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Earth Science

DELINEATION OF SURFACE GEOLOGICAL FEATURES BY USING REMOTE SENSING AND GIS TECHNIQUES IN PARTS OF YADADRI-BHUVANAGIRI, MEDCHAL-MALKAJGIRI AND RANGA REDDY DISTRICTS OF TELANGANA STATE, INDIA.

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ABSTRACT The IRS-R2 LISS-IV Satellite Image of an area of 694 Sq.km corresponding to the part of Yadadri-Bhuvanagiri, Medchal-Malkajgiri and Ranga Reddy Districts of Telangana State, Southeastern Part of the Peninsular Gneissic Complex (PGC), India, was analyzed. Remote Sensing and Geographic Information System (GIS) techniques were used to delineate the surface geological features. Satellite data facilitate the preparation of geological, lineament and drainage maps, particularly at a regional and smaller scale according to the resolution of the images. GIS has the capability to visualize, enhance, manipulate, generate, store, integrate and analyze the thematic data.

KEYWORDS : Remote Sensing, Geographic Information System (GIS),Thematic data, IRS-R2 Satellite imagery and Lineaments.

INTRODUCTION

Current socio-cultural concerns in the earth sciences relate to understanding, monitoring and conserving our biophysical environment. While resource monitoring falls under the purview of remote sensing with the increasing resolution of satellite sensors, it is possible to fruitfully exploit the special advantages of image analysis for a wide range of geological environments. Remote Sensing and satellite imagery studies provide inherent features to demarcate geological characteristics of the granitic terrain of the present study area An attempt has been made to delineate the surface Geological features, which are helpful to identify the Groundwater Potential zones, to be benefited by Formers. Surface structures, could be probable subsurface indicators of faults, are also identified using various techniques and correlated with lineaments. The present study area (Parts of Medchal-Malkajgiri, Yadadri-Bhuvanagiri and Ranga Reddy Districts) is surrounded by Choutuppal Mandal in the East, Hyderabad City in the West, Bhuvanagiri town in the North and Ibrahimpatnam Mandal in the South (Figure:1), and is about 694 square kilometers.

STUDY AREA AND TOPOGRAPHY

The study area selected for satellite image analysis is in the southeastern part of Medchal-Malkajgiri, Yadadri-Bhuvanagiri and Ranga Reddy districts lies at 78° 32' 47.8" E Longitude to 78° 56' 08.18" E Longitude and 17°15' 10.03" N Latitude to 17°30' 30.1" N Latitude. The Study area is about 682.15 sq.kms. The topography (SOI toposheet no. 56 K/11, & 15/S-E) of the study area can be treated as undulating with a gradual relief towards S-E (Figure: 2).

CLIMATE AND RAINFALL

The climate is typical of a tropical country with summer temperature soaring up to 44°C, where as in winter the minimum comes down to 10°C, which is of only one or two months duration. The normal rainfall (http://www.tsdps.telangana.gov.in/districtdata.jsp) received by the area of Medchal –Malkajgiri disrtict is about 710 mm, Yadadri Bhuvanagri district is about 693 mm and Ranga Reddy district is about 640 mm during the months of June to August and sometimes extending up to September. There are rains occasionally during other seasons also due to low pressures in the bay of Bengal.

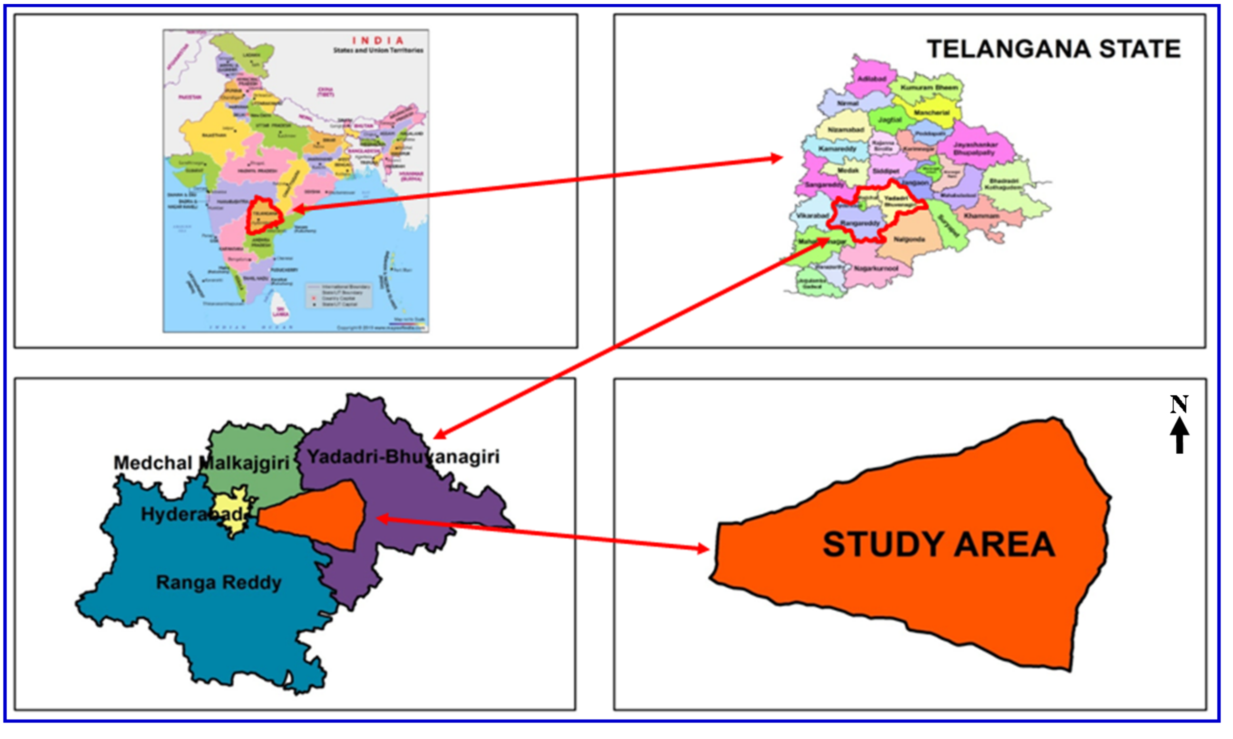

Figure: 1 Location map of the Study Area

GEOLOGY OF STUDY AREA

The present study area is situated in the granitic terrain of Peninsular India. Granites are the igneous rocks that have been originated under conditions of high pressure and temperature beneath the Sub Surface. These granites are also the oldest and most stable rocks of the earth's surface and in general are undulating with scattered denudational hills and ridges in the granite-gneiss terrain. The easterly flowing Musi drains the northwestern and southern parts of the area. Geology of the area was extensively studied by various earlier studies (Mahadevan, 1937) , (Heron, 1948). The erstwhile Hyderabad Geological Survey conducted extensive investigations.

The area (Figure: 3) constitutes mainly a granitic terrain exposing a variety of Archaean granitoids of Peninsular Gneissic Complex (PGC) and Schistose (Older metamorphic) rocks. They are intruded by basic dykes (Proterozoic). The granitoids (PGC) of the area is classified into two main suites based on the field relation and petrochemical characteristics. They are (i) Adamellite-granodiorite (Aag) and (ii) Granite-alkali feldspar granite (Agn).

Granite and alkali-feldspar granite are widely distributed throughout the area. They are grey to pink in colour, medium to coarse-grained, porphyritic/non-porphyritic and massive to foliate. Granite is mainly made up of potash feldspar (mostly microcline and orthoclase), quartz and plagioclase feldspar (oligoclase) and minor amounts of biotite and hornblende. Alkali-feldspar granite has higher amounts of K-feldspar than the granite.

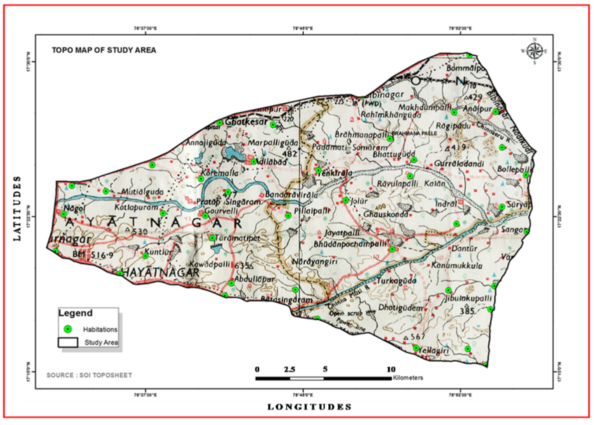

Figure: 2 Topography map of the Study area (After SOI,1986)

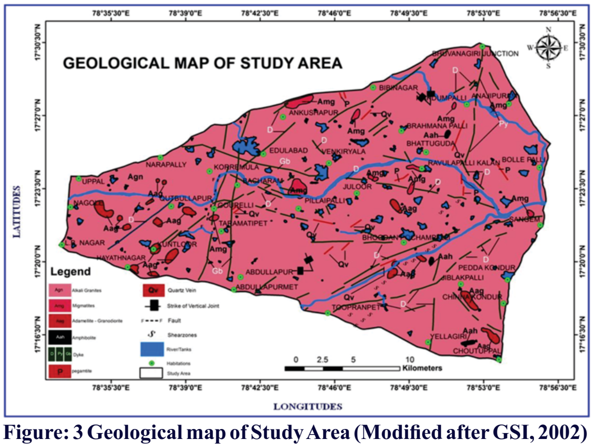

Figure: 3 Geological map of Study Area (Modified after GSI, 2002)

The pink and grey granites are broadly distinguished as the grey group characterized by pink colour and potash feldspars. These are found to have intrusive relationship with grey granites and occur as small pockets. However, it is difficult to demarcate pink and grey granites as there are no clear cut sharp boundaries between them (Balakrishna, 1961).

The Adamellite Granodiorite (AG) suite occurs as small mapable bodies as well as enclaves within the younger granitic rocks throughout the area. It is leucocratic to mesocratic, medium to coarse-grained, massive to crudely foliated; and is made up of plagioclase feldspar (oligoclase), quartz and potash feldspar (both microcline and orthoclase). Biotite and hornblende with inclusions of zircon, sphene and apatite are common. The basic intrusive include amphibolite, dolerite, gabbro, pyroxenite and lamprophyre. Based on field studies, three generations of dyke activity is noticed. The earlier two generations which have intruded into the TT and AG suites were migmatite and metamorphosed to amphibolite. These dykes are small in dimension and hence are not shown on the map.

SATELLITE IMAGE ANALYSIS

The remote sensing technologies display surface lineaments like joints, fractures; faults etc., those are penetrated into deep-seated, also delineated using various spectral geological techniques; intersections of these are the main source of sub surface geological signatures. Many studies have emphasized the importance of lineament interpretations and digital lineament analysis in localizing the major subsurface conditions and notes that there is a strong correlation between surface features and lineaments. Geological map (Figure: 3) was prepared by digitizing lineaments, faults in ArcGIS software package. Different structures that should be mapped have been represented on the map with appropriate line symbols. Satellite Imageries, for the present study area, were prepared from NRSC website (http://bhuvan.nrsc.gov.in). IRS-R2 LISS-IV image of 3 bands RGB, Resolution (Nileshwari et al., 1998) 5.8m, path & row: 100_60C & 100_60D and 100_61A & 100_61B of February 2014 and Survey of India toposheet map (1: 2, 50,000 and 1:50,000) are the primary (Toposheet No. 56K, 56K/11 and 56K/15) source. Drainage and Lineaments maps have been extracted from satellite image and topographic maps also as well, incorporating the ground truth. Subsequently the image was geo-referenced and analyzed (Sunitha et al., 2016) using appropriate software modules of Arc GIS version 10.2.2 software that is used for digital image processing (Preeja K.R et al., 2011). Satellite Image of Study area shown in Figure: 4

VEGETATION AND SOIL

Though the vegetation (Bhanu Sahu et al., 2015) and (Talal Al-Awadhi et al., 2011) in the study area is satisfactory around the Musi river places especially, it is considered to be very sparse when the whole area is considered. The area attains a dry look from immediately after the monsoons and continues up to next monsoon season. Hillocks wear a barren look and cultivation are confined to downstream or near the tanks.

Soil is an important natural resource, the fertile soil of the surface water banks was the result of evolution of our civilization and emergence of the great agriculture, soil constitute complex natural formation on surface of the earth and made up of five components viz water, minerals, organic matter, air and living organisms. The chief function of the soil is to provide all nutrients to plant to growth. Knowledge of the soil is helpful in agricultural practices, such as cultivation, irrigation and use of fertilizers. The soil (Figure: 4) is characterized by weathered granites, which is loamy with the reddish tinge. Black soil (Adam J et al., 2018) is also observed here and there probably formed by the weathering of dykes, and around low-lying areas towards tank beds.

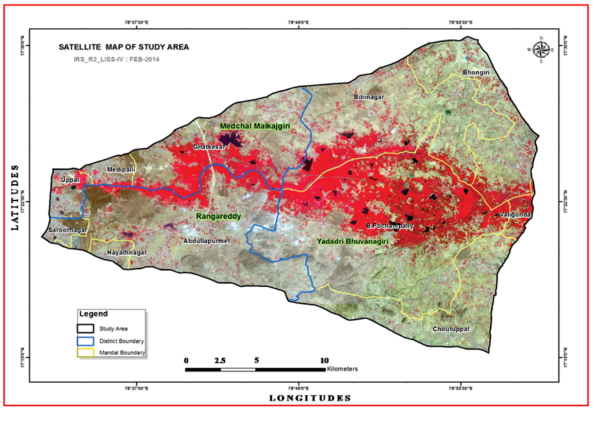

Figure: 4 Satellite Image Of The Study Area With Mandal Boundaries (Source: bhuvan.nrsc.gov.in)

WATER BODIES

The study examined the natural drainage pattern and surface water bodies in conjunction with the landforms and land use in the study area. The water bodies consist of rivers/streams lakes/ponds etc., and reservoir tanks when the drainage is compared with landform distribution, it reveals that most of the tanks were constructed with the help of linear ridges and river gaps. The tanks are providing irrigation facilities and agricultural crops in the study area. The combination of rivers and surface water bodies provide irrigation which can influence land use in that particular area. The present study area is covered by five major tanks, namely

(1) Edulabad Cheruvu, (2) Bibinagar Cheruvu (which is Very close to study area), (3) Raghavapuram Cheruvu, (4) Peddaravulapalli Cheruvu and (5) Revanapalli Cheruvu.

The tanks total areal extent is about 2.5 sq.km. Under normal rainfall, the tank gets overflowed. These are also seen clearly on the Drainage image (Figure: 5) in blue to dark blue or cyan colour depending on the depth of water. This category comprises areas with surface water, either impounded in the form of ponds, which are in more numbers, lakes and reservoirs or flowing as streams, rivers, canals etc. These areas were identified and mapped as water bodies.

DRAINAGE

The drainage (Figure: 5) is mostly dendritic type of drainage pattern, which is like tree or branching drainage pattern. The general trend of the drainage is towards the East joining the Musi river, the river which is passing from Nagole at West to Edullagudem at East side of the study area. The study area is covering two more divisions of Musi river, one is running parallel to, which is flowing from Sangam to Batasingram and another one is flowing towards East from Bibi Nagar to Bollepalli. Drainage map is prepared from digital data of IRS-R2 LISS-IV February 2014. Satellite imageries had been geo- referenced and merged using processing software Arc GIS V10.2.2.

Drainage Density (D)

Horton (1932 & 1945) defined the drainage density as the stream length per unit area ($D_d=\sum L_K/A_K$). The drainage density is in fact the result of the function of various parameters, such as, climate, lithology, structures, relief, infiltration capacity, vegetative cover, surface roughness and runoff intensity index.

$$D_d = \frac{\sum L_K}{A_K}$$

Where D_d = drainage density
ΣL_K = total length of all stream segments
A_K = total study area

It is the ratio of total length of all stream segments (2464.84Km) to the total study area (682.15 Km^2), which is expressed in terms of Km/Km^2. The drainage density (3.61 per km) indicating a coarse drainage texture. The coarse texture of the drainage is indicative of low rainfall intensity or permeable rock strata, high infiltration, thick vegetation, and low relief or combination of these factors. The Drainage Density of the area is coarse in texture and it could be due to the combination of relatively low rainfall intensity, relatively high permeability of rock strata resulted high infiltration, thick vegetation and relatively low relief (Strahler, 1964). Moderate drainage density indicates the basin is highly permeable subsoil and vegetative cover (Nag, 1998).

This is connected with a good drainage network of the streams and tanks, having clay, silt, sand, etc. Topographical, geomorphological, hydrological, geological and hydrogeological conditions play a significant role in the planning and execution of measures to be undertaken in watershed development programs. For example, topographic features can be considered in the selection of favorable sites in most of the recharge areas. Evaluation of the drainage characteristics of a basin, using quantitative Morphometric analysis in relation to the geomorphological features (Tiwari A et al., 1996).

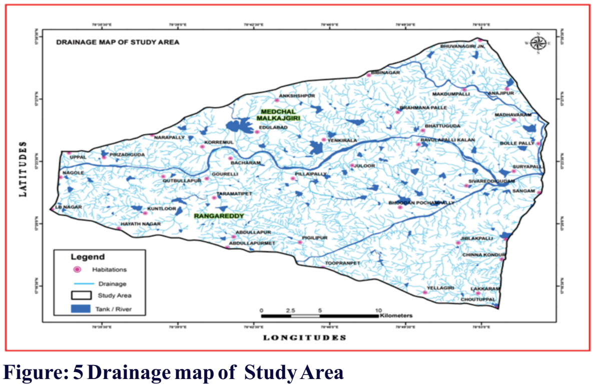

Figure: 5 Drainage map of Study Area

STRUCTURES AND LINEAMENTS

Lineaments are characterized in this study area as the linear, rectilinear, curvilinear features of tectonic origin observed in satellite data (Figure: 6), normally these lineaments (Ayaz Mohmood Dar, 2015) are showing tonal, textural, soil tonal, relief, drainage and vegetation linearity and curvilinearities in satellite data. All these linear features were interpreted from the satellite data and the lineament map prepared for the part of study area. The prominent directions of these are NE-SW and NW-SE and shown in Figure: 8, the lineament map was prepared in GIS environment. These features were enabling to map groundwater potential zones along these lineaments.

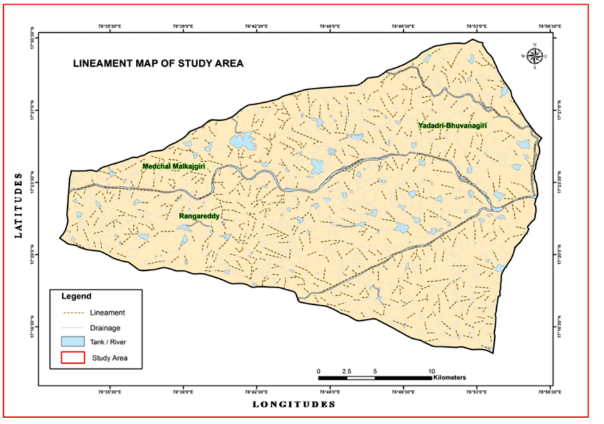

Figure: 6 Structures and Lineaments map of the Study Area

CONCLUSION

The IRS-R2 LISS IV Satellite Images of Yadadri-Bhuvanagiri, Medchal-Malkajgiri and Ranga Reddy Districts of Telangana State have been analyzed in order to understand the surface geological conditions. This produces characteristic structural, morphological features, which themselves are responsible for the groundwater accumulation, storage and movement. A detailed understanding of all these pathfinders and appreciation of their relative significance in different topographical environment is essential in proper planning and understanding structural features. Low elevated areas, which are Bibinagar, Sirivenikunta, Bhuttuguda, Gurraladandi, Peddaravulapalli, Chinnakondur, Yellagiri, Choutuppal, Sangam, Bollepalli, Shivareddygudem, Brahmanapalli, Muckdhumpalli, Madhavaram, Anajpur and Jibulakpalli etc., with the help of thematic maps geological features were identified.

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