

Delineation of Groundwater Potential Zones in the Mudugunduru Sub Watershed, Mandya District, Using Remote Sensing and GIS

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ABSTRACT: Recent times the south India in general is facing lot of water shortage both for irrigation and domestic consumption purposes. In this regard the ground water plays a vital role in overcoming this shortage. Since. The over exploitation of ground water without proper recharge mechanism and scanty rainfall, the water table of the surface and many a times even some of them were dried up. In order to increase the level of the water table of the region it was necessary to adopt newer methods of ground water recharge.

The presently the sophisticated GIS technique was a very useful tool in order to assess, monitor and plan suitable way of ground water utilization. The study area situated in Mandya district, Duddahobli and Mudugunduru SUB WATERSHED is carrying out such kind studies using GIS technique.

Recharging began in Europe early in 19th centuries and in United States near the end of the century, since then recharge installations have steadily increased throughout the world

As part of our research work we undertook the GIS studies on the area situated in Mandya District, Mudugunduru, subwatershed, Karnataka study area. Using the available georeference map of the region we have digitized and analyzed to create the drainage pattern, all the thematic map layers. Based on the lithology and topography of the area we have proposed some of the suitable methods of recharge. This is in order to overcome the water shortage and to improve the storage capacity of the ground water shortage and to improve the storage capacity of the ground water aquifer as well as increase the level of the ground water table

1.INTRODUCTION

Information technology (IT) is one among the rapidly developing technologies in Earth Sciences. Advances in this technology have create efficient possibilities of collecting and managing large amounts of data from earth resources processes in various forms an scales. Remote sensing and GPS (Global Positioning System) technologies are offering a great deal of potential to capture Geographic data through a variety of Earth observation platforms.

In recent times the artificial methods of recharging ground water has been adopted since the level of ground water is depleting in fast due to over exploitation. An earth scientist can provide a suitable method of recharging the ground water with the aid of spatial tools like Remote Sensing, GIS and GPS technology[1] &[2]. Using these technologies, the artificial recharge methods can be adopted to a site depending upon the local topographic, geologic and soil conditions.

One such attempt has been done for adopting artificial recharge methods at Mudugunduru village of Mandya Taluk, and district which is comparatively a semi draught area in Mandya . Previously there were no such artificial methods adopted to recharge the ground water for this area, hence this area was selected for the present study

II. FOLLOWING ARE THE OBJECTIVES OF THE PRESENT STUDY

- a) To prepare land use/land cover pattern maps for study area such as village boundary, survey boundary, road, water bodies, spot heights, and topographic features.
- b) Preparations of different thematic layers
- c) Preparation of percentage of slope map.
- d) GIS analysis was carried out to explore suitable artificial methods of groundwater recharge for the study area.
- e) Synthesis of data.

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III. METHODOLOGY

The present study area is Dudda hobli and Mudugunduru Sub watershed of Mandya taluk, and district, Karnataka. The map of the study area was georeferenced maps like village boundary, water bodies, roads, etc., were digitized using Arc GIS software.

Based on the geomorphology and lithology of the area, some of the artificial recharge methods suitable for the area were proposed for recharging the ground water.

LOCATION AND EXTEN

The present study area is the Mudugunduru of Mandya taluk, and District (Fig.1). The total area of the sub watershed is around 211sq.km. the Mandya district is situated in between $12^{\circ}13'N$ and $13^{\circ}09'N$ latitude and $76^{\circ}19'E$ and $77^{\circ}20'E$ longitude. The portion is 762-914 ft above MSL.

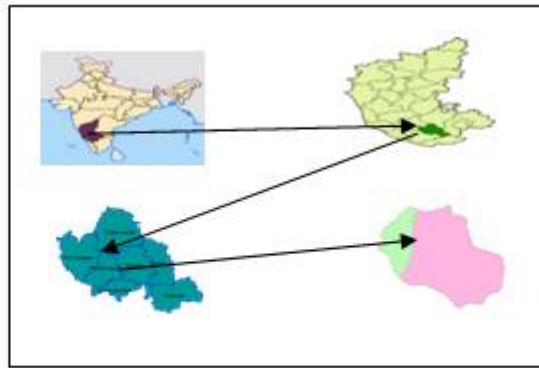


FIG.1 LOCATION MAP MUDUGUNDURU SUBWATERSHED

RAINFALL DATA

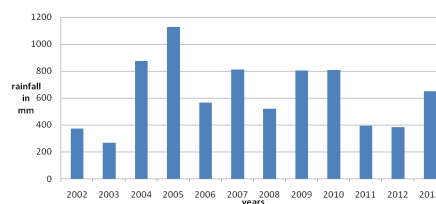


FIG.2 RAIN FALL DATA OF MUDUGUNDURU SUB WATERSHED

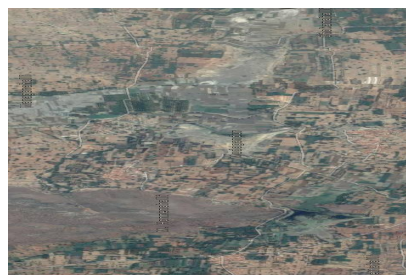


FIG.3 SATELLITE DATA OF MUDUGUNDURU SUB WATERSHED

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ROAD NET WORK

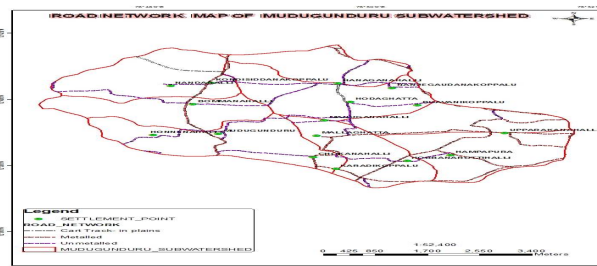


FIG.4 ROAD NETWORK MAP OF MUDUGUNDURU SUB WATERSHED

The base map is prepared for each District using the survey of India topographical map and the Satellite data. The base details such as State, District, Taluk boundaries, roads, railways, and river/ stream and settlement locations are extracted from the top maps. Multi-date IRS geo coded satellite data (which includes PAN+LISS 3 data also) is used for interpretation and for the preparation of wasteland maps. After the preliminary interpretation, the various wasteland categories are interpreted and delineated based on tone, texture, shape, pattern, association, location, etc.. using onscreen digitization. The interpreted maps are verified through ground verification and modified accordingly. Based on the field information the map is finalized.

MICRO WATERSHED

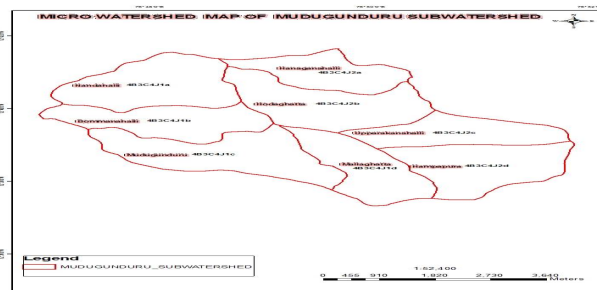


FIG.5 MICRO WATERSHED MAP OF MUDUGUNDURU SUBWATERSHED

Taluk lies in the water resource region of the bay of bengal drained by cauvery basin (4B) and includes the catchments krishnarajasagar (4B4) and krisnarajasagar to stanley Reservoir (4B3). Its is further dlinedated into one sub ctchment, many watershed again divided into sub watershed, and further divided into mini and microwatershed

DRAINAGE

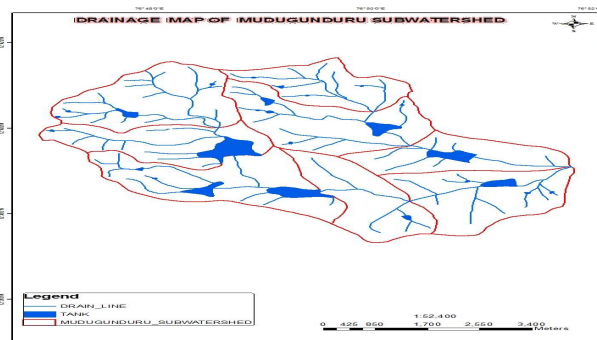


FIG.6 DRAINAGE MAP OF MUDUGUNDURU SUB WATERSHED

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Drain is a natural depression of the land surface. It's vertical, horizontal and length of depression depends on bedrocks, topography, geological structure and the nature of the soil etc.. Many other factors like slope, rainfall and vegetation etc.. Also contribute for the development of a drain. The study area is represented by dendritic to sub dendritic type of drainage pattern. The dendritic drainage pattern is the most common drainage pattern characterized by branching or tree like drainage pattern. Drainage network in the present study was prepared by top sheets and PAN+LISS merged data, in which the spatial resolution of the data is 5.8m. For this interpretation keys like tone, texture, pattern and association were used. After visual interpretation of the drainage map of the study area, it was scanned and digitized using AUTOCAD 2000 and ERDAS IMAGINE and finalized after field validation for the doubtful drainage.

LITHOLOGY

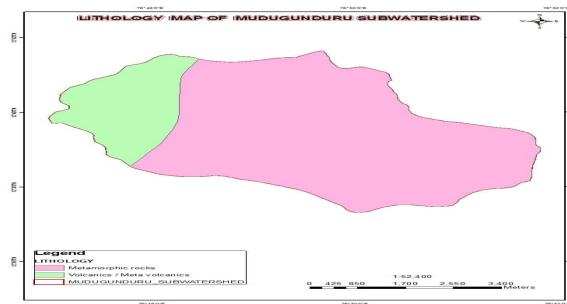


FIG.6.LITHOLOGY MAP OF MUDUGUNDURU SUB WATERSHED

The study area mainly made up of gneiss, amphibolites and some places granite rocks are Intruded into gneiss, near Dudda quartz vein are intruded into the gneissic rock among them Gneiss which are predominant in the southern Karnataka.

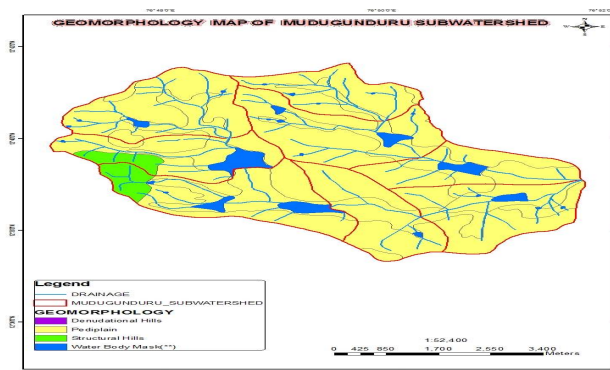


FIG.7 GEOMORPHOLOGY MAP OF MUDUGUNDURU SUBWATERSHED

The major geomorphic units in the sub watershed of Mudugunduru are PEDI plain and pediments. The sub water shed almost flat with slightly undulating and small mounds or runoff zones are called pediments and structural hill. The PEDI plain further divided into deeply weathered, PEDI plain moderate, PEDI plain shallow, these PEDI plains comes under the canal commands, there are areas with seasonal canal command

SOIL

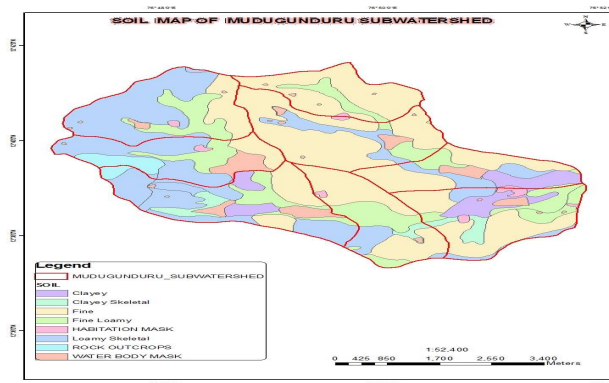


FIG.8 SOIL MAP OF MUDUGUNDURU SUBWATERSHED

Soil characteristics have a considerable role on the infiltration of water. The role of infiltration largely on the grain size of soils. Soil of IRB vary in their depth, texture drainage and degree of erosion from the high land to low land region.

LAND USE LAND COVER

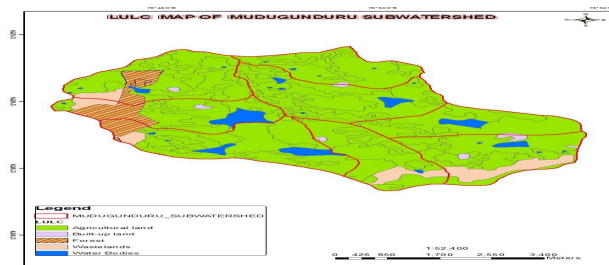


FIG.9 LULC MAP OF MUDUGUNDURU SUBWATERSHED

Using remote sensing and GIS techniques the study area is classified into different categories from the point of utility and natural cover, as double crop, kharif, plantations follow land, barren rocky land with scrub, tank.

Agricultural land: It is defined as the land primarily used for farming and for production of food, fiber, and other commercial and horticultural crops. It includes crop land, fallow and agricultural plantations.

Barren rocky: Stony waste may be defined as rock exposure of varying lithology often barren and devoid of soil cover and vegetation. They occur amidst forest hills as openings or scattered as isolated exposures or loose fragments of boulders or as sheet rocks on plateau and plains, in almost all parts of the study area. Stony wastes have been observed in all the sub-watersheds.

Fallow land: It is described as agricultural land, which is taken up for cultivation but it temporarily allowed to rest, un-cropped for one or more seasons. These lands are particularly those, which are seen devoid of crops at the time when the imagery is taken of both seasons. In the present study, this class is observed in only in sub-watershed with an area.

Land with scrub: This sub class is found usually at relatively higher topography like uplands or high grounds with scrub. These lands are generally prone to degradation or erosion. These exclude hilly and mountainous terrain. It is noticed in all sub-watersheds with an area.

water body: Water body is an area of impounded water, aerial in extent and often with a regulated flow of water. It includes man-made lakes/tanks besides natural lakes, rivers and streams.

Tanks:Tanks are the natural or manmade enclosed water body with a regulated flow of water. These features are medium/smaller in aerial extent when compared to reservoir with limited use. Based on the observations

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on the satellite image in all the three seasons, tanks may be differentiated into tank (dry) and tank (water spread). Tanks are found in almost all the sub watersheds.

Thematic mapping Descriptions of different land use/ land cover classes

1) Built-up land: Built-up land comprises all types of structures, houses, play grounds, etc., The major urban settlements are identified and mapped as towns and cities. It has been further classified as residential, commercial, recreation, industry, etc., Other smaller settlements are identified and mapped as villages.

2) Agricultural land: Cropping activities is seen throughout the year, mainly in the valley regions of the study area. these are three cropping season viz., kharif from June to September/October, rabi from October to February and summer from March to May. Different categories of croplands identified in the area are described below.

(a) Crop land of kharif season: The kharif season falls from June to September. The main crops are paddy, ground nut, ragi, etc.; They can be rain.

(b) Rabi season crop: The cropping seasons falls from October to February. The main crops are jowar, maize, cotton, sunflower, etc., They can be rain fed.

(c) Summer season crop: The cropping seasons falls from March to May, also called as Zaid crop. Some of the areas grow paddy, mulberry, groundnut, etc..mainly in the irrigated areas.

(d) Double cropped land (Kharif+Rabi)/(Kharif+Summer): From the two season satellite imagery that the double-cropped areas are marked, where we can see the cropping during Kharif + Rabi or Kharif +Summer crops such as paddy, sugar cane, mulberry, etc.

(e) Agricultural Plantation: It is an area under agriculture crops planted adopting certain agriculture management technique. Coffee, cashew nut, cardamom, coconut, tea and rubber plantations are predominant plantations in the study area.

(f) Fallow Land: Fallow land is an agriculture land left uncultivated during both kharif and rabi seasons. If the land is kept fallow up to one year it is current fallow and if the land is kept fallow for more than five years it is permanent fallow.

LINEAMENT

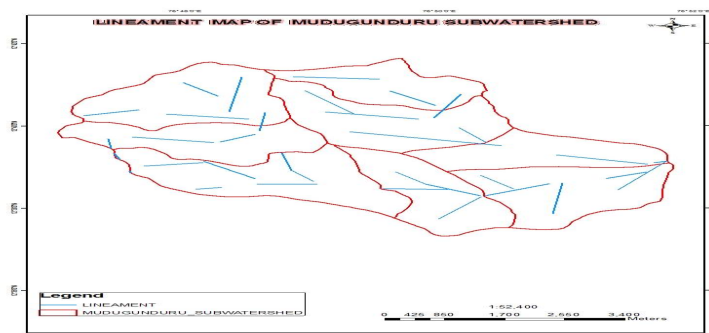


FIG.10 LINEAMENT MAP OF MUDUGUNDURU SUBWATERSHED

The lineaments are linear features, developed by the tectonic activities reflect a general surface manifestation of underground fractures, with inherent characteristics of porosity and permeability of under laying materials (Subba Rao 2006). Lineaments are the main condition of groundwater in impermeable rocks worldwide. In dedded, the fracture planes constitute the useful void volume corresponding to the potential space able to be occupied by the water in such medium. The aperture, the spacing, the interconnection and the orientation of fracture plans play

a significant role in the occurrence and movement of groundwater resources in fractured aquifers. Thus, zones with opened frequent and inter connected fractures are potentially favorable for water occurrence.

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Most of the lineaments in the area are aligned with the trend of stream courses. High porosity and hydraulic conductivity zones are associated with lineament have found that the normalized transmissivity near the lineaments is high and excellent relationship between high fracture densities and higher well yields. Generally, it is subjected that the thickness of weathered/fractured rock is greater along the lineaments and hence, a control on the availability of ground water. The fractures and lineaments are important in rocks where secondary permeability and porosity dominate and where intergranular characteristics combine with secondary openings influencing weathering and groundwater movements. Subsurface permeability can be suppressed as a function of fracture density of rocks. Majority of the lineaments were identified on the basis of the anomalies associated with features like straight drainage course, vegetation patterns, topography etc. The study areas interlaced by major and minor lineaments which vary in length from a few meter to kilo meter dimension.

SLOPE

slope is the rate of change of elevation and considered as the principal factor of the Imperfection water flow since it determines the gravity effect on the water movement. The slope is directly proportional to runoff and groundwater recharge will be lesser in the areas with steep slope.

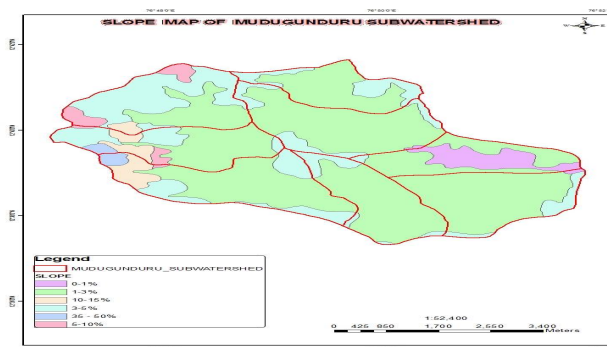


FIG.11 SLOPE MAP OF MUDUGUNDURU SUB WATERSHED

The water flow over the gently undulating plains is slow and adequate time is available to enhance the infiltration rate of water to the underlying fractured aquifer which was obtained from contour or topo map. The identification slope category (in percentage) were classified into seven category or classes. Varies from <1% (nearly level), 1-3% very gentle, 3-5% gently sloping, 15-35% moderately steep to steep sloping and >35% very steep.

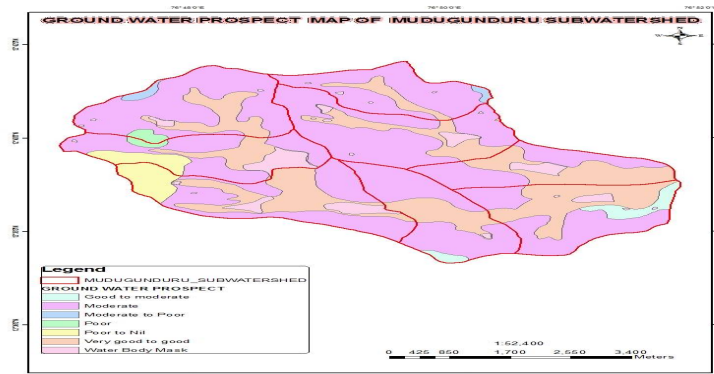


FIG.12.GROUND WATER PROSPECT MAP OF MUDUGUNDUR SUB WATERSHED

By integration of all the maps (classified maps of slope percentage geology, lineament, hydro morphology, isoyields, iso weather zone thickness, water table, tank distance, drainage channel distance and lineament –distance), ground

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water potential zones were delineated and classified as very high potential, high potential, moderate potential, low potential and very low potential of the study area was classified as having very high potential at few location.

IV. CONCLUSION

The geomorphological and hydrogeological studies, using GIS were dealt on the selected study area MANDYA District, KARNATAKA . This region was selected since the area is known as drought prone area with very scanty rainfall and no proper water supply system and the wells and tanks around this area were in the verge of complete semi dryness. The geology of the study area indicates that it mainly consists of granitic gneisses which are highly deformed and fractured. In the present study the following aspects were dealt and they are:

- The region has gentle slope in easterly direction which was inferred based on the drainage pattern of the region.
- The existing water body maps were prepared and percentage of slope was prepared based on the spot heights. Based on the above observations and the different thematic maps were prepared it was suggested the suitable methods of artificial recharge in order to delineated ground potential zones, in general , different thematic layers viz. hydrogeomorphology , lineaments, slope, drainage and depth of aquifer thickness. This provide a broad idea about the groundwater potential zones have been demarcated by integration of aquifer thickness derived from thematic layers, They are flooding method, dug well method, check dam and percolation tanks. The above mentioned artificial recharge will help in proper utilization of water resources and to overcome the shortage of water faced by this region.

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