Application of RS & GIS in micro level analysis of Forest Canopy Cover density in Kawal TR East (Jannaram) Division- Adilabad District- Telangana

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Abstract: Forest plays an important role in the natural environment of a particular place. In recent times, deforestation has become a major issue of concern as it is one of the causes of climatic change and Global warming. Up to date information is the need of the hour for monitoring the forest cover at the micro level. Remote sensing not only provides real-time information on forest cover but also provides a synoptic view. GIS has emerged as a handy tool in the analysis of the huge volume of forestry data. In this paper, an attempt is made to map forest canopy cover at micro level (Beat level) analysis for Jannaram (Kawal East Tiger Reserve) Division of Adilabad District. In this division, a large part of Kawal Wildlife Sanctuary & Tiger Reserve Forest is located. The study is based on IRS-R2 LISS-III data with 23.5 Mts resolution. The main objective of the study is to identify different classes of forest canopy cover density and its spatial distribution in the study area. A detailed analysis of forest type and canopy density is undertaken. Remote sensing and Geographic Information Systems (GIS) have the potential to provide accurate information regarding forest density. Forest cover mapping is based on NDVI technique. GIS is used in the preparation of various theme layer mapping & generation of forest statistics. The forest cover is classified into 6 classes based on canopy density such as Very Dense forest, Moderately Dense forest, Open Forest, Scrub, Non-Forest, and Waterbody. The canopy density categories are correlated with slope classes. Micro-level analysis of canopy cover density is an important factor in the evaluation of forest status which is very useful in improving the canopy cover. Estimation of forest canopy density is an essential part of Forest Inventories.

IndexTerms **– Forest Cover Change, Canopy, GIS, RS, Telangana.**

I. INTRODUCTION

The enormous extent of land is used for the activities like Urbanization, Mining, and Industrialization and so on, as they are the great trend for social and economic development during these days and for this reason, forest areas are decreased and deforestation is increasing. Deforestation contributes to CO2 emissions, leading to climate change and Global warming. According to the United Nations Framework Convention on Climate Change (UNFCCC), the main cause of deforestation was agriculture. 32% of deforestation is due to commercial agriculture; 48% of deforestation is due to existed farming; 14% logging is responsible for deforestation and 5% of the wood collection is responsible for deforestation (Billington.et.al, 1996. Coppin.et.al.2004). Forest areas, forest canopy density, and greenery of an area are important issues of concern for an ecosystem, biodiversity etc. and to be preserved. Hence forest management is an important part of achieving sustainable development. For better forest management, forestry decision-making and forest resource utilization purposes there is a continuous need for high-quality information regarding forest density.

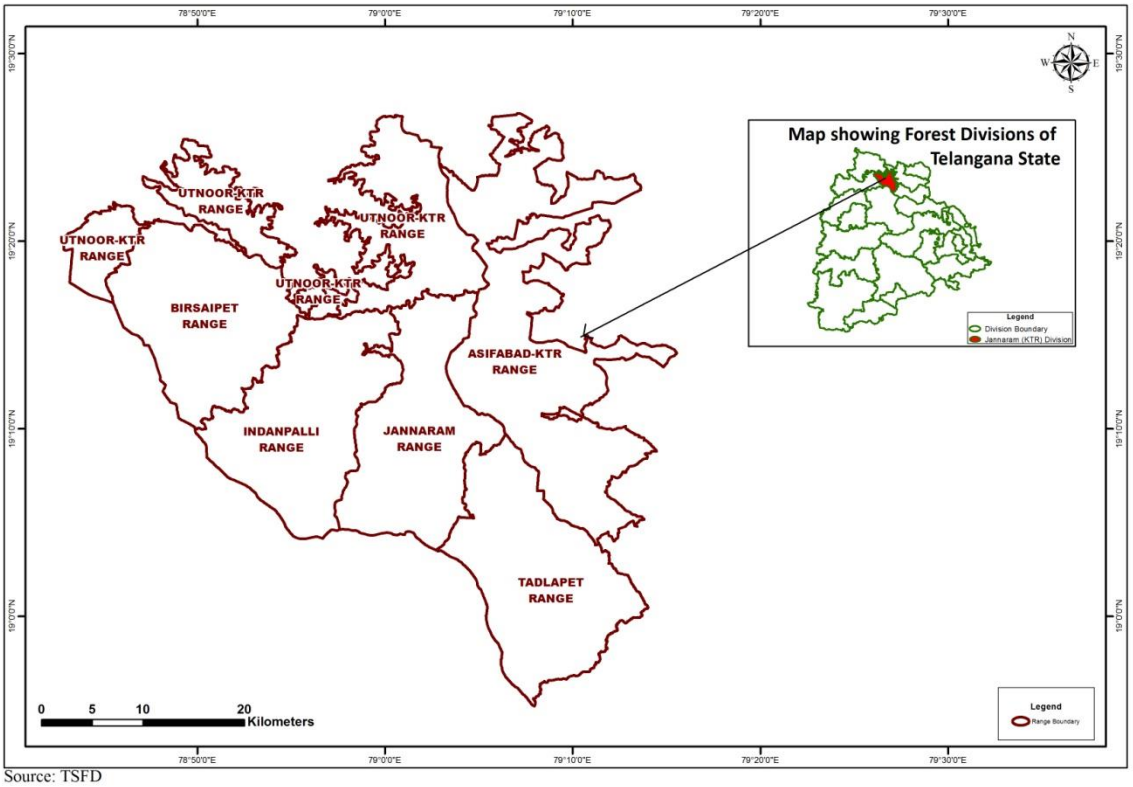
Forest Canopy cover density is an important factor in the evaluation of forest status. Forest canopy cover, also known as canopy coverage or crown cover, is defined as the proportion of the forest floor covered by the vertical projection of the tree crowns (Jennings et al, 1999). It may be possible that there isn't any change in the forest area during the time but the forest canopy cover density will change. Forest canopy density estimation is one of the most effective tools for detecting the condition of forest resources and monitoring of ongoing spatial processes in forest areas and useful in the planning and implementation of various forest rehabilitation programs (Rikimaru et al.,2002). Hence the Micro-level analysis of forest canopy density is undertaken in this work.

Remote Sensing and Geographical Information Systems are proved to be very much useful in forest analysis. The conventional way of measuring forest structure and its composite variables are field surveying by different methods and tools. These measurements are time-consuming, expensive and labor intensive, as well as difficult to operate, especially in mountainous and dense forests. The increasing use of satellite Remote Sensing has proved to be the most cost-effective means for obtaining real-time information about the quality and status of an environment. This information's are very crucial for the study of different forest types and rate of deforestation, afforestation, and reforestation for the conservation of forest area. The overall approach of the present study is based on Multispectral LISS–III data with 23.5 Mts Spatial Resolution. Forest canopy cover density is classified using the most accepted and efficient technique called Normalized Difference Vegetation Index (NDVI). The forests were

classified into Scrub (0-10% Canopy), Open forests (10 to 40% canopy) and Dense Forests (>40% canopy), Very Dense Forests (>70% canopy), Water bodies, Blanks/Non-Forests.

II. STUDY AREA:

This study was carried out in Jannaram (Kawal East Tiger Reserve) Division, located in the central portion of Adilabad District of Telangana State (Figure. 1). The division covers a huge part of the Kawal Wildlife Sanctuary & Tiger Reserve (TR). The entire notified forest area of the division is included in Kawal Wildlife Sanctuary & Tiger Reserve [1]. The Kawal East TR is known for its rich tropical dry deciduous forests with a predominance of teak, bamboo, and abundance of wild fauna. The important faunal species include Tiger, Panther, Wolf, wild dogs, sloth bear, Gaur (Indian Bison), Sambar, Chital, mouse deer, Neelgai, Chowsinga, blackbuck, Chinkara etc [Stripes]. The area lies between latitudes 180 55' 09'' N and 190 26' 45'' N and longitudes 780 42' 57'' E and 790 15' 37'' E. Geographical Area of the Division is 1550.34 km2. Birsaipet plateau lies in the northwestern corner of the division which is 396 m above Mean Sea Level. The plateau is all undulating and drains into Peddavagu stream which runs across the plateau from north-east to southwest from either side (TSFR 2015). The climatic condition of Jannaram was generally hot, specifically a tropical wet and dry climate, with warm conditions year-round. Minimum and the Maximum temperature are 15°C & 29 °C during winter and 28°C & 46°C during summer. Annual Rainfall of the Division is 750 mm, the temperature ranges between 150C to 400C. Average annual Rainfall is 750 mm, which is received mainly from southwest monsoons.



Source: TSFD

Figure 1 Administrative map of Kawal TR East (Jannaram) Division

III. OBJECTIVES:

The purpose of the study was to

- To identify the spatial distribution of forest cover.
- To map the forest canopy cover density at micro (beat) level.
- To classify the Forest Cover into forest canopy density classes.

IV. MATERIALS AND METHODS:

To achieve the objective of the study, both primary, as well as secondary data, were used. Primary data is IRS-R2 LISS-III data with 23.5m resolution. Secondary data is attribute data obtained from State Forest Dept. Erdas Imagine image processing software used for Digital image processing and ArcGIS software is used for creation, integration, and analysis of the different layers and generation of maps.

The simple flow chart of Methodology was shown below (Figure- 2). The study was divided into two stages; the first stage was the collection and creation spatial database of forest layers, while the second stage was geospatial analysis. Satellite data of IRS-P6 LISS-III data dated 28 Jan 2015, with a 100-59 path and row was taken. The Area of Interest (AOI) was built around the study area Jannaram (Kawal East Tiger Reserve) Division (Figure. 3). The satellite image was then digitally classified with Normalized Difference Vegetation Index (NDVI) technique.

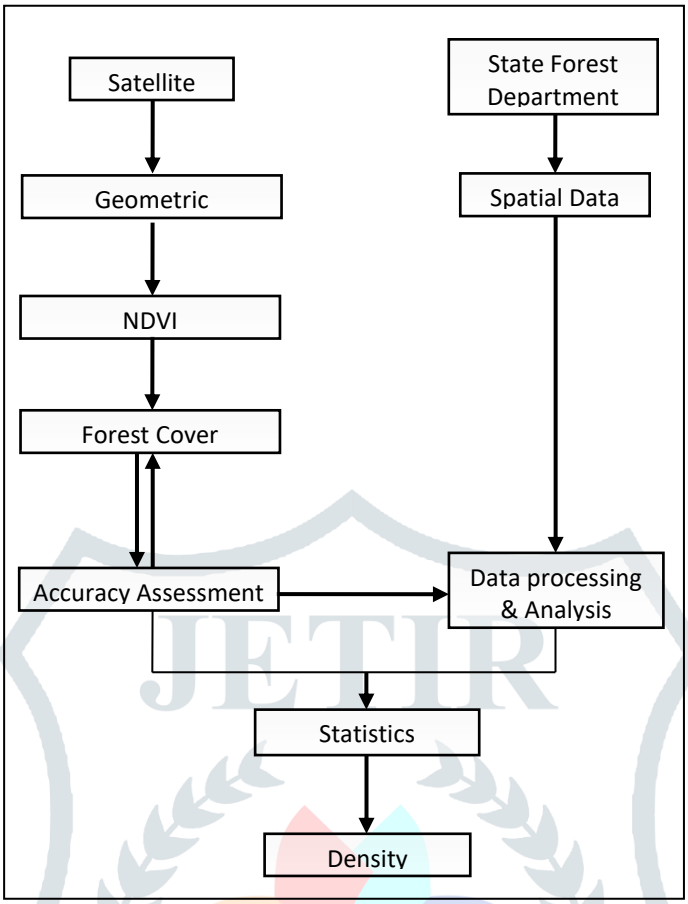
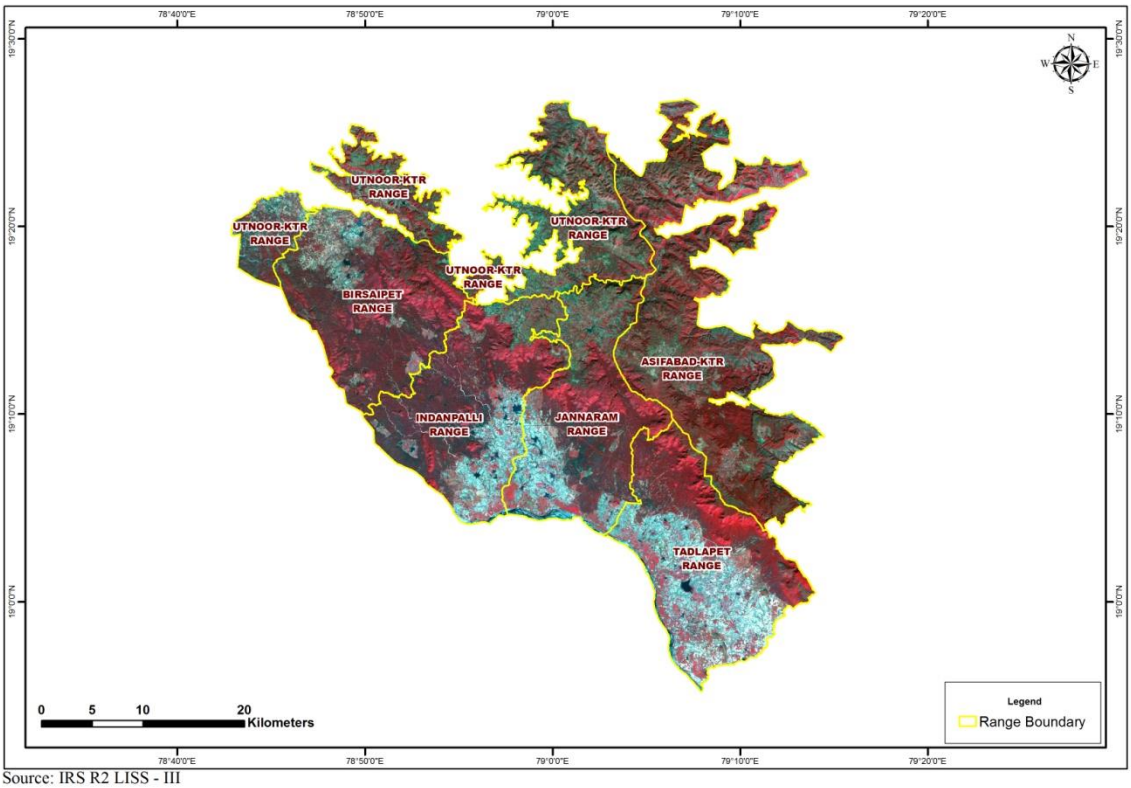


Figure 2 Paradigm of the study



Source: IRS R2 LISS - III

Figure 3 Kawal TR East (Jannaram) Division - A satellite view

NDVI is a method of measuring vegetation density. For this measurement, it uses the ratio of visible and near-infrared bands of the electromagnetic spectrum, which were absorbed and reflected by the plants and it assess whether the target being observed contains live green vegetation or not. This ratio lies between (-1) to (+1). The NDVI value with and under zero means no vegetation and when the value is nearer to +1, then the highest possibility of vegetation density. NDVI values were derived by using the following formula:

NDVI = (IR−R)/ (IR + R),

Where IR = infrared and R = red.

The resultant NDVI values that came after classification will be recorded and were then categorized into various canopy density classes, they are <10% (Scrub), 10–40% (Open), 40–70% (Medium Dense) and >70% (Very Dense), Non-Forest and Waterbodies. Using Arc GIS raster data is converted into a vector format. Then analysis and area calculation of corresponding classes and mapping procedure was done.

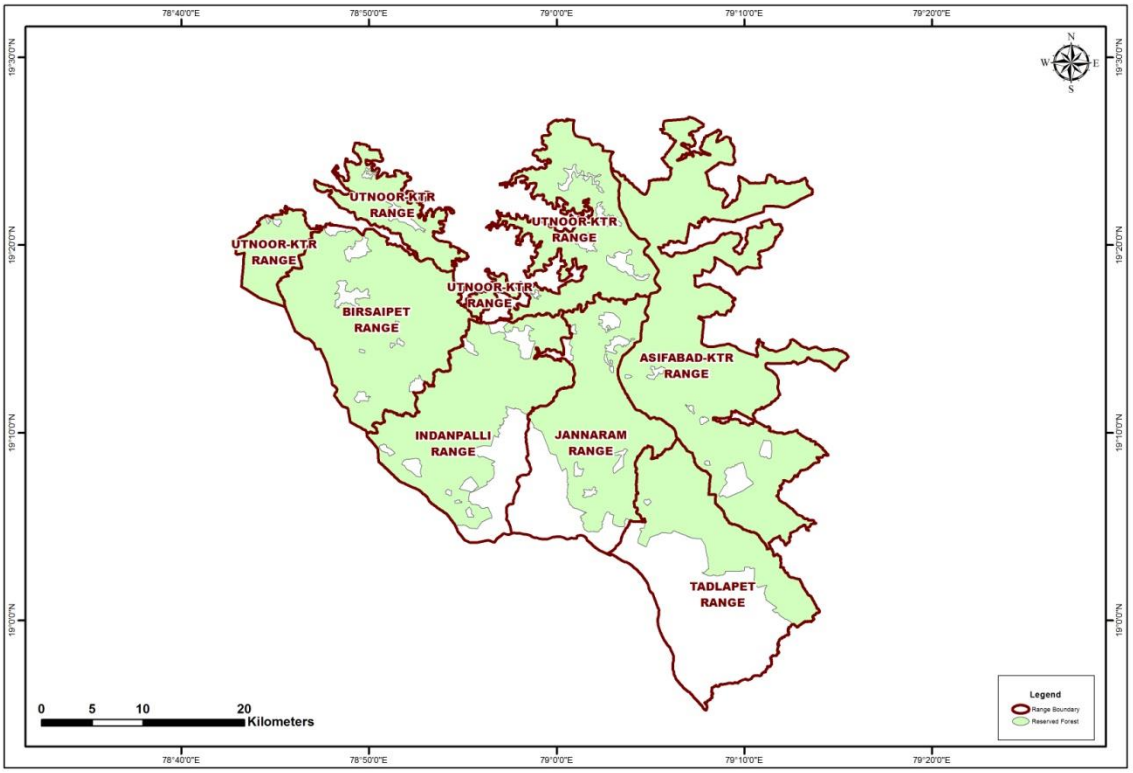


Figure 4 Kawal TR East (Jannaram) Division - Distrubution of Forest areas

5.ANALYSIS AND DISCUSSION:

The present study highlights that solid database utilization was helpful in predicting the forest canopy density of an area with acceptable accuracy. The study revealed that Jannaram (Kawal East TR) division has fairly good diversified forest density. Further, the result revealed that approximately 1.69 % of forest area is covered by forest canopy density of more than 70%, while 38.01 % with the density class of 40–70 %, 19 % with the density class of 10-40% and 18.05 % with the density class of less than 10 % and 23.23 % area is without forest canopy density (Non-Forest) (Table-1).

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Table 1: Different category of forest canopy density In Kawal TR East (Jannaram) Division

Category	Area in Ha	Area %
> 70%	2108.08	1.69
40 - 70%	47300.09	38.01
10 - 40%	23640.90	19
< 10%	22471.65	18.05
Non Forest	28913.63	23.23
Waterbody	19.66	0.02
Total	**124454.01**	**100**

An analysis of forest canopy cover density in Jannaram Division revealed that the total forest area under Jannaram Division is 124454.01 Ha. The majority of canopy density falls under Moderately Density Forest category. It constitutes 38.01% with an area of 47,300.09 Ha (Table-1).

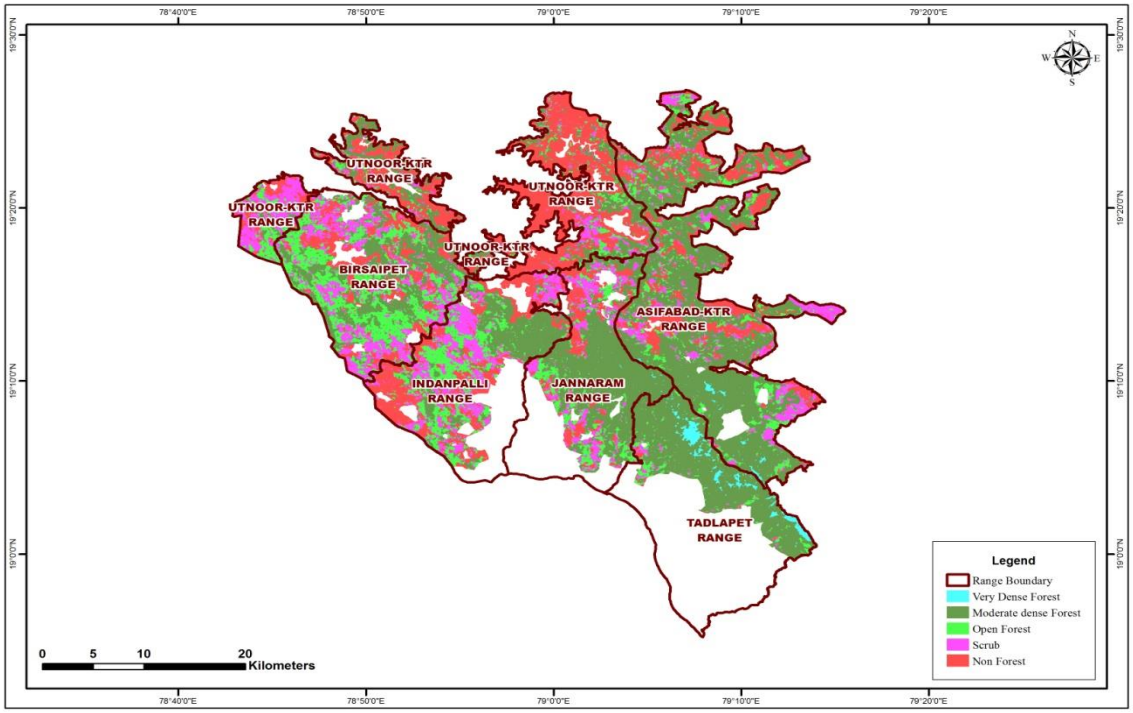
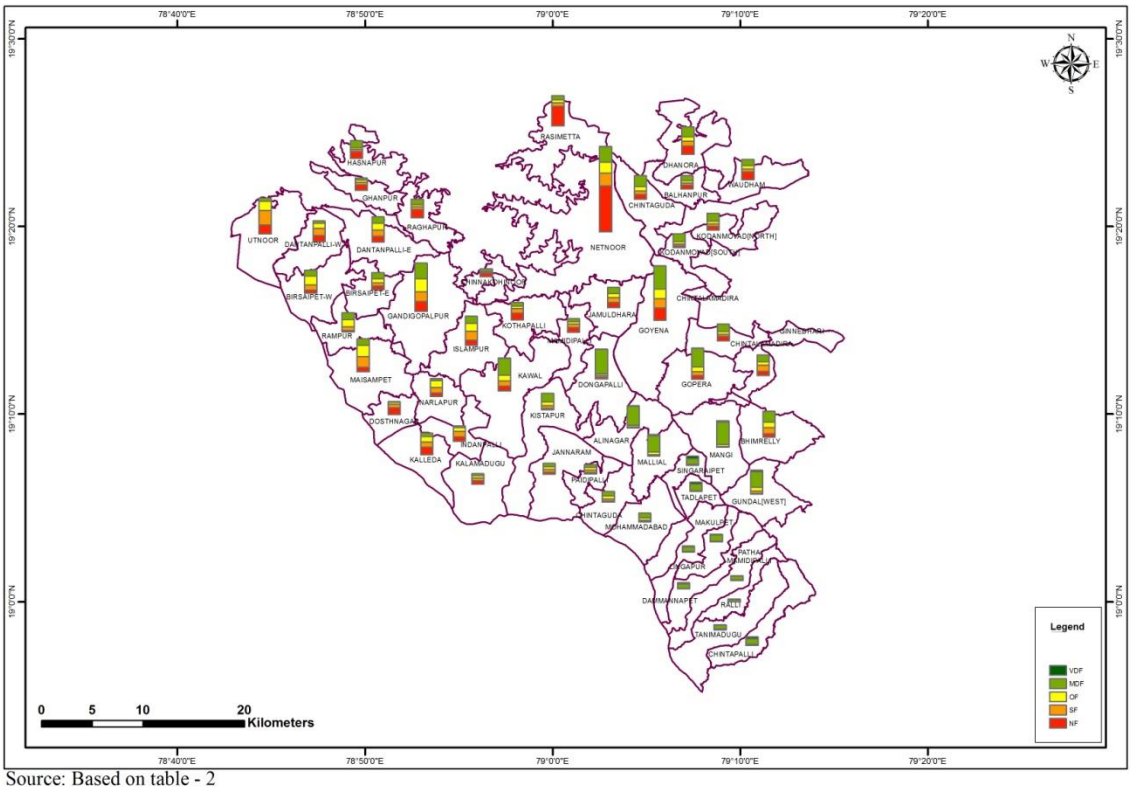


Figure 5 : Kawal TR East (Jannaram) Division - Distribution of Rangewise

A year-wise analysis of forest fires revealed vast variations in the occurrence of fires. It was as low as (66No.s) in the year 2006 and 2011. Maximum incidence of forest fires occurred during the year 2012 (284No.s) followed by the year 2016 (280No.s). It is seen from the fig-6 that, the year 2009, 2012 and 2016 recorded exceptionally high incidence of forest fires. The trend analysis of forest fire occurrence, therefore, registered a wide year wise fluctuations.



Source: Based on table - 2

Figure 6: Kawal TR East (Jannaram) Division - Distribution of Beatwise

Table-2 Beat level Forest Cover Density in Kawal Tiger Reserve East (Jannaram) Division

Area in Ha

S. No	Range	Beat	VDF	MDF	OF	SF	NF	WB	Total
1	Asifabad-KTR	Balhanpur	0.59	578.64	263.31	226.95	440.77	0	1,510.25
2	Asifabad-KTR	Bhimrelly	17.5	1,225.50	628.37	691.23	376.1	0	2,938.71
3	Asifabad-KTR	Chintaguda	8.11	1,257.24	489.22	396.41	560.12	0	2,711.11
4	Asifabad-KTR	Chintalamadira	0	889.75	285.18	267.77	509.71	0	1,952.41
5	Asifabad-KTR	Dhanora	5.04	1,133.05	529.62	545.98	923.2	0	3,136.89
6	Asifabad-KTR	Ginnedhari	1.35	782.08	401.74	693.1	488.22	0	2,366.48
7	Asifabad-KTR	Gopera	15.82	2,134.98	550.05	403.76	436.38	0	3,540.99
8	Asifabad-KTR	Goyena	23.47	2,634.65	1,077.37	1,067.01	1,421.47	0	6,223.98
9	Asifabad-KTR	Gundal[West]	201.13	1,772.54	424.7	290.03	68.1	0	2,756.50
10	Asifabad-KTR	Kodanmovad[North]	0	881.86	330.71	270.3	451.85	0	1,934.73
11	Asifabad-KTR	Kodanmovad[South]	0	910.42	277.37	173.06	230.71	0	1,591.57
12	Asifabad-KTR	Mangi	188.09	2,542.20	219.17	51.9	8.22	0	3,009.58
13	Asifabad-KTR	Waudham	1.11	729.02	376.11	332.19	887.72	0	2,326.15
ASIFABAD-KTR Total			462.23	17,471.93	5,852.91	5,409.71	6,802.58	0	35,999.35
14	Birsaipet	Birsaipet-E	0	693.29	487.18	329.54	434.57	0	1,944.58
15	Birsaipet	Birsaipet-W	0	676.29	986.62	612.68	353.85	9.81	2,639.25
16	Birsaipet	Dantanpalli-E	6.82	739.14	773.89	707.29	687.96	0	2,915.09
17	Birsaipet	Dantanpalli-W	0.85	272.85	603.24	803.04	704.05	0	2,384.02
18	Birsaipet	Gandigopalpur	0.82	1,823.99	1,468.03	1,112.33	1,097.09	0	5,502.26
19	Birsaipet	Maisampet	0	747.96	1,265.32	1,235.06	513.71	0	3,762.05
20	Birsaipet	Rampur	0	780.33	812.07	446.68	166.18	0	2,205.27
BIRSAIPET Total			8.48	5,733.84	6,396.35	5,246.63	3,957.41	9.81	21,352.52
21	Indanpalli	Dosthnagar	0	87.21	239.97	384.16	796.54	0	1,507.88
22	Indanpalli	Indanpalli	0	181.49	440.69	609.6	515.26	0	1,747.04
23	Indanpalli	Islampur	0.65	803.24	916.62	1,010.12	574.16	0	3,304.79
24	Indanpalli	Kalamadugu	0	224.1	298.01	287.42	400.89	0	1,210.42
25	Indanpalli	Kalleda	2.41	363.87	650.22	597.16	821.75	0	2,435.40
26	Indanpalli	Kawal	7.23	1,914.28	692.07	581.64	518.46	1.48	3,715.16
27	Indanpalli	Kothapalli	2.24	418.09	266.45	540.81	777.8	0	2,005.40
28	Indanpalli	Narlapur	0	227.09	795.87	623.33	396.3	0	2,042.58
INDANPALLI Total			12.53	4,219.37	4,299.89	4,634.24	4,801.16	1.48	17,968.67
29	Jannaram	Alinagar	90.84	2,123.03	207.05	96.7	43.66	0	2,561.29
30	Jannaram	Chintaguda	0	493.01	347.91	246.99	95.26	0	1,183.17
31	Jannaram	Dongapalli	63.09	2,746.14	207.67	201.81	172.54	0	3,391.24
32	Jannaram	Jamuldhara	2.1	705.23	472.96	541.27	585.18	1.18	2,307.92
33	Jannaram	Jannaram	0	385.08	308.42	299.65	232.89	0	1,226.05
34	Jannaram	Kistapur	16.93	941.96	452.52	309.53	160.01	0	1,880.95
35	Jannaram	Mamidipalli	12.23	353.71	263.48	389.78	559.18	6.43	1,584.80
36	Jannaram	Paidipalli	0	340.29	312.04	262.45	153.65	0	1,068.43
JANNARAM Total			185.18	8,088.45	2,572.04	2,348.20	2,002.37	7.61	15,203.85
37	Tadlapet	Chintapalli	225.87	610.97	126.23	12.57	0.51	0	976.14
38	Tadlapet	Dammannapet	142.7	509.63	24.94	6.77	0.86	0	684.9
39	Tadlapet	Lingapur	84.77	702.57	49.42	24.98	14.71	0	876.46
40	Tadlapet	Makulpet	110.02	529.42	48.3	12.79	0	0	700.54
41	Tadlapet	Mallial	135.63	1,849.26	282.89	112.54	47.59	0	2,427.91
42	Tadlapet	Mohammadabad	5.07	541.81	274.74	154.12	29.57	0	1,005.30
43	Tadlapet	Patha Mamidipalli	48.91	424.58	70.82	19.62	8.13	0	572.06
44	Tadlapet	Ralli	77.84	235.84	11.89	2.45	0	0	328.02
45	Tadlapet	Singaraipet	304.9	640.74	73.2	37.36	5.38	0	1,061.57
46	Tadlapet	Tadlapet	260.6	721.66	60.77	22.99	0.53	0	1,066.55
47	Tadlapet	Tanimadugu	37.4	440.73	60.33	31.58	7.01	0	577.05
TADLAPET Total			1,433.72	7,207.20	1,083.53	437.77	114.29	0	10,276.50
48	Utnoor-KTR	Chinnakohinoor	0	289.03	68.29	126.02	428.88	0	912.22
49	Utnoor-KTR	Ghanpur	0	237.16	267.27	260.51	635.62	0	1,400.56
50	Utnoor-KTR	Hasnapur	1.77	837.94	191.38	245.25	763.71	0	2,040.04

51	Utnoor-KTR	Netnoor	4.17	1,770.05	1,256.50	1,455.71	5,207.62	0.76	9,694.81
52	Utnoor-KTR	Raghapur	0	616.53	250.2	285.43	934.31	0	2,086.46
53	Utnoor-KTR	Rasimetta	0	465.99	367.17	374.61	2,223.27	0	3,431.04
54	Utnoor-KTR	Utnoor	0	362.6	1,035.38	1,647.58	1,042.43	0	4,087.99
UTNOOR-KTR Total			5.93	4,579.30	3,436.18	4,395.11	11,235.84	0.76	23,653.12
Kawal TR East Division Total			**2,108.08**	**47,300.09**	**23,640.90**	**22,471.65**	**28,913.63**	**19.66**	**124,454.01**

The analysis revealed that the Asifa-KTR Range has highest forest cover with an area of 35999.35 Ha (28.93%) and the least forest cover is associated with Tadlapet Range with an area of 10276.50 (8.26%). A Micro (Beat) level analysis revealed that highest forest cover is associated with Netnoor Beat in Utnoor-KTR Range with an area of 9694.81 Ha, which constitutes 7.79% of the forest cover of Jannaram Division. Least forest cover is associated with Singaraipet beat in Tadlapet Range with an area of 328.02 Ha with 0.26% of forest cover of Jannaram Division. Micro (Beat) level analysis (Figure-5) of forest cover revealed that area under forest varies between 328.08 Ha to 9694.81 Ha.

As seen from Table-2 Singaraipet beat in Tadlapet Range recorded the highest area under Very Dense Forest with an area of 304.90Ha. Highest Moderately Dense Forest is present in Dongapalli beat in Jannaram Range with an area of 2746.14 Ha and least Moderately Dense Forest is in Dosthnagar beat in Indanpalli Range with 87.21Ha.

Gandhigopalpur beat in Birsaipet Range has the distinction of having the highest area under Open forest with an area of 1468.03 Ha and the least Open Forest is in Dammannapet beat in Tadlapet Range. Utnoor beat in Utnoor KTR Range has the distinction of having the highest area under Scrub 1647.58 Ha. It is interesting to note that Ralli beat in Tadlapet Range recorded the least concentration of both Scrub Forest and Non-Forest. The highest Non-Forest area is in Netnoor Beat of Utnoor-KTR Range with area 5,207.62 Ha.

CONCLUSION:

It is summarized from forest canopy cover density analysis that higher canopy density class such as Moderately Dense Forest (40-70%) predominates in the study area. At the same time, there is a need to note that a large percentage of area under is Non-Forest category. These variations are also quite visible at the micro (beat) level. Due to the fact that the considerable area is under a non-forest category, there is a necessity for the undertaking of afforestation or plantation programs for overall improvement in the forest cover and there is also a strong need for the better management and management interventions in case of Very Dense Forest category. It can be concluded that RS & GIS proved to be a powerful convergent technique in the assessment of characterization of forest canopy density at Microscale.

ACKNOWLEDGEMENTS:

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