International Journal of Remote Sensing & Geoscience (IJRSG)
www.ijrsg.com

WATER RESOURCE DEVELOPMENT AND MANAGEMENT OF TIGALERU WATERSHED USING HIGH RESOLUTION DATA, DORNALA, PRAKASAM DISTRICT, ANDHRA PRADESH, INDIA

G. Arun Kumar: Research Scholar, Dept. of Geology, Acharya Nagarjuna University, Nagarjunanagar – 522510.
P. Sankara Pitchaiah: Professor, Dept. of Geology, Acharya Nagarjuna University, Nagarjunanagar – 522510.

Abstract

Integrated watershed management requires a host of inter-related information to be generated and is studied in relation to each other. Remote sensing techniques provide valuable and up-to-date information on natural resources. Geographical Information System (GIS) with its capability of integration , multilayer information obtained both from remote sensing and other conventional sources has proved to be an effective tool in planning for watershed development. In the present study specific watershed development plans were generated for Tigaleru watershed, Dornala Mandal Prakasam district A.P., adopting IMSD guidelines. Suitable sites for artificial recharge structures were suggested using lithology, geomorphology, ground water potential, and structural maps.

Keywords: Watershed management, GIS, artificial recharge structures, LISS.

Introduction

Groundwater is an important natural resource, especially in arid and semi-arid regions for the developmental activity. For the integrated sustainable development the basic inventory of the natural resources is a must for an area. Groundwater potential mapping also depends on the regional frame work. Remote sensing and GIS and present day satellite technology helps in bringing out the regional picture of an area.

Tigaleru watershed (Fig.1), Dornala Mandal forms a part of the western Prakasam district, falls in arid and semi arid region. The watershed stretches from 13°22´40 to 13°38´20″ North Latitudes and 78°30´17″ to 79°08´18″ East Longitudes. It is covered in the Survey of India Toposheet number 57M/01 and spread in of 70.769 sq km area. It is well known for drought and needs for the assessment of its natural resources. Normal annual rainfall in the area is 872 mm.

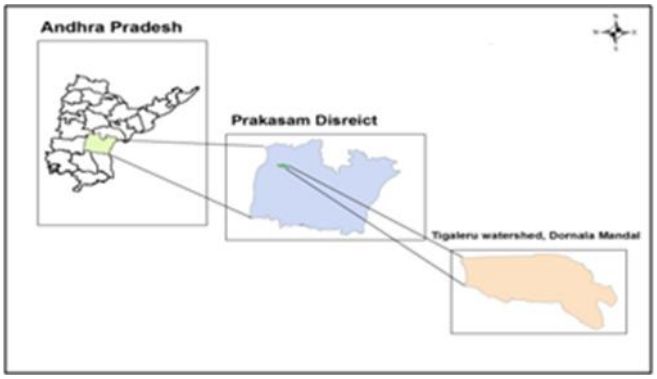


Fig.1 Location map of Tigaleru watershed

Materials and Methods

The Methodology is basically a systematic procedure evolved to prepare a ground water prospects map using satellite data and GIS techniques in conjunction with field work. The data used in the present study are;

- Satellite imagery LISS-III & LISS-IV (23.5 m.& 5.8m. resolution data) of 2006, 2009 supplied by National Remote Sensing Centre (1:50,000 scale).
- Ground truth data (photographs, etc.) and GPS control points, collected during field survey.
- Map is generated in LCC projection with WGS84 datum and 1:50,000 scale grid is generated for the 2D mapping of study area.

Geology

Tigaleru watershed is underlain by Nallamalai Group comprising Cumbum (Pullampet), Bairenkonda (Nagari) Formation and Srisailem Quartzite of rocks, Cuddapah Supergroup. The Bairenkonda formation consists of slate and quartzite. The Cumbum formation dominantly

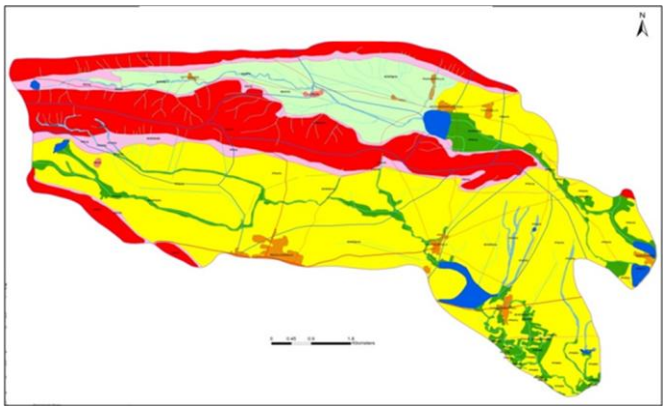
comprises shale with minor phyllite, and intersection of dolomite, limestone and quartzite.

Results and Discussion

Results of the study are presented below and relevant discussion is added wherever necessary.

Hydrogeomorphology

The main geomorphic units in the study area are Pediment, Pediment Inselberg Complex (PIC), shallow weathered pediplain (PPS) and moderately weathered pediplain (PPM), Structural hills (SH), Bazada (BZ), and valley fill (unconsolidated sediments) (Fig.2).



MAP SYM BOL	GEOMORPHIC UNIT/LANDFORM	LITHOLOGY	GROUND WATER PROSPECTS
VF(UCS)	VALLEY FILL	UNCONSOLIDATED SEDIMENTS	EXCELLENT
BZ(UCS)	BAZADA	--do--	POOR
PPM(CS)	PEDIPLAIN MODERATELY WEATHERED	CUDDAPAH SUPER GROUP NALLAMALAI GROUP (Cumbum Shale,Quartzite)	GOOD TO MODERATE
PPS(CS)	PEDIPLAIN SHALLOW WEATHERED	--do--	MODERATE TO POOR
PD(CS)	PEDIMENT	--do--	POOR
TR(CS)	TOR	--do--	NEGLIGIBLE
SH(CS)	STRUCTURAL HILL	--do--	NEGLIGIBLE
PPM(Cq)	PEDIPLAIN MODERATELY WEATHERED	-do-	GOOD TO MODERATE
PPS(Cq)	PEDIPLAIN SHALLOW WEATHERED	--do--	MODERATE TO POOR
PD(Cq)	PEDIMENT	--do--	POOR
SH(Cq)	STRUCTURAL HILL	--do--	NEGLIGIBLE
PPM(BS)	PEDIPLAIN MODERATELY WEATHERED	CUDDAPAH SUPER GROUP NALLAMALAI GROUP (Bairenkonda Shale)	GOOD TO MODERATE
PPS(BS)	PEDIPLAIN SHALLOW WEATHERED	--do--	MODERATE TO POOR
BPS(BS)	PEDIPLAIN SHALLOW WEATHERED	--do--	MODERATE TO POOR
DR	DYKE RIDGE	DOLERITE	NEGLIGIBLE
LR	LINEAR RIDGE	QUARTZ	NEGLIGIBLE
	LITHOLOGY BOUNDARY		
	MINI MICRO WATERSHED		
	SETTLEMENT		
	TANK		
	DRAINAGE		
	FRACTURE / LINEAMENT		
	DYKE RIDGE / QUARTZ REEF		
	STATE HIGHWAY		
	DISTRICT ROAD		
	VILLAGE ROAD		

Fig.2. Hydrogeomorphological Map

Ground water potential zones have been demarcated integrating the structural information with geomorphology, geology and well inventory data. General fall in the slope is from east to west in the eastern portion and north to south in the western portion. The study area is well drained by a number of 1st, 2nd, 3rd and 4th order streams (Fig. 3).

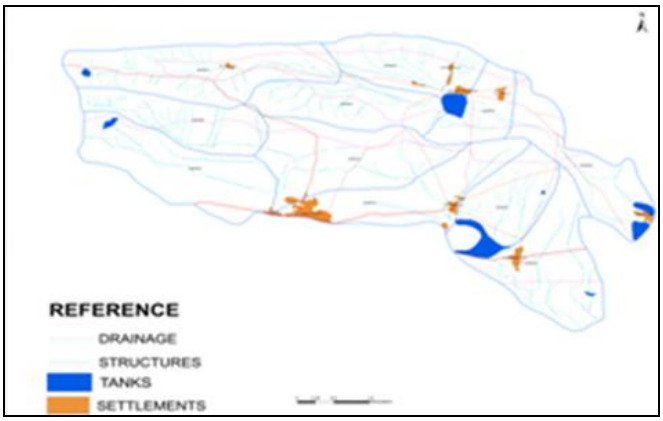


Fig.3. Drainage Map of Tigaleru Watershed

Artificial Recharge Structures

The term artificial recharge has different connotations for various practitioners. Artificial recharge to ground water is defined as the recharge that occurs when the natural pattern of recharge is deliberately modified to increase recharge (CGWB, 2007). Any man-made facility that adds water to an aquifer may be considered as artificial recharge (CGWB 1994).

The area's arid environment has necessitated over utilisation of groundwater, while concretisation of roads have resulted in the reduction of recharge areas, scanty distribution of rain fall and coupled with over exploitation have further aggravated the problem. The appreciable drop in the water table and ever increased demanding for the groundwater especially during summer has warranted initiation of artificial recharge structures on a large scale. The site suitability for specific structures is evaluated based on the criteria followed by Rajiv Gandhi National Drinking Water Mission. The types of structures proposed are

- Check dams and
- Mini percolation tanks

While suggesting the above structures the rock type, geological structures, drainage, soil type, slope, characteristics have been considered.

Check dams

The check dam locations are given on first order and second order streams with medium slopes (Fig.4). They are proposed where water table fluctuations on the stream is influent or intermittently effluent. The parameters to be considered are slope, soil cover and its thickness and hydrogeological conditions such as rock type, thickness of weathered strata, fracture, depth to bed rock etc. These structures will serve for dual purpose. Firstly, they reduce runoff velocity, thereby minimising erosion and secondly allows the retained water to percolate and thus results in increased recharge in the wells located downstream.

Mini percolation tanks

Mini percolation tanks are structures constructed across nalas / streams for checking velocity of runoff increasing water percolation and improving soil moisture regime. The main objective is to impound surface run off coming from catchment and to facilitate percolation of stored water into the soil substrata with a view to rise groundwater level and also to hold the silt flow which would otherwise reach multipurpose reservoirs and reduce their useful life. These structures are different from check dams by the way of having an emergency spill way in the case of heavy runoff. The location is indicative and actual location may be decided based on field conditions. The size of the structures may be limited to or less than 1mcft capacity (Fig.4).

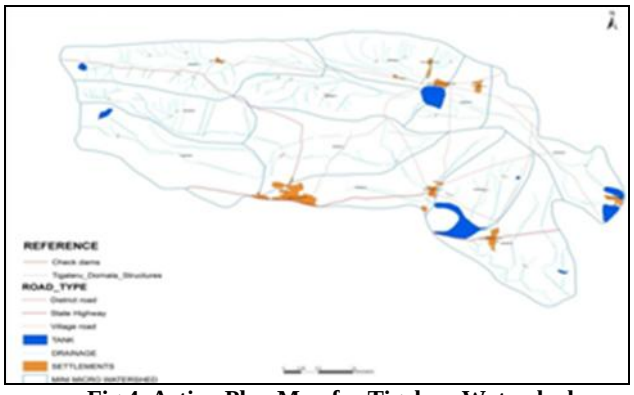


Fig.4. Action Plan Map for Tigaleru Watershed

The tanks got silted are identified and shown in fig.4 and it is suggested to desilt the tanks. Mini percolation tanks are recommended on 2nd, 3rd or higher order streams.

Conclusion

The main geomorphic units in the study area are pediment, pediment inselberg complex (PIC), shallow weathered pediplain (PPS) and moderately weathered pediplain (PPM), Structural hills (SH), Bazada (BZ), and valley fill. General fall in the slope is from east to west in the eastern portion and north to south in the western portion. The types of recharge structures proposed are check dams and mini percolation tanks. These structures will serve dual purpose. Firstly, they reduce runoff velocity, thereby minimising erosion and secondly allows the retained water to percolate and thus results in increased recharge in the wells located downstream. The tanks got silted are identified and it is suggested to desilt the tanks for better recharge. Mini percolation tanks are recommended on 2nd, 3rd or higher order streams.

References

[1]. CGWB, (2007) Ground water information Prakasam District, Andhra Pradesh. American Society of Civil Engineers (ASCE) 2001, Standard Guidelines for Artificial Recharge of Ground Water, EWRI/ASCE 34-01(ASCE Standard No. 34-01).

[2]. CGWB (1994), Manual on Artificial Recharge of Ground Water, Ministry of Water Resources, Central Ground Water Board, Govt. of India, New Delhi.