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Water Resource Development Plan for Rural Development: A Geospatial Solution

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Abstract- The present study is to examine the potential for water harvesting and conservation of ground water against drought in Moinabad Mandal of Rangareddy district of Telangana (India). The Climate of the Block is characterized by a hot summer and is generally dry except during the South west monsoon season. Water resources development plan needs better understanding about the various natural resources their relations with each other and their relations with livelihood of the stakeholders. In order to optimum utilize the existing natural resources like land, vegetation and water in a selected area, proper scientific surveys should be conducted. These include mapping of soils, hydro-geomorphic features, land use/land cover pattern, surface & ground water potential surveys in addition to gradient of the terrain particularly, slope and aspect which plays a vital role in suggesting various soil and moisture conservation measures. Based on the mapping and analysis (using GIS& RS as a powerful information tools) of these natural resources, water resource development plan has been prepared on the basis of integration of information on Geomorphology, Land use / Land cover, Drainage, Ground water Prospect map and slope. Suitable structures are suggested for surface harvesting / recharge in the study area. Based on this location priority, various water-harvesting structures have been proposed to mitigate the adverse effects of drought conditions which lead to the degradation of natural resources.

Keywords: Water harvesting, Remote Sensing, GIS, Ground water, Water resources

I. Introduction

Water resource development plan is very much important for growth and sustainability of agriculture in the rain fed regions [1]. Water resource development plan is initiated to enhance agricultural production, conserve natural resources base and ensure rural livelihood. The water resource development plan is vary according to the geography and ecology of the area at which the watershed is initiated [2]. To increase the irrigated areas it mostly depends on ground water and hence preference is given to water harvesting and ground water recharge [3]. Groundwater is held in geological material such as soil, sand and rock beneath the surface such geologic layers is called an aquifer which can supply water continuously [4].

The modification of agricultural practices and changes in irrigation schemes are the most crucial steps should be taken to eliminate the miss management of water [5]. Development of the water resources needs better understanding about the various natural resources their relations with each other and their relations with livelihood of the stakeholders. Geo-scientific studies of the terrain, socio-economic appraisal of the stake holders and knowledge about local practices aimed at providing well-coordinated and synthesized information on the overall geographical area.

In order to optimum utilize the existing natural resources like land, vegetation and water in a study area many plans and programmes were executed but proper scientific surveys were not conducted. In this study, the proper scientific survey and mapping tools were used. These include mapping of soils, hydro-geomorphic features, land use/land cover pattern, surface & ground water potential surveys in addition to gradient of the terrain particularly, slope and aspect which plays a vital role in suggesting various soil and moisture conservation measures [6]. Based on the mapping and analysis (using GIS & RS) of these natural resources mentioned proper soil and moisture conservation practices can be adopted to mitigate the adverse effects of drought conditions which lead to the degradation of natural resources [7]. The natural resource data thus generated will be useful to conserve and manage water resources properly to achieve

sustainable development of land particularly, in ecologically fragile areas in order to meet the living standards of the rural communities.

II. Location and Extent

The location of study area falls under Moinabad Mandal of Rangareddy district of Telangana State. (Fig-1). The study area falls in Survey of India Toposheet No. 56K3NE, 56K3SE, 56K4NE, 56K7NW, 56K7SW and 56K8NW (Fig-2). The present study area is spread over between 78° 11' 26" E - 78° 20' 50"E Longitude and 17° 14' 36" N - 17° 24' 34" N Latitude occupying 206 Sq. Km area. The Moinabad Mandal is surrounded by Rajendranagar, Shankarpalli, Chevella, Shabad and Shamshabad Mandals. The study area map was shown in Figure 1. The Climate of the Block is characterized by a hot summer and is generally dry except during the South west monsoon season. The year may be divided into four seasons. March to May is the summer season, June to September constitutes the South West monsoon season, October to December from the North East monsoon season and January to February is the winter season.

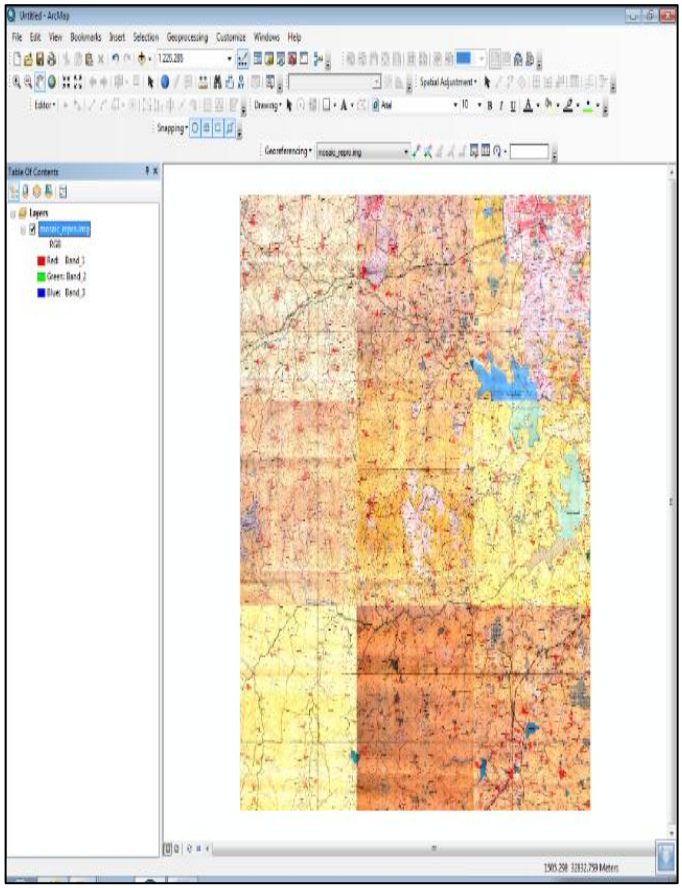

Fig- 1: Toposheet

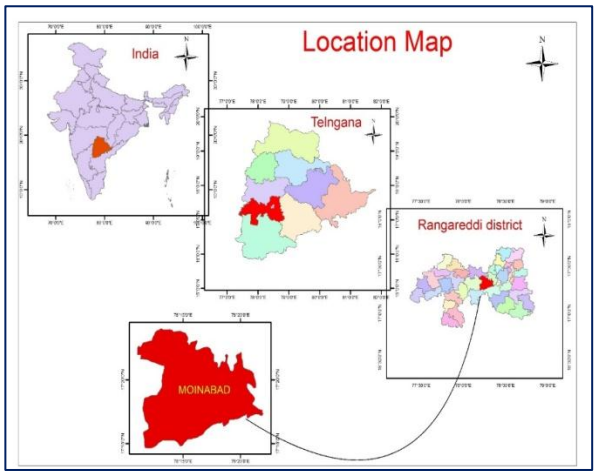

Fig- 2: Location Map

III. Objectives

The present paper made here is an attempt applying Geospatial Technology to achieve the following objectives.

- To enlist, generate and use geo-database for arriving Geo-spatial solution for Water Resource Development Plan.
- To work out a location specific model resulting into identification of Rain Water Harvesting measures / structures.
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IV. Methodology

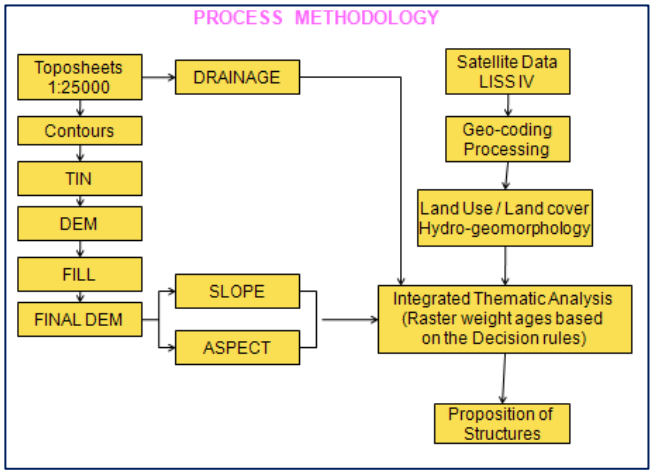

Fig- 3: Methodology flow chart

To achieve the above objectives, the following methodology (Fig-3) and procedure is adopted in the present study. Collection of satellite data and Survey of India Topographical maps covering the study area, prepared of Base map (Fig-4) on 1:25000 scale using Survey of India

Topographical Maps, prepared of Drainage (Fig-5), watershed and Surface water bodies using SOI topographical maps, prepared contour map (Fig-6) of 10 mts contour interval using SOI topographical maps, prepared TIN (Triangulated Irregular Network) map (Fig-7) from contours and then prepared of DEM (Digital Elevation Model) (Fig-8) from TIN, prepared of Slope (Fig-9), Aspect (Fig-10), Flow Accumulation (Fig-11) maps from DEM, prepared Geology (Fig-12), Geomorphology map (Fig-13), Land use / Land Cover (Fig-14) using Satellite data on 1:25,000 Scale after ground truth data collection, verification of doubtful areas and correction, modification and transfer of post field details and recommendation of water resources development plan. The satellite imageries were processed in Erdas imagine software and all digitization, analysis and mapping done in ArcGIS environment. The Spatial Analyst and 3D Analyst tools were used for giving weightages, conversion from vector to raster and calculation of all the thematic layers. Finally, integration of all thematic maps were done in GIS for propose various water harvesting structures.

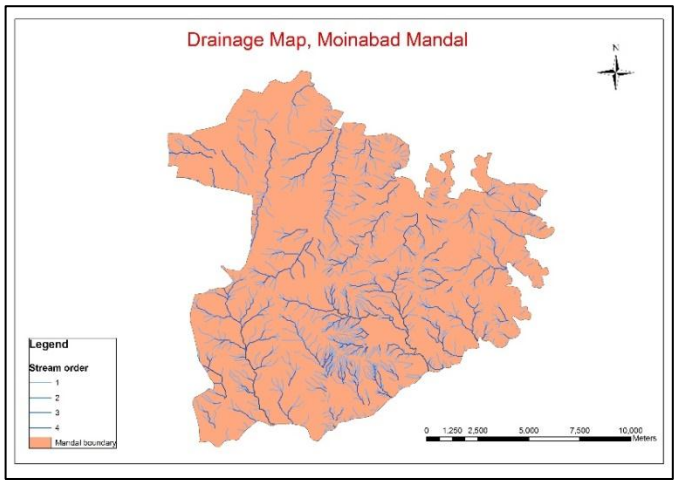

Fig- 4: Drainage Map

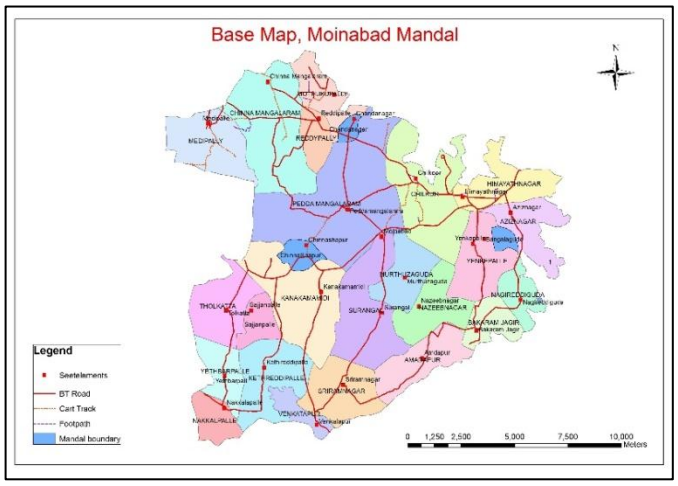

Fig- 5: Base Map

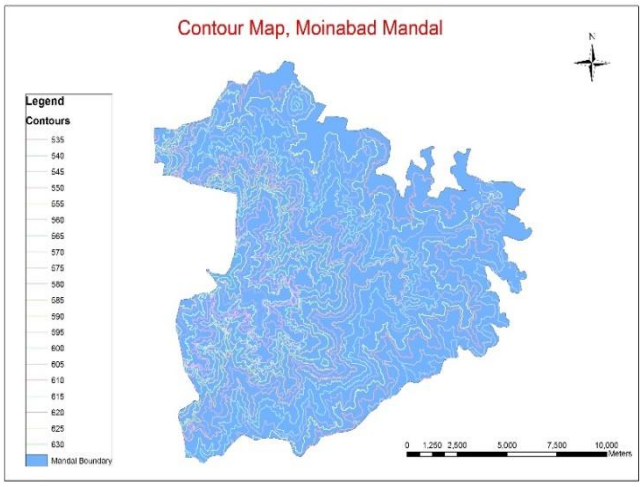

Fig- 6: Contour Map

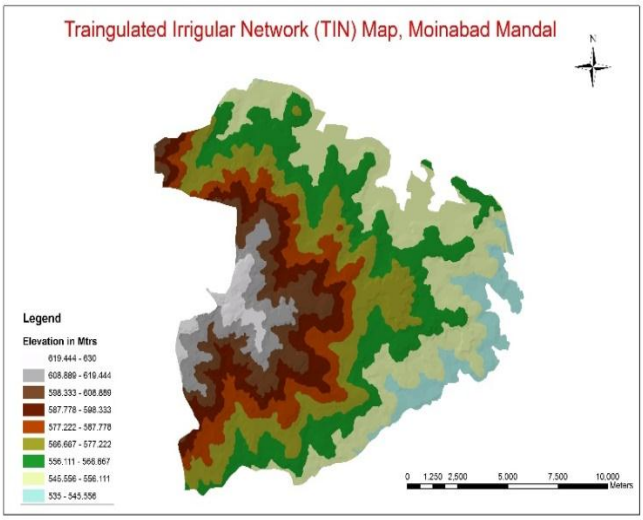

Fig- 7: TIN Map

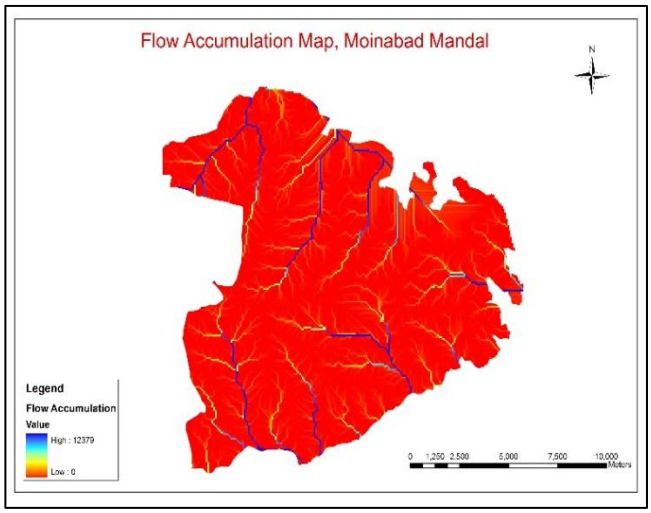

Fig- 8: Flow Accumulation Map

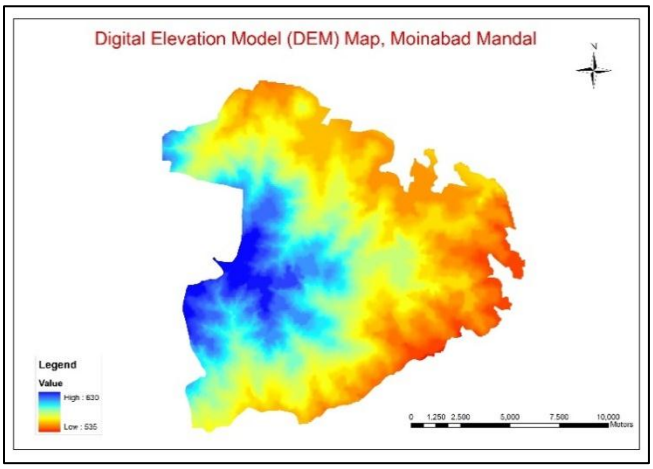

Fig- 9: DEM Map

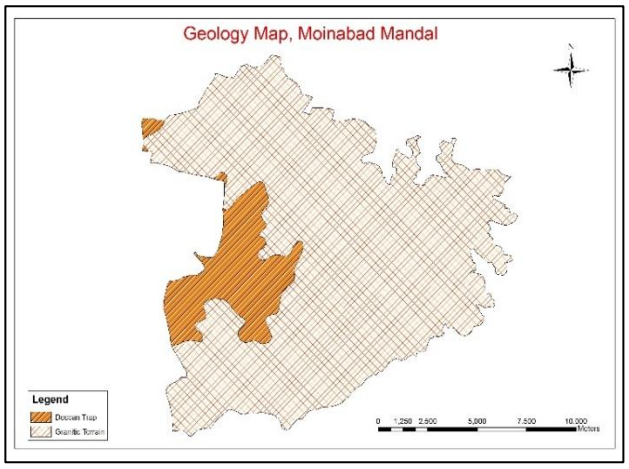

Fig- 13: Geology Map

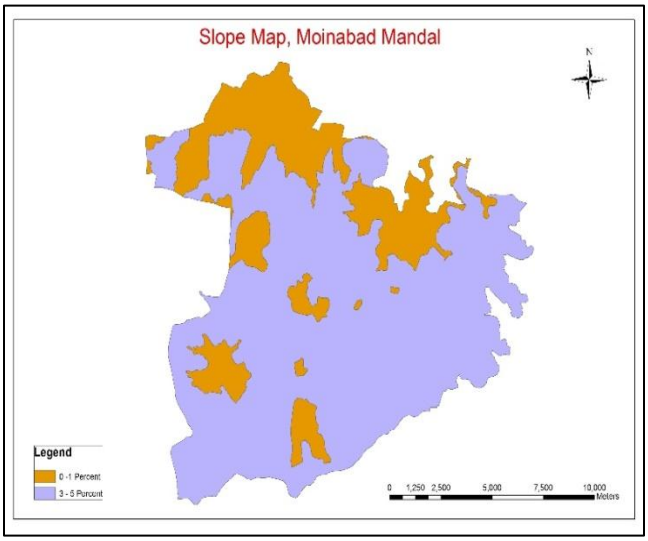

Fig- 10: Slope Map

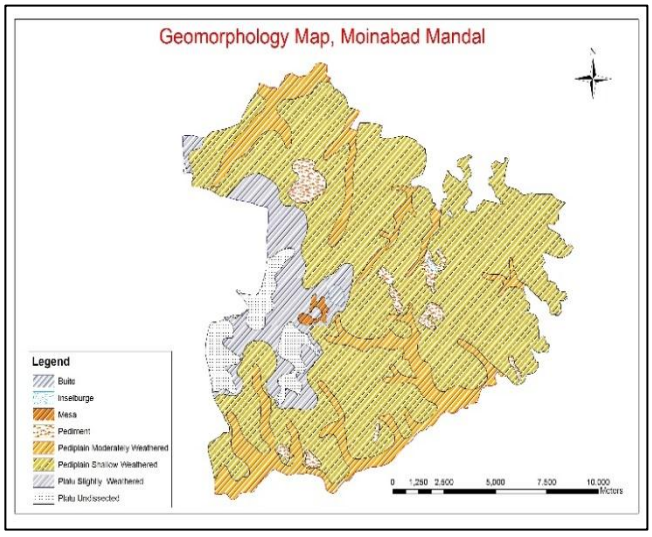

Fig- 14: Geomorphology Map

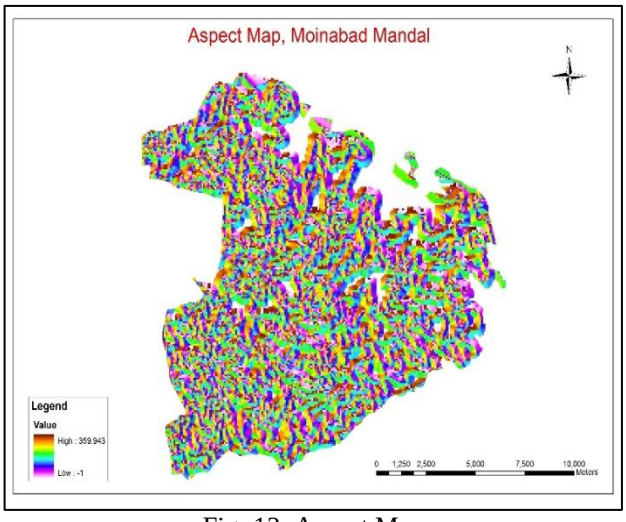

Fig- 12: Aspect Map

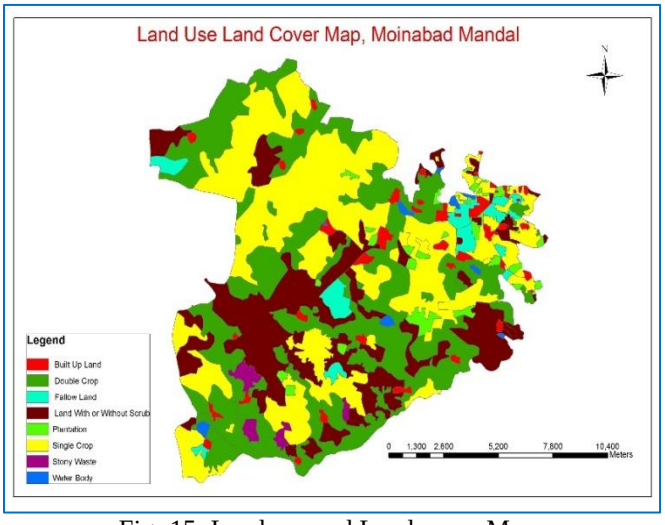

Fig- 15: Land use and Land cover Map

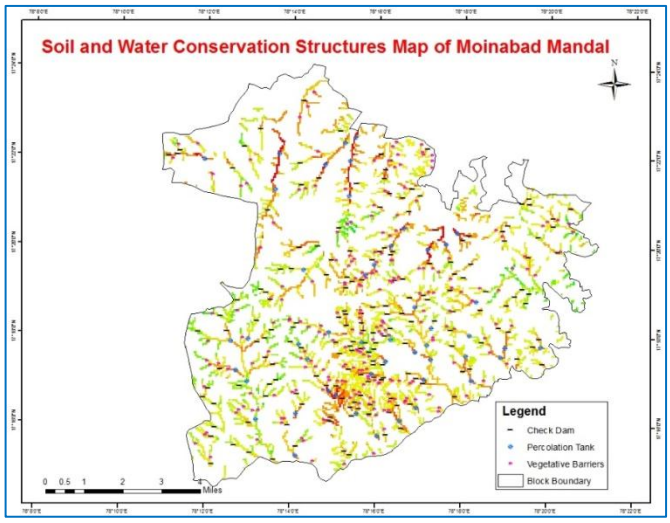

Fig-16: Proposed Soil and Water conservation structures Map

V. Results and Discussion

In the present study most of the analysis was done using Hydrological analysis tools in ArcGIS 10.4 software. The hydrological analysis process in GIS is one of the effective methods in terms of cost and time in proposing various water harvesting structures. This process deals with assessing various hydrological characteristics of a surface. Slope and aspect play a vital role in determining the shape of a surface. The basic inputs required to generate a hydrological model for a region are slope, aspect, flow direction, flow accumulation, and a possible stream network.

Water resource development plan has been prepared on the basis of integration of information on Geomorphology and Land use / Land cover, Drainage, Ground water Prospect map and slope. Suitable structures are suggested for surface harvesting / recharge. Weightages are given to significant units (on priority basis) in various thematic layers such as ground water prospects, slope, drainage and land use/land cover in raster form in order to prioritize locations for suggesting appropriate recharge structures. First, all the thematic layers have been converted to raster form to assign weightages, since the analysis should be performed in raster mode.

Based on this location priority, various water-harvesting structures have been proposed (Fig-15). All these functions are used either by themselves or in conjunction with other mathematical or statistical or simulation models for varied applications in GIS. There is a wide range of spatial analysis functions in a GIS. To take advantage of its capabilities, user must define the problem clearly; decide the data required and the spatial operations to be performed for reaching the goal.

VI. Conclusions

Generated information/databases pertaining to Base map, Drainage, Contours, Geology, Hydro-geomorphology, Land use / land Cover, Slope and Aspect using multi-temporal satellite data and SOI Toposheets.

Proposed various water harvesting structures like Percolation Tanks, Check Dams and Vegetative Barriers at appropriate places by assigning the weightages based on the priorities using hydrology tools in ArcGIS software. This model is very useful for the site suitability analysis for water harvesting structures in land and water development projects.

This water resource development plan enables in better planning for water harvesting in the study area by giving the scientific inputs. This plan will help to rural areas by increasing the vegetation, crop lands, ground water and it will decrease the soil erosion and waste lands etc. This plan also helps in optimal land use planning using the proposed water harvesting structures.

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