Identification of Groundwater Potential Zones using Remote Sensing and GIS, Case Study: Mangalagiri Mandal

Kesana Sai Teja, Dinesh Singh

Abstract: ***Ground water is one of the major sources that contribute to the total annual supply. The explosive growth and uneven distribution of population, poor irrigation practices, rapid urbanization/industrialization, large-scale deforestation and improper land use practices creates depletion of ground water. Therefore, increases demand of water for agriculture, household and industry. The objective of this paper is to review techniques and methodologies applied for identifying groundwater potential zones using GIS and remote sensing. In order to evaluate the ground water potential zones, different thematic maps such as geology, slope, soil, drainage density map, Land use and Land cover and surface water bodies at a 1: 50000 scale were prepared, using remotely-sensed data as well as topographical sheets and secondary data, collected from concern department. The prepared thematic layers are further used for mapping and identification of groundwater potential zone and analysis. A probability weighted approach has been applied during overlay analysis of thematic maps in ARC GIS. This produces ground potential map considering linear combination of weights of each thematic map. This map shows good, moderate, poor and very poor ground potential zones. This groundwater potential information will be useful for effective identification of Ground water condition.***

Index Terms: GIS, Ground water, RS, Thematic Layers.

I. INTRODUCTION

Ground water is the surface water that seeps into the ground through a process called infiltration. Developing populations in rocky terrain locales have a basic need to find new groundwater in that capacity areas ordinarily on the whole need perpetual surface water [1]. GIS is a successful instrument for collecting, storing, transforming, retrieving, displaying and analyzing spatial data from this present reality for specific client [2].

Ground water is a primary hotspot for industries, communities and agricultural consumptions on the planet and because of its freshness, synthetic mixes, steady temperature, bring down contamination coefficient and higher unwavering quality dimension, considered as an essential wellspring of providing solid fresh water in urban and rural areas [3].

The all out amount of groundwater on Earth is assessed at in excess of 50 million cu.km. Of this, 4 million cu.km. are considered as a sensible amount of crisp water that could be misused, which bars water that won't deplete from little pore spaces, saline water and water lying somewhere down in restricted aquifers. In India, over 90% of rural and almost 30% of urban population rely upon groundwater for meeting their drinking and domestic prerequisites [4].

Maps of ground water potential zones prepared from satellite images, serves as efficient tools for detailed ground based hydro geological surveys which ultimately lead to the selection of suitable sites for bore wells/Dug wells. Satellite data offers the unique capability for extracting information on geology, drainage, land use/ land cover and soil from a single image. Information on all these factors is essential in understanding the occurrence and movement of ground water.

Study Area Description

Mangalagiri mandal is one of the 57 mandals in Guntur district of the Indian state of Andhra Pradesh. It is under the administration of Guntur revenue division and the headquarters are located at Mangalagiri town. The mandal is bounded by Thullur, Tadepalle, Tadikonda, Pedakakani and Duggirala mandals and a portion of the mandal lies on the banks of Krishna River. As of 2011 census, the Mangalagiri mandal had a population of 160,303.The average literacy rate stands at 72.32% with 104,479 literates. Mangalagiri has a tropical climate. In tropical climates temperature remains relatively constant (hot) throughout the year. The average annual temperature in Mangalagiri is 28.5 °C. Annual total Precipitation is 996mm.fig-1 displays the location of the study area.

Fig 1: Location of study area

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Scope

Ground water mapping assumes critical job in the improvement of wells and cylinder wells to take care of the demand of residential, farming and ventures. Ground water mapping gives data showing the idea of aquifer, kind of aquifer, sort of wells appropriate, their profundity run, yield go, achievement rate, maintainability, and so on.

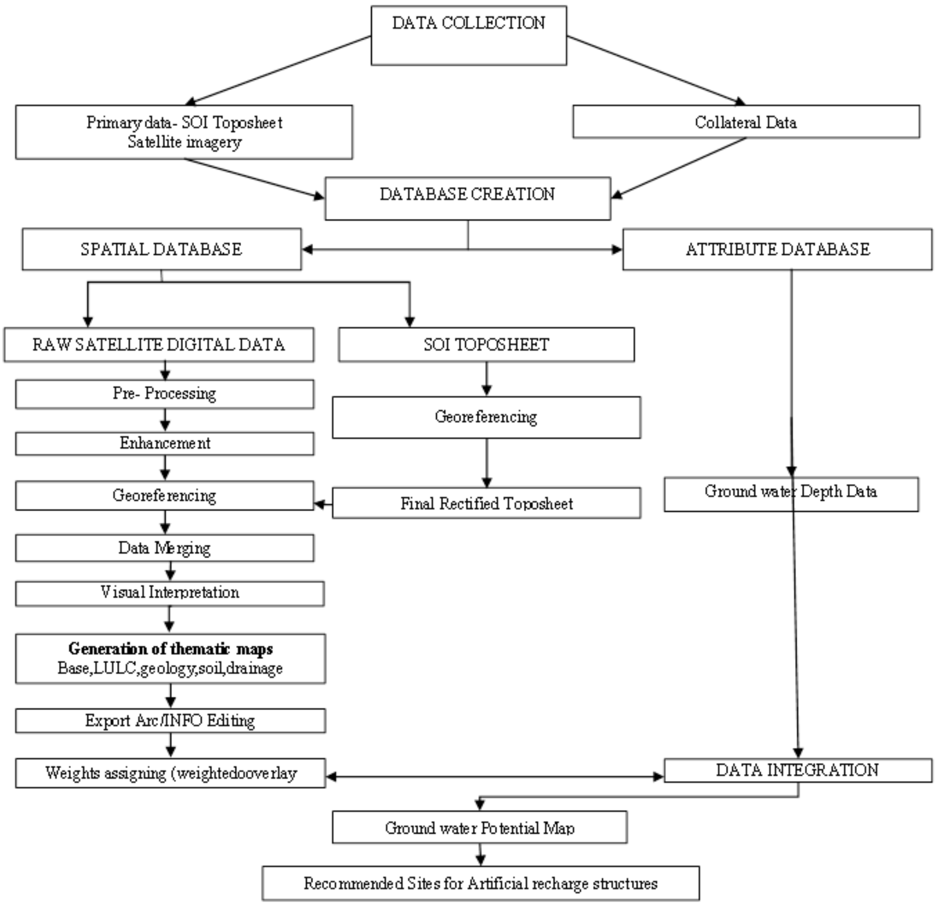
II. RESEARCH SIGNIFICANCE

The fundamental objective of the present investigation is to apply inventive way to deal with survey the groundwater controlling highlights, to distinguish and depict groundwater zones lastly develop a groundwater potential zones delineate. This objective is accomplished by readiness of topical maps for the most imperative contributing parameters that demonstrate groundwater potential, for example, geology, soil, drainage, topography and inclines through GIS module. Field perceptions and geophysical examinations are connected to test the legitimacy of the subsequent GIS module for finding groundwater prospective zones. The benefit of such techniques is to direct territorial and financially savy examinations over huge territories just like the case with the investigation region.

III. DESCRIPTION OF WORK

General

The regular hydrogeological maps arranged primarily dependent on ground hydrogeological surveys give land unit-wise ground water potential. Be that as it may, inside each land unit (shake type), the ground water conditions change fundamentally relying on the alleviation, slant, profundity of enduring, nature of the endured material, nearness of breaks, surface water bodies, waterways, inundated fields, and so forth. Along these lines a methodical approach is required to comprehend the ground water potential all the more plainly. Such a strategy has been produced by characterizing the complete ground water routine as a blend of 4 factors, for example geology, Landform, Structure and Recharge conditions, the ground water potential maps shape a decent database and help the geologists of client divisions in recognizing good zones around the issue towns, there by narrowing down the objective zones. By leading point by point ground hydrogeological and geophysical surveys inside these zones, most fitting destinations can be chosen for penetrating. The ground water maps are helpful in distinguishing ground water forthcoming zones and site determination for arranging revives structures to enhance manageability of drinking water sources. Flow chart-1 explains the methodology of the present study.



FLOW CHART 1: Preparation Of Groundwater Potential Map

Base Map: The base map has been set up on a straight forward overlay utilizing the SOI toposheet on 1:50,000 scale. The satellite image, field and insurance information have been utilized for refreshing the base map just as for outfitting certain details. Base map comprises of different highlights like the road network, settlements.Fig-2 displays base map.

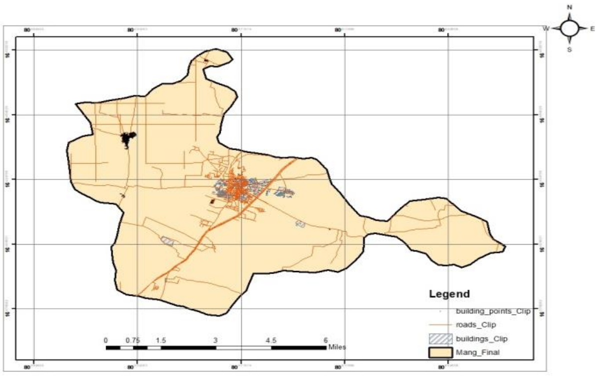


Fig 2: Base Map

Drainage Density Map: The examination region has been drawn drainage design with the assistance of Survey of India topographic map and refreshed from SRTM DEM. All the drainage lines are inspected intently and last drainage map is readied. The Drainage density map is prepared using hydrology tools in Arc map from SRTM DEM.Fig-3 displays the Drainage Density map.

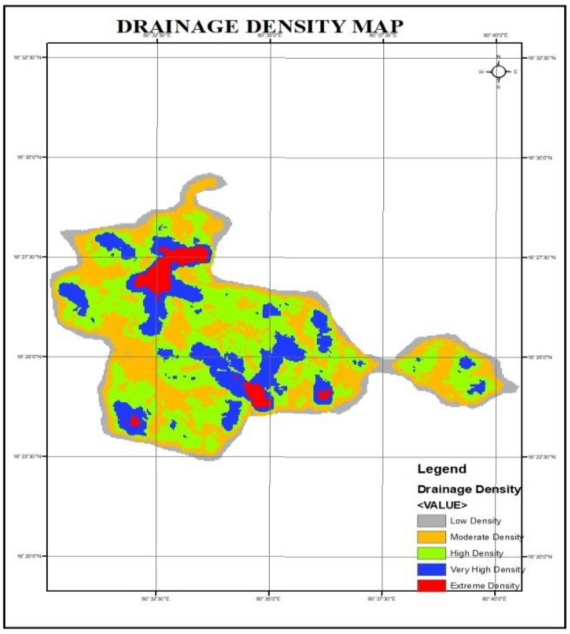


Fig 3: Drainage Density Map

Slope Map: Slope of a region is one of the controlling elements of groundwater energize. It impacts surface and subsurface stream of rain water and its revive to the groundwater repository. Delicate slope of a territory gives more opportunity to penetrate the rainwater to aquifer zone where as high slope permits lesser time coming about low invasion to fundamental groundwater stores. The slope guide of the examination territory has been set up from SRTM DEM. Fig-4 displays the slope map.

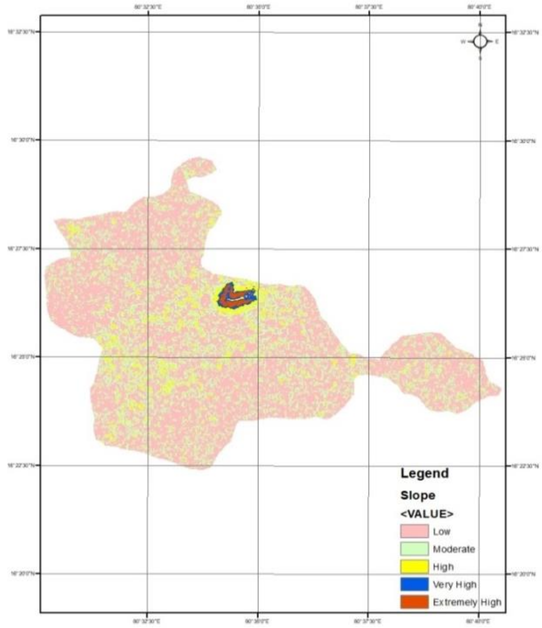


Fig 4: Slope map

Land Use / Land Cover Map: Land use alludes to man's exercises and different uses, which are continued land. Land cover alludes to natural vegetation, water bodies, rock/soil, artificial cover and others coming about because of land change. In spite of the fact that land use is for the most part surmised dependent on the cover, yet both the terms land use and land cover are firmly related and tradable. Data on the rate and sort of progress in the use of land assets is fundamental to the best possible arranging, the board and direction of the use of such assets. LANDSAT-8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) LEVEL 1 imagery have been used to develop the LULC map. Landsat-8 imagery consist of 11 bands.Fig-5 displays the LULC map.

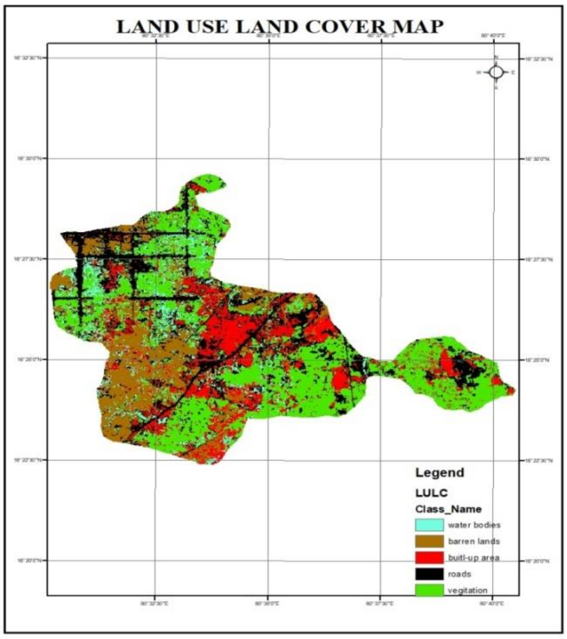


Fig 5: LULC map

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Soil Map: The investigation territory is arranged into 3 classes for example clayey to gravelly clayey moderately deep dark brown soils, Moderately deep black clayey soils, Loamy to clayey skeletal deep reddish brown soils. Each soil have its very own attributes. Ground water relies on the distinctive factors like soil penetrability and porosity and so on. Clayey soils have less porousness contrasted with different soils. Loamy soils have good infiltration of water. Clayey soils have lesser permeability.Fig-6 displays the Soil map.

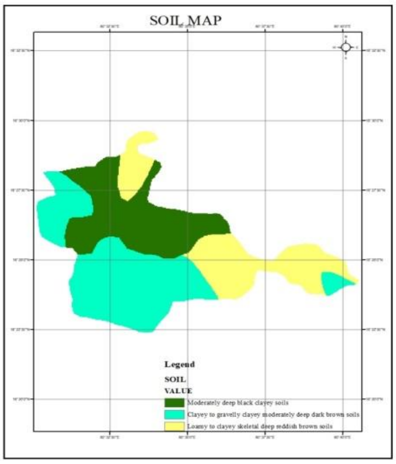

Fig 6: Soil Map

Geology Map: Geologically the examination zone covers by 2 classes for example Quaternary Sediments and Precambrian Rocks. Quaternary, in the geologic history of Earth, a unit of time inside the Cenozoic Era, starting 2,588,000 years back and proceeding to the present day. The Quaternary is a standout among the best-considered pieces of the geologic record. To some degree this is on the grounds that it is very much protected in correlation with different times of geologic time. The Precambrian is so named in light of the fact that it went before the Cambrian, the principal time of the Phanerozoic age, which is named after Cambria, the Latinised name for Wales, where rocks from this age were first examined. The Precambrian represents 88% of the Earth's geologic time.Fig-7 displays Geology map.

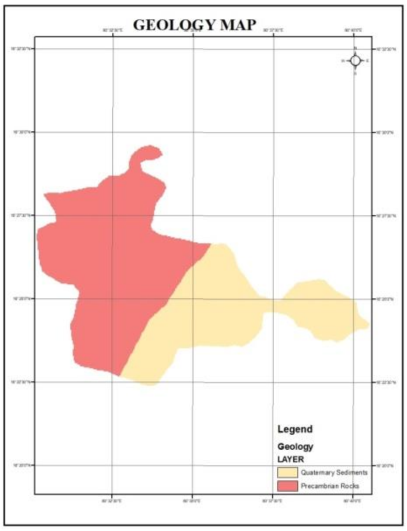

Fig 7: Geology Map

Ground Water Potential Map: The ground water potential map is readied dependent on the investigation of different themes, geology, land use/land cover, soil, intersection points, drainage density, confirms by utilizing merging proof idea, other than the collateral data acquired from State Ground Water Board with fundamental field checks. The ground water potential map uncovers the accessible quantum of ground water . This map is depicted into zones appearing, good, moderate, poor and very poor ground water potential territories. The precise Good and moderate zones speak to zones with sufficient ground water assets, poor and very poor speak to zones where unnecessary with drawls may prompt ground water exhaustion. The penetration map is readied dependent on essential and auxiliary porousness of the geological landscape and data from farming office. Groundwater potential mapping is done using weighted overlay tool in Arc map. Different weights are assigned based upon the factors influencing the groundwater. Table-1 displays the weights assigned to prepare the ground water potential map. Fig-8 displays the final groundwater potential zone map.

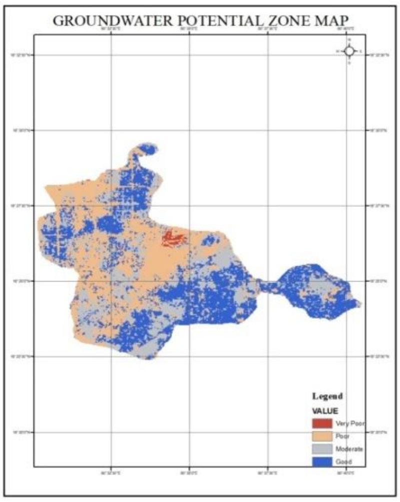

Fig 8: Ground water potential Map

Table 1: Weights assigned for preparation of Ground water potential zone map

THEMATIC MAP	WEIGHT ASSIGNED (%)
SOIL MAP	20%
GEOLOGY MAP	10%
LAND USE AND LAND COVER MAP	25%
DRAINAGE DENSITY MAP	20%
SLOPE MAP	25%

IV. RESULTS

Remote sensing and GIS have been utilized to incorporate different thematic maps viz., geological, drainage density, slope map, soil map, LULC map which being exceptionally educational assumes essential job in the study of event, quality and development of groundwater in the area under

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thought. High return ranges of groundwater are seen along krishna River canals and encompassing significant streams and tanks, good-moderate yield ranges are seen in the staying real piece of the study area and poor-very poor yield ranges are seen in a few places in the study area.

V. CONCLUSION

The study area consist of mangalagiri mandal,Guntur dist. The landforms saw in the study area are pediplains with moderate and shallow weathering, pediments, pediment inselberg complex, valley fill and dykes. In spite of the fact that waste system is disseminated in the whole study area, a large portion of it is dispersed in the southwest piece of the study area. The guide appearing changed potential zones for artificial recharge has been set up for the study area. The last (groundwater potential) delineate arranged by incorporating different thematic maps, viz., and geological, soil, slope and drainage maps. The present study demonstrates that the areas to construct artificial recharge structures to enhance groundwater levels in the point of view of groundwater use for future generations.

VI. RECOMMENDATIONS

Awareness campaign for conservation, augmentation to ground water should be taken up on a large scale.

Several artificial recharge structures like roof top/road top rainwater harvesting structures, pits and scavenger wells are to be constructed.

Intense road network and development activities with less vacant land between dwelling units have reduced surface area. Such localities are to be prioritized and separate planning has to be taken up for recharge.

Regulation and control of groundwater development is required to be made operational for not only protecting the environment and also to ensure equity in sharing groundwater.

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