



Research Paper

Inference of structural features from Satellite Image in Armour Area, Nizamabad District, Telangana State

Telu Raju, G. Udayalaxmi and D. Vidyasagarachary
Department of Geophysics, Osmania University, Hyderabad-500007
Email id: teluraju50@gmail.com

Received: 28/12/2020

Revised: 04/01/2021

Accepted: 14/01/2021

Abstract: Understanding the subsurface structural features in the Indian peninsular shield is a major geological challenge. The Remote sensing IRS P6 - LISS IV satellite image data and geographic information system (GIS) were used to comprehend the faults, folds, lineaments and other structural features in the region. The structural features like faults and dykes are mapped along with their interceptive zones in the study area. These features will act as potential loci for mineral resources in any geological terrain. The region is part of peninsular shield characterized by undulating topography with erosional and denudational landforms like inselbergs and inselberg complexes and ridges are found amidst vast areas of dissected pediments and pediplains. Remote sensing satellite images are proved to be more authentic in characterizing the structural features and are indirectly supports in mineral exploration strategies.

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

Introduction:

The present study area is part of the south Indian peninsular shield of Archean era in the eastern Dharwar craton in parts of Armour area, Nizamabad district, Telangana State (Figure 1), located on the north western flank of the Godavari basin. The area is bounded by the coordinates $78^{\circ}00'E$ to $78^{\circ}30'E$ and $18^{\circ}30'N$ to $19^{\circ}00'N$ and forming part of the toposheet no E44G1, E44G2, E44G5 & E44G6 (survey of India) of eastern Dharwar craton.

Several scientists put their efforts for detailed investigations on the Indian peninsular shield and on the Godavari basin (Qureshy *et. al.*, 1968; Radhakrishna and Vasudev, 1977, Naqvi *et. al.*, 1974 and Mishra *et. al.*, 1987) in geological and geophysical aspects. The structural aspects in the study area were not adequately deliberated in the interest of mineral exploration. The inherent geological setup of the area that stems from its setting, the younger craton emplaced in Lower Proterozoic gneissic complex and marked by major lineaments, that makes the area more potential and fruitful for mineral exploration.

Geologically, the terrain is covered with the rock types of Dharwar Super Group belonging to Archaean Proterozoic to Paleo-Mesozoic ages are exposed in the area. A number of N-S, ENE-WSW and NW-SE trending igneous intrusive dykes are the distinct features of the area (GSI, 1994).

The IRS P6- LISS IV satellite image covering of an area of 604 Sq.km provides inherent features to deter the geological and geomorphological characteristics over the granitic terrain. The study area is characterized by undulating topography with erosional landform features like inselbergs, tors and ridges are noticed amidst vast areas of dissected pediments and pediplains. The overall drainage pattern is sub-dendritic to dendritic, while locally rectilinear and trellis pattern are also noticed at places. The main rivers flowing through this region are the mighty Godavari and a tributary Manner river.



Figure 1: Location map of the Study area
Data Base

The database is extracted from different sources available to cohere the geological structures from the Achaean granitic terrain. The study region forms a combination of four Survey of India (SOI) toposheets, E44G1, E44G2, E44G5 & E44G6 of 1:50,000 scale. A LISS IV satellite image from the Indian Remote

Sensing Satellite (IRS)-P6 acquired from the BHUVAN (www.bhuvan.com), has high resolution with an accuracy of 5.8-meters spatial resolution. Required and favourable locations can be demarcated as polygons on different FCCs. The lineament directions mapped would help in demarcating the area for conducting ground geophysical surveys of interest. The study area is picked up from public domain google earth. The LISS IV data guides in the translation of various land use types for different purposes.

Geology

Remote sensing images used in mineral exploration to map geology and structures to localize the ore deposits. 90% of the Nizamabad District is covered by hard crystalline rocks, banded gneissic complexes are (67%), granites (24%) of Archaean to Proterozoic age and volcanic basaltic rocks (Deccan Traps) (9%) of late Cretaceous to early Eocene age. Granite, granodiorite / tonalite rocks of Peninsular Gneissic Complex (Archaean) are widely exposed in the study region is shown in Fig.2. The basic intrusive dykes trending N-S, ENE-WSW and NW-SE direction and in many places intruding into pre-existing rocks. These dykes are massive and are mostly doleritic and few gabbroic in composition.

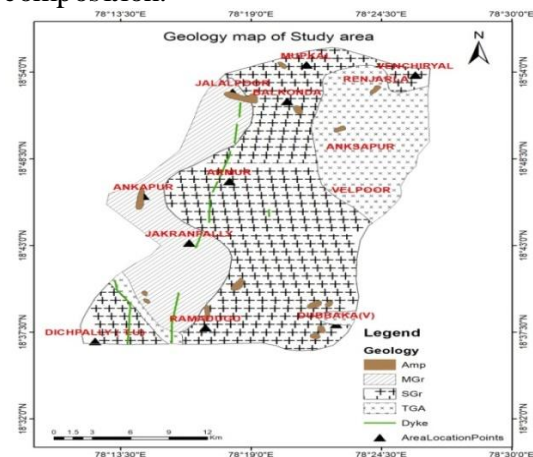


Figure 2: Geology map of the study area (After GSI, 2002)

Results and Discussions

The present work based on the LISS IV satellite image analyses and interpretation. The standard image processing techniques have been adopted to read the satellite imageries along with ERDAS software. False Color Composites (FCC) of satellite imageries have been prepared for the year 2014 using band 2 (green), band 3 (red) and band 4 (near infrared) as shown in Figure 3.

The IRS P6 LISS IV satellite images are widely applicable in identifying and characterizing the various lithological and topographical signatures more accurately used to Lithological segregation. Various types of FCC images were prepared using several band combinations and many band rationing/indexing techniques mentioned by several authors (Goetz, 1975; Chavez et al. 1982; Singer, 1980; Miller and Pearson, 1971; Price, 1995, Blessy et al. 2018) were utilized to access the lithological variations of the investigated region in the identification of new litho-units if any. Different endeavors have been made to do such lithological limits utilizing topographical techniques.

It is emphasized to prepare a detailed geomorphological map of the area and related land use and land cover features. A part from geomorphological units various linear features such as lineaments, dykes, faults and including surface water bodies and drainage from IRS P6 LISS IV satellite images are generated with accuracy (Aleky et al. 2017; Ramadass et al. 2016) and are presented in Figure.3.

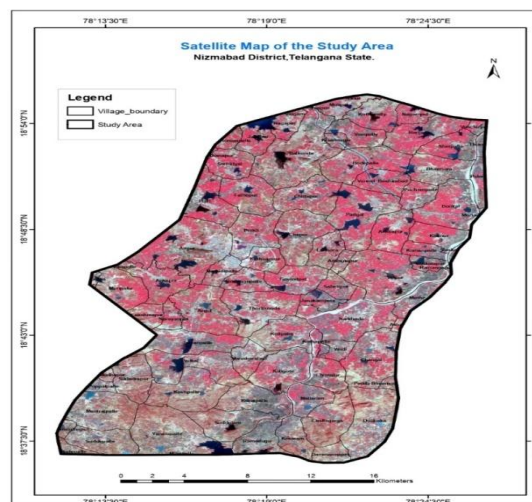


Figure 3: IRS P6 – LISS IV Satellite image of study area

The Sriram Sagar is the major reservoir built on the Godavari river and another minor project built at Ramadugu on the Peddavagu tributary in the study area. The study area is drained by the mighty river Godavari and its tributary Peddavagu and different streams of the basin are merging into Sriram Sagar main canal. Maps depicting drainage, lineaments and water bodies is presented in the Figure 4. The overall drainage pattern is dendritic to sub-dendritic, while locally rectilinear and trellis pattern are noticed. Peddavagu is the most occupying channel in the area running towards north into Godavari river from Ramadugu region.

Many studies have emphasized the importance of lineament interpretations and digital lineament analysis in localizing the major mineral deposits and notes that there is a strong correlation between mineral deposits and lineaments (Kutina, 1969, Katz, 1982, Liu *et al.*, 2000, Rein and Kaufmann, 2003).

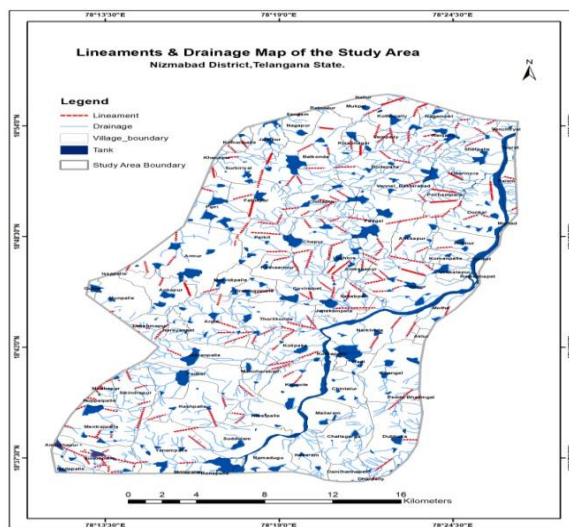


Figure 4: Drainage, Lineaments map of the study area

Satellite images were interpreted to prepare land use/land cover maps by using ERDAS image processing system. The land use can be grouped into 11 classes i.e., Agricultural plantation, Barren Rocky, Canal, Crop Land, Forest Plantation, Hamlets, Reservoirs, River/Stream, salt affected, scrub Land, dense and open scrub land is shown in the Figure5. In the study region 12.5% of

land covered by scrub land consists of open scrub land and dense scrub land. The people in the area depends upon Agriculture. Hence, the agriculture plantation and crop land are covered by 70.8% (Table 1). The fewer part of land covered by barren rocky, Forest, water bodies and settlements.

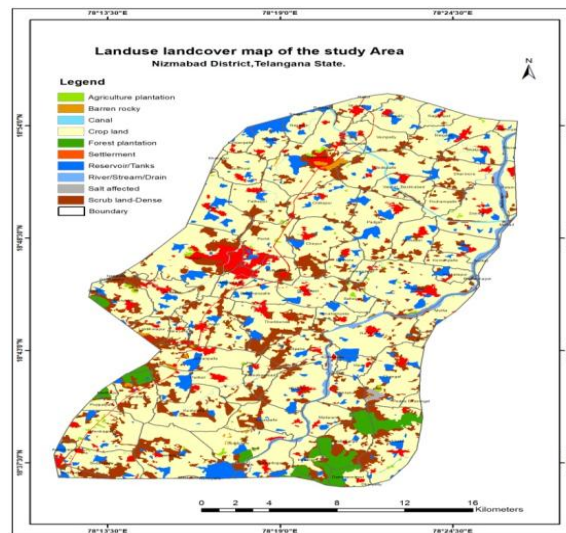


Figure5: Land use / Land Cover map of the study are

Table 1: Spatial Analysis of Land use /Land Cover in the study area

Land Use / Land Cover	Area in Sq. Km	Area in %
Agriculture plantation	2.848	0.471
Barren rocky	1.963	0.325
Canal	2.944	0.487
Crop land	425.379	70.396
Forest plantation	15.769	2.610
Hamlets and dispersed household	29.737	4.921
Reservoir/Tanks	38.175	6.318
River/Stream/Drain	10.642	1.761
Salt affected	0.698	0.116
Scrub land-Dense	2.139	0.354
Scrub land-Open	73.972	12.242
Grand Total	604.266	100%

All the hydro geomorphological features (Chorley, 1972; Thornbury, 1986) explored from satellite imagery and shown in Figure.6 with different signatures and are interpreted to determine the ground water potentiality of the area (Kruse, 2012). The aquifers from the area mostly confined to unconfined developed from weathered and fractured zones. The weathered zone thickness is in the range of 10-20 mbgl, followed by < 12 m found along the major fractured zones. The climate of the district is characterized by hot summer with dry weather except during S-W monsoon period. Pediplains are major geomorphic features (covered 60% of the area) followed by pediments and structural hills and the area is drained by the mighty river Godavari and its tributaries. The other landforms observed are denudation hills, plateau, flood plain, residual hill, valley fills, etc. North of the study area is drained by Sriram Sagar project and is found with good ground water recharge. The irrigation in this area is under canal command whereas in the southern part the irrigation is ground water control (Figure.6).

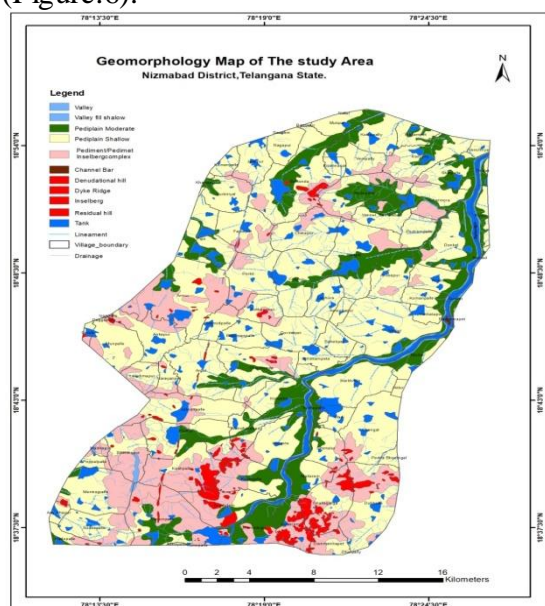


Figure 6: Geomorphological map of the study area

Conclusion

The Indian Remote Sensing Satellite (IRS-P6-LISS-IV) data with Spatial resolution 5.8m and Geographical Information System techniques were used to demarcate the boundaries of geological, geomorphological and Hydrogeomorphological units. A detailed land use-land cover map is attained to delineate the groundwater potential zones. Satellite images in combination with predated topographic sheets of Survey of India were used for analyzing land use and land cover change detection. With the help of Geographic Information System, the various land use and land cover zones are mapped, which are helpful for macro and micro level planning. Geomorphology map is used for better demarcation of ground water potential zones. Agricultural plantation and crop land area together is 71% and forest area is 2.6% which needs further afforestation in the area of investigations in depleting the forest. Undeveloped open scrubland and dense scrub land area is 12.5% required more attention to bring the land into utility. The geomorphological units such a flood plain, valley fills, deeply buried pediplains are most prospective zones for the groundwater development in the vicinity.

Acknowledgements:

The authors gratefully acknowledge the UGC, New Delhi, India for their support to work and funding from the RFSMS Fellowship. We acknowledge the help rendered by N. Ramudu, Research Scholar, Geology Department, Osmania University in preparing the figures is highly appreciated.

References:

Qureshy M. N., Krishna Brahmam, N., Garde S.C. and Mathur B. K., (1968) Gravity anomalies and the Godavari rift,

- India. Geol. Soc. Am. Bull., v. 79, pp: 1221-1230.
- Radhakrishna B. P. and Vasudev V. N. (1977) The early Precambrian of the southern Indian shield; J. Geol. Soc. India 8 525–541.
- Kutina J. (1969) Hydrothermal Ore Deposits in the Western United States: A New Concept of Structural Control of Distribution. Science. 165; 1113-1119.
- Miller L. D. and Pearson R. L. (2005) Areal Mapping Program of the IBP Grassland Biome, Remote Sensing of the Productivity of the Short Grass Prairie as Input Into Bio System Model. 7th Proceedings of the International Symposium. Remote Sensing of Environment. 1971. 1, 175.
- Chorley R. J. (1972) Spatial Analysis in Geomorphology, Harper & Row Publishers, N.Y.
- Naqvi S. M., Divakara Rao, V. and Narain H. (1974) The Proto continental growth of the Indian Shield and antiquity of its rift valleys, Precambrian Res. 1, 345–395.
- Goetz A. F. H. (1975) Application of ERTS Images and Image Processing to Regional Geologic
- Singer R. B. (1980) Near Infrared Spectral Reflectance of Mineral Mixtures, Systematic Combinations of Pyroxenes, Olivine and Iron Oxide. PSD Publications. No.258, MIT, Cambridge, MA.
- Chavez P. S, Jr. Berlin G. L., and Sowers L. B. (1982) Statistical Method for Selecting Landsat MSS Ratios. Journal of Applied Photographic Engineering. 8 (1) 23-30.
- Katz M. (1982) Lineament Analysis of Landsat Imagery Applied to Mineral Exploration. In Mineral Exploration Techniques in Tropical Forest Areas. Edited by Laming, D.I.C. and Gibbs, A.K. Hiden Wealth. 157-166.
- Thornbury William D. (1986) Principles of Geomorphology, 2nd edition, Wiley Eastern Ltd.
- Mishra D. C., Gupta S. B., Rao M. B. S. V., Venkatarayudu M., and Laksman G. (1987) Godavari basin- a geophysical study, Journal of the Geological Society of India, v.30, pp: 469–476.
- Geological Survey of India, (1994) Project Vasundhara: Geoscientific analysis, database creation and development of GIS for parts of South Indian Peninsular Shield. Special Publication, AMSE wing, Geol. Surv. India, 73p.
- Price J. C. (1995) Examples of high resolution visible to near infrared reflectance spectra and a standardized collection for remote sensing studies: International Journal of Remote Sensing, Vol. 16, pp. 993 – 1000.
- Liu C. C., Sousa Mf.D.A Jr., and Gopinath T. R. (2000) Regional Structural Analysis by Remote Sensing for Mineral Exploration, Paraiba State, Northeast Brazil. Geocarto International. 15 (1) 70-77.
- Geological Survey of India, Geology map with 1 : 2,50,000 scale (2002)
- Rein, Bert. And Kaufmann, H. 2003. Exploration for Gold using panchromatic stereoscopic intelligence satellite photographs and Landsat TM data in the Hebei area, China. International Journal of Remote Sensing. Vol. 24. No. 12, pp. 2427-2438.
- Kruse F. A. (2012) “Mapping Surface Mineralogy Using Imaging Spectrometry,” Geomorphology, Vol. 137, No. 1, pp.41-56.
- Ramadass G., UdayaLaxmi G. and Sriramulu G. (2016) Application of RS and GIS for Land Use/ Land Cover, Geomorphological Studies in Nalgonda District, Telangana, India. International Journal of Advanced Remote Sensing and GIS (IJARSG), Cloud Publications, Vol.5 (3), pp. 1592-1604.
- Alekhyia K., Ramadass G. and Udaya Laxmi G. (2017) Application of remote sensing and GIS mapping for

Hydrogeomorphological and land use studies in Southern parts of Godavari river basin, jagtial District.T.S. India. International Research Journal of Natural and Applied Sciences, Vol.4, Issue, 8, pp.62-77.

Blessy Ganduri, Udaya Laxmi, G., Vidyasagarachary D. (2018) IRS P6-LISS IV Satellite image analysis for mapping geomorphology and hydrogeological features along the Musi River from Hyderabad To Valigonda, Telangana State, India. International Journal of Engineering Science Invention (IJESI), Volume 7 Issue 8 Ver, Aug 2018, PP 06-11.