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Mapping the Groundwater Potential Zone for Bengaluru Urban District

Nandishkumar.L, Karthick.M, Arul Prakash.A, Lokpal Bharani Dharaa.D, Revathy S.S, S.Sureshbabu

Department of Civil Engineering,
Adhiyamaan College of Engineering, Tamil Nadu, India

Abstract-Ground water contributes to about 80% of the drinking water requirements in the rural areas, fifty percent of the urban water requirements and more than fifty percent of the irrigation requirements of the nation.The search for new groundwater resources is essential to sustained economic development in arid environment. The study area is around Bengaluru urban falling between latitude of 12° 58‘ N to 77° 38' E at Survey of India toposheets 57 G & H covering an area of 2,191 sq.km in Karnataka State, India. In the present paper, by methodological approach based on remote sensing &GIS, Topographical maps are to be prepared using the ARCGIS, and LISS IV data. The area is characterized by undulating terrain interspersed by low ranges of rocky hills. The elevation ranges from 883 to 940 m above MSL .Thus the different ground water potential zones are identified in to 4 classes namely ‘good’, ’moderate’ , ‘moderate-poor’ and ‘poor’.

Keywords:GWPZ,GIS, ARCGIS, Weightage overlay.

INTRODUCTION

Very own survival on earth depends on two basic resources water and soil, which are nature’s two valuable gift to mankind. Ground water contributes to about eighty percent of the drinking water requirements in the rural areas, fifty percent of the urban water requirements and more than fifty percent of the irrigation requirements of the nation. It is a crucial source of fresh water throughout the world. More than 1.5 billion people worldwide and more than 90% of rural and nearly 30% of urban population in India depends on groundwater for meeting their drinking and domestic requirements. Groundwater is an essential part of the hydrologic cycle and is important in sustaining streams, lakes, wetlands and aquatic communities. Groundwater is a dynamic and replenishable natural resource, but in hard rock terrains availability of ground water is to a limited extent and its occurrence is essentially confined to fracture and weathered zones. Integrating remotely sensed data with auxiliary data is essential to have more precise and correct information about various factors involved in the water resources management.

For ground water occurrence is influenced by climate, physiography, drainage, geology, degree of weathering, etc.GIS has the capability for captures, storage, manipulation, analysis, retrieval of multiple layer resource information occurring both in spatial and aspatial forms.

STUDY AREA

Bangalore Urban is a district of the Indian state of Karnataka. It is surrounded by the Bangalore Rural district on the west, east and north and the krishnagiri district of Tamil Nadu on the south. Bangalore Urban district came into being in 1986, with the partition of the Bangalore district into Bangalore Urban and Bangalore Rural districts. Bangalore Urban has four taluks: Bangalore North, Bangalore East, Bangalore South and Anekal. The city of Bangalore is situated in the Bangalore Urban district. The district is located in the southeastern part of Karnataka. It is having an areal extent of 2190 sq.km and is located between the North latitude 12˚39' 32’’: 13˚14' 13’’and East longitude 77˚19’44’’: 77˚50'13’’. The district is bounded by Bangalore rural district in the East, West and North except in southeast, where he district is bounded by Dharmapuri district of Tamil Nadu state. The district is divided into four taluks namely Anekal, Bangalore North, Bangalore South and Bangalore East taluks. There are 17 hoblies, 9 municipal corporation and 668 villages in the district.

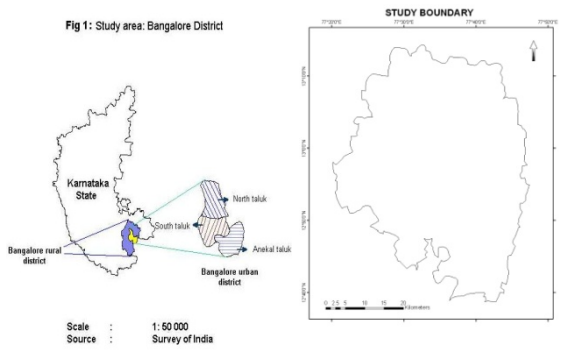


Figure 1: Location of the Study Area.

DATABASE AND METHODOLOGY

In the present study various types of data have been used. Both satellite borne remote sensing data and other published maps and reports constitute the database necessary for the interpretation and delineation of various thematic layers and information. Multi-date IRS-P6 LISS IV data in digital format were used in conjunction with secondary or collateral data Basic technical guidelines provided by the Integrated Mission for The thematic map depicting the various classes was prepared using digitally enhanced satellite data. ArcINFO software package was used for creation of digital database, data integration and analysis.

Methodology

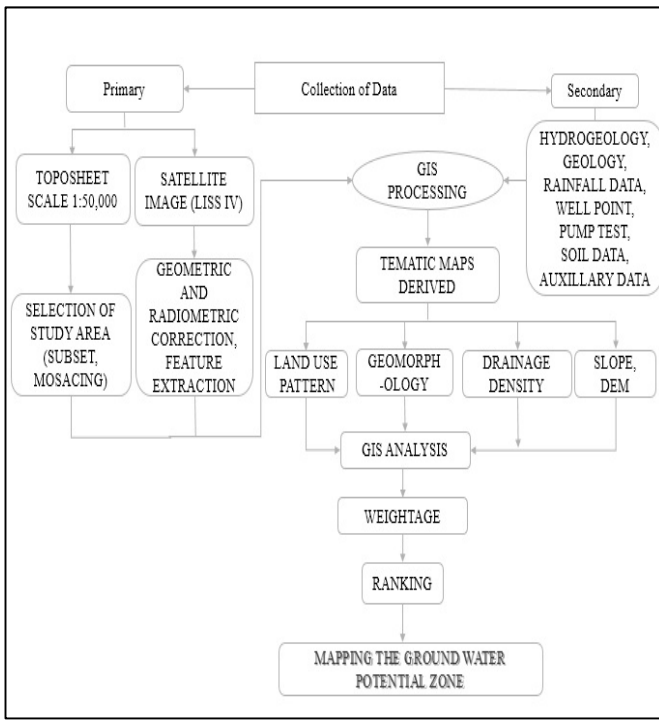


Figure 2: Flow chart showing methodology

RESULTS AND DISCUSSION

Drainage: The Three principal valleys are known as Vrishabhavathi, Koramangala and Chellaghatta and three valleys run generally in a north to the south direction and divide the greater part of the metropolitan area which lies to the south of the ridge into three separate and distinct drainage zones.

A fourth valley system referred to as the Hebbalseries forms drainage zone to the north of the ridge and runs in north easterly direction.Five minor valleys, the Kathriguppa and Tavarekere to the south, the Arkavathi and Kethamaranahally to the north west and Marathhally to the east, lie outside thetributaryarea of the major valleys and they drain independently to the fringe areas which form the remainder of the metropolitan area.The configuration of valleys in well graded side slopes of their tributary areas have provided Bangalore with a natural system of drainage without recourse to pumping. Both sewerage and storm water flow by gravity beyond the city.

Slope: The varying degree of slope leads to severe erosion of land and soil. The effect of slope on geomorphology, soil and land use was studied and a direct relationship was observed. Different percentage slope classes and their areal extents were calculated at waterlevel and Wereassigned class.

Landuse/landcover: The different landuse classes that cause problem in the natural resource management are the existence of wasteland in the area to be taken up for the development purpose. Similarly the depletion of the forest cover, presence of forest blanks .forest, presence of scrubs in the larger area, degradation of dense forest into open forest andopen in to scrubs pose serious problems to the environment.

Geomorphology: Different geomorphic units, their ground water prospect and proneness to erosion and areal extent were calculated at micro-watershed level. Different geomorphic units based upon their origin and nature was assigned specific classes/ranks.

Soils: The soils of the districts can be broadly grouped into red loamy soil and lateritic soil.Red loamy and sandy soils generally occur on hilly to undulating land slope on granite and gneissic terrain. The soils are light textured and are highly leached in nature with good infiltration rate. It is mainly seen in

the eastern and southern parts of Bangalore north and south taluks.Laterite soils occur on undulating terrain forming plain to gently sloping topography of peninsular gneissic region. It is mainly covered in Anekal taluk and western parts of Bangalore North and south taluks.

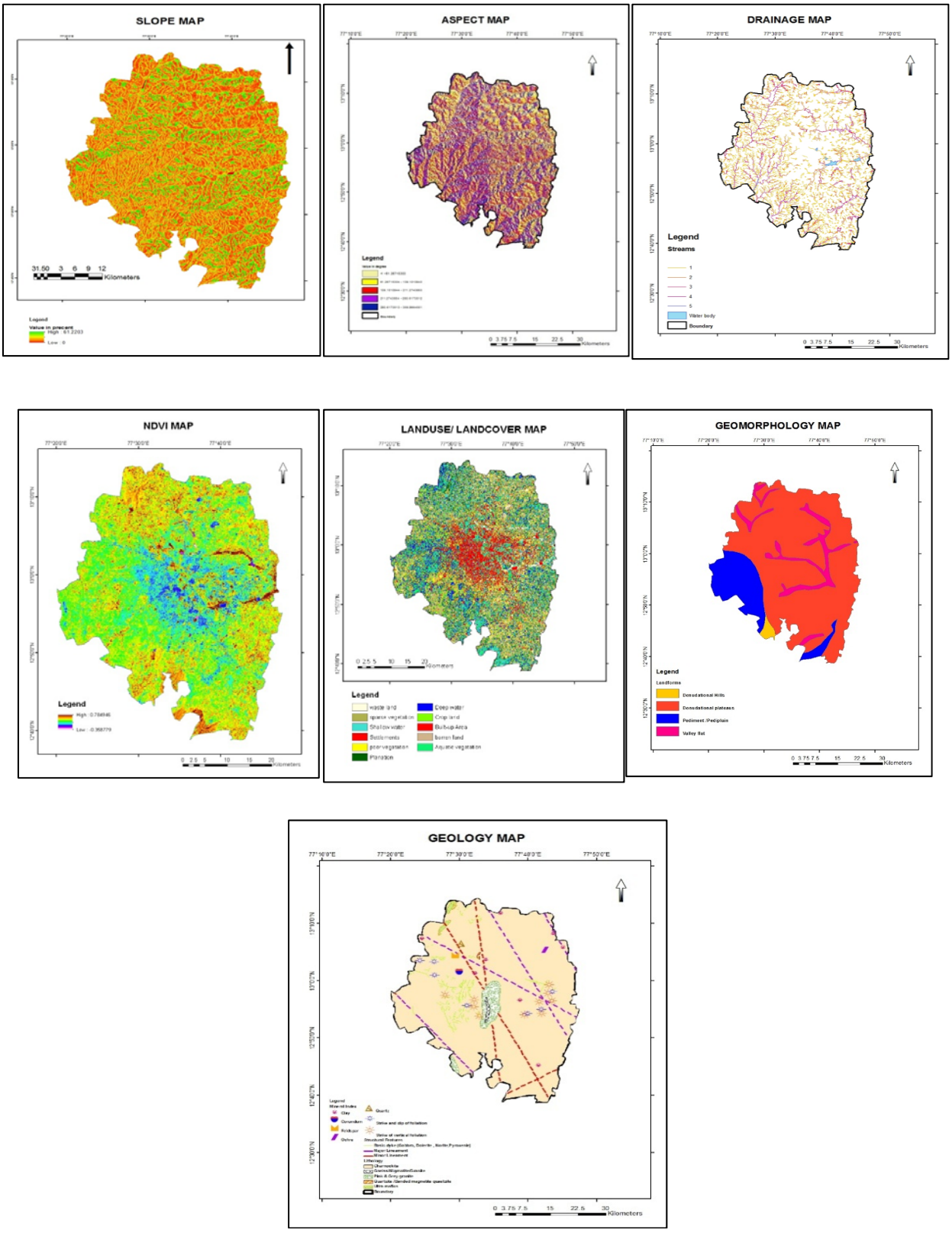


Figure 3 : Preparation of Various Thematic Layer

Weighted Indexing Method

There are different ways is which the suitability assessment can be done. There havebeenstudies of suitability assessment employinga "maximization where the worst"parameter determine the suitability . As a result , a relatively less important parameter could determine the suitability in the final analysis. This anomaly arises because all parameters are considered to be of equalimportance.

The weights of the different themes were assigned based on the their influence on the groundwater survival. On a scale of 1to 9 assigned basedSaaty's Analytic Hierarchy Process is a most widely accepted method for scaling the weights of parameters by constructing a pair wise comparison matrix of parameters where entries indicate the strength with which one element dominates over another vis-à-vis the relative criterion. The pair wise comparison of parameters results into the "importance matrix" which is based on a scale of importance intensities. The importance matrix can then be analyzed by various methods " Eigenvector" method or "Least Square" method, to arrive at the weightages of each parameter in the matrix. Experimental analysis has shown that the weightages obtained by these two methods are similar and are comparable. However, in the present study, Eigen vector method is employed for obtaining the weights of different parameters.

Table 1: Criteria for Generating Comparison Matrix

Assigned Value	Definition Explanation
1	***Parameters are of equal importance*** (Two parameters contribute equally to the objective)
3	***3 - Parameter j is of weak importance compared to parameter i*** (Experience and Judgment slightly favour parameter i over j)
5	***5 - Essential or strong importance of parameter i compared to j***(Experience and Judgment strongly favour parameter i over j)
7	***Very much more importance*** (Criteria i is strongly favoured over j and its dominance is demonstrated in practice)
9	***Absolute more importance*** (The evidence favouring parameter i over jto the highest possible order of affirmation)
2,4,6,8	***Intermediate values between two adjacent judgment*** (Judgment is not precise enough to assign values of 1, 3, 5, 7 and 9)

Based on this scale qualitative evaluation of different features of theme was performed with: i) Poor, ii) Moderate-Poor, iii) Moderate iv) Good.

Each and every thematic map is overlaid with Geomorphology+Geology=O1

O1+ Soil=O2.

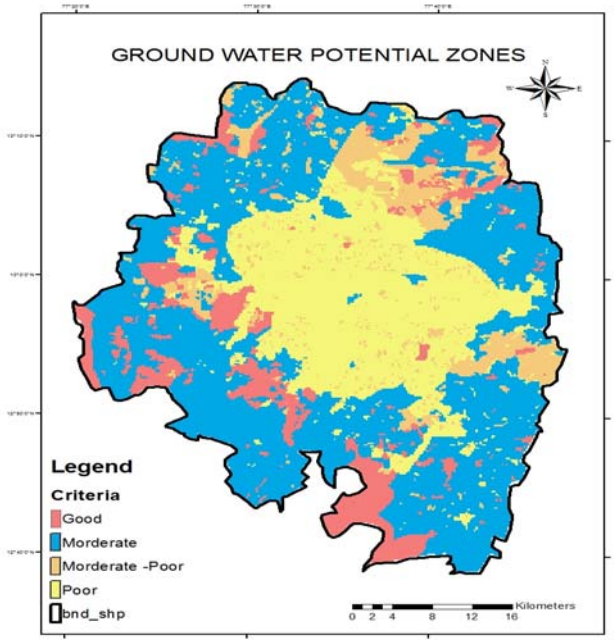
O2+Slope=O3.

O3+Landuse=O4.

O4+ DD=O5.

O5+NDVI=O6.

O1,O2,03,04,05,06 Which represent overlay Process.Thus overlaying all the thematic layer the ground water potential zone has been identified.



CONCLUSION:

The present study was to understand the Groundwater potential zone in Bengaluru Urban District and pictorially to represent it using GIS . Moreover , GIS makes the groundwater potential zone in to an easily understood format. Identifying groundwater potential zones and integrating the thematic maps prepared from platforms of remote sensing and GIS gives more accurate results. Thus the above present study has capabilities of a remote sensing and GIS technique of ground water potential zones in Bengaluru Urban District. This vital Information could be used effectively for identification of suitable locations or extraction of drinkable water The current approach using GIS and remote sensing is holistic in nature and

will Minimize the time and cost especially for identifying ground water-potential zones and suitable site-specific recharge structures in hard rock terrain on a regional as well as local scale, thus enabling quick decision-making for water management.

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