

# Trend analysis of Forest Fires in Adilabad District- using GIS

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**Abstract:** Forests are very valuable natural and renewable resource and have a significant role in human life and the environment. Forests are subjected to various kinds of natural and anthropogenic disturbances, out of which Forest Fire is the most detrimental, bringing about incalculable harms to the extensive forest area. The Adilabad district is covered by forest area up to nearly 50%. It has three important wildlife sanctuaries named as Kawal wildlife sanctuary, Pranahita wildlife sanctuary, and Shivaram wildlife sanctuary. Temporal analysis of forest fires was based on historical data on the incidence of fire obtained from FSI. Based on the frequency of incidence of a forest fire the forest fire occurrence at range level was classified into 3 categories as low, medium and high. For the temporal analysis of the incidence of forest fires, monthly data on the number of occurrence of forest fires from 2006-2016 is analyzed. The incidence of forest fires is monthly seasonal in nature. They are more frequent during the dry pre-summer season especially in the months of February and March. The spatial analysis of the incidence of forest fires revealed that they are concentrated in the central part of Adilabad District in the close proximity to the wildlife sanctuary where the frequency of occurrence is very high. The trend analysis of the incidence of forest fires can be of great use in the monitoring of forest fires, estimation of loss of biodiversity and environmental management strategies.

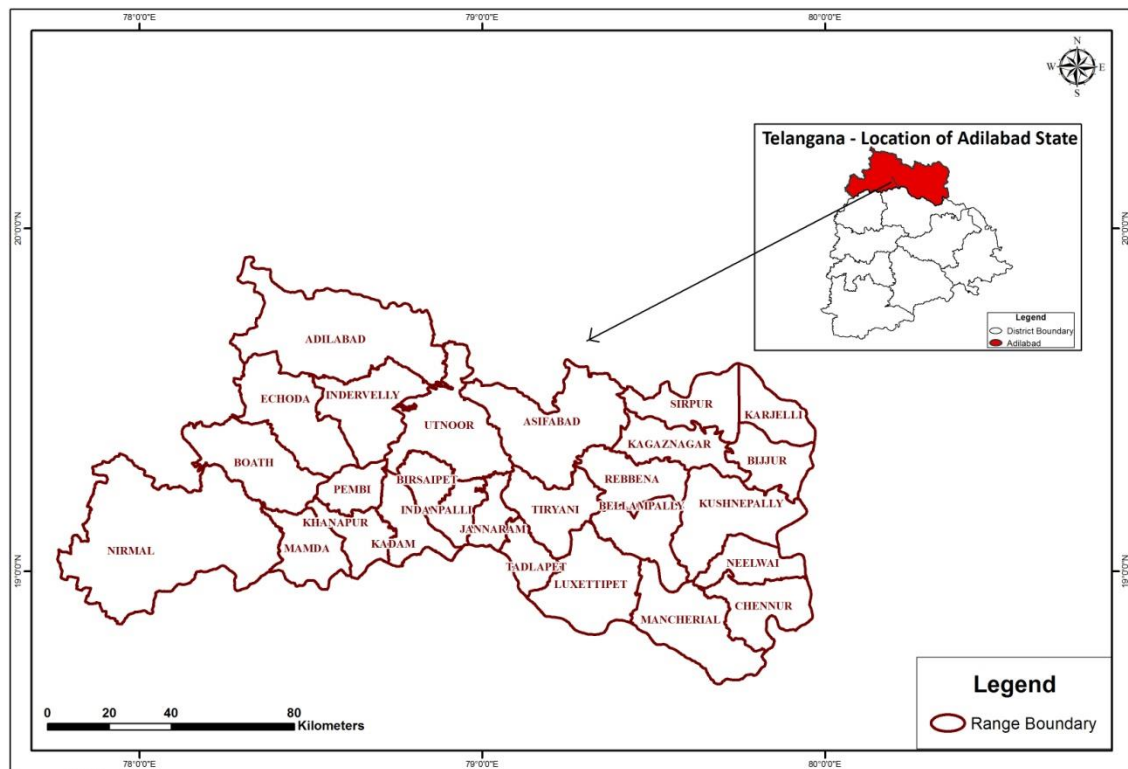
**Index Terms – Forest Fires, GIS.**

## I. INTRODUCTION

Forests are very valuable natural and renewable resource and have a significant role in the human life and environment. Forests are subjected to various kinds of natural and anthropogenic disturbances, out of which Forest Fire is the most detrimental, bringing about incalculable harms to the extensive forest area. Forest fire poses the serious threat to forest environment by degradation of forest area, fragmentation of native forest habitat, loss of biodiversity and forest ecology. The forest fire is one of the most common hazards in a forest environment. Forest fires pose a threat to forest wealth. Telangana has an area of around 26,903km<sup>2</sup> of forest land out of which an area of about 18765km<sup>2</sup> is subjected to forest fires(SFR-2015). These figures reflect the proneness and magnitude of forest fires.

## II. STUDY AREA:

Adilabad District is located in the Northern part of Telangana State (Fig-1). The area lies between latitudes 18° 40' 10'' N and 19° 55' 02'' N and 77° 45' 42'' E and 79° 58' 21'' E longitudes. Geographical Area of the district is 16,128 km<sup>2</sup>. Minimum and the Maximum temperature are 15°C & 29 °C during winter and 28°C & 46°C during summer. Annual Rainfall of the district is 1044.5 mm, which is received mainly from southwest monsoons. The Adilabad district is covered by forest area up to nearly 50%. It has three important wildlife sanctuaries named as Kawal wildlife sanctuary, Pranahita wildlife sanctuary, and Shivaram wildlife sanctuary.(Fig-2).



Source: TSFD

Figure 1 Adilabad District - Forest Ranges

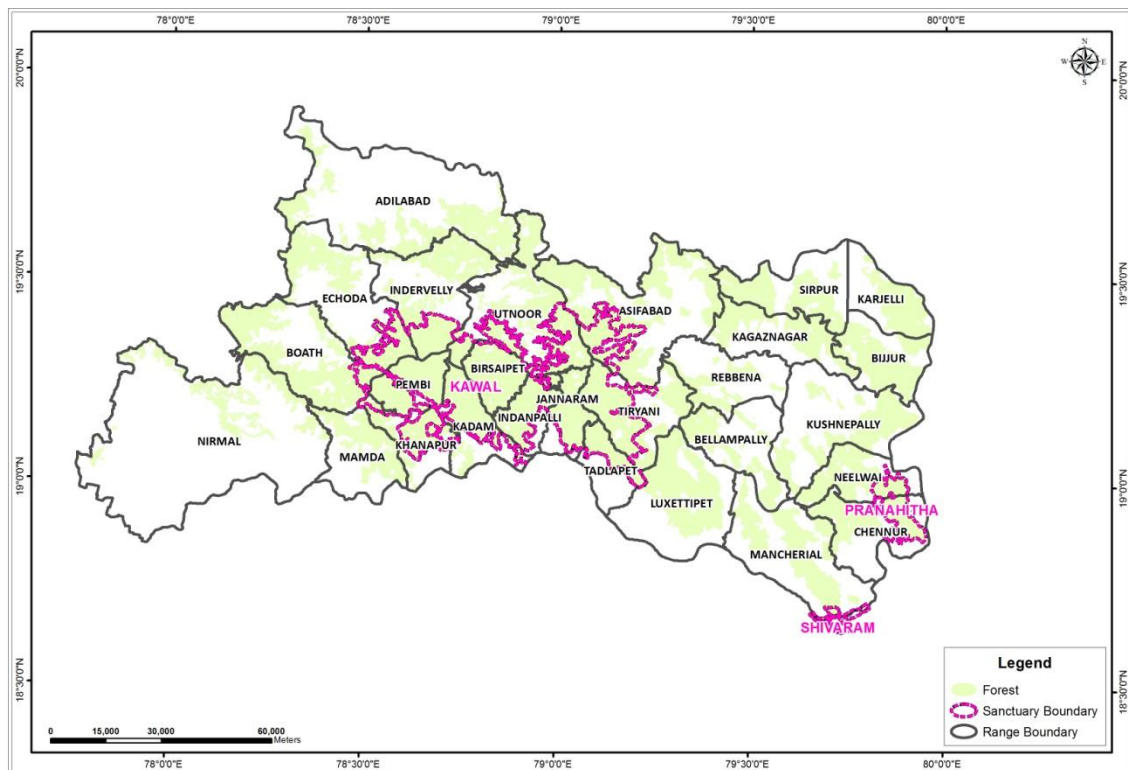


Figure 2 Adilabad District - Forest Cover

**III. OBJECTIVES:**

The purpose of the study was to

- To analyze the temporal analysis of the incidence of forest fires.
- To analyze the seasonal/monthly incidence of forest fires
- To bring out the spatial distribution of forest fires.

**IV. MATERIALS AND METHODS:**

The spatial and attribute data sets were derived from secondary sources. The coordinates of forest fire locations were obtained from Forest Survey of India (FSI). The spatial analysis of forest fires based on coordinates was done using ArcGIS. The layer of a forest was obtained from State Forest Department on which the Block, Range, and Division level boundaries are overlaid. Temporal analysis of forest fires was based on historical data on the incidence of fire obtained from FSI. Based on the frequency of incidence of a forest fire the forest fire occurrence at range level was classified into 3 categories as low, medium and high.

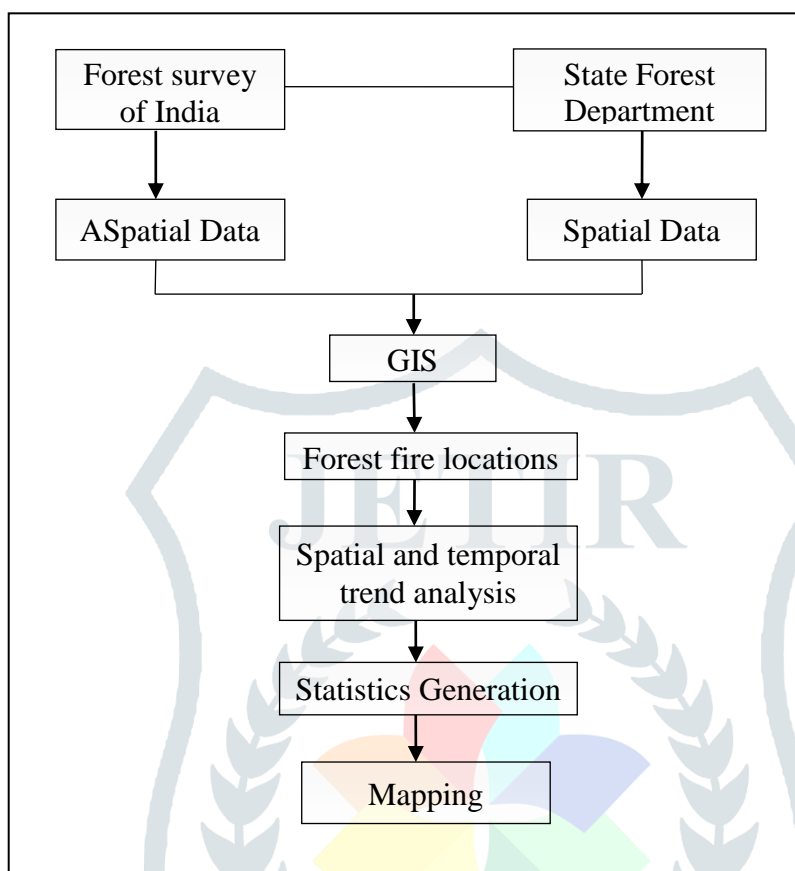


Figure 3 Methodology – Flow chart

**4.1 Temporal/Seasonal analysis of incidence of forest fires:**

For the temporal analysis of the incidence of forest fires, monthly data on the number of occurrence of forest fires from 2006-2016 is analyzed. It is seen from table-1 that incidence of forest fires in Adilabad District is occurring in five months i.e. from January to May.

Table 1: Adilabad District – Yearly and Monthly incidence of forest fires

Month	Year											Total
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
January	3	6	23	60	3	0	5	0	0	0	71	<b>171</b>
February	31	27	69	98	22	0	102	1	7	91	108	<b>556</b>
March	27	104	37	95	104	39	170	96	40	50	67	<b>829</b>
April	5	13	4	4	14	26	3	96	35	18	25	<b>243</b>
May	0	1	3	3	0	1	4	4	4	3	9	<b>32</b>
<b>Total</b>	<b>66</b>	<b>151</b>	<b>136</b>	<b>260</b>	<b>143</b>	<b>66</b>	<b>284</b>	<b>197</b>	<b>86</b>	<b>162</b>	<b>280</b>	<b>1831</b>

Source: Compiled from FSI

It is evident from the monthly analysis that occurrence of forest fires in the month of May is least (32 occurrences out of 1831) followed by the month of January (171 no. out of 1831). The highest occurrence of forest fires is seen the month of March. Overall February and March months recorded the highest occurrence of forest fires in Adilabad District (Fig-5). The occurrences of forest fires in Telangana State are ground fires in nature and man-made. March is the most susceptible month for a forest fire. Telangana is mostly covered with dry deciduous forest. The trees start shedding the leaves on the ground from January onwards which adds to the inflammable material along with twigs, branches etc (SFR-2015).

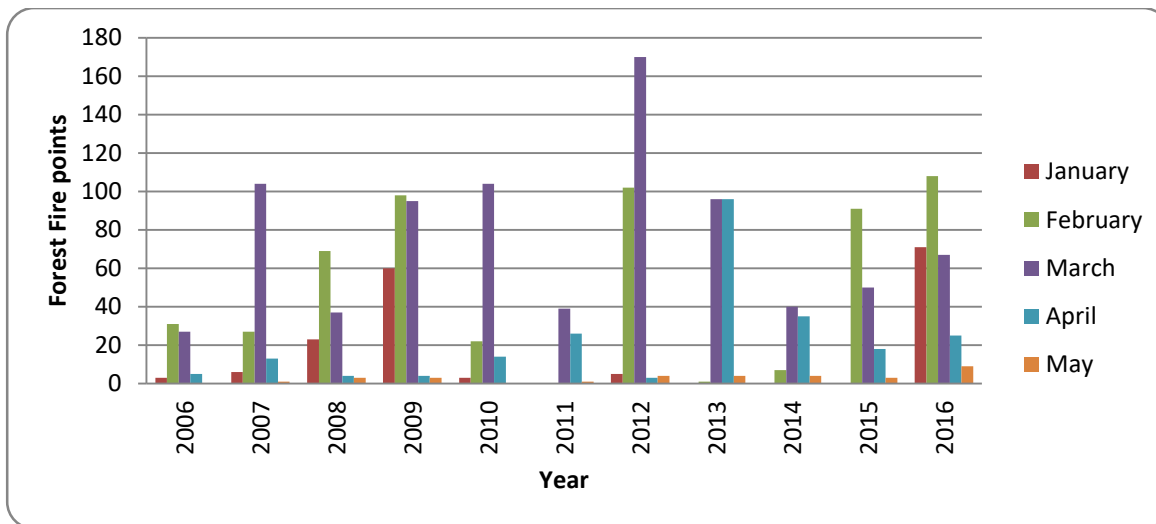


Figure 4 : Yearly and Monthly trend of incidence of forest fires

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.

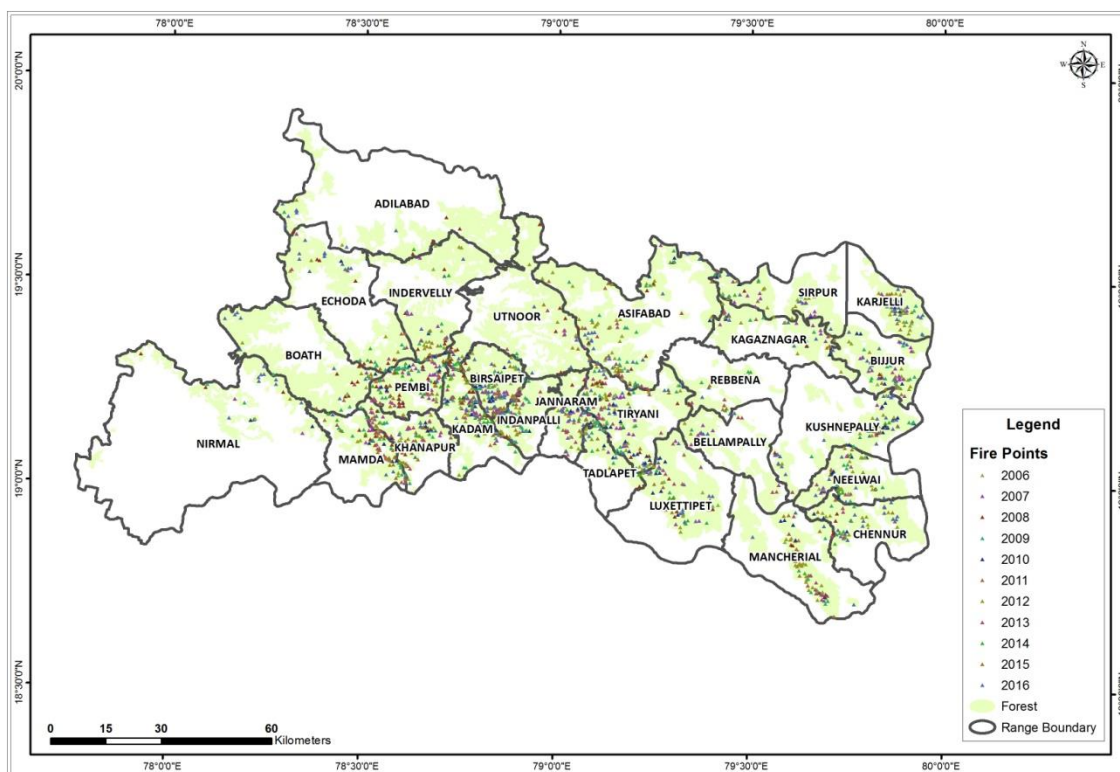


Figure 5 Adilabad District - locations of forest fire

A spatial forest Range wise and year wise analysis of the occurrence of fires in Adilabad district has shown that the inter-forest variations are very wide. From 2006-2016, maximum incidence of forest fires occurred in Tiryani range (161No.s), followed by Pembli range (136No.s). As evident from table-2, out of 11 years, Tiryani range recorded the highest incidence of fires i.e. during the year 2006, 2010, 2012, 2013 and 2016. The Range wise incidence in forest fires in Adilabad district has shown that its occurrence is as low as 17No.s, which is recorded by Adilabad Range in the north and Bellampally and Rebbana in the west central part of Adilabad District.

Table 2 Adilabad District – Forest Range wise yearly analysis of incidence of forest fires

S.No.	Range	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
1	Adilabad	0	0	5	1	0	0	2	0	1	0	8	17
2	Asifabad	4	2	12	22	3	7	27	15	0	4	17	113
3	Bellampally	0	3	0	1	0	0	2	7	0	0	4	17
4	Bijjur	1	16	2	14	7	0	17	4	2	6	16	85
5	Birsaipet	6	10	3	16	12	3	15	12	4	19	22	122
6	Boath	1	1	6	3	1	2	4	2	1	1	9	31
7	Chennur	0	0	2	7	3	0	16	6	1	3	14	52
8	Echoda	0	1	8	7	1	2	5	3	1	2	11	41
9	Indanpalli	2	4	4	14	3	2	11	14	6	8	8	76
10	Indervelly	4	6	7	6	2	2	8	0	1	6	5	47
11	Jannaram	3	6	3	4	7	1	7	10	2	6	12	61
12	Kadam	6	14	9	23	8	5	11	15	15	13	13	132
13	Kagaznagar	1	7	2	7	3	3	5	2	0	3	6	39
14	Karjelli	4	4	1	7	3	0	17	2	3	8	16	65
15	Khanapur	2	8	4	21	7	7	17	14	2	21	5	108
16	Kushnepally	2	3	1	8	16	2	14	3	2	5	18	74
17	Luxettipet	5	8	5	5	7	5	7	4	5	4	15	70
18	Mamda	1	3	7	13	6	4	5	12	6	16	4	77
19	Mancherial	2	2	6	10	5	3	22	13	2	11	6	82
20	Neelwai	3	4	0	10	10	1	13	8	4	5	7	65
21	Nirmal	1	2	3	2	3	0	1	0	0	0	9	21
22	Pembi	1	20	18	21	9	8	8	20	18	8	5	136
23	Rebbena	0	0	0	3	0	1	0	3	3	3	4	17
24	Sirpur	1	11	2	6	3	2	13	1	1	0	7	47
25	Tadlapet	2	1	1	8	3	0	4	0	1	2	6	28
26	Tiryani	14	12	15	17	20	4	26	23	2	4	24	161
27	Utnoor	0	3	10	4	1	2	7	4	3	4	9	47
	<b>Total</b>	<b>66</b>	<b>151</b>	<b>136</b>	<b>260</b>	<b>143</b>	<b>66</b>	<b>284</b>	<b>197</b>	<b>86</b>	<b>162</b>	<b>280</b>	<b>1831</b>

Source: Compiled from FSI

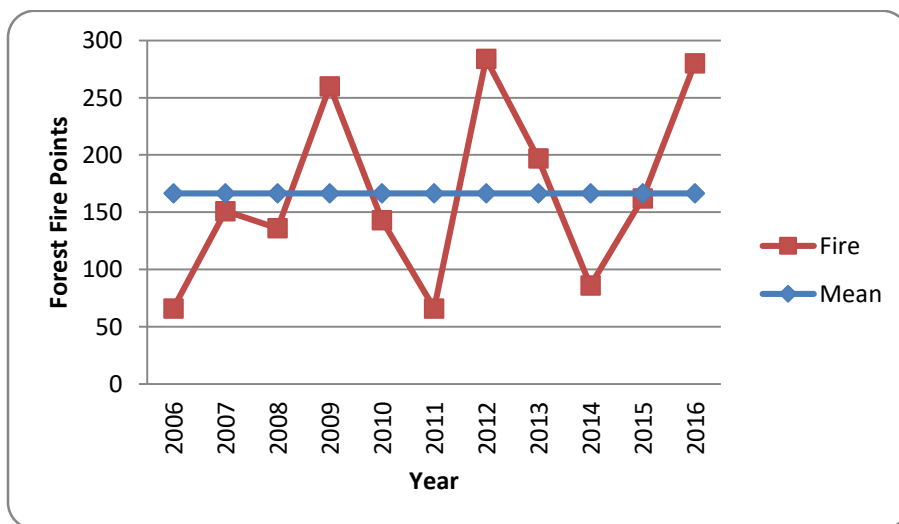


Figure 6 Year wise trend of forest fires

A spatial forest Range wise and year wise analysis of the occurrence of fires in Adilabad district has shown that the inter-forest variations are very wide. From 2006-2016, maximum incidence of forest fires occurred in Tiryani range (161No.s), followed by Pembani range (136No.s). As evident from table-2, out of 11 years, Tiryani range recorded the highest incidence of fires i.e. during the year 2006, 2010, 2012, 2013 and 2016. The Range wise incidence in forest fires in Adilabad district has shown that its occurrence is as low as 17No.s, which is recorded by Adilabad Range in the north and Bellampally and Rebbana in the west central part of Adilabad District.

Table 3 Adilabad District - Range wise frequency of forest fires

Division	Range	Year											No. of Days Total	Frequency class
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016		
Bellampally	Bellampally	0	3	0	1	0	0	2	5	0	0	2	13	Low
Adilabad	Adilabad	0	0	5	1	0	0	2	0	1	0	6	15	Low
Bellampally	Rebbana	0	0	0	3	0	1	0	3	2	2	4	15	Low
Nirmal	Nirmal	1	2	3	2	2	0	1	0	0	0	6	17	Low
Jannaram Wlm	Tadlapet	2	1	1	6	3	0	2	0	1	2	6	24	Low
Adilabad	Boath	1	1	3	3	1	1	4	2	1	1	8	26	Low
Adilabad	Echoda	0	1	4	5	1	1	4	2	1	2	6	27	Low
Adilabad	Utnoor	0	1	6	3	1	2	5	2	2	4	5	31	Medium
Kagaznagar	Kagaznagar	1	5	2	7	3	2	4	2	0	3	4	33	Medium
Mancherial	Chennur	0	0	2	4	3	0	7	5	1	3	10	35	Medium
Kagaznagar	Sirpur	1	7	2	5	3	1	8	1	1	0	7	36	Medium
Jannaram Wlm	Jannaram	3	4	3	2	5	1	5	7	2	2	5	39	Medium
Adilabad	Indervelly	4	4	5	5	2	2	6	0	1	5	5	39	Medium
Kagaznagar	Karjelli	2	3	1	4	3	0	9	2	2	3	10	39	Medium
Mancherial	Neelwai	2	3	0	5	7	1	7	5	2	4	6	42	Medium
Bellampally	Kushnepally	2	2	1	5	7	1	9	3	1	2	10	43	Medium
Nirmal	Mamda	1	2	4	7	5	3	3	7	4	6	4	46	Medium
Kagaznagar	Bijjur	1	5	2	9	6	0	12	3	1	3	8	50	Medium
Mancherial	Mancherial	2	1	5	7	4	3	8	9	2	5	5	51	Medium
Mancherial	Luxettipet	4	5	4	4	5	3	5	4	3	3	10	50	Medium
Jannaram Wlm	Indanpalli	2	3	3	9	3	2	5	9	4	5	7	52	Medium
Bellampally	Asifabad	3	1	5	6	2	2	14	10	0	2	11	56	Medium
Nirmal	Khanapur	2	5	4	12	4	4	10	10	1	10	4	66	High
Jannaram Wlm	BirsaiPET	4	5	3	6	6	2	10	8	4	10	18	76	High
Nirmal	Kadam	4	9	6	14	4	2	7	9	9	5	9	78	High
Nirmal	Pembi	1	8	8	10	7	4	7	12	12	5	5	79	High
Bellampally	Tiryani	7	6	5	10	10	2	14	9	2	4	16	85	High
<b>Total</b>		<b>50</b>	<b>87</b>	<b>87</b>	<b>155</b>	<b>97</b>	<b>40</b>	<b>170</b>	<b>129</b>	<b>60</b>	<b>91</b>	<b>19</b>	<b>1163</b>	

Source: Compiled from FSI

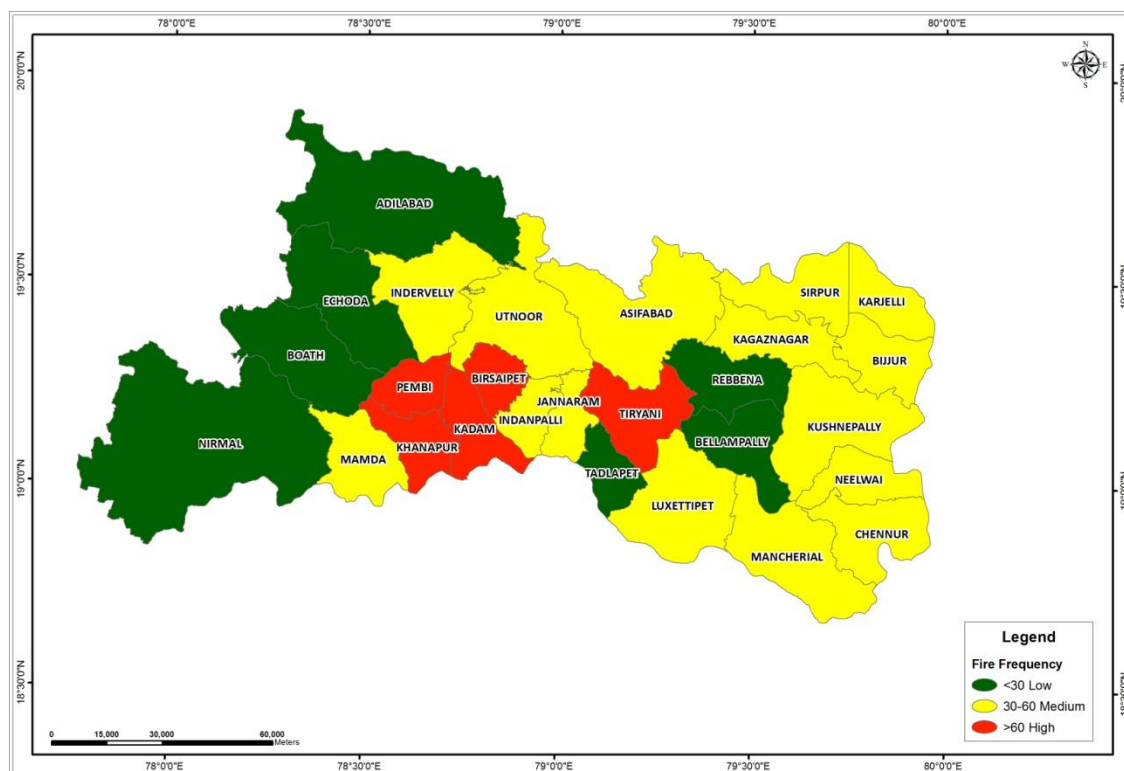


Figure 7 Adilabad District - Frequency of forest fire occurrence

Table 4 Adilabad District – Frequency classification of forest fires

No. of Days	Criteria	no. of Ranges	Percentage
<30	Low	7	26
30-60	Medium	15	56
>60	High	5	19

Source: Computed based on table-3

As evident from table-4, the range wise frequency of forest fires has shown wide variations, nearly 26% of the forest fires recorded are in low forest fire frequency(<30days) which includes Bellampally, Adilabad, Rebbana, Nirmal, Tadlapet, Boath and Echoda ranges. The spatial distribution of low-frequency forest fire areas is mainly concentrated along the north & eastern parts of Adilabad district (Fig-7). Minor pockets of low-frequency forest fire zones are located in the central part off the Adilabad District.

Most widely distributed areas belonging to medium frequency forest fire zones (30-60 days) are located in the north and eastern margin of Adilabad District. The areas recording the high frequency of forest fires are least in number. Interestingly, these high frequencies forest fire zones are concentrated in the central part of Adilabad district which to a great extent are proximity located to wildlife sanctuary zone. From the occurrence of high-frequency forest fires in the close vicinity of Kawal wildlife sanctuaries is a matter of great concern.

**CONCLUSION:**

It is seen from the temporal analysis of the incidence of forest fires has revealed that there exists wide fluctuations in the number of occurrences of forest fires but overall it has shown on an upward trend with few exceptions. The incidence of forest fires is monthly seasonal in nature. They are more frequent during dry pre-summer season especially in the months of February and March. The spatial analysis of the incidence of forest fires revealed that they are concentrated in the central part of Adilabad District in the close proximity to the wildlife sanctuary where the frequency of occurrence is very high. The trend analysis of the incidence of forest fires can be of great use in the monitoring of forest fires, estimation of loss of biodiversity and environmental management strategies. Besides, such analysis can be used in the promotion of fire awareness activities for residents of buffer zones and National Park visitors by using information boards, posters and notices in public places for reducing the fire hazards and establishment of Fire Detection and Information Dissemination system.

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