MODELLING OF GROUND WATER POTENTIAL ZONES USING REMOTE SENSING AND GIS TECHNIQUE: A CASE STUDY FOR HOSUR UNION, KRISHNAGIRI DISTRICT, TAMIL NADU, INDIA

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ABSTRACT

Water is most important resource for domestic, agriculture and industrial purposes. The main aim of this study is evaluation of ground water potential zones for Hosur Union, Krishnagiri District, Tamilnadu. For evaluation, GIS and Remote Sensing Technology contributes on efficient and effective result oriented methods for studying the occurrence and movement of ground water resources. Integration of various thematic layers which influencing the ground water such as slope, geology, lineament density, soil, geomorphology, land use and drainage density have been used to classify the ground water potential zones. Based on this concept, weightage and ranking scores were assigned to each thematic layer with respect of influencing rate of water percolation. Finally weightage, multiplied by ranking and computed all the multiply values for quick assessment of occurrence and movement of ground water potential zones in the study area.

Key Words: Groundwater potential, Thematic maps, Groundwater suitability index, Remote Sensing, Geographical Information System (GIS)

INTRODUCTION

Groundwater constitutes important sources of water supply for various needs, such as domestic, industrial and agriculture. While the surface water resources are inadequate to fulfill the water demand and productivity. Development of nation is highly depending upon the groundwater resources. Increasing population and social changes reflects adversely on the groundwater potential. The
main source for ground water is precipitation resulting in drainage flows through fracture zone on the earth surface. In order to ensure a judicious use of ground water, proper evaluation of ground water resource is required. Integration of remote sensing and GIS techniques provides an appropriate platform for the holistic analysis of diverse datasets for decision making in evaluation and planning of ground water potential. The present study is an attempt made to evaluate the groundwater potential zones of Hosur Block in Krishnagiri District using an integrated approach of Remote Sensing and GIS. Ramalingam and Shanthakumar have made use of remote sensing and GIS techniques for delineating potential areas for groundwater recharge for the entire state of Tamil Nadu. Thematic maps of geomorphology, geology, soil, slope, landuse, drainage density, lineament density, runoff isolines and depth of water table zones. Groundwater level fluctuation and water quality were used for the analysis extensive field. Minor et al developed an integrated interpretation strategy to characterize ground water resources for identification of well locations in Ghana using GIS.

The present study aims at delineating water potential zones for Hosur Union. The Hosur union is a part of the Krishnagiri District, Tamil Nadu. It is located about 40 kilometers South-East of Bangalore. Hosur also known as Little England, for its climatic conditions. It is known for thousands of industries located here. Hosur union is located in the Northern part of Tamil Nadu State. Its lies between 12°38”52.4’ N and 12°52”7’ N latitude and 77°44”11’ E and 77°55”11’ E. Topographic Sheets (57 H/10, 13, 14,) of 1: 50000 Scale. The study area covers a total area of about 275sqkm. It is bounded by Bangalore district in North and West, Vellore district in East, Dharmapuri District in South and Karnataka State towards North. It has an average elevation of 950 m (2883 feet) above mean sea level. The entire area is a vast stretch of rolling plain. In general the altitude varies from more than 900 m in the Southwest to less than 750m on the East.

This geology of study area is Achaean period – Bhavani groups of Gneiss. The most common rocks are the Granitoid Gneiss. The average maximum and minimum temperature are 38°C and 20.3°C respectively. The climate of the Krishnagiri District is generally warm. The climate becomes cool in December and continuous up to February, touching a minimum of 17°C in January. On an average the District receives an annual rainfall of 895 mm. Fig. 1 shows the location map of Hosur block.

MATERIAL AND METHODS

For evaluation of ground water potential in this region, the procedure includes data collection, mapping of various themes, acquisition of satellite data from NRSA and image processing using ERDAS, building of geo-data base, development of matrix for assigning weights to various factors and ranking of the hydro geological unit based on integration of all the thematic layers. A flow chart has been presented to indicate the methodology in Fig 2.

Data and software used

Indian Satellite imagery IRS-P6 LISS IV (Resourcesat), with 5.3m Resolution, SRTM imagery of 90 m Resolution. Survey of India Toposheet 57 H/10,13,14 on 1:50,000 scale, geological map published by a Geological Survey of India(1985), soil...
map NBSS. The packages have been used to perform the data processing and analyses are ERDAS 8.7, ArcGIS 9.1 and MS office for data processing.

**Fig. 1**: Location map of the study area

**Fig. 2**: Flow chart for delineating ground water potential zone
RESULTS AND DISCUSSION
The entire area is a vast stretch of rolling plain. In general the altitude varies from more than 900 m in the Southwest to less than 750m on the East. This region consists of small hill ranges and ridges. of these, central part of the study area Santhirasude-suvanar malai (950 m), TVS manufacture company (940 m), Eastern part of Dinnur (860m), Jujuvadi on western part (880 m), Southern part of area Sudalam (900m), and Bagalur on the Northern part (870m). The variation of relief and slope are shown in Fig. 3 and Fig. 4.

Geomorphology : The geomorphologic characteristics of Hosur Union are broadly classified into Pedi plain, pediments, structural hill, flood plain, shallow pediments upper undulating alluvial plains and Water body mask.

Geology: This geology of study area is Achaean period – Bhavani groups of Gneiss. The most common rocks are the Granitoid Gneiss. Besides this there also occurs the Southern part basic Dykes and Northern part Shear zone. Geomorphology and Geology structure of the study area is shown in Fig. 5 and Fig. 6.
Soil: The Soil type ranges from fine loamy, loamy, clayey soils are seen in Hosur union.

Black and loam soil are found in Krishnagiri district. Generally the soil is low in Nitrogen.
and Phosphate content with no marked variation between Hosur Union.

**Land use and land cover**: Land use and land cover Map was prepared using Geocoded IRS LISS IV data and was visually interpreted based on classification system. Soil map and Landuse and land cover map is depicted in Fig. 7 and Fig. 8.

**Analysis of ground water potential zone**: Ground water suitability index is used to identify the groundwater potential zones. Groundwater suitability index is the sum of the product of weightage and rank of the schemes given below.

\[
GWP = \sum W \times R
\]


The Ground water potential zones are derived by grouping the suitability index by using standard deviation. The output is then classified into five groups such as very high, high, moderate, low and very low potential zones using the Quartile classification method. The formula of the groundwater potential zone (GPZ) as shown below:

\[
GPZ = Sp + Geo + Ld + S + Geom + Lu + Dd
\]


![Ground Water Potential Zone Map](image)

**Fig. 9**: Ground water potential zone map

In order to delineate the groundwater potential zones, in general, different thematic layers like Slope, Geology, Lineament density, Soil, Geomorphology, landuse and Drainage density are used to be integrated without considering subsurface lithology.
This provides a broad idea about the groundwater potentiality of any area. Presently, groundwater potential zones have been demarcated by integration of thematic layers, using GIS technique. Each thematic layer consists of number of polygons, which corresponds to different feature. The polygons in each of the thematic layer have been categorized based on the influence of the feature on the ground water sources. The ranks are assigned based on their weightage to delineate the ground water potential zone. Higher number in the ranking order will show Low potential zone and lower number in the ranking order will show high potential zone. The ground water potential Zone map and its classifications are shown in Fig. 9 and Table 1.

Table 1: Classification of Groundwater Potential Zone (GWPZ)

<table>
<thead>
<tr>
<th>Groundwater Potential Zone</th>
<th>Area in Sq.km</th>
<th>% Area</th>
<th>Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>0.25</td>
<td>0.18</td>
<td>Madivalam, Pedda Elasagiri and Agraharam Villages</td>
</tr>
<tr>
<td>High</td>
<td>21.84</td>
<td>7.94</td>
<td>Hosurtown, Kottagondapally, Mukkondapally, Baddarapaly and Jujuvadi villages</td>
</tr>
<tr>
<td>Moderate</td>
<td>170.44</td>
<td>61.97</td>
<td>Kottapalli, Begapalli, jujuvadi, Hosur town, Balagondapalli, Edyanallur, and Hanumanthapuram Villages</td>
</tr>
<tr>
<td>Low</td>
<td>81.92</td>
<td>29.78</td>
<td>Bagalur and its market area, Jimangalam, Venketarayapuram, Avalapalli and China Sandram villages</td>
</tr>
<tr>
<td>Very Low</td>
<td>0.36</td>
<td>0.13</td>
<td>China Belagordapalli, Achitattipalli and Gudisandhanapalli Villages</td>
</tr>
<tr>
<td>Total</td>
<td>275 Sq.km</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

The study area covers 275 Km², The final groundwater potential zone map shows that nearly 0.18% (.25 Km²) of the area comes under Very high groundwater potential found in Madivalam, Pedda elasagiri, and Agraharam area. The high rise undulating terrain and intensity of lineament in the shear zone is characterized by very gentle slope and geomorphologic features like Pedi plain and flood plains indicates fairly very high groundwater potential in these areas. 7.94% (21.84 Km²) found in Hosur town, Kottagondapally, ukkkondapally, Baddarapally, Jujuvadi are have high groundwater potential. The rolling terrain, very gentle slope to moderate slope, and intensity of lineament in granitoid gneiss in shear zone and Geomorphological features spread over...
upper undulating alluvial plains, flood plains, pediplain, shallow pediments and structural hill represents high ground water potential in these areas. About 61.97% (170.44 Km²) comes under Moderate groundwater potential found in Kottapalli, Begapalli, jujuvadi, Hosur town, Balagondapalli, Edyanallur, and Hanumanthapuram in the study area. This zone cramped on gentle, very gentle slope and moderate sloping. The very high intensity of lineament in granitiod gneiss, shear zone and dykes. Where geomorphologically this zone stretch over shallow pediments, upper undulating alluvial plains, flood plain, pediplain and pediments. The landuse for this zone Stony waste, open forest, dense forest type of rock groups help to maintain moderate ground water potential. The groundwater potential where geomorphologically this zone stretch over shallow pediments, upper undulating alluvial plains, flood plain, pediplain and pediments. The landuse for this zone Stony waste, open forest, dense forest, land increasing the groundwater potentiality. 29.78% (81.92 Km²) and 0.13% (0.36 Km²) comes under low and very low groundwater potential. Which occupies the region like Bagalur and its market area, Jimangalam, Venketarayapuram, Avalapalli, China Sandram, China Belagordapalli, Achitattipalli and Gudisandhanapalli of the study area. This zone is cramped on moderate steep to steep sloping. The slope indicates the poor groundwater potentiality. Where the geology is granitiod gneiss. The lineament density is very low. Soil type is fine Loamy and clay. Where the geomorphologically this zone stretch over structural hill. The landuse for this zone stretch over stony waste and land without scrub. The drainage density is very low. Over all the parameters are not supported to the groundwater potential.

**CONCLUSION**

1. Integration of GIS remote sensing techniques provides an excellent tool for the determination of ground water potential in a region.
2. Ground water potential is computed for relative assessment of ground water potential zones by integration of all the related data that influence the occurrence and movement of ground water in the region using GIS.
3. Based on the analysis of relief map, the slope map of the study area has been derived. The slope map indicated that the entire study area is a vast stretch of rolling plain. In general the altitude varies from more than 900 m in the Southwest to less than 750m on the East.
4. Based on the analysis of Geomorphology maps, it is concluded that the geomorphic characteristics were classified into Pedi plains, pediments, structural hill, flood plain, shallow pediments and the water body mask.
5. Based on the analysis of Geology maps, it is concluded that the geology of study area is Achaean period– Bhavani groups of Gneiss. The most common rocks are the Granitoid Gneiss. Besides the Southern part consists of basic Dykes and Northern part Shear zone.
6. Based on the analysis of soil map it was concluded that the Soil type ranges from fine loamy, loamy and clayey soils.
7. Based on the concept model analysis concluded that the identified the GWPZ. The GWPZ classified in to Very High, High potential, Moderate, Low, Very Low Potential Zones.
8. The results of the analysis indicated that 0.18% of the total area comes under very high water potential zone, 7.94% of the total area comes under high water potential zone, 61.97% of the total area comes under moderate water potential zone, 29.78% comes under low water potential zone and 0.13% of the total area comes under very low water potential zone.

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REFERENCES


