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Original Research Paper

Watershed Management plan using Geospatial techniques in Darweshpuram watershed, Kangal mandal, Nalgonda District, Telangana.

Geography

KEYWORDS: Watershed development, remote sensing, Geospatial, Hydrogeomorphology, Darweshpuram

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ABSTRACT

Integrated watershed management requires a host of inter-related information to be generated and studied in relation to each other. Remote sensing techniques provide valuable and up –to date information on natural resources. GIS with the capability of integration multilayer information obtained both from remote sensing and other conventional source has proved to be effective tools in planning for watershed development. The ground water prospecting map has been prepared considering major controlling factors, which influence the water yield. The map depicts Hydro geomorphology coupled with hydro geological and structural/ lineament which have proved to be very effective tool to discern ground water potential zones. The High Resolution Satellite Data is IRS -P6 LISS-IV is used for quick and useful base line information on the parameters like Geology, Drainage, Geomorphology, Land use/land cover, lineaments etc. controlling the occurrence and movement of ground water. The present study is aimed to use the above mentioned maps prepared by integrating remote sensing with ERDAS and GIS software's as an efficient tools to target the ground water prospects in the study area. The study area Darweshpuram Watershed is located in South West direction of the district of Nalgonda, Telangana State, India. Main aim is to evaluate the impact on soil and water conservation measures on changes of land use of watershed and on water yield from the watershed, using soil conservation methods. The present study is totally the development of natural resources in micro level for each survey no, for the purpose of agricultural and area development.

1.0 INTRODUCTION

Background: The study area "Darweshpuram" watershed" falls in Kangal Mandal of Nalgonda district, Telangana State, India. The watershed is around 10 km from Nalgonda in South-East direction. The extent of the watershed stretches from between 17°01'33" and 16°54'27" North Latitudes, and 79°11'57" and 79°15'58" East Longitudes. Elevation is 263 met. (MSL) and is covered in the Survey of India. Toposheets number 56O4SE, 56P1NE and 56P5NW. On the scale of 1:25,000 and covers an area of 6190 hectares, (62 sq kilometers).

The study area people occupation is agricultural, 90 percent of the people depending only on agricultural, the present study is totally the development of Groundwater resources Development in Watershed level, under this, and we are preparing all thematic data like landuse / landcover, soil map hydrogeomorphology, lineament map extra. Totally and technically, by using Remote sensing techniques Arc-GIS and ERDAS. Using this software and preparing action plan map of the Darveshpuram watershed, all thematic information and Groundwater resources Evaluation information and conservation measures and predictions and management of watershed, for solving the study area problems.

Objective: The main objective of the study is Watershed level Groundwater development by using remote sensing, and GIS. In this we did prepare the Hydrogeomorphology, land use/land cover, Soil and Slope maps of the Darveshpuram watershed on 1:10,000 scale using high resolution satellite data LISS IV using remote sensing and GIS techniques. All the thematic mapping data integrate and preparing of action plan map of Darveshpuram watershed, and all the themes promises to bring the benefits of green revolution hitherto untouched by adopting a farming system approach on watershed management principle , in order to conserve precious rain water and equally precious soil.

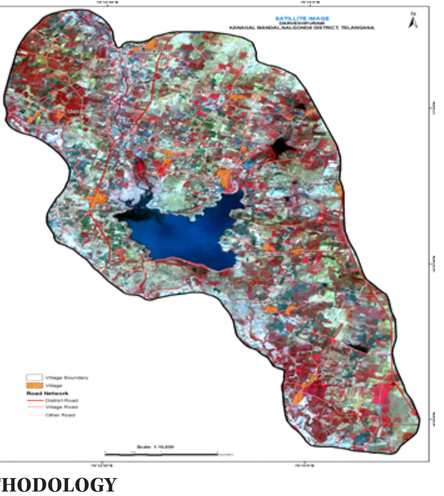
The watershed project, aimed at

(1) Conserve Groundwater resources Evaluation

(2) Increase the crop production through efficient use of available surface and groundwater resources.

(3) Specific improved technologies for in situ soil and moisture conservation / water harvesting measures, drainages, improved cropping systems, restoration of eco-balance through alternate land use system and enhancing the income levels of the rural households through adoption of subsidiary activities in farm and non-form activities.

Land Resource Information System (LRIS) aims to discuss several purposes for land records, cadastral data and land natural resource information. Data from LRIS has been used in a diverse range of applications - including Education, Postgraduate Research, Catchment Area Management, Resource Management in several regions and preparation of Farm Plans for Land Managers.



2.0 METHODOLOGY

Location and Extend: Darveshpuram watershed is located in Kangal Mandal and occupying an area of 62 Sq km of Darveshpuram Chennaram, Erragaddagudem parvatgiri Timmannagudem Telakatigudem, Nimmalagudenm Manchinilabaviguem Lingavatam Kummarigudem Milawaram villages in Kangal Mandal Nalgonda District and is situated between stretches from between 17°01'3" and 16°54'27" North Latitudes, and 79°11'57" and 79°15'58" East Longitudes. Elevation 263 met (MSL) and covers an area of 6190 hectares, 62 sq kilometers .Survey of India Toposheet number 5604SE 56P/1/NE 56P5NW on a scale of 1:10,000 scales.

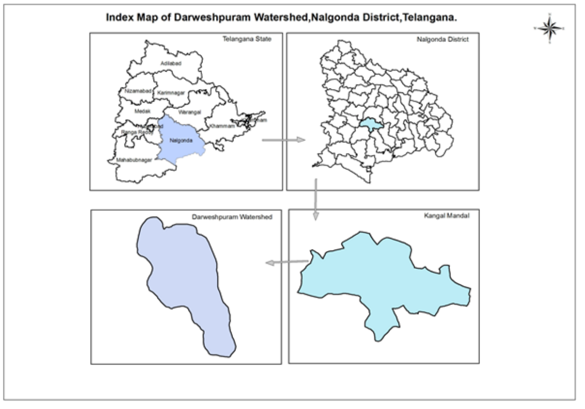


Fig2: Location map of the study area

Drainage Map: Drainage map of the study area has been prepared from the SOI Toposheet and updated on the high resolution satellite of LISS IV. The watershed area shape is elongated and consisting of dendritic drainage pattern, with the stream order ranging from 1st to 3th order.

Slope: Slope, aspect and altitude are important terrain parameters from land utilization point of view. Among the three, slope is very vital one for land irrigability and land capability assessment.

The study area has been categorized in to 7 slope classes in which slope cases 1 to 2 cover major portion of the area. The moderate and steep slope categories correspond to hilly terrain of residual hills and Inselberg of granite gneiss region.

Geology& Structure: Darweshpuram Watershed is underlined by the formation of Granite, granodiorite-granite gneiss, in the age of Achaean. Geologically Darveshpuram watershed is stable and consisting of hard rock terrain of granite gneiss. Have a bearing on the capacity of the rocks to hold and transmit groundwater. The area is marked by numerous fractures and the drainage is mainly controlled by these fractures/lineaments.

A number of lineaments running in NE-SW, NW-SW directions are identified. Major lineaments are noticed in the area of Darveshpuram.

Land use/Land Cover: Land Use/land cover mapping for the Darveshpuram watershed was carried out by standard visual interpretation techniques using LISS-IV false composite (FCC) Data Generated on 1:10,000 Scale. Identification of Different Land Use/land cover classes were made based on the image characteristics like tone, size, shape, pattern, texture, geographic location and association etc.

Survey of India (SOI) topographic maps was also consulted along with the multi-date satellite imageries. The interpreted details were then checked to verify and confirm the prefield interpretation. Based on the ground verification, the boundaries of the different land use /Landover units were then finalized. The area under different classes was calculated using GIS techniques.

- It is defined as an area of human habitation developed due to non-agriculture activities that include buildings, transport, communications, utilities in association with water and vegetation. Total numbers of villages covering in the watersheds are Darveshpuram watershed. Built-up area Covers 109 hectares.

- This is a land, which is generally prone to deterioration due to erosion. Such lands generally occupy topographically high locations, excluding/mountain terrain. They appear in light yellow to brown to greenish blue depending on the surface moisture cover and vary in size from small to large having either contiguous or dispersed pattern. Scrublands are associated with moderate slopes in plains and foot hills and are generally surrounded by agricultural lands. Besides there is scrub jungle and other plants used for fuel.

- It is defined as the land primarily used for farming and production of food, fiber, and other commercial and horticultural crops. It includes land under crops (irrigated and non-irrigated, fallow, plantations etc.).

- These areas are separable from cropland, especially with the data acquired during kharif season. Plantations appear in dark-red to red tone of different sixes with regular and sharp edges indicating the presence of a fence around it. Depending on the location, they are exhibit a dispersed or contiguous pattern.

- It is described as an area under agricultural trees planted adopting certain agricultural management techniques. It includes mango orchards and horticultural nurseries. Few patches of mango plantations are identified in the agricultural land.

- It is described as degraded lad which can be brought under vegetative cover with reasonable effort, and which is currently under utilized and land which is deteriorating due to lack of appropriate water and soil management or on account of natural causes. Wastelands can result from inherent/imposed constraints such as, by location, environment, chemical and physical properties of the soil or financial or management constraints.

- Lands affected by salinity/alkalinity have excess soluble salts (saline) or high exchangeable sodium salinity is caused due to movement of water, capillary rise during extreme weather condition s leaving salts encrustation on the surface.

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Hydrogeomorphology: The procedure adopted to prepare the hydro geomorphology map of the project area it consists of basically four distinct parts. They are

1) Acquisition of satellite and collateral data
2) Preparation of prefield interpretation maps
3) Limited field checks in the doubtful areas and
4) Preparation of hydrogeomorphological map The hydrogeomorphology units obtained are moderately weathered pediplain, Shallow weathered pediplain, Residual hill, and Pediment.

- PPM is a gently sloping smooth surface of granite gneiss with more than 5m depth of weathered material, generally covered with red soil. In general, the ground water prospects are moderate to good. Good yields can be expected along fractures / lineaments with yields. Ground water development is extensive in these areas due to the availability of good ground water potential. These landforms are developed throughout catchment area.

- PPS is a gently sloping smooth surface of Granite gneiss with less than 5m depth of weathered material, generally covered with red soil. The ground water prospects are poor to moderate. Moderate yields are expected along fractures/lineaments with yields ranging.

- RH is an isolated low relief relict hill occupying considerably small area. The ground water prospects are poor. These landforms are seen in the granite rocky terrain of the area.

- PD is a gently sloping rock-cut surface of granite with thin veneer of detritus. In general, the ground water prospects in a pediment area poor. These rock-cut outcrops are exposed extensively near hill area.

- A Prominent Isolated Steep sided, usually smoothed and rounded, residual knob hill or small mountain of circumdenudation rising abruptly from and surrounded by Extensive and nearly level lowland erosion surface in hot, dry region generally bare and rocky although partly buried by the debris derived from and overlapping its slopes it characteristics of representing the end result (the "Peneplain") of the mature stage of the erosion cycle.

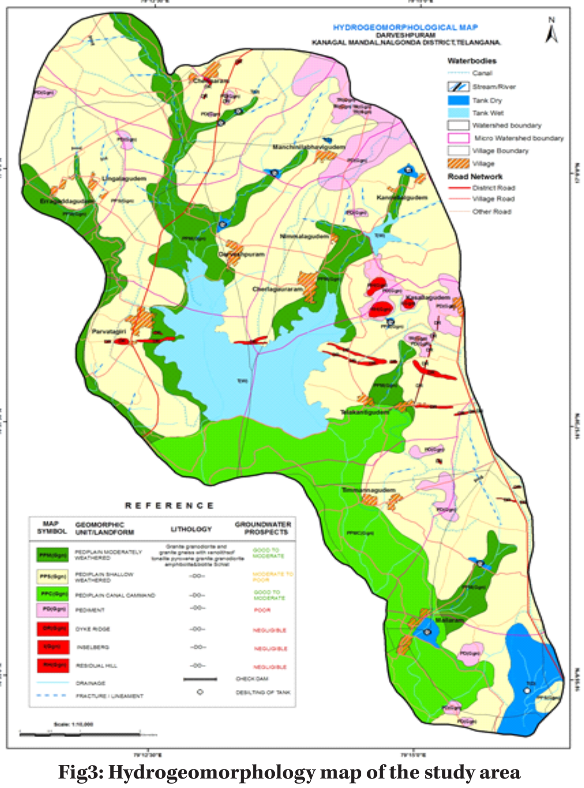

Fig3: Hydrogeomorphology map of the study area

Ground water prospects: 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 hydro geomorphology, structural information and from field well inventory data. The Study area is divided into various Hydro geomorphic units based on landforms, genesis, Geology, soils etc

The major landforms of the area include shallow weathered pediplain, moderately weathered pediplain, residual hills, inselbergs, pediment and Dykes. The ground water prospects in shallow weathered pediplain are moderate to poor and while in moderately weathered pediplain the prospects are good to moderate. In pediments, the ground water Prospects are negligible to poor while in hilly areas it is negligible. Excellent groundwater prospects may be expected in the fracture valley depending upon the thickness for the weathered material.

In the Study 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 rock's 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. The presence of dykes, 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 15 m.The degree of fracturing and depths 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 80 Ft depth and mostly after 110 Ft depth.

North-eastern part of the study area consists of pediments and Residual hills with poor to negligible ground water prospects; in western part of the watershed is shallow weathered pediplain with moderate to poor groundwater conditions To arrive at local specific recommendations (water conservation methods) at village level, Hydrogeomorphological map to identify / proposed Rainwater harvesting structures like check dams, are already in progress. The construction of the artificial recharge structures should be taken up on the designed for 50% of non-committed run-off so as not to deprive the downstream watersheds.

The predominant groundwater irrigated areas along lineament, and facture 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 for recharge the ground water through surface runoff which is useful for sustaining the drinking water bore wells.

3. RECOMMENDATIONS

Water Conservation: A good understanding of and water conservation with reference to their nature and distribution is essential to formulate any land based production system. The watershed as a planning unit for development of land and water resources has gained importance since the Ministry of Agriculture, Government of India, initiated various developmental programmers on watershed basis. According to the guide lines given by the department of Agriculture the soil and water conservation measures have been recommended for the 'Darveshpuram' watershed depending upon the land attributes. Check dams are proposed on lower order streams to control water velocity and to store the water.

Action Plan for Water Conservation Measures: Terracing and bonding and construction of Check dams are recommended after considering the climate, groundwater potential, surface water availability, and morphology of the area, soil characteristics, current land use practice and slope of the area. The socio-economic conditions of the particular watershed were also taken into consideration to suggest optimum utilization of land and water resources. Te details of action plan suggestions are described below.

Check Dam: On the 2rd order streams along the foot hill zones and in the areas with 0-5% slope.

Desilting of Tanks: The Desilting is recommended in small tanks which are partially silted up. Siltation in the tanks is found by study of the image and ground truth.

Soil Erosion Control Measures including planting of soil binding species, gully control works etc: These soil conservation measures are suggested in relatively flat cultivated areas. Vegetative barriers can be easily established across a wide spectrum of soil and climatic conditions except in arid conditions. These are usually a few rows of grasses and shrubs long the contours for erosion control. Water harvesting structures may be constructed across the slopes to store as much water as possible for use in lower slope areas

Ground Water Development with Conservation Measures and Horticulture/Nurseries Development: To increase crop lands, horticulture and nurseries groundwater exploration is suggested which is not earlier exploited in moderate range. Horticulture plantations with interspaced cultivation can bring better returns than the field crops. Interspaces in horticulture plantations may be grown with vegetables in both seasons. Different tree species are recommended for forest nurseries.

Fodder/Fuel Wood Plantation: These are suggested in the marginal lands with poor groundwater potential areas and not able to sustain crops. The open forest areas may be converted into grazing lands by over seeding grasses and fuel wood species are recommended to meet the demand of local people requirement.

Afforestation: Afforestation is proposed in the forest blanks/open forest areas to increase the density of vegetation. These gaps may have been caused due to several reasons which include grazing in the initial stage and unauthorized tree felling. The economic forest plantations are suggested for compensating forest degradation. Afforestation with special efforts are proposed to increase the vegetation density, to control soil erosion, check runoff etc. The open forest areas may be converted into grazing lands by over seeding grasses. Agro-Forestry/ social forestry is recommended on hill slopes. Soil and water conservation methods are also suggested for the development of Agro-Forestry. Complete protection against biotic interference to promote natural regeneration of vegetation is proposed in areas otherwise unsuitable for plantation. Development of social forestry on wastelands would help to promote forest protection to a large measure.

Vegetative Barriers, contour bunding with bund plantation, stone checks: vegetative barriers are closely spaced grass hedges or plantations, usually a few rows of grasses or shrubs grown along contours in agricultural lands. They prevent soil erosion and silting of tanks, check dams. They also augment production of food, fuel, fodder and fiber from farm lands by growing suitable species.

Wastelands: Land with or without scrub (Scrub Lands) come under this category. Over seeding on grasses, silvipasture, and agro-forestry plantation are recommended on upland with or without scrub. Water harvesting structures in middle slopes ranging from 5-10% will help in raising soil moisture, in slopes at higher reaches brushwood dams and rubble dams will arrest soil erosion. Water-harvesting will improve subsoil moisture helpful for crop growth and change in land use. In uplands higher slopes should be covered with Agro-forestry or silvipasture.

4. CONCLUSION

The Indian remote sensing satellite data is IRS-P6 LISS-IV satellite data is with the spatial resolution of 5.8 m can be enlarged even up to 1:4000 scales. With the help of high resolution data expansion of rural settlement, drainage and road network, is updated, the boundaries of all geomorphic unit are drawn more precisely. with the advent of high resolution satellite data, site specific recommendations for ground water exploration can be given of cadastral level for effective management of ground water resources all smallest possible revenue boundary i.e. in the individual field of the formers. The effect of check dams resulted in stabilizing the water levels in the wells, increasing the pumping hours, rejuvenating the abounded wells, and resulting. We are suggesting the contour bundling and vegetative barrier is very cost and vast expenditure.

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