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IRS P6-LISS IV Satellite Image Analysis For Mapping Geomorphology And Hydrogeological Features Along The Musi River From Hyderabad To Valigonda, Telangana State, India.

* Blessy Ganduri, Udaya Laxmi G., Vidyasagarachary D.
Department of Geophysics, Osmania University, Hyderabad-500007.
Corresponding author: ganduriblessy@gmail.com

Abstract: *The IRS P6-LISS IV satellite image provides a synoptic overview of the region from Hyderabad to Valigonda along the Musi River Telangana State, India. Which are parts of Eastern Dharwar craton (EDC) of Peninsular India. Remote sensing data and geographic information system (GIS) were used to amalgamate, the different units to ascertain the land use-land cover and geomorphology to decipher the groundwater potential zone for further development in the study area. IRS satellite imagery can be fruitfully utilized in groundwater prospecting on regional scale in hard rock terrain.*

Keywords: *IRS P6-LISS IV, Geomorphology, Land Use /Land Cover, Lineaments, Drainage*

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Introduction:

Remote Sensing and satellite imagery studies provide inherent features to demarcate geological and geomorphological characteristics of the granitic terrain of the present study area. The present study area Hyderabad to Valigonda region lies between 78° 35' 30" E Longitude to 78°57' 30" E Longitude and 17°15'0" N Latitude to 17° 31' 30" N Latitude of Rangareddy and Nalgonda districts of Telangana State covers to an area of **894.7904 sq.kms** (Figure 1). The topography of the study area is undulating with a gentle slope towards South-East. The highest contour elevation is 473m and the lowest elevation is 317m above mean sea level. The IRS P6-LISS IV Satellite image is utilized to examine the regional/ geological and geomorphologic features to understand the groundwater potentiality in the region.

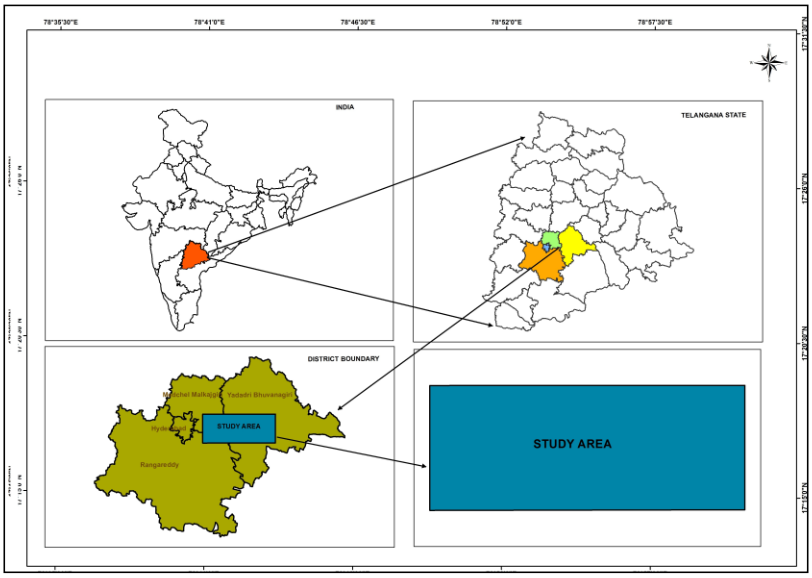

Figure1: Location and key map of Study area

Data Base

The data base is made possible from different sources available and also freely accessible on internet blogs. The basic data acquired from Survey of India (SOI) topographic maps of scale of 1:50,000 and 1:250,000 (toposheet No's 56 K, 56 K/11 and 56K/15) were used to provide the base map and boundary map of the study area. The remote sensing multispectral Satellite Imagery of the IRS P6-LISS IV 2016, Resolution is 5.8 m, and with the number of spectral bands are three (B2: 0.52 -0.59; B3: 0.62-0.68; B4:0.77-0.86 in µm) of the study region are gathered from public domains at (http://glovis.usgs.gov/) and Google Earth (http://earth.google.com). These maps provide the additional information to assist the interpretation of different land use types.

Geology

The study area is a part of Peninsular Gneissic Complex (PGC) and Archaean era of proterozoic epoch. Granitic gneisses and schist are the oldest rock exposed in the area, minor amounts of biotite schist, amphibolites and granodiorites are also noticed (Figure.2) (Ganapuram et al **2009)** . These Granitoid rocks are further intruded by basic intrusive like dolerite dykes. Quartz veins and pegmatites. Granitiods are widely distributed and are classified based on petrochemical characteristics and mineral assemblages as pink and grey granites (Sitaramayya 1968).

The dykes cut across all the granitoid rocks, and these dykes are oriented in E-W, NE-SW and N-S directions. They have a width of 5 to 50m and extend to few kilometres with occasional breaks in their physical continuity (Figure.2). They are massive and are mostly doleritic in composition (GSI 2002).

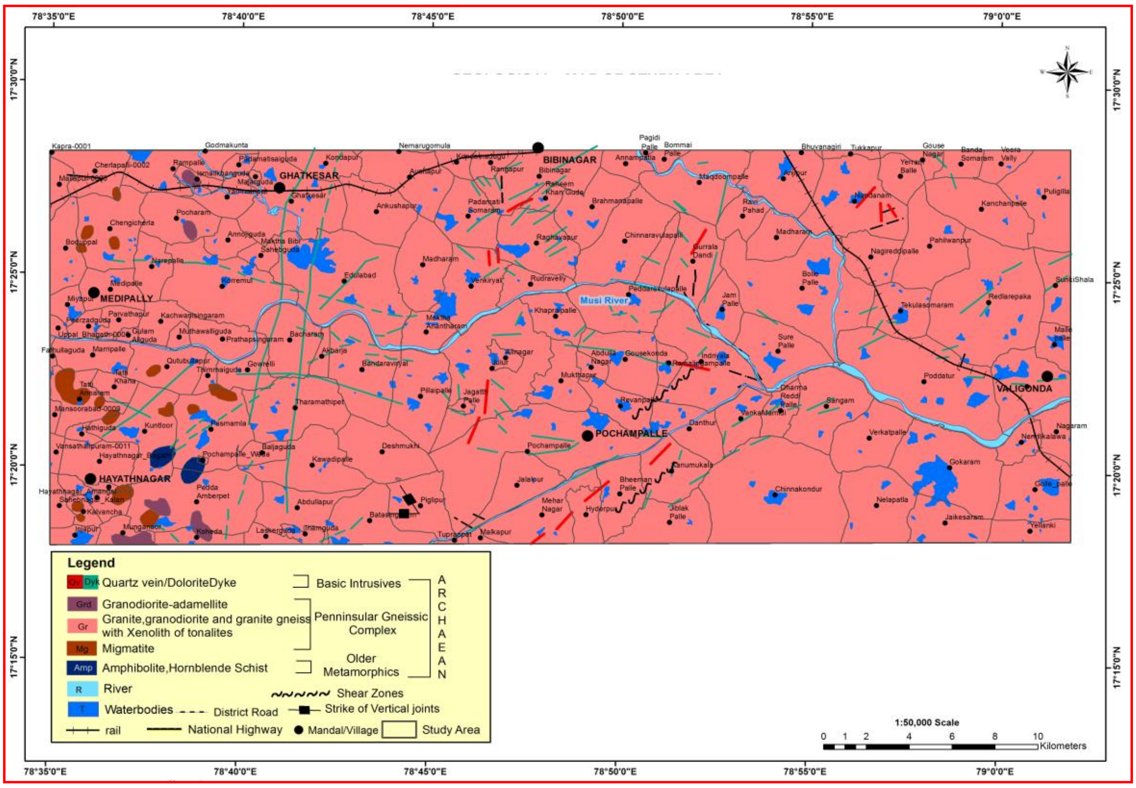

Figure: 2 Geology Map of Study Area (Source: GSI: 2002)

Results and Discussions

IRS P6-LISS IV satellite imagery is used to analyze the various geological formations based on different FCC signatures. These signatures depend on several band combinations (B2: 0.52 -0.59; B3: 0.62-0.68; B4:0.77-0.86 in µm) and many band rationing/ indexing techniques adopted by several authors (Miller and Pearson, 1971, Goetz, 1975; Singer, 1980; Chavez et al., 1982. Price, 1995, Subhash Babu et al., 2014) this made possible to correlate the available lithology and hydrogeomorphic features of the study area (Figure .3).

The satellite image analysis techniques display surface lineaments like joints, fractures, faults etc. (Sriram et al., 2015) and those extended and into deeper levels. Many studies have stressed on the importance of lineament interpretations and digital lineament analysis (Kutina, 1969, Katz, 1982, Liu et al. 2000, Rein and Kaufmann, 2003). Geological structures / rock lineaments, faults etc. were digitized using ArcGIS 10.2.2 with the help of satellite imagery (Figure.3). Different structures that should be mapped have been represented on the map with appropriate line symbols (Figure.4).

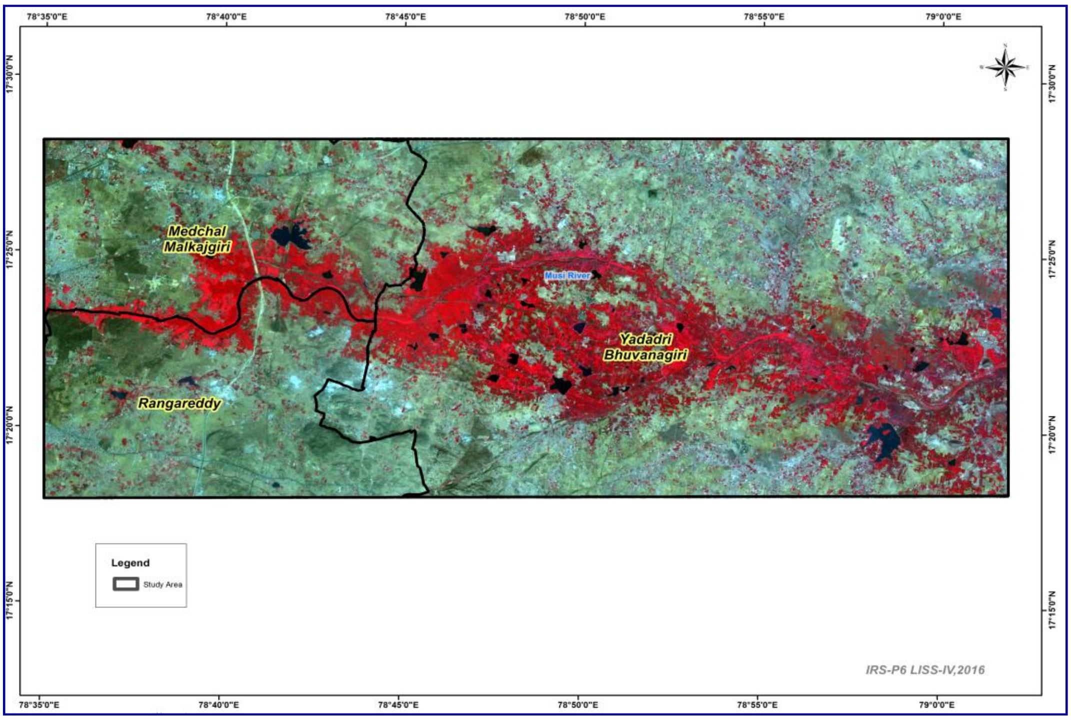

Figure.3: Satellite map of the study area (Source: bhuvan.nrsc.gov.in)

In the present context, visually interpreted lineaments using satellite image reveals the densities of lineaments. On the North and North-East of the study area, the densities of lineaments density of lineaments are more and are found in the upland region where the surface runoff and erosion is high. The drainage pattern and texture appear on images as good indicators of landforms and bedrock type (Thornbury, 1986). This is also suggesting the soil characteristics and drainage conditions. Drainage of the area is dendritic and is a common phenomenon of granitic terrain and the overall drainage is dendritic to sub dendritic (Alekya et al 2017).

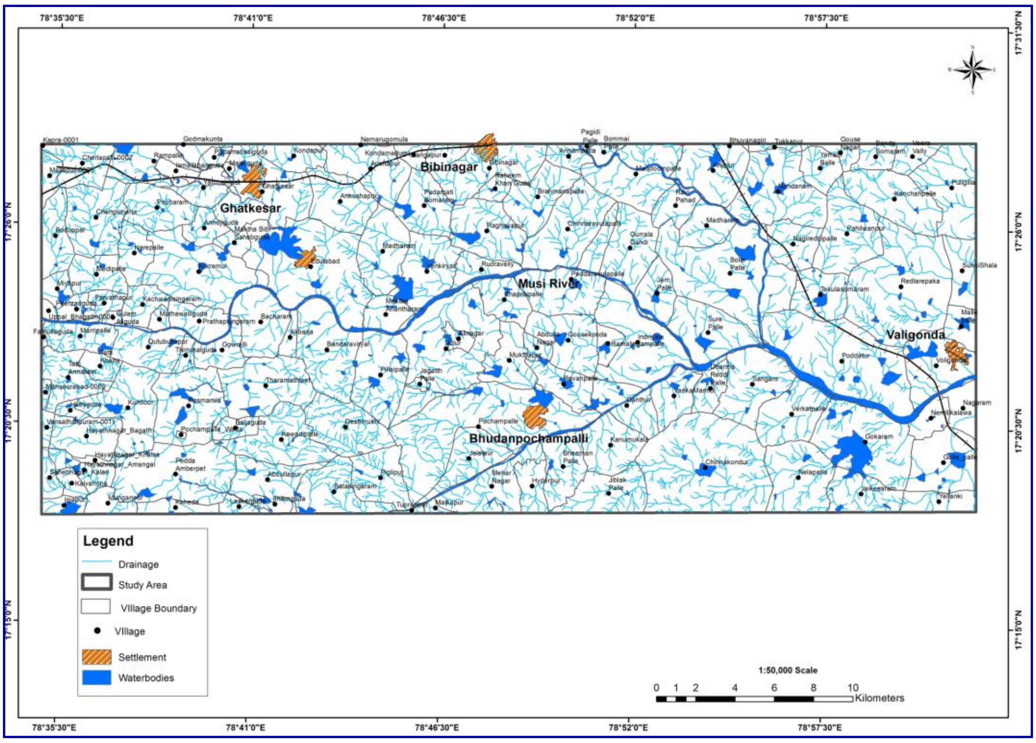

Figure 4: Drainage and structural map

The drainage density is also quite high in the western side of the area. All streams and streamlets irrespective of order are flowing and joining the River Musi and the river further flows to eastwards and merges with mighty river Krishna (Figure.4). There are numerous surface water bodies of small and the marginal sizes forming due to high density of first and second order streams. At some location, circular or radial alignment of drainage is also noticed and reflecting on topographic highs and other geological features (Udayalaxmi et al., 2016; Kirkley et al., 1991) was also under the opinion that domal, circular and radial drainage features demarcate the good runoff zones.

The meandering of the river is self- explanatory for different structural features of both inferred and confirmed. In the western part of the study area the number of joints, faults and fractured features are noticed with the presence of thick vegetation and rugged topography (Figure.4)

Geomorphology of any region refers to the surfacial features of earth and their development (Khadri etal.2014, Richard Vogel, 2011). Hydro geological processes over earth materials with the interaction of geomorphic forms with surface and groundwater in temporal and spatial dimensions (Sidle and Onda., 2004). All the hydrogeomorphological features depicted in Figure.5 from satellite imagery and presented with different notations. The geomorphologic features categorized on the basis of satellite imagery signatures and interpreted to the ground water potentiality of the area (Kruse, 2012). These forms are further useful in the ground water developmental activities.(Chorley R.J., 1972)

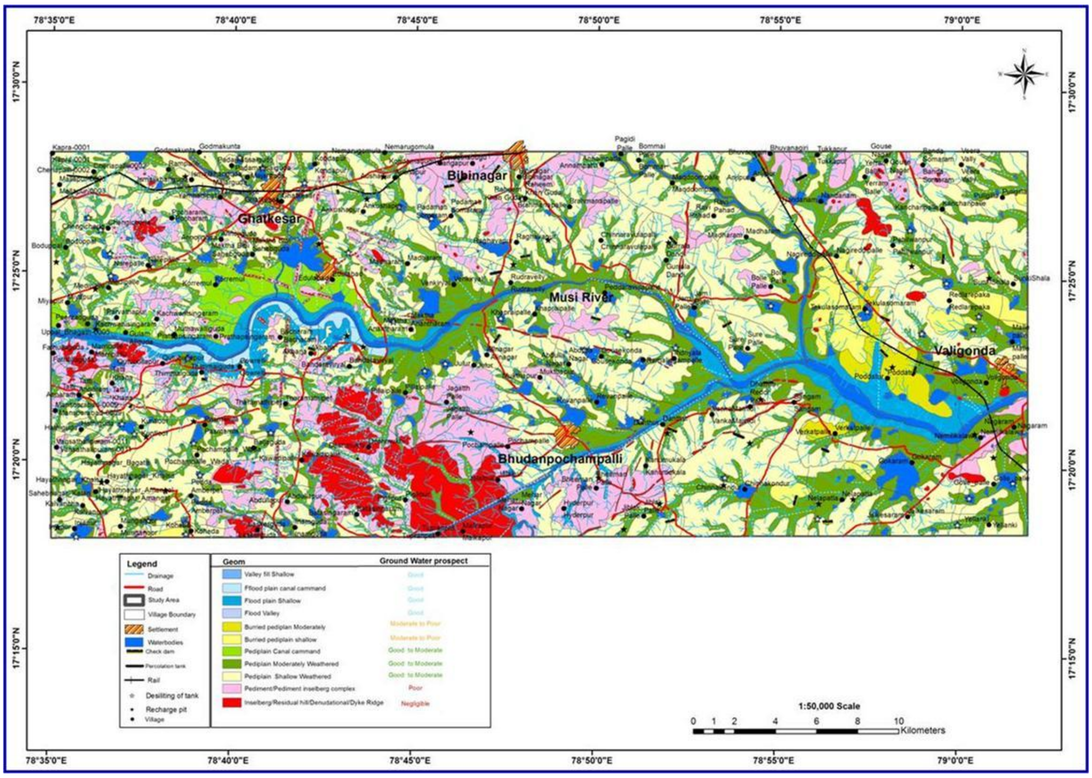

Figure 5: Hydrogeomorphological map of the study region

The land forms identified are Valley fills , pediplains ,pediments ,residual/denudational hills, structural hills and inselbergs ,weathering etc. These Land forms further such divided based on the subsurface weathering thickness and extent. Pediment land forms are not feasible for groundwater development, where the weathering thickness is negligible or absent.

In case, the weathered zone thickness, and intensity is more than the area becomes more favourable for groundwater recharge. Structural hills and ridge-like landforms act as conduits for ground water accumulation (Figure .5).valley fill regions are due to accumulation of unconsolidated/weathered sediments at valley repositories and compacting the valley width and become good groundwater repositories.

The Land use and land cover pattern and its spatial distribution are the major fundamentals of a successful strategy required for the appropriate development and organization of any domain (Ramadass et al., 2016). The land use map prepared from remote sensing satellite imagery and their spatial distribution and there percentile amounts and division are shown in(Figure 6), Table -1 based on the ground truth data. The various land use patterns are depicted in the study area using the visual interpretation of the satellite imagery of IRS P6+ LISS-IV.

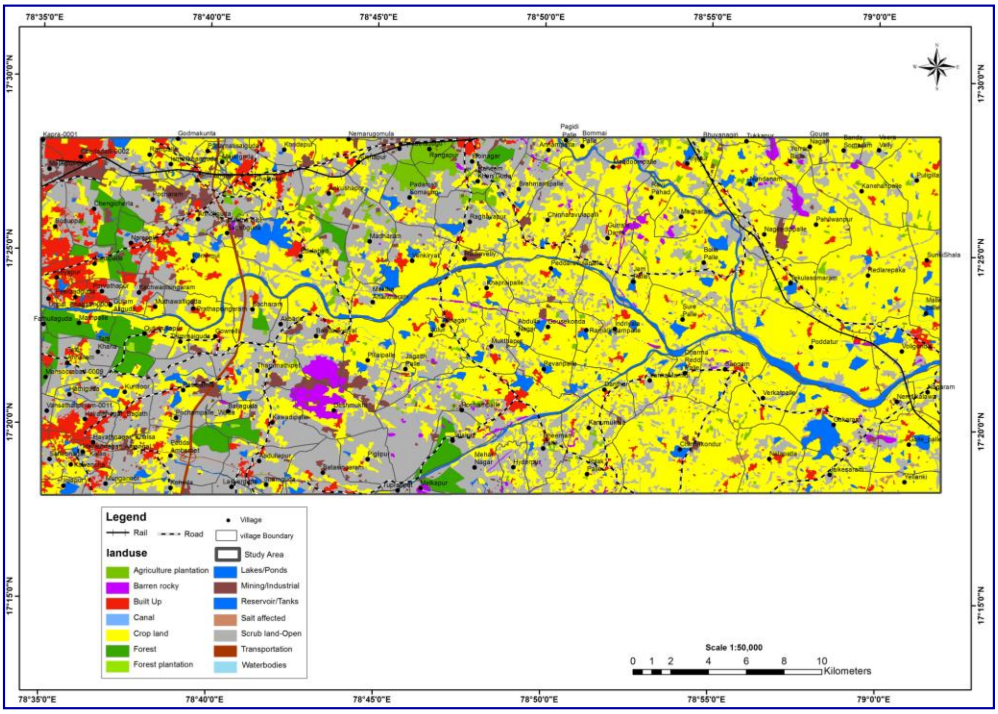

Figure 6: Land use-land cover map of the study region

The land use Land cover is made around of fifteen conventional divisions in the present study and is shown in Table 1. These divisions were identified and mapped using visual interpretation keys such as colour, tone, texture, pattern, size, and shape of the satellite imagery.

Table 1: spatial distribution of land use-land cover

Land Use Land Cover Data		
Row Labels	**Sum of Area in surface**	**Percentage of the Area (%)**
Agriculture plantation	16.7967	1.8772
Barren rocky	11.7162	1.3094
Built Up (Rural)	0.0433	0.0048
Built Up (Urban)	1.3711	0.1532
Canal	1.2045	0.1346
Core-urban	13.2437	1.4801
Crop land	470.3602	52.5665
Forest	53.02	3.1722
Forest plantation	0.286	0.032
Grassland & Grazing Land	0.1416	0.0158
Hamlets and dispersed household	1.9776	0.221
Lakes/Ponds	0.0426	0.0048
Mining/Industrial	22.9385	2.5636
Mixed settlement	0.1373	0.0153
Reservoir/Tanks	27.9699	3.1259
Scrub land-Open	245.158	27.3984
Transportation	5.8026	0.6485
Village	21.8802	2.4453
Waterlogged	0.022	0.0025
Grand Total	**894.7904**	

Conclusions

Elucidation of geological, geomorphological and Hydrogeomorphological units and demarcation of their boundaries are made possible by utilizing satellite imaginary IRS-P6 LISS-IV with a spatial resolution of 5.8m. Satellite image digitally processes and interpreted using Arc GIS to get clean structural fabric. After the amalgamation of all the units, a detailed land use-land cover map is attained to delineate to the groundwater potential zones. Agricultural cropland area is around 52% and forest area is 3% which needs further forestation in the area of investigations. Undeveloped open scrubland area 27% required more attention to bring the land into utility. The geomorphological units such a flood plains, valley fills, deeply buried pediplains are most prospective zones for the groundwater development in the vicinity.

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