Original Research Paper Geology

Hydrogeomorphological Mapping of Palavay Basin Using Remote Sensing and Gis Techniques Anantapur District, Andhra Pradesh, India

G.Shobha Rani	Department of Geology S.V. University, Tirupati
B.RamaNarasimha Rao	Department of Geology S.V. University, Tirupati
K.Sunil Kumar	Department of Geology S.V. University, Tirupati
* V.Gope Naik	Assit. Prof., Department of Geology S.V. University, Tirupati * Corresponding Author

ABSTRACT

Anantapur District is a hot and arid District, falls in rain shadow zone with a very low annual rainfall of 520mm. The recurrence of drought increased considerably and unless collective measures are initiated on a permanent basis the situation will become grim in future. Palavay Basin in Anantapur District is selected to demonstrate the capability of high resolution satellite data in ground water mapping. This basin is located in Survey of India toposheet Nos. 57F/2, F/3, F/4 and F/5. This basin with an area of about 205sq.km is underlined by Hornblende- biotite gneiss and Closepet Granites traversed by dolerite dykes. Hydrogeomorphological mapping was carried out on 1:10,000 scale using IRS-P6 LISS-IV satellite data. The satellite data facilitates to update the extent of built-up area, road and drainage network. Further, the revenue villages enclosed in the watershed are digitized, mosaic and superimposed on hydrogeomorphology map. This helps to give site specific recommendation on ground water prospects survey number wise i.e. for individual farmers. In addition, the impact analysis of check dams constructed in the watershed is also discussed. Studies showed that after construction of check dams the water levels in wells increased, abandoned wells got rejuvenated, new bore wells came up resulting increased irrigated area.

KEYWORDS : – Survey of India toposheet (SOI), Arc GIS, LISS-IV Satellite Image, Geomorphology

INTRODUCTION

The hydro geomorphic unit is evolved from the original rock formation due to structural, geo morphological and hydrological processes. These processes and the resultant changes are manifested on the surface. Satellite imagery is the best data base where the information pertaining to all these parameters is available in an integrated environment. Based on the interpretation of satellite imagery in conjunction with limited ground truth information, the extraction and mapping of spatial distribution of the rock formations, landforms, structural network and hydrological conditions can be done accurately. They can be better studied and understood in association with each other. This is not possible through conventional ground surveys. Apart from this it takes lot of time and energy there by becoming the ground water survey costly. The geology maps showing rock types and major structures prepared by Geological Survey of India are being used for gross estimation of the resource and its distribution. Particularly, the data on the land forms, geological structures and recharge conditions are not at all available.

Palavay basin, an area occupied by granite gneisses intruded by dolerite dykes and cut across by a number of faults and lineaments, it is possible to draw conclusions on - the dolerite dykes act as barrier for movement of groundwater, where as the lineaments/faults which cut across them act as conduits for groundwater movement. The weathered zones within the granite gneisses contain limited quantities of groundwater. The water bodies (tanks) which are seen on the imagery as black patches not only provide irrigation facility in the area but also contribute for recharge to groundwater. Thus, by providing appropriate Hydrogeological information the satellite data facilitate proper identification and mapping of prospective groundwater zones. The satellite data by providing spatial distribution of irrigated crop land as bright red patches are not only useful in calculating where and how much of groundwater is being tapped Satellite data is the main input for preparing the hydrogeomorphological maps. It is used mainly for preparing the lithology, geomorphology, structures and hydrology map layers which in turn are integrated to generate the hydro geomorphology maps.

The raw IRS P6 LISS IV scene-wise data, preferably of summer season (Feb-April period), procured from NRSC Data Centre have been subjected to ortho and geo- rectifications using Landsat ETM+ data as the reference. As the ETM+ data is in UTM projection and WGS 84 datum, the IRS P6 LISS IV data also carries the same projection and datum. Figure 1 shows the UTM zones of India. the thematic information i.e. Lithological, structural, geo morphological, and hydrological information besides the base map details are mapped (Fig. 2) based on on-screen visual interpretation using image interpretation techniques. A detailed on-screen digitization procedure, geological structures, landforms, hydrological and base map features. The interpreted data need to be cross-checked and corrected with ground truth information collected during the limited field work .

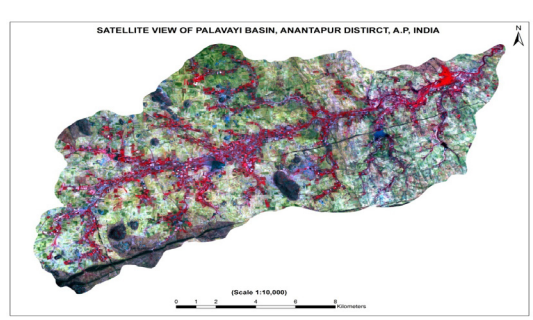


Fig: 1 Satellite of view of Palavay Basin

STUDY AREA

The area of the Palavay Basin (Lat.14° 28′ 30″ to 14° 35′ 30″ N; Long.

77° 4′ 30″ to 77° 15′ 00″ E) is 205 sq.km included in Survey of India toposheet Nos. 57F/2,F/3,F/4 and 57F/5 of Anantapur District, Andhra Pradesh (Fig.2). The Palavay basin encompasses part of kalyandurg mandal Eight villages namely Kalyandurg rural, Garudapuram, kurbhrahalli, Bedrahalli, palavay, Varli, East kottapalle Mudinyanapalle and Mudigal. Kalyandurg mandal is 544 mm and the cumulative departure from normal rainfall from 2010 to 2015 is - 108% (CGWB 2015).

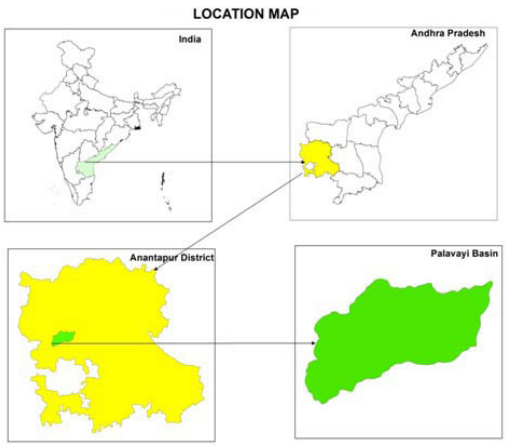


Fig:2 Location map of Palavay Basin, Anantapur District

METHODOLOGY

High resolution Indian Remote Sensing satellite, IRSP6 LISS-IV data of 11th April 2012 with a spatial resolution of 5.8m covering Palavoy basin is analyzed. Onscreen interpretation is carried out delineating different geomorphological units/landforms, lithological formations, geological structures and hydro geomorphological map is prepared by integrating the above said parameters (NRSA 2008)(Table 1). Further, well inventory data collected during fieldwork is made use in finalizing hydro geomorphological / ground water prospects map of the study area on 1:10,000 scale. By zooming the satellite data up to 1:4,000 scale, extent of built up area, drainage and road network is updated. Palavay basin are digitized and mosaic on 1: 10,000 scale. All the Thematic maps are rectified with WGS -1984 Datum Projection, IRS-P6 LISS-IV satellite data (Fig.1) as well as with hydro geomorphology map (Fig:3).

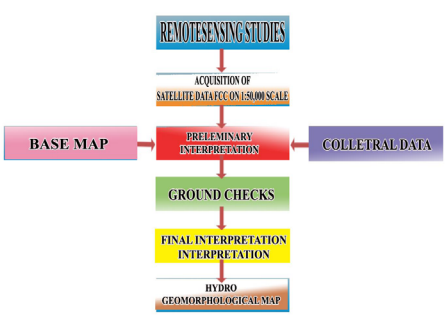
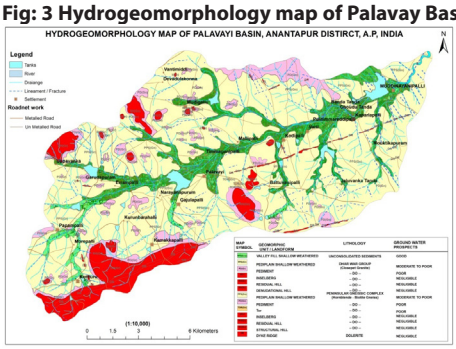


Table:1 Flow Chart of Method Adopted

Fig: 3 Hydrogeomorphology map of Palavay Basin



DENUDATIONAL HIIL(DH):

Denudation hills are group of hills , which have formed due to differential erosion and weathering and cover large areas. Acts as a run-off zone. Poor ground water prospects along fractures at the lower levels.

RESIDUAL HILL (RH):

Residual hill is the affect of weathering and erosion. In fact, it can also be considered as Denudational hill, but the isolated occurrence qualifies it to be a 'Residual Hill'. This is an erosional land form. Acts as a run-off zone. Limited prospects along fractures at the lower levels.

STRUCTURAL HILL (SH):

Structure and lithology are the two endogenic factors that control the evolution of land forms. The following are best identified in gneiss is a structural element. But the hills constituted by gneiss are considered as Denudational hills. Hence, they are not dealt with separately under the present head. . Acts as a run-off zone. Limited prospects along fractures at the lower levels.

VALLEY FILL SHALLOW (VFS):

The filled material being loose unconsolidated material acts as a moderate recharge zone. The underlying fractured rock act an as aquifer zone fracture rock , fissured rock, loose sediments and weathered rocks present in this land form .Ground water prospects is good to very good

PEDIPLAIN SHALLOW (PPS):

This is basically an erosional landform with certain degree of association of depositional landform. This type of land form covers major part of the Palavay basin. reflects the thickness of the weathered material to be less than 2mts, supporting the field observation that the covered terrain can be classified as Pedi plain Shallow Weathered (PPS) .Ground water prospects is moderate

PEDIMENT(PD):

Pediment is erosional land form, It is a bedrock portion of a piedmont slope. It is relatively gently varying from ½ degree to about 7^0. It may or may not have any veneer of alluvial material (Thornbury, 1986). The weathered pediment may have *limited* prospects, but the un weathered one will have *poor* prospects.

INSELBERG (I):

This means small light hilly. These landforms are located in the Northeast corner part of the catchment area. Gently sloping rock-cut surface of granites and gneisses with thin veneer of detritus. In general, the ground water prospects in a pediment area Negligible.

CONCLUSIONS

The Indian Remote Sensing satellite (IRS P6 LISS-IV) data with a spatial resolution of 5.8m can be enlarged even up to 1:4,000 scale. With the help of high resolution data, expansion of rural settlements drainage and road network is updated. The boundaries of all geomorphic units are drawn more precisely. in the individual fields of the farmers. The effect of check dams resulted in stabilizing the water levels in the wells, increasing the pumping hours, rejuvenating the abandoned wells, and resulting increase in irrigated area. Integrated studies i.e. geology, geomorphology, hydrogeology, hydro geomorphology, structure and drainage in preparing the Hydrogeomorphology map of Palavoy basin revealed that the remote sensing and GIS are the best tools to assess the ground water conditions. The categorization of groundwater potential zones in the study area is satisfactory level with the field checks also. The interpretation of this kind of information is much useful in improving the groundwater conditions of the area i.e. like in demarcating the drainage watersheds and planning for the construction of the structures like check dams, percolation tanks etc.

REFERENCES:

1. Fetter, c.w, (1990). Applied Hydrogeology. CBS Publishers, Delhi.
2. NRSA (1989). Manual of Nationwide Land Use/ Land Cover Mapping using Satellite Imagery, Department of Space, Hyderabad
3 Bhagavan, S.V.B.K and V.Raghu, "Integrated Remote Sensing based Study of National Watershed Development Project for Rained Area In A.P". Abstract Volume of National Symposium on Remote Sensing for Natural Resources with Special Emphasis on Watershed Management held during 21st March to 24th March 2000 at Bhubaneshwar, pp.15.

4. Department of Space/ ISRO (1988). Manual for Hydrogeomorphological mapping for drinking water mission.
5. V.Raghu and K.M REDDY Hydrogeomorphological Mapping at Village Level UsingHigh Resolution Satellite Data and Impact Analysis of Check Dams in Part of Akuledu Vanka Watershed, Anantapur District, Andhra Pradesh .
6. Eshwar Reddy(2013): integrated Hydrogeological studies of ground water using spatialtechnology, in parts of Anantapur Mandal, Anatapur district,Andhra pradesh, india .Unpublished Ph.D. Thesis, S.V.University.
7. Bhagavan, S.V.B.K. & Raghu, V., 1998. Implementation of remote sensing based action plan and impact analysis of check dams – A case study of Somagatta watershed, Anantapur District, Andhra Pradesh. Workshop on Watershed Management – Problems and Prospects Jawaharlal Nehru Technological University, Hyderabad, 34-41.
8. GWD (Ground Water Department, Govt. of A.P.) 1998. Note on evaluation studies carried out on water harvesting structures in Anantapur District, Technical report, 35p.
9. Thornbury, W. D. (1986). Principles of Geomorphology, Second edition. 600pp.