Identification of Suitable Site for Artificial Recharge Structure Using GIS and Remote Sensing – A Review

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***Abstract*: One of the main sources contributing to the overall annual supply is ground water. Ground water scarcity is created by explosive development and unequal population distribution, inadequate irrigation practices, rapid urbanization/ industrialization, large-scale deforestation and improper land use practices. Thus, the demand for water for agriculture, households and industry is growing. The goal of this paper is to review the techniques and methodologies used to identify potential zones of groundwater using GIS and remote sensing. Various thematic maps were prepared, such as geology, slope, soil, drainage density map, land use and land cover at a scale of 1:50000, to assess the groundwater potential zones, Using remotely sensed data, topographical sheets and secondary data gathered from the Department of Concern. The thematic layers prepared are further used for mapping and defining the possible area and study of groundwater. Overlay analysis of thematic maps based on the analytical hierarchy method in ARC GIS, a probability weighted approach was applied. This generates a possible groundwater map, taking into account the linear combination of weights for each thematic map. This possible groundwater knowledge would be useful for the successful identification of the state of the groundwater.**

***Keywords*: GIS, Ground water, RS, Thematic layers.**

1. Introduction

Groundwater is an important natural resource which promotes human well-being, economic development and agricultural sustainability. About 90% of the rural population and about 30% of the urban population depend on groundwater to meet their domestic needs. Due to the growing population, unsustainable use of groundwater resources results in mismanagement and depletion of water quality and quantity in most parts of the world and India in particular. Artificial recharge is one of the best strategies for replenishing the groundwater. By using various strategies such as spreading water on the ground surface, building recharge wells or manipulating natural hydrological conditions to increase the rate of infiltration, artificial recharge is used to directly penetrate the available surface water into the ground. To assess the possible areas of groundwater, geospatial approaches such as the Geographic Information System and Remote Sensing can be combined together. Remotely sensed data obtained from satellites play an important role in water resource assessment and growth and can be used to obtain immediate and important information on parameters that govern groundwater occurrence and movement. An organized analysis of all these determining parameters contributes to the delineation process's better performance. The purpose of the analysis is to delineate the potential recharge zones and suggest suitable recharge structures for the potential recharge zones at the identified locations.

2. Literature Review

Abebe Debele Tolche: Studied that Mapping groundwater potential using remote sensing data and GIS techniques have been increasingly implemented because of applicability in the inaccessible area, saves time and money. In this study, qualitative analysis was carried out to assess the groundwater potential zones using GIS and remote sensing techniques for DhungetaRamis sub-basin, Wabi Shebele basin, Ethiopia. Groundwater potential zonation map generated via weighted index overlay analysis. Results obtained were used as a preliminary reference in selecting suitable sites for groundwater resource exploration/exploitation.

Arunava Poddar, Preeti, Navasal Kumar and Vijay Shankar: Studied Artificial Ground Water Recharge Planning Using Geospatial Techniques in Hamirpur Himachal Pradesh, India. After collecting all the base maps and preparing thematic maps a final groundwater potential zone map was obtained. Results of the study depicts that most areas in Hamirpur have 'moderate' recharge potential (around 73%), whereas 18% have 'high' recharge potential and only 9% have 'poor' recharge potential.

Khadri, S.F.R Kanak Moharir: Analyzed that Combination of geology, land use land cover, geomorphology, contour, soil and digital elevation model has been found very useful in the selection of suitable sites for artificial recharge. He used GIS and remote sensing for ground water source analysis. He concluded that the recharge sites situated on a gentle slope and lower order streams are likely to provide artificial recharge to a larger area.

Kesana Sai Teja, Dinesh Singh: Did analysis to find groundwater recharge at mangalagiri mandal area. Prepared thematic layer maps of geological, soil, slope and drainage

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maps, weightage was assigned to each thematic layer and recharge structure was recommended. He also recommended several artificial recharge structures like roof top/road top rainwater harvesting structures, pits and scavenger wells are to be constructed.

M Rajasekhar, G Sudaesana Raju, R Siddi Raju, and U Imran Basha: Found artificial recharge site by using geospatial tools in semi-arid region of Anantapur district, Andhra Pradesh, India. Prepared thematic maps of Land Slope, Geomorphology, Geology, Soil, Drainage Density, Lineament Density, Landuse/Landcover, Hydrogeomorphology. Based on the groundwater potential index values, the study area is classified into four different groundwater potential zones such as 'good', 'moderate to good', 'moderate' and 'poor' and he suggested the construction of check dams and permeation lakes.

Muthukrishnan a and Manjunatha V: They studied that the Groundwater recharge of the watershed is the result of an interaction between geomorphology and water level in the process of permanent adjustment between constraining properties. Generally, the recharge sites situated on a gentle slope and lower order streams are likely to provide artificial recharge to a larger area.

M Vijay Prabhua and S Venkteswaranab: Had done analysis and the investigations were carried out in accordance with updated hydrogeological methodology. Key findings have been made in GIS environment for identifying micro level village wise favorable areas amenable to different artificial recharge structures have been derived for sustainable development of groundwater resources in the Sarabanga sub basin, Cauvery River. Such advancements will certainly enable us to develop and manage precious groundwater resources in a real sustainable and environment-friendly way.

P *Karthick, Lakshumanan Chokkalingam*: Integrated all the thematic layers by using a GIS based model and got the zonation map Thuraiyur taluks categorized into four different zones most favorable 20%, moderately favorable 22%, drainage favorable 34%, and least favorable 24%. Drainage network map was superimposed above the artificial recharge zone map and taking into concern terrain condition for construction of artificial recharge structure were suggested accordingly such as percolation tanks, check dams, nala bund, recharge well, desilting of tanks and recharge pits.

R *Chandra Mohan, T E Kanchanabhan and N Siva Vignesh*: In this study, de-saturated aquifers and locations that could potentially benefit from artificial recharge techniques were assessed in the Palani taluk in Tamil Nadu, India. Suitable sites for implementing artificial recharge structures were identified using land use and land cover maps, slope, lineament density, drainage, drainage density, and micro-drainage catchment area maps of the study area. Artificial recharge zones that were identified as good, moderate, or excellent were merged with various thematic layers using GIS software and one or more appropriate artificial structures for a particular location were identified.

Tesfa Gebrie Andualem and Girum Getachew Demeke: This paper aimed to delineate the groundwater potential zones using GIS and remote sensing. Multi-Criteria Decision Analysis (MCDA) technique is used to develop the groundwater potential prospect zones by integrating different groundwater contributing thematic layers. The thematic layers of land cover, drainage density, lineament density, soil, geology, slope, and geomorphology were prepared and used for groundwater potential map development by assigning weights to each thematic layer and features. The weights of each thematic layer were assigned and normalized based on their characteristic and relationship with groundwater recharge. Finally, the thematic maps were integrated by a weighted sum overlay analysis tool to develop groundwater prospect zones.

3. Methodology

Multi-parametric dataset containing satellite data information and topographical data maps including SOI toposheets were used to classify artificial recharge structures in the study region. By using SOI toposheets, the base map of the study area is prepared. By using supervised and unsupervised classification using ERDAS Imagine 9.3 software, the Land-use/Landcover map is prepared from satellite images. ArcGIS 10.4 software is used to prepare distinctive thematic layers such as geomorphology, soil, geology, and lineament density maps. The drainage network for the study region was primarily digitized from the SOI toposheets on a scale of 1:50,000 to prepare the drainage density map of the study region. In addition, for the measurement of drainage density, each drainage is expressed in terms of the channel length per unit of vicinity (km/km2). The overall area was demarcated into advisable drainage density zones after obtaining drainage densities. Elevation contours (10 m interval) were digitized from the SOI (Survey of India) toposheets for the preparation of the slope chart, and a digital elevation model (DEM) of the research region was created. The Slopes are calculated from the elevation contours, and then a slope map used to be prepared by using ArcGIS 10.4 software. One of the features/classes of the individual themes are defined after preparing all the thematic layers, which were then assigned weights in accordance with their relative significance based on the analytical hierarchy process (AHP). The eight thematic layers, i.e., land slope, geomorphology, geology, soil, drainage, drainage density, land use/land cover, line density, hydrogen morphology, are considered for the delineation of artificial recharge zones, as stated above. For these parameters, two thematic layers were prepared, categorized, weighted and constructed using weighted overlay analysis. Finally, the possible zone for ground water is obtained and materials which are used is presented in this section.

4. Conclusion

It can be inferred from the above literature that the present study revealed that geospatial techniques are potentially successful in delineating various potential groundwater zones considering seven parameters affecting groundwater recharge viz. slope, drainage density, land use/land cover, geomorphology, geology, lineament density and soil texture. These findings should be used to prepare a proper groundwater

resource exploration plan in order to ensure that this scarce resource is sustainable in the long term.

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