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Investigation on Selection of Artificial Recharge Structures Using Remote Sensing GIS and Geo Physical Method

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Abstract
Nowadays ground water is decreasing and therefore there is an increase in demand of water. Ground water is one of the major source that contributes to the total annual supply. The objective of this paper is to review techniques and methodologies applied for identifying groundwater potential zones using GIS and remote sensing. Several methods are used for mapping of ground water zones. The parameters that are used for controlling groundwater zones are soil, drainage density, land use\land cover, geology, geomorphology, rainfall, slope, and contour. Groundwater mapping techniques are described and derived from satellite remote sensing and additional data sources. These techniques include both conventional methods and advanced methods. The thematic layers are used for mapping and identification of groundwater potential analysis. The importance of each thematic layer and its weight is discussed for the location groundwater potential zones using groundwater conditions. This groundwater potential Information will be useful for effective identification of appropriate locations for extraction of water. Mechanical sensors play a vital role in the detection of area using satellite hence, the combine study of mechanical sensors with GIS, Remote sensing(RS) and GPS will be a powerful weapon to study the ground water potential information. The objective of this study is to delineate the groundwater potential zones of this area using Remote Sensing (RS) and Geographic Information System (GIS) techniques.

Keywords: *Remote sensing, GIS, GPS, Underground water.*

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I. INTRODUCTION

In recent years, RS, GPS and GIS technology have been widely used in various industries for the vast gathering of the information and to reach the people in an uncomplicated way.

Ground water is the major source for more than 85 percent of India's rural domestic water requirements, among which more than 50 percent of this is used for irrigation requirements and around 50 percent of this is used for urban water requirements, hence it is depleting fast in many areas due to the large-scale withdrawal for various sectors.

Ground water is one of the most valuable natural resources, which supports human health, economic development and ecological diversity. Ground water has become an immensely important and dependable source of water supplies in all climatic regions including urban and rural areas of developed and developing countries, since it has several inherent qualities like consistent temperature, widespread and continuous availability, excellent natural quality, limited vulnerability, low development cost, drought reliability etc. The occurrence, origin and movement of ground water depend mainly on geologic framework, i.e., lithology, thickness, structures and permeability of aquifers. Ground water in hard rock aquifers is essentially confined to fractured or weather horizons.

For systematic study of ground water conditions extensive hydro-geological investigations are often required. Locating, delineating and evaluating the new sources of ground water are the typical objectives of any exploratory ground water investigation.

There is an urgent requirement for augmentation of the ground water resources in order to tackle two major hazards of consequent deterioration of ground water quality and de-saturation of aquifer zones, through suitable management interventions. Artificial recharge has now been accepted world-wide as a cost-effective method to strengthen ground water resources in areas where continued overexploitation without due regard to their recharging options has resulted in various undesirable environmental consequences.

CLASSIFICATION OF WATERSHED

Watershed is defined as topographically delineated area that is drained by a stream system and is characterized by a common outlet through which excess overland flow collected within the watershed is drained out. Watersheds are classified according to different sizes.

a. Micro watersheds
b. Small watersheds
c. Large watersheds

FUNCTION OF WATERSHED

The main function of watershed is to receive the incoming precipitation and then dispose it off. Watersheds are the planning units for administrative purpose to conserve precious resources. This is the major essence of soil and water conservation. For effective planning and sustainable development of land and water resources, this helps by preparing the database of the available natural resources. The watershed management identifies the relationships between land use, soil and water, and the linkage between the uplands and downstream areas.

THE STUDY AREA

The study area lies between 13º6`7.2``N to 77º22`26.4``E longitude and latitude covering area of nearly 735 km2. The Nelamangala Taluk consists of 243 villages. The number of tube wells present in the region is 5077 and the Net Area Irrigated is around 3911 square metres. The area experiences different climate depending on the altitudes. Summer, rainy, winter seasons are prominent and experience from April to June, September to December, January to march respectively. Water resource depends on the nature of the rock types and the physiographic conditions.

In the study area, for the past 70 years, the average mean rainfall is in the order of 916.15 mm. The quality of water is good in major part of study area, in general and contains 482 ppm of dissolved solids and chloride content of about 100 ppm. For better approach and understanding about the water resources scenario, Sub-surface geological data, geophysical data have been collected. Number of tanks has also been identified in the study area.

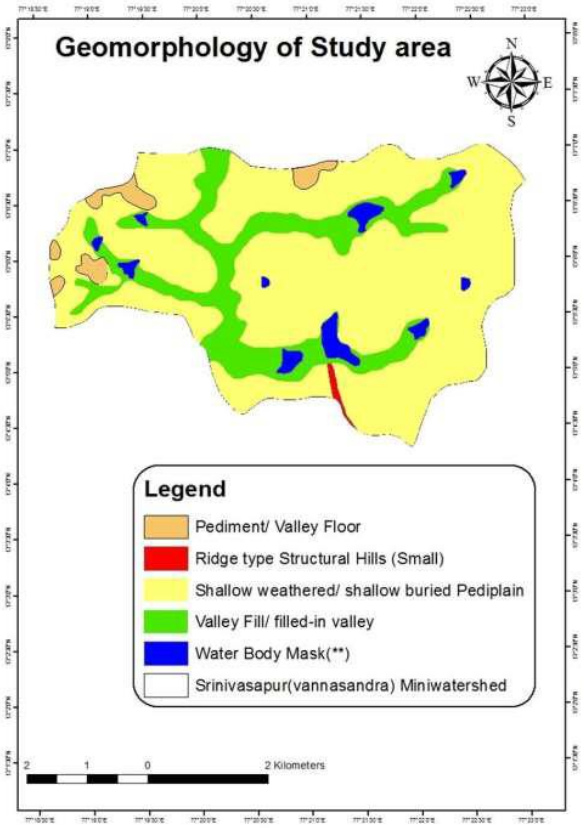

Fig.1: Geomorphology Of Study Area

II. METHODOLOGY AND DISCUSSION

DATA USED AND METHODOLOGY:

The methodology adopted in the present study is presented schematically and described in the following steps:

- The LISS-1V satellite image was used for different thematic maps for interpretation.
- The image interpretation characteristics such as tone, texture, shape, size, pattern and association along with sufficient ground truth and local knowledge were used to finalize the maps of the sub watershed area.
- The maps were geo referenced and digitized using the Arc GIS 9.3 and attributes were assigned to create the digital data base
- The survey of India toposheets scale 1:50000 are used for delineating watershed boundary, drainage pattern for the preparation of base map and extracting thematic layers for various part of analysis namely drainage road, lithiology, geomorphology soil Lineaments and water bodies and VES data etc using and prepare the ground water potential maps finally using above layers information to select the suitable sites for artificial recharge structures

APPLICATION OF REMOTE SENSING, GIS, GPS AND GEOPHYSICAL TECHNIQUES

1. REMOTE SENSING:

"Remote sensing is defined as the science and art of obtaining information about an object, area, or phenomenon through the analyses of data acquired by the sensor that is not in direct contact with the target of investigation"

The major elements of remote sensing are Data acquisition and Data processing and analysis. Springs and nearby areas indicate relatively shallow depths to ground water. Phreatophytes, which transpire water from shallow water tables, defined depths to ground water halophytes plants with high tolerance for soluble salts and white effloresce at ground surface indicate the presence of shallow brackish or saline ground water.

2. GEOGRAPHIC INFORMATION SYSTEM

A GIS is a computer based system which is used to digitally reproduce and analyze the feature present on the earth's surface and the events that take place on it. GIS constitutes of five key components viz., Hardware, Software, Data, People and Method.

The important point to remember is that there are as many different types of GIS software system as there are decision making processes. Particular GIS software systems are often specialized to fit certain types of decision making. There are various software and the software used in the current project study area is Arc GIS version 9.3 .

2.1 Arc GIS 9.3

The Arc GIS 9.3 version we organize and edit data stored in a geodatabase, prepare data for analysis, create and edit geoprocessing models using ModelBuilder, and work through a challenging analysis project.

- Add data from different sources to a geo database.
- Work with subtypes to edit data.
- Edit and validate feature geometry and attributes using geodatabase topology.
- Run analysis tools using dialog boxes and models.
- Build a complex model using Model Builder.
- Getting data into the geodatabase:
- Editing GIS data
- Aligning spatial data:
- Managing geo processing tools and settings:
- Analyzing GIS data
- Using Model Builder for analysis:

3. GLOBAL POSITIONING SYSTEM

GPS is a satellite based navigation system. The present Navigation System with Timing and Ranging GPS was conceived as ranging system, from known positions of satellites in space to unknown positions on land, sea, air and space. The advent of the Global Positioning System (GPS)has not only enhanced the ease and versatility of spatial data acquisition, but has also diversified the approaches by which it is integrated with remote sensing and geographic information systems (GIS).

Compared to conventional techniques, GPS surveying is not bound by constraints such as line-of- sight visibility between survey stations. The stations can be deployed at greater distances from each other and can operate anywhere with a good view of the sky, rather than being confined to remote hilltops as previously required.

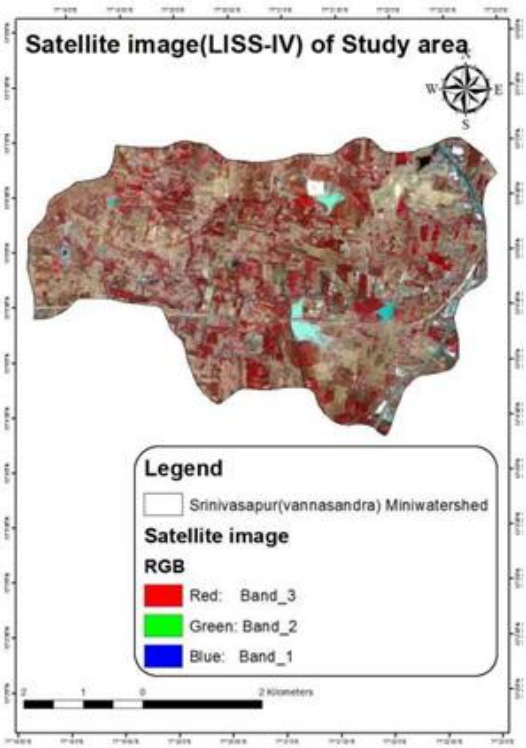

Fig. 2: Satellite Image Of Study Area

GEOPHYSICAL EXPLORATION

Geophysical exploration is the scientific measurement of physical properties of the earth crust for investigation of mineral deposits or geologic structures. Density, magnetism, electricity and electrical resistivity are the most commonly measured entities using geophysical exploration. They are in exact and difficult to interpret but can provide useful information in locating the ground water. This method is very important for both groundwater resource mapping and water quality evaluations. Over the last few years, due to the rapid advances in computer packages and associated numerical modelling solutions, its application for groundwater exploration purposes has increased.

Geophysical survey is therefore one of the sub-methods under the surface method of groundwater exploration. Geophysical survey incorporates the Vertical Electrical Sounding (VES) and Horizontal Profiling (HP) activities. Currently due to the simplicity in performing, the Vertical Electrical Sounding (VES) is the most popular for groundwater investigations. This geophysical survey method is used for the detection of the surface effects produced by the flow of electric current inside the earth. It provides depth and thickness of various subsurface layers and their relative water yielding capacities.

SENSORS USED IN REMOTE SENSING

Remote sensing sensors can be classified into imaging sensors and non-imaging sensors. In terms of their spectral characteristics, the imaging sensors include optical imaging sensors, thermal imaging sensors, and radar imaging sensors, as shown in figure.

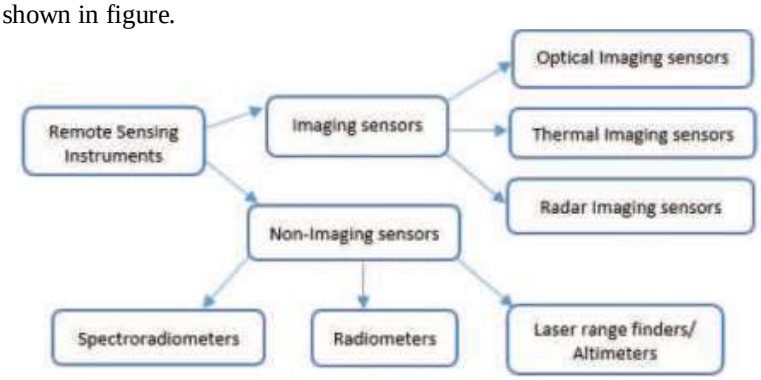

Fig. 3: Spaceborne remote sensing sensors

1. Optical imaging sensors: Optical imaging sensors operate in the visible and relective IR ranges. Typical optical imaging systems on space platform include panchromatic systems, multispectral systems, and hyperspectral systems.

2.Thermal IR imaging sensors: It typically operates in the electromagnetic spectrum between the mid-to-far infrared and microwave ranges, roughly between 9 and 14 μm. Any object with a temperature above zero can emit infrared radiation and produce a thermal image.

3. Non-imaging sensors: A non-imaging sensor measures a signal based on the intensity of the whole field of view, mainly as a profile recorder. In contrast with imaging sensors, this type of sensor does not record how the input varies across the field of view. In the remote sensing field, the commonly used non-imaging sensors include radiometers, altimeters, spectrometers, spectro radiometers, and LIDAR.

4. Radar imaging sensors: A radar (microwave) imaging sensor is usually an active sensor, operating in an electromagnetic spectrum range of 1 mm–1 m. The sensor transmits light to the ground, and the energy is reflected from the target to the radar antenna to produce an image at microwave wavelengths.

III. CONCLUSION

The Overall results demonstrates that remote sensing and GIS tools are less time consuming and cost effective which provides sufficient support in ground water studies where the region lacks previous hydrological investigations and data, and also it integrates all geospatial information to delineate ground water potential zones.

Finally, it concludes that the RS, Geophysical and GIS technique are very efficient and useful for the identification of groundwater potential zones in the following views. Based on the study, several conclusions can be made and they are:

- The indicators of the groundwater occurrences are related to the hydrological cycle and these are rainfall distribution, land use, soil type, lithology, geological structures, and elevation, slope and drainage features of the study area.
- Satellite data has been proven to be very informative and useful for the surface study, especially in detecting the surface feature and characteristics such as lineament and land use.
- In subsurface study, remote sensing could be used more effectively supported by the suitable GIS approach or technique and good back ground knowledge of the related application.
- The methods and results of this study were effective only for ground water zone prediction and hard rock terrain, but was less effective in the alluvium environment.
- The efficiency of the RS, Geophysical and GIS based method for groundwater evaluation could be further improved by considering adequate number of thematic layers having direct and indirect control over groundwater occurrence.

In this study we come to conclusion that still we have to concentrate on water resource management and development by taking some measures like increase in the greenery, maintain the present wet land and construct the suitable water harvesting structure. Therefore still there is scope for such kind of studies.

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