed a maximum concentration of (5.83 mg/l and 710 mg/l) respectively at Golnaka. While highest values of TDS (1180 mg/l) at Imlibun bus station, highest value of Alkalinity (690 mg/l) at Kamalanagar, Nitrate of 140 mg/l near Bathkammakunta were observed. The possibility for the high concentration observed in the above parameters is contamination of ground water by domestic sewage and also due to the fact that sewage is directly discharged into Musi River, Stream of Musi River (Kamalanagar Musi) and, Bathkammakunta.

## V. CONCLUSIONS

Based on the water quality data obtained from physico-chemical analysis and WQI, the areas where ground water showed high concentrations of water quality parameters are identified. The results indicated that certain parameters such as fluoride, TDS, Hardness, Alkalinity, Nitrates exceeded the permissible limits as given by Bureau of Indian Standards. Concentrations of Sodium, Sulfate and Chloride and Phosphate were observed to be within the permissible limits. The Recommendations are suggested based on source of pollutant and drinking water standards of the parameters and the associated landuse.

**1. Control of Fluorides:** Water in contact with natural deposits of fluoride such as fluorspar and fluoropalite are found to contain excess of fluoride. Nalgonda

Technique developed by Neeri is used. It involves addition of aluminium salts, lime and bleaching powder followed by rapid mixing, flocculation, Sedimentation and filtration.

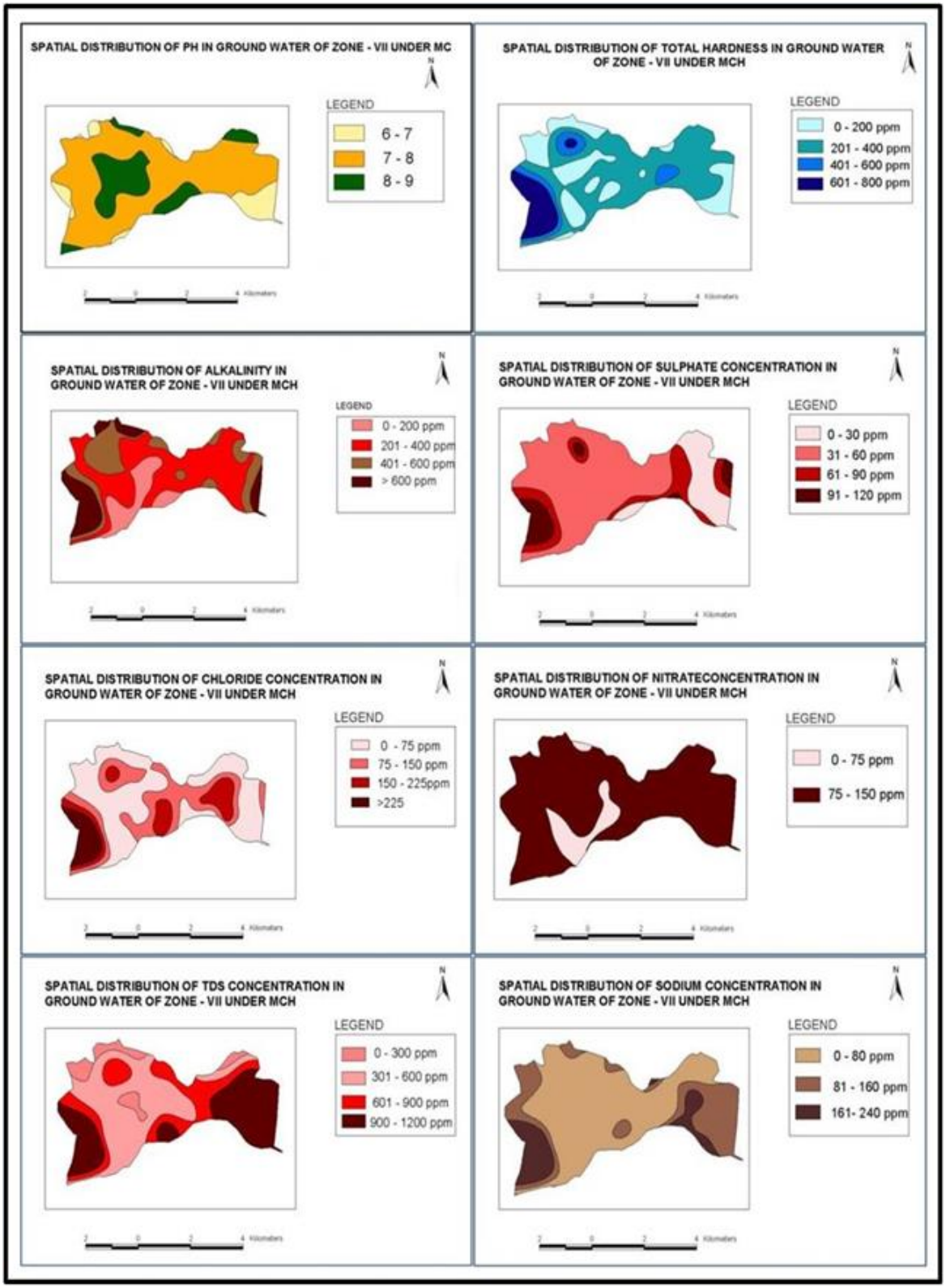


**Figure 3**. Spatial Distribution maps of the study area for various water quality parameters

**2. Control of TDS:** Ground water invariably contains dissolved solids. The rain water percolating through the soil stratum dissolve salts like chlorides, fluorides, nitrates etc. The deeper the water percolates, the higher will be the dissolved solids in ground water. removal of dissolved solids has been tried with Coagulation, Ion Exchange, Reverse Osmosis and Electro dialysis.

**3. Control of Hardness:** Hardness of Water is not exactly a pollution parameter but indicates water quality (soft water or hard water). The hardness content of a water sample can be reduced by lime soda process.

**4. Control of Nitrates:** Natural constituent of ground water is nitrate. High concentrations of nitrate may indicate sources of part or present pollution. The main source of nitrates are chemical fertilizers, decayed vegetable, animal matter, domestic waters and industrial discharges.

Control of different sources of pollution is necessary to prevent ground water from pollution.

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