GEO SPATIAL ANALYSIS OF GROUNDWATER POTENTIAL ZONE USING REMOTE SENSING AND GIS TECHNIQUES IN VARAHANADHI SUB BASIN, TAMILNADU

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ABSTRACT

Groundwater is vital natural resources available on the earth. Due to rapid growth of population, the available water resources are unable to meet the agricultural, industrial and domestic needs. The demand for water has increased from the last few decades and has led to water scarcity. Evaluating the potential groundwater zone for recharge is very important for the protection of water quality and management of groundwater systems. Remote sensing and Geographic Information System (GIS) is a rapid and effective techniques, it provides information of large and inaccessible area within short period for assessing, monitoring and management of groundwater resources. In this paper, a case study was conducted to find out the groundwater potential zones in Varahanadhi Sub basin, Tamil Nadu, India. Thematic maps such as geology, geomorphology, land use/land cover, lineament, drainage, soil, rainfall maps are prepared in the Arc GIS. The thematic maps and data are integrated in to GIS environment where it is digitized, registered, stored analyzed and finally overlaid to classify the groundwater potential zones. Based on this concept, weightage, and ranking were assigned to each thematic layer with respect of influencing rate of water percolation. The groundwater potential zones thus obtained were divided into four categories, viz., Poor, Moderate, Good and Very Good.

KEYWORDS: Groundwater, GIS, Land use/ Land cover, Varahanadhi sub basin, Tamilnadu.
1. INTRODUCTION

Groundwater resources are an important natural resource for its use in domestic, agriculture, and industries purposes. There has been a tremendous increase in the demand for groundwater due to increase in population, advanced irrigation practices and industrial usages. Groundwater is an significant natural resource in present day, but of limited use due to frequent failures in monsoon, undependable surface water, and rapid urbanization and industrialization have created a major risk to this valuable resource. The present days GIS has effective tool for evaluating the ground and surface water resources, recharge sites, identifying contaminated sites, land use pattern, land cover etc.

In recent years several workers such as Teeuw 1995; Goyal et al 1999; Saraf A. K. and Choudhary P. R. 1998; Murthy, 2000; have successfully applied remote sensing and GIS technique for groundwater prospecting and recharge sites. Krisnamurthy et al., 1996; Singh and Prakash, 2000; Jayswal et al., 2003; have used GIS to delineate groundwater potential zones.

Identification of potential zone ever remains a mystery. Hence geoscientists were adopting various techniques to target groundwater. Amongst high resolution satellite images are increasingly used in groundwater exploration because of their utility in identifying various ground features, which may serve as direct indicators of presence of ground water (Krishanmurthy, et al., 1996; Das et al., 1997; Ravindran and Jayaram, 1997; Pratap, et al., 2000; Sankar, 2002; Bahuguna, et al., 2003; Jagadeeswara Rao, et al., 2004; Ratnakar Dhakate, et al., 2008).

Indirect analysis of some directly observable terrain features like geological structures, geomorphology and their hydrologic characteristics using remote sensing enables to target groundwater (Basudeo Rai, et al., 2005; Lokesha, et al., 2005; Samuel Corgne, et al., 2010 ).
2. STUDY AREA

The study area Varahanadhi sub basin (Figure 1) is bounded by Palar basin in the north, Ponnaiyar basin in the west and south and the bay of Bengal in the east. Varahanadhi sub basin is located between latitudes 11°86'00" to 12°49'00" N and Longitudes 79°13'00" to 79°84'00" E. The sub basin occupies an aerial extent of 2622.82 sq.km.

The study area falls in the following Survey of India toposheets on 1:50,000 scale 57 P/3, 57 P/4, 57 P/7, 57 P/8, 57 P/11, 57 P/12, 58 M/5, 58 M/9, 58 M/12.

2.1 METHODOLOGY

The base map of study area was prepared based on Survey of India toposheets (57 P/3, 57 P/4, 57 P/7, 57 P/8, 57 P/11, 57 P/12, 58 M/5, 58 M/9, 58 M/12) on 1:50,000 scale. Arc Gis 9.3 was used to prepare various thematic maps like drainage, lineament, rainfall, geomorphology, soil, land use/land cover, geology, etc.

Finally all the thematic layers were integrated and prepared potential ground water zones. the final integrated map was classified into four categories of groundwater prospect zones as (i)Poor, (ii) Moderate, (iii) Good and (iv) Very Good.
3. RESULTS AND DISCUSSION

3.1 GEOLOGY

Geology plays an important role in the distribution and occurrence of groundwater. The study area consists of hard crystalline rock masses of Archaen age for the most part of the area (84%) on the western portion and sedimentary rocks of Upper Gondwana, Cretaceous, Territory and Quaternary age on the eastern portion (16%). The geological map of study area is shown in Figure 2.

3.2 GEOMORPHOLOGY

Geomorphological map is a very effective tool in the management of natural resources and helps in various types of planning, watershed management and developmental activities. In the Varahanadhi sub basin study, the remote sensing techniques have been applied in delineating the different major geomorphological forms and the process like fluvial and denudational action that have developed, modified and shaped the rugged terrain into geomorphological units.

Figure 2: Geology map of the Study area
The following geomorphological units are found in the study area are, Duricrust, Pediment, Pediment Outcrop, Buried pediment Deep, Buried pediment.
Moderate, Buried pediment Shallow, Structural Hill, Paleo deltaic plain (Figure 3).

### 3.3 LAND USE / LAND COVER

The Land use and Land cover study is essential for effective management of the natural resources in the sub basin. The following land use categories are identified in the study area, Settlement, Crop land / Dry crop, Forestland, Tanks, Outcrop, Grooves, Beach, Shrub, Barren land, Alkalinity/Salinity etc. 1298.44 Sq.km of study area is covered by agriculture land it includes crop and dry crop land. A linear stretch of alkalinity and salinity zone is occupying in the course of and along the Vegavathy river from Gingee in the downstream area up to Tempattur. Some isolated patches of wasteland are identified near Thiruvakkarai and Northwest of Valudavur in the study area (Figure 4).

### 3.4 DRAINAGE

Drainage pattern reflects the major attribute of surface as well as subsurface formation. The main river Varahanadhi originates in the western slopes/part of Gingee Taluk( Figure 5). It has two arms, i.e. left arm and right arm. The right arm originates from Pakkammalai hills and left arm originates from Melmalayanur. They join together near Thenpalai village and forms the main river Varahanadhi and flows in an easterly direction.

![Figure 5: Drainage map of the Study area](image-url)
The study area shows parallel to sub parallel type of drainage pattern and very low drainage density.

### 3.5 LINEAMENT

Lineament map was generated using satellite image. Lineaments represent the zones of faulting and fracturing resulting in increased secondary porosity and permeability. These factors are hydro-geologically very important as they provide the path ways for ground water movement (N. S. Magesh et al. 2012). Lineament density of an area can indirectly reveal the ground water potential, since the presence of lineaments usually denotes a permeable zone. Areas with high lineament density are good for groundwater potential zones (Haridas et al., 1998). The lineament map of study area is shown in Fig:6 and it shows that high lineament density was observed in the central part of the study area.

### 3.6 SOIL

Soil is an important for distinguish the potential groundwater zones. The types of soil in the Varahanadhi sub basin have been shown in (Fig:7). The major soil types in the study area are nceptisols(168,169,181,182,213,259), Alfisols (186,193,267,275) & Vertisols (220,229,285). Due to different stage of weathering of parent material, the
above soil types are met with in combination.

3.7 RAINFALL
Rainfall data was collected from the raingauge stations in the study area they are Gingee, Pondicherry, Vidur dam are the main raingauge stations (Fig:8) in the study area. Average annual rainfall varies from 900 to 1250 mm.

4. GROUNDWATER POTENTIAL ZONES
The thematic maps such as geology, geomorphology, soil, lineament, land use/land cover, soil, drainage, rainfall are integrated with Arc GIS software and assigning the weighted values & there rank (Table: 1) based on their influence on ground water regime. Finally the groundwater potential zone map (Figure 9) was prepared and classified as

(i) Very good
(ii) Good
(iii) Moderate
(iv) Poor

Figure 7: Soil map of the Study area
Figure 8: Rainfall map of the Study area

Figure 9: Groundwater Potential zone map
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Features</th>
<th>Weightage</th>
<th>Rank</th>
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<td></td>
<td>River</td>
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5. CONCLUSION

The remote sensing and GIS is a powerful tool for water resources management. It plays a vital role in integrating all the data to generate various thematic maps in the study area such as geomorphology, geology, lineament, rainfall, drainage, soil and land use/land cover for preparing potential groundwater zone map. The geomorphic units viz. buried pediment deep and paleo deltaic plain are good prospective zones for groundwater exploration. Presence of high lineament density, very low drainage density influences the occurrence of groundwater. From the analysis weightages of the thematic data sets the groundwater potential zones are classified as very good, good, moderate and poor. The Groundwater potential zone map shows the very good and good source of groundwater falls in the southeastern part of the study area. The integrated groundwater potential map thus, could be useful for development of sustainable scheme for groundwater development in the study area.

REFERENCES


