

Integrated Study using Remote Sensing and GIS for Ground Water Prospect Zones and Management in Mylavaram Mandal, YSR Kadapa, Andhra Pradesh

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Abstract

An attempt has been made to explore the ground water potential of Mylavaram Mandal, Kadapa District using RS and GIS Techniques, Kadapa District is arid and knowingly drought affected district of Andhra Pradesh characterized by high temperature, frequent failure of monsoon, low humidity and high wind velocity. Hydro geomorphological map has been prepared at 1:10,000 scale using IRS-P6 LISSIV data and ground water prospects zones have been identified in the Mylavaram watershed of Kadapa district, Cadastral maps superimposed over the hydro geomorphologic map to identify specific areas of ground water prospects. Artificial recharge Pits and Farm ponds have been suggested to augment ground water. The study also indicates that predominantly ground water irrigated areas along lineaments, fractures and Fault system brought out by the satellite data interpretations are of immense use for taking up artificial Recharge Structures at suitable sites.

1. Introduction

Kadapa district is one of the four districts of Rayalaseema Region among the 23 districts of Andhra Pradesh. The district is economically backward and chronically drought affected. The district occupies the southern part of the State and is bounded on the north by Kurnool district of Andhrapradesh and Ananthapur dist in west of Andhra Pradesh, on the East by Nellore and districts of Andhra Pradesh and South by Chittoor Dist (Fig. 1). The geographical area of the district is 15,339 sq.km with a population of 36.39 lakhs. The population density, which was 169 persons per sq.km as per 2001 census has risen to 187 persons per sq.km as per 2011 census. This has led to stress on available land and the size of land holdings has decreased considerably.

Kadapa district forms the 2nd driest part of the country next to Jaisalmer of Rajasthan. The distribution of the rainfall in the district is erratic, uneven, and irregular. The district receives annual rainfall of 654 mm. which is the lowest in the state and second lowest in the country. The entire district is declared as arid due to severity of soil erosion, frequent failure of monsoon, decline in rainfall, low humidity, and vegetation degradation, over exploitation of ground water, high wind velocities etc. This district is economically backward and chronically drought affected.

Remote sensing provides multi-spectral, multi-temporal and multi-sensor data of the earth's surface. One of the advantages of using remote sensing data for hydrological investigations and monitoring is its ability to generate information in spatial and temporal domain, which is very crucial for successful analysis, prediction and validation, Satellite data provides quick and useful baseline information on the parameters controlling the occurrence and movement of ground water like geology, structure, geomorphology, soil, land use / land cover, etc (Krishna murthi and C.V chary 1996). Hence, a study was made in entire Mylavaram mandal with a buffer zone of four km with the aim of exploiting and conserving ground water potential.

1.1 Study Area

The study area of Mylavaram mandal consists of villages Mylavaram, Dommaranandyala, Vaddirala, Narjampalle, Talamanchipatnam and Veparala, Buchampalle etc . and lies between latitude 15^o 03' 36" to 14^o 47' 48" N and longitude 78^o 16' 50" to 78^o 16' 50" E (Fig:1).

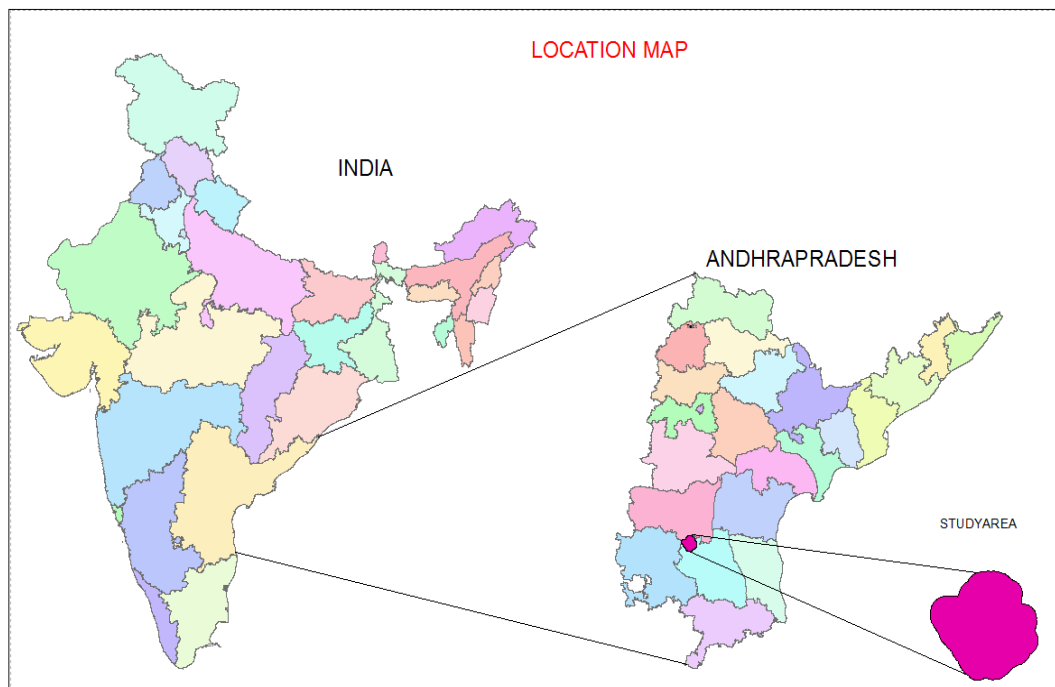


Fig 1: Location Map of study area

2. Methodology

The methodology involves generating of thematic maps such as geology, geomorphology, structural/lineament, drainage, Recharge structures and Base map using IRS-P6 LISS IV data in March 2012 and May 2012 at 1:10000 scale. Later the derivation maps such as hydro geomorphology map depict ground water prospects zones is prepared (Fig.2).

GIS technique is useful to derive and integrate geology, structural and geomorphological details. The various layers generated using remote sensing data like lithology, structure, geomorphology, lineaments etc. are integrated with already available information on slope, drainage density and other collateral data in a Geographic Information System (GIS) framework and analyzed with reference to the groundwater zones as well as artificial recharge sites.

To arrive at local specific recommendations at village level, the cadastral maps of Mylavaram mandal in Dommaranandyala, Vaddirala, Narjampalle, Talamanchipatnam and Veparala villages and four Km buffering are superimposed over the hydro geomorphology map.

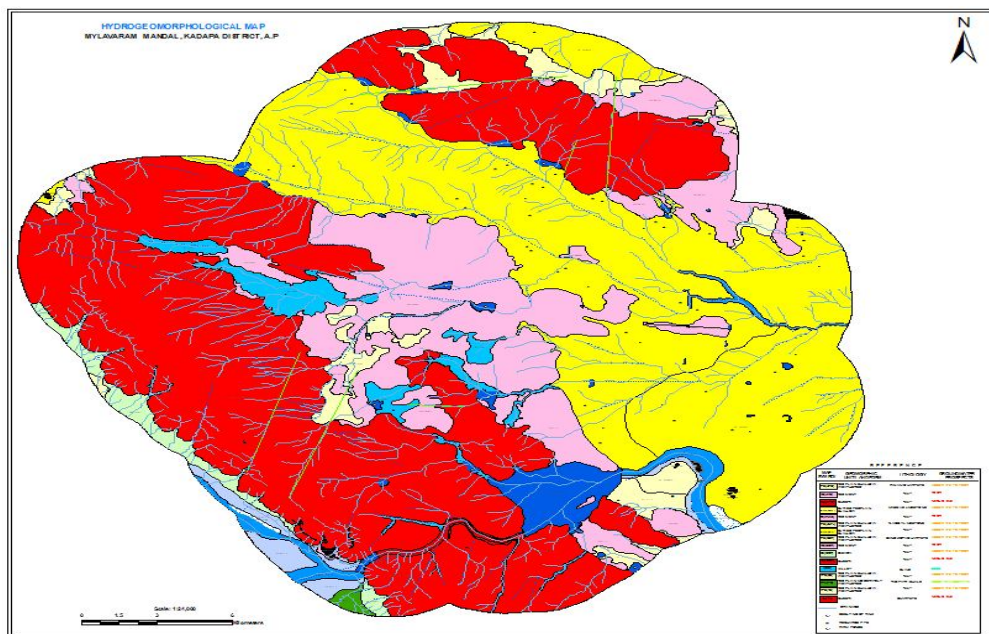


Fig. 2: Hydro-geomorphological map of study area.

3. Results and Discussions

3.1 Geology

The district is underlain by various geological formations ranging in age from Middle proterozoic. Major part of the district is underlain by the Gandikota quartzite and Flaggy Limestone of Kadapa Supergroup. North eastern part of the district is occupied by the Bairon konda quartzite, and Shale with phyllite of Nallamalai Group of rocks. Alluvium is restricted to Pennar, Chitravati and Penneru rivers . Mylavaram mandal is

underlain by various geological formations ranging in age Middle proterozoic; but the major part of the watershed is underlain by Gandikota quartzite, Massive and flaggy lime stones, Tadipatri shale, Paniam quartzite, Shale and Middle proterozoic age. Some of the Faults seem to act ground water movement so much that the areas of good ground water potential and fracture conditions are indicated downstream. The NE-SW and S-E trending Fault areas are ground water is very good, and the NS-EW and the N-S trending Faults are usually Disturbance in rocks and Fractures act as conduits for the flow of ground water (APSRAC Technical Report 1997).

3.2 Lineaments

Lineament analysis for ground water exploration in Gandikota quartzite area has considerable importance as joint/fractures and Faults serve as conduits for movement of groundwater. For extraction of lineaments, the Procedure of Moore and Waltz (1986) has been followed. In the watershed area of the mandal, many lineaments are mapped using satellite data. In the watershed the lineaments are mostly trending NE-SW, E-W, and NW-SE direction (Fig. 3)

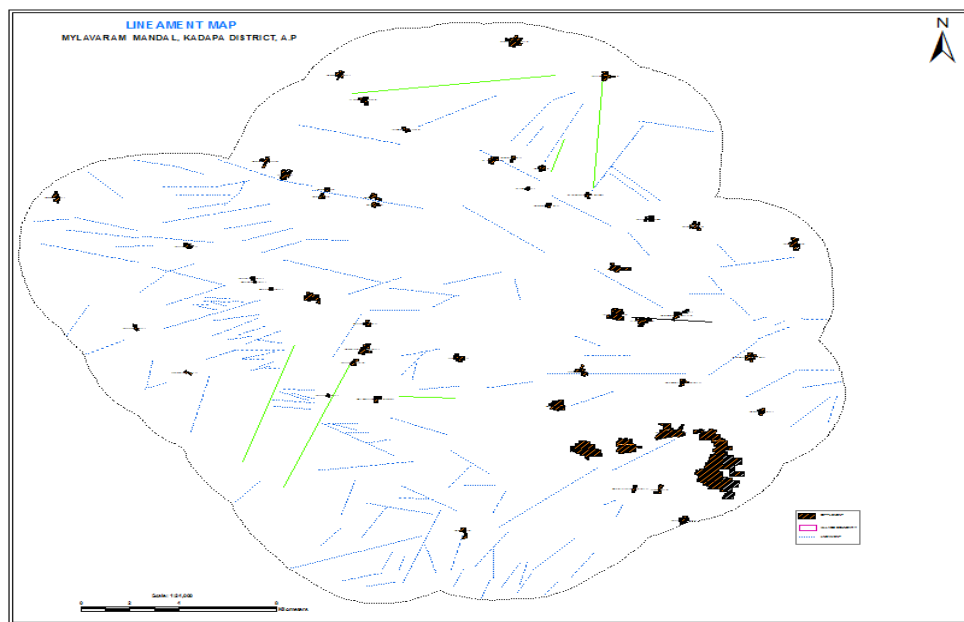


Fig. 3: Lineament map of study area.

3.3 Hydro geomorphology

Study of geological, hydrological, and meteorological data provides information on the parameters such as rock types, geological structures, landforms, and recharge conditions which control the occurrence and distribution of ground water. Remote Sensing based study has been carried out for hydrogeomorphological mapping to identify various landforms based on their groundwater prospects for tapping groundwater. Groundwater potential zones were delineated from hydrogeomorphology, structural information and from field well inventory data. The

watershed is divided into 25 Hydro geomorphic units based on landforms, genesis, geology, soils etc.

The major landforms of the area include Pediplain in shallow weathered, pediment, Cuesta, Bazada, Buried pediplain shallow weathered, and Stabilized dunes. The ground water prospects in shallow weathered Buried pediplains are moderate to poor and while in Shallow weathered pediplains the prospects are good to moderate. The ground water prospects are negligible to poor in Hills and Pediments . Excellent groundwater prospects may be expected in the fracture valley depending upon the thickness for the weathered material.

In the watershed area, the groundwater occurs in the weathered and fractured rocks under water table and semi-confined to confined conditions. The study area is predominantly underlined by hard rocks which have very low permeability or transmissivity values. But, due to the development of secondary porosity with the introduction of fracturing and weathering, they have improved chances of tapping potential aquifers. and acting as barriers to ground water movement also has improved yield prospects from the aquifers. The degree of weathering in the hard rock's varies from a meter to as much as more than 30 m. The degree of fracturing and depth of fracturing vary from place to place. In general, as evidenced by CGWB exploratory drilling in the district, the intensity and occurrence of fracturing reduce after 40 m depth and mostly after 60 m depth.

Eastern and southern part of the study area consists of Buried pediplain shallow and Cuesta hills with Negligible ground water prospects, in western part of the Cuesta and Pediment with Moderate to poor groundwater conditions

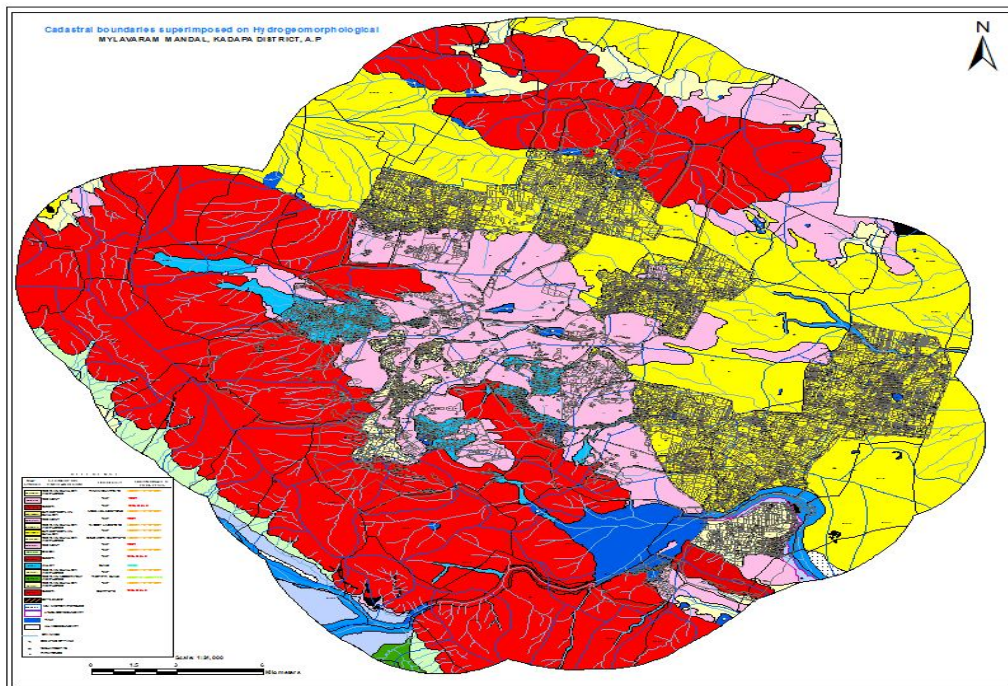


Fig.4: Cadastral boundaries superimposed on Hydrogeomorphological map.

To arrive at location specific recommendations(water conservation methods) at village level, the cadastral map of Mylavaram, Dommaranandyala, Vaddirala, Narjampalle, Talamanchipatnam and Veparala villages are digitized and overlaid on both image as well as watershed wise hydrogeomorphological map to identify / proposed rain water structures like recharge pits etc., at cadastral level(Fig. 4). Rainwater harvesting structures like check dams Recharge pits, farm ponds are already in progress. The construction of the artificial recharge structures should be taken up on the watershed basis and designed for 50% of non-committed run-off so as not to deprive the downstream watersheds.

The predominant groundwater irrigated areas along lineament, and fracture systems brought out by satellite data interpretation are of immense use of for taking up artificial recharge structures. The locations which are recommended for artificial recharge structures (check dams) are upstream of the irrigated areas and some recharge pits are proposed in and around the village settlement locations for recharge the ground water through surface runoff which is useful for sustaining the drinking water bore wells.

4. Conclusion

The study indicate that both high, moderate and low potential zones of ground water prospect are noticed in them, Rainwater harvesting or any other artificial recharge methods are more suitable to improve the ground water potential in low and moderate potential zones. Recharging process can be made effective and efficient to meet the demands of water for human consumption and irrigation purpose through planning and using appropriate scientific methods and tools.

Reference

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