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FOREST FIRE ZONE DEMARCATION IN UTTARA KANNADA DISTRICT USING GIS TECHNIQUES

A.G. KOPPAD, PAVAN TIKHILE AND SANDHYA SHASTRI

Department of Natural Resource Management,
College of Forestry, Sirsi-581401, Karnataka,
E-mail: koppadag@uasd.in

ABSTRACT

The study was taken up to assess the intensity of forest fire in different talukas of Uttara Kannada district. The fire spots in Uttara Kannada district from 2012-2016 was taken from the State Forest Report 2016, Forest Survey of India. The location of the fire spots (Latitude and Longitude) are converted in to shape file. The fire spots are shown in the map from 2012 to 2016. The forest fire intensity over the period of five years are exhibited in separate map and fire intensity from very low to high has been depicted. The results indicated that the higher fire intensity zone is found in north and north east part of the Uttara Kannada district covering the taluka of Mundgod, Haliyal and part of Jioda. Moderate fire intensity zone is covered in part of Mundgod, Yellapur and Joida. Remaining talukas are having low to very low forest fire intensity. The higher forest fire zone in Mundgod, Haliyal and part of Jioda taluka is due to the dry deciduous forest.

Key words: Forest; Fire intensity; GIS; Spatial location.

Introduction

Forest fire has been regarded as one of the major reasons for the loss of biodiversity and degradation of environment. Global warming is increasing its intensity at an alarming rate. Thus one needs to understand the complex biophysical parameters, which are responsible for this disaster. As it is difficult to predict forest fire, fire risk zone map can be useful for combating the forest fire Saklani (2008). With the global climate change and the impact of human activity, the forest area reduces rapidly, while the forest fire results in most of reduction, because it is uncontrolled fire that occurs in the countryside or a wilderness area, forest fire usually causes life and property loss and does harm to the ecology and environment of a region. Forest fires can cause substantial damage to natural resources and human lives regardless of whether it is caused by natural forces or human activities (Chengcheng *et al.,* (2011). To minimize threat from wildfires, fire managers must be able to plan protection strategies that are appropriate for individual local areas. A pre-requisite for the planning is the ability to assess and map forest fire risk zones across both broad areas and local sites. Forest fire risk zones are locations where a fire is likely to start, and from where it can easily spread to other areas (Jaiswal *et al.,* (2002).

The forest fire control measures can also reduce its frequency and losses. It is well known that effective guarding against the forest fire risk and reducing the loss is important for both long-term forest fire management planning and strategies. Fire is a dominant disturbance in many wild land ecosystems worldwide. Because fire influences the structure, composition and function of ecosystems, maps of fire regimes like fire frequency, severity, fire zone, damage zone, size and pattern are useful for planning, assessing risk, and evaluating ecological conditions.

The development of GIS has provided a powerful tool for managing and solving emergency management problems. GIS developed functions such as analyzing available information and using them as a decision and a support system as well as it compiles the information as a whole and stores it, especially in the operational field needing to make important decisions of a spatial nature (Ilmavirta, 1995; Botton and Duquenne, 1997; Sauvagnargues *et al*., 1997). GIS technology can serve as a vital technological core for forest fire crisis management (Lymberopoulos, 1996; George *et al.,* 1999; Goodrick *et al.,* 1999; Keramitsoglou *et al.,* 2004). Forest usually located in the rural area, has covered large amount of territory. GIS as a spatial analysis tool has great advantage for forest fire risk management (Chengcheng *et al.,* 2011).

Fire has a profound influence on ecosystem structure, composition and function at temporal scales from years to decades and centuries, and from spatial scales from local to regional and continental. (Morgan *et al.,* 2001) on the brink of understanding what determines

The highest forest fire zone in Mundgod, Haliyal and part of Jioda taluka is due to the dry deciduous forest.

and drives fire regimes andtheir change across scales. Because fire regimes may be very sensitive to our changing climate (Lenihan *et al.,* 1998), this understanding will be crucial to managing fuels, fire risk, and ecological impacts of fires upon ecosystems now and in the future.

Material and Methods

Uttara Kannada district lies between 13.9220° N to 15.5252° N latitude and 74.0852° E to 75.0999° E longitude and covers an area of 10,291 km^2 (Fig.1). It extends from north south to a maximum of 180 km, and from west to east a maximum width of 110 km. The Arabian Sea borders it on the west creating a long continuous, though narrow, coastline of 120 km running north south. The district comprises of 11 Taluks namely, Joida, Haliyal, Mundgod, Yellapur, Karwar, Ankola, Sirsi, Siddapur, Honnavar, Kumta and Bhatkal. Climate of Uttara Kannada is tropical climate. Southwest monsoon winds bring down rains during the months June to September. Average annual rainfall is about 250 cm. The month of July experiences the heaviest rains. Rainfall is very heavy in the coast, averaging more than 300 cm annually. The average rainfall in the Ghat section is about 500 cm, and in the far east is about 200 cm. The driest months are between March to May. The day temperature during these months reaches a maximum of 38°C. The winters are not very cold with the lowest temperature ever recorded being 11.9°C. Winter season sets in during December and lasts till the end of February. During this period the weather is dry, with clear bright sky, and an agreeably low temperature as well as humidity.

Fire spot analysis in Uttara Kannada district, the fire spot data has been used which is given by Forest Survey of India from 2012 to 2016 (State Forest Report, 2016). All input data available in table format with latitude and longitude values of fire spot location in study region. The same latitude and longitude values were used to generate shape file. For each year data separate shape file were generated and for fire spot intensity analysis all shape file was merged in to a single file. The final fire spot zone map was generated using point density analysis tool in spatial analysis platform with merged shape file (2012 – 2016). The output point density map further divided in to the four major groups (Fig.2).

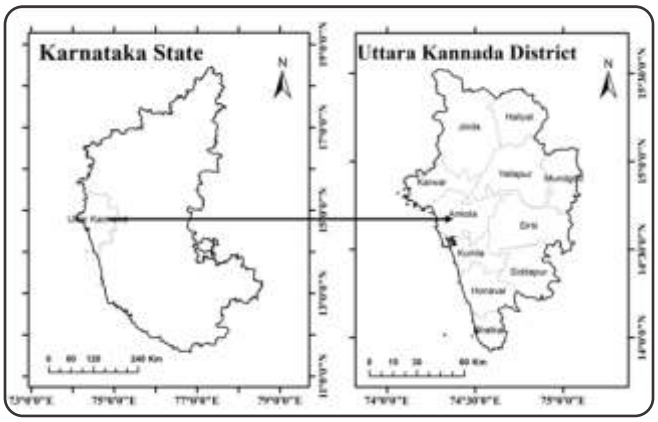

Fig.1: Location map of the study area.

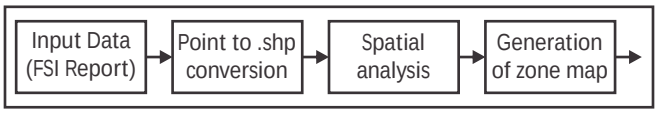

Fig. 2:

Result and Discussion

The forest fire occurrence spot locations (Latitude and longitude) of Uttara Kannada district during the year 2012 to 2016 is given in Table 1 and depicted in the Figs. 3 to 7. In all the years fire occurred places are concentrated in the north and north-east part of Uttara Kannada district. The forest fire spots are recorded in talukas of Haliyal, Joida, Mundgod, Yellapur, Karwar, Ankola and Sirsi. The three talukas namely Haliyal, Joida and Mundogod area have found higher number of forest fire spots compared to other talukas. Therefore forest fire intensity was more concentrated on these three talukas. The forest fire intensity map was prepared (Fig. 8) for Uttara Kannada district. Forest fire intensity-lies between very low to high. Southern and western part of the study area shown very low forest fire spots. North and north eastern part of the study area are affected with more forest fire intensity compared to other part of the study region. Part of Haliyal, Joida and Mundgod talukas are comes under higher forest fire intensity level. Dry deciduous forest present in Haliyal, part of Joida and Mundagod taluka has prone to forest fire would be the reason for the higher intensity of forest fire (Puyravaud *et al.,* 1994). The chances of fire occurrence are more in dry deciduous forest. Unfortunately the information on cause of the forest fire either due to natural or manmade is not available from the source data.

The mean maximum and minimum temperature in all talukas of Uttara Kannada district is given in Table 2. Higher temperatures were recorded in Mundgod, Haliyal, Joida, Honnavar, Kumta, Bhatkal, Karwar talukas but forest fire occurred comparatively more in Haliyal, Mundgod and Joida taluka only due to dry deciduous forest. Remaining talukas come under hilly and coastal region in which semi-evergreen and evergreen forest is found and the occurrence of forest fire is almost negligible. Average rainfall of the study area is given in Table 3. The forest fire occurred more in Haliyal, Mundgod and Joida taluka where rainfall occurrence was less and temperature recorded was more which is occurred in area where dry deciduous forest is existed causing high forest fire. The rainfall and temperature had not provided the exact

Table 1: Forest fire occurrence spots (Lat and Long.) during the year 2012-2016 in Uttara Kannada district (Source: Forest Survey of India, State Forest Report 2016).

2012			2013			2014			2015			2016		
FireDate	Long	Lat	FireDate	Long	Lat	FireDate	Long	Lat	FireDate	Long	Lat	FireDate	Long	Lat
18-05-12	74.41	15.45	25-05-13	74.56	15.00	20-04-14	74.73	14.84	06-05-15	74.95	15.02	10-05-16	74.47	14.87
04-05-12	74.58	15.01	25-04-13	74.54	15.11	17-04-14	74.62	15.19	27-04-15	74.61	15.06	08-05-16	74.65	15.08
18-04-12	74.44	15.04	21-04-13	74.60	14.77	15-04-14	74.54	15.16	27-04-15	74.55	14.97	08-05-16	74.56	15.07
14-04-12	74.42	14.66	21-04-13	74.61	14.77	15-04-14	74.58	14.96	27-04-15	74.47	4.88	08-05-16	74.67	14.84
14-04-12	74.59	15.03	21-04-13	74.71	14.84	13-04-14	74.54	15.15	20-04-15	74.60	15.00	08-05-16	74.58	14.85
14-04-12	74.42	14.66	21-04-13	74.70	14.84	13-04-14	74.64	15.37	20-04-15	74.53	15.00	06-05-16	74.60	15.11
14-04-12	74.59	15.03	21-04-13	74.71	14.84	13-04-14	74.54	15.15	18-04-15	74.56	15.27	06-05-16	74.70	14.87
13-04-12	74.56	14.78	21-04-13	74.49	14.92	13-04-14	74.53	15.14	18-04-15	74.61	15.02	06-05-16	74.72	14.88
11-04-12	74.59	15.28	21-04-13	74.55	14.97	13-04-14	74.61	15.03	18-04-15	74.60	15.02	04-05-16	74.70	15.16
11-04-12	74.58	15.28	21-04-13	74.58	15.03	10-04-14	74.83	15.06	18-04-15	74.59	15.00	04-05-16	74.62	15.28
11-04-12	74.56	14.76	21-04-13	74.58	15.05	10-04-14	74.94	14.99	16-04-15	74.60	15.01	01-05-16	74.62	14.72
09-04-12	74.61	15.05	21-04-13	74.51	15.07	10-04-14	75.00	14.88	16-04-15	74.68	14.85	01-05-16	74.66	14.93
09-04-12	74.54	14.78	21-04-13	74.76	15.11	08-04-14	74.43	15.21	16-04-15	74.69	14.85	01-05-16	74.60	15.02
09-04-12	74.54	14.75	21-04-13	74.58	15.32	08-04-14	75.03	14.82	16-04-15	74.60	15.01	01-05-16	74.55	15.03
31-03-12	74.71	14.84	21-04-13	74.50	15.37	03-04-14	74.66	15.37	16-04-15	74.59	15.00	01-05-16	74.59	15.15
31-03-12	74.7	14.84	19-04-13	74.68	14.85	03-04-14	74.63	15.33	16-04-15	74.60	15.00	01-05-16	74.66	15.26
31-03-12	74.51	14.9	19-04-13	74.55	14.99	03-04-14	74.57	15.27	16-04-15	74.55	14.97	29-04-16	74.86	14.48
31-03-12	74.61	15.02	19-04-13	74.51	15.10	03-04-14	74.62	15.14	16-04-15	74.69	14.85	29-04-16	74.63	14.67
31-03-12	74.61	15.03	19-04-13	74.64	15.33	03-04-14	74.61	15.14	16-04-15	74.68	14.84	29-04-16	75.08	14.83
29-03-12	74.76	15.27	17-04-13	74.55	14.98	03-04-14	74.68	15.09	15-04-15	74.55	14.96	29-04-16	75.06	14.78
28-03-12	74.75	14.83	17-04-13	74.59	15.05	03-04-14	74.66	15.09	11-04-15	74.45	15.03	29-04-16	74.63	15.01
28-03-12	74.83	14.95	17-04-13	74.59	15.05	03-04-14	74.80	15.08	11-04-15	74.55	14.29	29-04-16	74.57	15.03
28-03-12	74.87	15.01	17-04-13	74.58	15.05	03-04-14	74.98	14.58	04-04-15	74.58	15.34	29-04-16	74.31	15.06
26-03-12	74.75	14.82	17-04-13	74.44	15.17	01-04-14	74.56	15.27	04-04-15	74.57	15.34	29-04-16	74.66	15.08
26-03-12	74.69	14.86	16-04-13	74.54	15.00	01-04-14	74.61	15.20	04-04-15	74.99	14.96	29-04-16	74.62	15.20
26-03-12	74.89	14.94	16-04-13	74.55	15.00	01-04-14	74.71	15.13	04-04-15	74.94	14.95	29-04-16	74.51	15.34
26-03-12	74.6	15.08	14-04-13	74.47	14.93	30-03-14	74.71	15.12	04-04-15	74.94	14.94	27-04-16	74.48	14.78
26-03-12	74.53	15.19	14-04-13	74.48	14.93	30-03-14	74.68	15.36	04-04-15	74.56	14.92	27-04-16	74.32	14.96
26-03-12	74.62	15.21	12-04-13	74.57	15.35	30-03-14	74.67	15.36	04-04-15	74.71	14.83	27-04-16	74.59	15.19
26-03-12	74.6	15.23	12-04-13	74.54	15.11	30-03-14	74.48	15.35	04-04-15	74.71	14.83	27-04-16	74.54	15.17
26-03-12	74.64	15.27	12-04-13	74.62	15.04	30-03-14	74.56	15.32	02-04-15	74.72	15.20	27-04-16	74.64	15.12
26-03-12	74.64	15.37	10-04-13	74.65	15.13	30-03-14	74.74	15.13	21-03-15	74.72	15.27	27-04-16	74.64	15.14
26-03-12	74.65	15.38	10-04-13	74.64	15.13	30-03-14	74.73	15.13	21-03-15	74.89	14.93	26-04-16	74.61	15.13
24-03-12	74.92	14.91	08-04-13	74.54	15.10	30-03-14	74.74	15.13	21-03-15	74.90	14.92	24-04-16	74.47	15.14
24-03-12	74.93	14.92	08-04-13	74.63	15.35	30-03-14	74.72	15.13	19-03-15	74.70	15.37	24-04-16	74.69	15.00
24-03-12	74.92	14.92	07-04-13	74.68	14.81	30-03-14	74.73	15.13	19-03-15	74.59	15.36	24-04-16	74.68	15.07
24-03-12	74.9	14.93	07-04-13	74.69	14.81	30-03-14	74.70	15.12	12-03-15	74.93	14.96	22-04-16	74.63	15.09
24-03-12	74.96	14.95	07-04-13	74.53	14.91	30-03-14	74.71	15.12	12-03-15	74.08	14.94	22-04-16	74.63	15.08
24-03-12	74.94	15	07-04-13	74.84	14.92	30-03-14	74.70	15.12	12-03-15	74.92	14.94	22-04-16	74.76	15.36
24-03-12	74.44	15.04	07-04-13	74.92	14.97	30-03-14	74.71	15.11	12-03-15	74.92	14.93	22-04-16	74.64	15.11
24-03-12	74.65	15.18	07-04-13	74.84	15.01	30-03-14	74.70	15.11	05-03-15	74.92	14.42	22-04-16	74.69	15.10
24-03-12	74.66	15.18	07-04-13	74.85	15.02	30-03-14	74.92	15.03	05-03-15	74.74	15.27	22-04-16	74.65	15.04
24-03-12	74.76	15.18	07-04-13	74.73	15.02	30-03-14	74.81	14.95	05-03-15	74.86	15.18	22-04-16	74.71	15.03
24-03-12	74.55	15.2	07-04-13	74.43	15.03	28-03-14	74.67	15.35	05-03-15	74.78	15.11	22-04-16	74.62	15.02
24-03-12	74.56	15.2	07-04-13	74.43	15.03	28-03-14	75.07	14.92	24-02-15	74.77	15.18	22-04-16	74.57	15.09
24-03-12	74.77	15.21	07-04-13	74.50	15.04	28-03-14	74.90	14.91	24-02-15	74.83	15.09	22-04-16	74.55	15.07
24-03-12	74.54	15.21	07-04-13	74.48	15.06	27-03-14	74.91	15.02	24-02-15	74.82	15.09	22-04-16	74.77	14.89
24-03-12	74.56	15.21	07-04-13	74.53	15.09	27-03-14	74.96	14.81				22-04-16	74.84	14.94

2012			2013			2014			2016		
FireDate	Long	Lat	FireDate	Long	Lat	FireDate	Long	Lat	FireDate	Long	Lat
24-03-12	74.72	15.22	07-04-13	74.56	15.12	23-03-14	74.94	15.00	22-04-16	74.69	14.83
24-03-12	74.8	15.22	07-04-13	74.64	15.34	23-03-14	74.72	15.16	22-04-16	74.75	14.82
24-03-12	74.73	15.22	07-04-13	74.65	15.34	23-03-14	74.72	15.16	20-04-16	74.65	15.16
24-03-12	74.55	15.22	07-04-13	74.56	15.34	23-03-14	74.75	15.18	20-04-16	74.63	15.03
24-03-12	74.7	15.27	07-04-13	74.57	15.34	23-03-14	74.78	15.22	20-04-16	74.72	15.17
24-03-12	74.55	15.27	07-04-13	74.64	15.34	23-03-14	74.79	15.22	20-04-16	74.63	15.04
24-03-12	74.52	15.3	07-04-13	74.65	15.35	23-03-14	74.78	15.23	20-04-16	74.66	15.41
24-03-12	74.49	15.35	05-04-13	74.90	14.91	23-03-14	74.79	15.23	18-04-16	74.75	15.15
24-03-12	74.56	15.38	03-04-13	74.74	15.20	23-03-14	74.58	15.33	17-04-16	74.68	14.91
24-03-12	74.54	15.39	03-04-13	74.75	15.20	23-03-14	74.51	15.36	17-04-16	75.10	15.03
22-03-12	74.81	15.01	03-04-13	74.67	15.15	23-03-14	74.56	15.38	15-04-16	74.61	14.99
14-03-12	74.94	14.96	03-04-13	74.57	15.11	23-03-14	74.51	15.40	15-04-16	74.72	15.01
13-03-12	74.75	14.84	03-04-13	74.55	15.11	23-03-14	74.55	15.41	15-04-16	74.69	15.17
13-03-12	74.55	15.41	03-04-13	74.67	15.15	23-03-14	74.87	14.95	15-04-16	74.58	15.12
12-03-12	74.83	14.96	02-04-13	74.62	15.17	23-03-14	74.56	14.77	13-04-16	74.56	15.01
12-03-12	74.82	14.99	02-04-13	74.59	15.03	19-03-14	74.51	15.19	13-04-16	74.68	15.17
10-03-12	74.91	14.97	02-04-13	74.57	15.03	18-03-14	74.54	15.40	13-04-16	74.61	15.00
10-03-12	74.82	15.01	01-04-13	74.44	14.67	18-03-14	74.55	15.40	13-04-16	74.70	15.01
10-03-12	74.87	15.01	01-04-13	74.56	15.10	18-03-14	74.72	15.13	13-04-16	74.59	15.11
10-03-12	74.76	15.04	01-04-13	74.58	15.10	18-03-14	74.97	14.88	13-04-16	74.69	15.12
10-03-12	74.74	15.08	31-03-13	74.73	14.84	18-03-14	74.96	14.82	11-04-16	74.73	14.96
10-03-12	74.85	15.11	31-03-13	74.22	14.91	17-03-14	74.68	15.29	08-04-16	74.58	15.09
10-03-12	74.77	15.17	31-03-13	74.23	14.91	16-03-14	74.91	14.53	06-04-16	74.63	15.08
10-03-12	74.78	15.17	31-03-13	74.52	14.93	16-03-14	74.93	14.84	06-04-16	74.79	15.17
10-03-12	74.61	15.19	31-03-13	74.54	14.93	16-03-14	74.95	14.87	04-04-16	74.65	15.14
10-03-12	74.72	15.24	31-03-13	74.88	14.94	16-03-14	74.95	14.89	04-04-16	74.71	15.15
10-03-12	74.72	15.26	31-03-13	74.54	15.01	16-03-14	74.88	14.92	04-04-16	74.82	15.16
10-03-12	74.64	15.31	31-03-13	74.59	15.03	16-03-14	74.92	14.93	04-04-16	74.60	15.16
10-03-12	74.63	15.33	31-03-13	74.60	15.03	16-03-14	74.85	15.01	04-04-16	74.66	15.14
10-03-12	74.63	15.34	31-03-13	74.58	15.10	16-03-14	74.86	15.02	04-04-16	74.76	15.11
10-03-12	74.49	15.35	31-03-13	74.55	15.10	16-03-14	74.88	15.03	04-04-16	74.72	15.34
10-03-12	74.55	15.39	31-03-13	74.69	15.13	16-03-14	74.91	15.03	02-04-16	74.66	15.14
10-03-12	74.56	15.4	31-03-13	74.57	15.27	16-03-14	74.79	15.04	02-04-16	74.58	15.19
08-03-12	74.96	14.94	31-03-13	74.52	15.31	16-03-14	74.78	15.07	02-04-16	74.70	15.09
08-03-12	74.96	14.95	29-03-13	74.58	14.80	16-03-14	74.78	15.19	01-04-16	74.75	15.08
08-03-12	74.82	14.96	29-03-13	74.59	14.80	16-03-14	74.77	15.20	01-04-16	74.64	15.12
08-03-12	74.83	14.96	29-03-13	74.47	14.88	16-03-14	74.77	15.20	01-04-16	74.64	15.21
08-03-12	74.75	15.07	29-03-13	74.59	15.00	16-03-14	74.78	15.20	01-04-16	74.78	15.09
08-03-12	74.76	15.07	29-03-13	74.55	15.01	16-03-14	74.68	15.23	31-03-16	74.72	15.12
08-03-12	74.71	15.12	29-03-13	74.57	15.34	16-03-14	74.78	15.26	30-03-16	74.88	14.86
08-03-12	74.71	15.13	29-03-13	74.57	15.35	16-03-14	74.69	15.23	30-03-16	74.75	14.91
08-03-12	74.66	15.19	29-03-13	74.59	15.35	16-03-14	74.55	15.31	30-03-16	74.62	15.01
08-03-12	74.59	15.28	27-03-13	74.60	15.05	16-03-14	74.60	15.30	28-03-16	74.82	14.90
08-03-12	74.66	15.3	25-03-13	74.75	15.04	16-03-14	74.53	15.34	28-03-16	74.93	14.94
08-03-12	74.66	15.31	25-03-13	74.62	15.07	16-03-14	74.67	15.35	28-03-16	74.64	15.11
08-03-12	74.63	15.34	25-03-13	74.65	15.07	16-03-14	74.53	15.39	28-03-16	74.72	15.11
08-03-12	74.65	15.34	24-03-13	74.49	15.35	16-03-14	74.48	15.39	28-03-16	74.68	15.09
05-03-12	74.92	14.93	24-03-13	74.59	15.21	14-03-14	74.75	15.25	28-03-16	74.63	15.10

2012			2013			2014			2016		
FireDate	Long	Lat	FireDate	Long	Lat	FireDate	Long	Lat	FireDate	Long	Lat
05-03-12	74.25	15.23	24-03-13	74.60	15.09	14-03-14	74.84	15.11	28-03-16	74.66	15.14
03-03-12	74.87	14.81	24-03-13	74.61	15.09	14-03-14	74.87	15.01	28-03-16	74.76	15.15
03-03-12	74.82	15.04	24-03-13	74.60	15.08	14-03-14	74.87	15.00	26-03-16	74.75	15.13
03-03-12	74.83	15.04	24-03-13	74.62	15.08	14-03-14	74.88	15.00	26-03-16	74.61	15.14
03-03-12	74.96	15.07	24-03-13	74.58	15.07	14-03-14	74.98	14.84	26-03-16	74.67	15.15
03-03-12	74.82	15.07	23-03-13	74.60	15.09	14-03-14	74.99	14.77	26-03-16	74.57	15.16
02-03-12	74.72	15.25	23-03-13	74.60	15.08	07-03-14	74.83	14.95	26-03-16	74.75	15.21
25-02-12	75.08	14.96	23-03-13	74.74	15.07	05-03-14	74.69	15.13	26-03-16	74.60	15.13
25-02-12	74.91	14.97	23-03-13	74.60	15.04	05-03-14	74.70	15.24	26-03-16	74.59	15.14
25-02-12	74.91	14.98	22-03-13	74.57	15.37	05-03-14	74.70	15.24	26-03-16	74.72	15.16
25-02-12	74.45	15.17	22-03-13	74.59	15.36	03-03-14	74.87	15.05	26-03-16	74.57	15.25
25-02-12	74.73	15.17	22-03-13	74.59	15.36	03-03-14	74.88	15.04	25-03-16	75.22	15.00
25-02-12	74.44	15.2	22-03-13	74.58	15.35	28-02-14	74.91	14.97	25-03-16	75.14	15.03
25-02-12	74.83	15.33	22-03-13	74.68	15.35	26-02-14	74.74	15.22	25-03-16	75.18	15.06
25-02-12	74.84	15.33	22-03-13	74.77	15.28	24-02-14	74.95	14.94	25-03-16	74.78	15.23
22-02-12	75.07	14.96	22-03-13	74.58	15.26	24-02-14	74.94	14.94	25-03-16	74.63	15.14
21-02-12	74.85	15.1	22-03-13	74.55	15.12	24-02-14	74.94	14.94	25-03-16	74.76	15.28
21-02-12	74.85	15.07	22-03-13	74.59	15.09	23-02-14	74.89	15.01	24-03-16	75.03	15.03
21-02-12	75.07	14.98	22-03-13	74.58	15.09	23-02-14	74.89	15.01	24-03-16	74.73	15.08
18-02-12	75.03	14.83	22-03-13	74.60	15.08	17-02-14	74.84	15.22	24-03-16	74.81	15.18
16-02-12	74.84	15.09	22-03-13	74.59	15.06	17-02-14	74.79	15.10	24-03-16	74.73	15.18
14-02-12	74.63	15.32	22-03-13	74.61	15.06	17-02-14	74.84	15.09	24-03-16	74.73	15.13
			22-03-13	74.63	15.05	17-02-14	74.82	15.08	24-03-16	74.62	15.14
			22-03-13	74.71	15.03				24-03-16	74.78	15.19
			22-03-13	74.56	15.01				24-03-16	74.55	15.15
			22-03-13	74.63	14.98				24-03-16	74.59	15.17
			22-03-13	74.55	14.98				24-03-16	74.67	15.26
			22-03-13	74.54	14.98				24-03-16	74.67	15.23
			22-03-13	74.93	14.97				24-03-16	74.74	15.42
			22-03-13	74.48	14.94				24-03-16	74.59	15.54
			22-03-13	74.51	14.90				24-03-16	74.98	15.00
			22-03-13	74.50	14.90				24-03-16	75.08	15.03
			22-03-13	74.52	14.89				24-03-16	74.54	14.98
			21-03-13	74.58	15.08				24-03-16	74.96	14.99
			21-03-13	74.57	15.08				24-03-16	74.94	14.99
			20-03-13	74.63	15.06				24-03-16	74.88	15.03
			20-03-13	74.60	15.05				24-03-16	74.73	15.21
			20-03-13	74.56	15.01				24-03-16	74.67	15.22
			20-03-13	74.55	15.01				24-03-16	74.64	15.20
			20-03-13	74.57	15.00				24-03-16	74.66	15.29
			18-03-13	74.62	15.07				24-03-16	74.80	15.35
			17-03-13	74.63	15.16				23-03-16	75.07	14.86
			13-03-13	74.62	15.36				23-03-16	74.98	14.86
			13-03-13	74.64	15.16				23-03-16	75.06	14.96
			13-03-13	74.62	15.08				23-03-16	74.79	15.02
			13-03-13	74.64	15.06				23-03-16	74.76	15.09
			13-03-13	74.86	14.96				23-03-16	74.73	15.11
			06-03-13	74.69	15.38				23-03-16	74.73	15.19

2013			2013			2016			2016		
FireDate	Long	Lat	FireDate	Long	Lat	FireDate	Long	Lat	FireDate	Long	Lat
06-03-13	74.66	15.37	04-03-13	74.73	15.08	23-03-16	74.65	15.19	21-03-16	74.62	15.37
06-03-13	74.72	15.30	04-03-13	74.71	15.08	23-03-16	74.68	15.10	19-03-16	74.89	15.11
06-03-13	74.74	15.29	04-03-13	74.87	15.02	23-03-16	74.67	15.21	19-03-16	74.94	15.12
06-03-13	74.73	15.29	04-03-13	74.58	15.02	23-03-16	74.98	15.19	19-03-16	74.83	14.91
06-03-13	74.74	15.28	04-03-13	74.91	14.97	23-03-16	74.75	15.18	19-03-16	74.79	14.92
06-03-13	74.75	15.28	04-03-13	74.92	14.97	23-03-16	74.72	15.20	19-03-16	74.87	14.94
06-03-13	74.68	15.23	04-03-13	74.92	14.97	23-03-16	74.84	15.21	19-03-16	74.60	14.93
06-03-13	74.61	15.23	04-03-13	74.08	14.97	23-03-16	74.65	15.23	19-03-16	74.86	15.02
06-03-13	74.60	15.23	04-03-13	74.92	14.97	23-03-16	74.63	15.23	19-03-16	74.81	15.12
06-03-13	74.48	15.15	04-03-13	74.91	14.97	23-03-16	74.63	15.25	19-03-16	74.77	15.19
06-03-13	74.63	15.09	04-03-13	74.98	14.95	23-03-16	74.73	15.28	19-03-16	74.70	15.20
06-03-13	74.85	15.09	04-03-13	74.98	14.94	23-03-16	74.70	15.15	19-03-16	74.68	15.10
06-03-13	74.63	15.08	04-03-13	74.95	14.93	23-03-16	74.82	15.17	19-03-16	74.72	15.22
06-03-13	74.80	15.07	04-03-13	74.96	14.93	23-03-16	74.60	15.16	19-03-16	74.62	15.10
06-03-13	74.71	15.06	04-03-13	74.96	14.93	23-03-16	74.57	15.18	18-03-16	75.00	14.96
06-03-13	74.72	15.05	04-03-13	74.96	14.92	23-03-16	74.58	15.26	17-03-16	74.90	15.07
06-03-13	74.94	14.95	04-03-13	74.95	14.92	23-03-16	74.56	15.28	17-03-16	74.96	15.05
06-03-13	74.95	14.94	04-03-13	74.95	14.89	23-03-16	74.87	15.30	17-03-16	74.83	15.11
06-03-13	74.75	14.84	04-03-13	74.97	14.79	23-03-16	74.88	15.23	17-03-16	74.87	14.98
05-03-13	74.92	14.95	04-03-13	74.97	14.79	23-03-16	74.85	15.25	17-03-16	74.76	15.07
05-03-13	74.94	14.94	04-03-13	74.02	14.79	23-03-16	74.81	15.32	17-03-16	74.80	15.16
04-03-13	74.68	15.39	03-03-13	74.81	15.36	23-03-16	74.57	15.40	17-03-16	74.73	15.21
04-03-13	74.65	15.27	03-03-13	74.79	15.18	23-03-16	74.61	15.43	17-03-16	74.66	15.48
04-03-13	74.77	15.22	03-03-13	74.69	15.12	23-03-16	74.60	15.44	16-03-16	74.89	15.12
04-03-13	74.92	14.97	02-03-13	74.70	15.38	23-03-16	74.48	15.56	16-03-16	74.83	15.21
04-03-13	74.63	14.93	02-03-13	74.68	15.36	22-03-16	74.76	15.33	16-03-16	74.81	15.17
04-03-13	74.97	14.79	02-03-13	74.67	15.36	22-03-16	74.82	15.35	16-03-16	74.73	15.27
04-03-13	74.68	15.39	02-03-13	74.69	15.36	21-03-16	74.66	15.24	16-03-16	74.79	15.14
04-03-13	74.68	15.39	02-03-13	74.69	15.35	21-03-16	74.64	15.11	16-03-16	74.73	15.15
04-03-13	74.69	15.38	02-03-13	74.67	15.35	21-03-16	74.66	15.13	16-03-16	74.61	15.23
04-03-13	74.57	15.37	02-03-13	74.71	15.29	21-03-16	74.80	15.44	15-03-16	74.98	15.02
04-03-13	74.53	15.34	02-03-13	74.76	15.27	21-03-16	74.74	15.45	15-03-16	74.75	15.10
04-03-13	74.52	15.34	02-03-13	74.73	15.21	21-03-16	74.64	15.31	15-03-16	74.72	15.21
04-03-13	74.64	15.33	02-03-13	74.78	15.20	21-03-16	75.15	14.52	15-03-16	74.64	15.38
04-03-13	74.65	15.33	02-03-13	74.68	15.19	21-03-16	75.09	14.53	15-03-16	74.69	15.40
04-03-13	74.64	15.32	02-03-13	74.78	15.19	21-03-16	75.14	14.61	15-03-16	74.70	15.28
04-03-13	74.64	15.31	02-03-13	74.60	15.18	21-03-16	75.08	14.63	15-03-16	74.72	15.38
04-03-13	74.65	15.27	02-03-13	74.76	15.13	21-03-16	74.79	14.89	15-03-16	74.72	15.41
04-03-13	74.65	15.27	02-03-13	74.71	15.13	21-03-16	74.94	14.92	14-03-16	75.01	14.95
04-03-13	74.77	15.22	02-03-13	74.69	15.13	21-03-16	74.81	15.07	14-03-16	75.10	14.96
04-03-13	74.77	15.22	02-03-13	74.70	15.12	21-03-16	74.88	15.13	14-03-16	74.95	14.93
04-03-13	74.78	15.21	02-03-13	74.71	15.12	21-03-16	74.96	15.12	14-03-16	74.99	15.01
04-03-13	74.77	15.21	02-03-13	74.70	15.11	21-03-16	74.96	15.13	14-03-16	74.94	14.87
04-03-13	74.81	15.20	02-03-13	74.71	15.11	21-03-16	74.68	15.21	14-03-16	75.00	14.99
04-03-13	74.63	15.18	02-03-13	74.81	15.08	21-03-16	74.63	15.14	14-03-16	74.87	14.96
04-03-13	74.65	15.15	02-03-13	74.75	15.06	21-03-16	74.72	15.16	14-03-16	74.92	14.99
04-03-13	74.65	15.14	02-03-13	74.75	15.06	21-03-16	74.59	15.28	14-03-16	74.98	15.09
04-03-13	74.70	15.09	02-03-13	74.07	15.04	21-03-16	74.57	15.29	14-03-16	74.92	14.96

2013			2016			2016			2016		
FireDate	Long	Lat	FireDate	Long	Lat	FireDate	Long	Lat	FireDate	Long	Lat
02-03-13	74.96	14.91	14-03-16	75.01	15.00	07-03-16	74.71	15.26	07-03-16	74.62	15.34
02-03-13	74.95	14.91	14-03-16	74.96	15.09	07-03-16	74.68	15.28	07-03-16	74.59	15.36
02-03-13	74.95	14.90	14-03-16	74.91	15.10	07-03-16	74.62	15.34	07-03-16	74.76	15.41
02-03-13	74.31	14.88	14-03-16	74.90	15.14	07-03-16	74.59	15.36	07-03-16	74.59	15.36
02-03-13	74.77	14.69	14-03-16	74.83	15.19	14-03-16	74.69	15.12	07-03-16	74.72	15.46
02-03-13	74.89	14.48	14-03-16	74.81	15.19	14-03-16	74.75	15.19	07-03-16	74.97	15.00
01-03-13	74.89	15.20	14-03-16	74.69	15.12	14-03-16	74.69	15.23	07-03-16	74.96	15.03
01-03-13	74.87	15.12	14-03-16	74.75	15.19	14-03-16	74.64	15.25	05-03-16	75.03	14.83
01-03-13	74.88	15.00	14-03-16	74.69	15.23	14-03-16	74.78	15.20	05-03-16	75.02	14.92
01-03-13	74.86	15.00	14-03-16	74.64	15.25	14-03-16	74.59	15.26	05-03-16	75.02	14.93
01-03-13	75.07	14.96	14-03-16	74.78	15.20	14-03-16	74.70	15.32	05-03-16	74.85	14.99
01-03-13	75.10	14.95	14-03-16	74.59	15.26	14-03-16	74.65	15.34	05-03-16	74.64	15.21
01-03-13	74.90	14.94	14-03-16	74.70	15.32	14-03-16	74.66	15.27	05-03-16	74.83	15.16
28-02-13	74.71	15.15	14-03-16	74.65	15.34	14-03-16	74.61	15.28	05-03-16	74.74	15.21
28-02-13	74.71	15.11	14-03-16	74.66	15.27	14-03-16	74.71	15.30	05-03-16	74.44	15.56
27-02-13	74.74	15.21	14-03-16	74.61	15.28	14-03-16	74.64	15.36	05-03-16	74.95	15.10
27-02-13	74.72	15.12	14-03-16	74.71	15.30	14-03-16	74.59	15.38	05-03-16	74.98	14.99
27-02-13	74.71	15.12	14-03-16	74.64	15.36	14-03-16	74.69	15.40	03-03-16	74.94	15.01
27-02-13	74.70	15.12	14-03-16	74.59	15.38	14-03-16	74.63	15.46	03-03-16	74.78	15.23
25-02-13	74.62	15.33	14-03-16	74.69	15.40	14-03-16	74.60	15.51	03-03-16	75.09	14.93
25-02-13	74.61	15.33	14-03-16	74.63	15.46	12-03-16	75.06	14.89	03-03-16	74.95	15.13
25-02-13	74.66	15.33	14-03-16	74.60	15.51	12-03-16	75.11	14.96	27-02-16	74.69	15.21
25-02-13	74.76	15.29	12-03-16	75.06	14.89	12-03-16	75.05	14.98	25-02-16	74.87	15.23
25-02-13	74.66	15.25	12-03-16	75.11	14.96	12-03-16	74.90	15.08	25-02-16	74.81	15.24
25-02-13	74.73	15.24	12-03-16	75.05	14.98	12-03-16	74.83	15.16	25-02-16	74.68	15.31
25-02-13	74.71	15.24	12-03-16	74.90	15.08	12-03-16	74.71	15.23	25-02-16	74.77	15.27
25-02-13	74.72	15.21	12-03-16	74.83	15.16	12-03-16	74.67	15.19	25-02-16	74.69	15.41
25-02-13	74.71	15.21	12-03-16	74.71	15.23	12-03-16	74.89	15.17	25-02-16	74.66	15.53
25-02-13	74.74	15.13	12-03-16	74.67	15.19	12-03-16	74.74	15.23	25-02-16	74.75	15.25
25-02-13	74.76	15.08	12-03-16	74.89	15.17	12-03-16	74.63	15.26	25-02-16	74.74	15.45
25-02-13	74.84	15.04	12-03-16	74.74	15.23	12-03-16	74.57	15.32	25-02-16	75.13	14.86
25-02-13	74.94	15.00	12-03-16	74.63	15.26	12-03-16	74.69	15.44	23-02-16	75.12	14.80
25-02-13	74.92	14.96	12-03-16	74.57	15.32	12-03-16	74.63	15.46	18-02-16	75.02	14.94
25-02-13	74.92	14.95	12-03-16	74.69	15.44	10-03-16	74.97	14.92	18-02-16	75.11	14.89
25-02-13	74.92	14.94	12-03-16	74.63	15.46	08-03-16	75.03	14.92	18-02-16	75.16	15.03
25-02-13	75.01	14.87	10-03-16	74.97	14.92	07-03-16	74.98	14.90	18-02-16	75.03	14.94
25-02-13	74.64	14.86	08-03-16	75.03	14.92	07-03-16	74.96	15.00	18-02-16	75.09	15.04
25-02-13	74.98	14.85	07-03-16	74.98	14.90	07-03-16	74.96	15.04	18-02-16	75.01	15.08
25-02-13	75.05	14.83	07-03-16	74.96	15.00	07-03-16	74.86	15.04	18-02-16	75.08	15.13
23-02-13	74.65	15.31	07-03-16	74.96	15.04	07-03-16	74.92	15.10	18-02-16	75.03	15.03
17-02-13	74.78	15.05	07-03-16	74.86	15.04	07-03-16	75.08	15.15	18-02-16	74.96	15.03
17-02-13	74.77	15.05	07-03-16	74.92	15.10	07-03-16	74.91	15.17	18-02-16	74.90	15.04
11-02-13	74.84	15.09	07-03-16	75.08	15.15	07-03-16	74.88	15.19	18-02-16	74.95	15.11
11-02-13	74.99	15.09	07-03-16	74.91	15.17	07-03-16	74.81	15.26	18-02-16	74.81	15.05
02-02-13	74.88	15.00	07-03-16	74.88	15.19	07-03-16	74.73	15.31	18-02-16	74.84	15.19
02-02-13	74.88	15.00	07-03-16	74.81	15.26	07-03-16	74.70	15.33	18-02-16	74.84	15.21
02-02-13	74.89	15.00	07-03-16	74.73	15.31	07-03-16	74.71	15.26	18-02-16	74.96	15.19
02-02-13	74.89	15.00	07-03-16	74.70	15.33	07-03-16	74.68	15.28	18-02-16	74.90	15.21

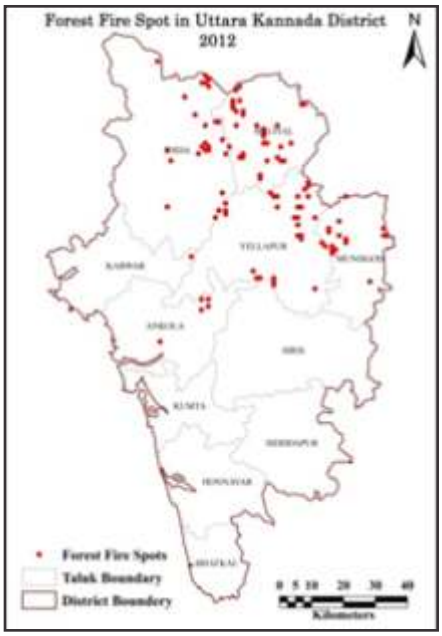

Fig. 3:

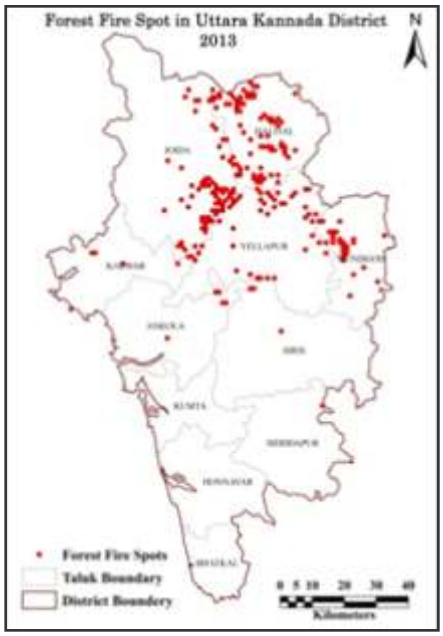

Fig. 4:

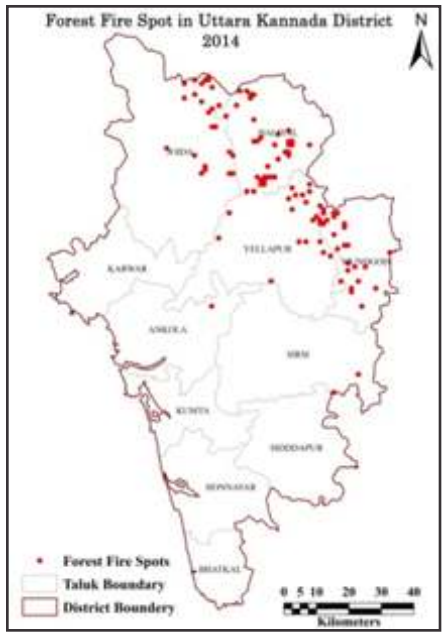

Fig. 5:

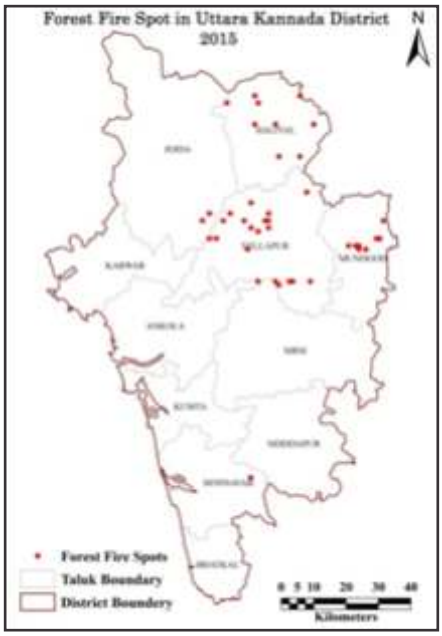

Fig. 6:

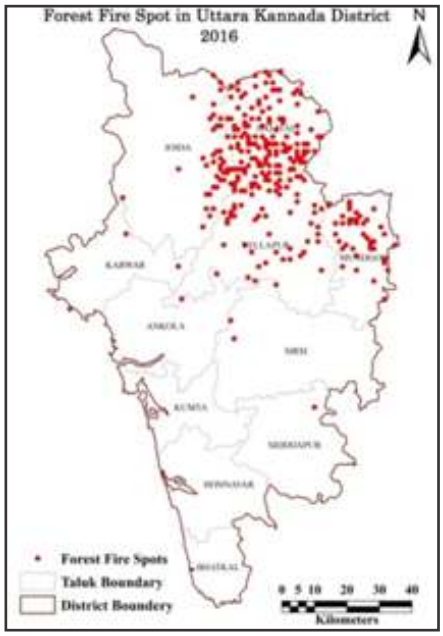

Fig. 7:

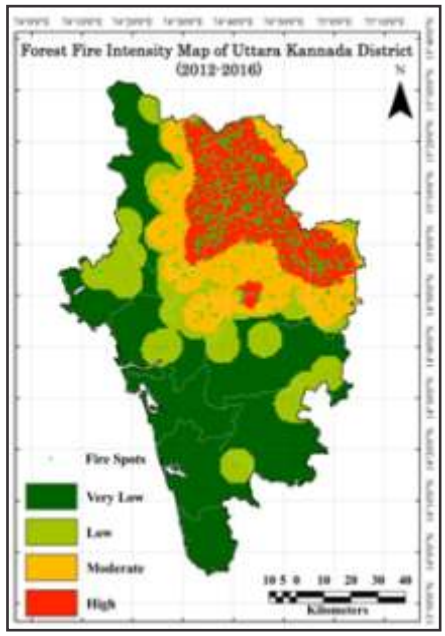

Fig. 58:

Table 2: Maximum and minimum temperature (degree Celsius) in Uttara Kannada district during the year 2012-16.

Taluk	2012		2013		2014		2015		2016	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Siddapur	38.9	10.4	40.1	11.0	40.5	10.3	43.2	7.4	40.8	8.4
Sirsi	39.0	9.3	38.9	13.9	39.8	10.3	40.9	8.1	43.6	7.8
Joida	40.2	9.8	40.1	12.3	40.4	9.6	38.7	7.1	39.8	5.1
Yellapur	37.5	11.0	40.0	10.1	40.2	12.0	40.2	9.1	42.1	10.0
Ankola	39.9	9.7	40.6	12.6	40.3	13.8	38.8	10.8	38.5	13.2
Bhatkal	36.7	16.5	37.1	18.1	39.3	17.7	39.0	16.7	38.5	17.2
Haliyal	41.0	9.0	40.6	8.9	42.0	8.4	44.5	5.6	45.0	6.7
Honnavar	36.9	13.0	37.4	15.3	42.6	14.9	42.2	13.1	40.0	13.3
Karwar	40.1	12.0	40.2	13.2	42.5	13.8	45.0	11.0	43.3	12.6
Kumta	38.0	0.0	46.7	17.0	42.3	14.6	39.1	11.2	40.3	13.9
Mundgod	37.8	9.9	39.4	9.5	40.7	8.0	40.7	7.4	41.9	8.5

(Source: Karnataka State Natural Disaster Monitoring Centre, 2017).

Table 3: Average rainfall details (in mm) of Uttara Kannada district in the year 2012-16.

Taluk	2012	2013	2014	2015	2016
Siddapur	3108.2	3574.04	3279.81	2560.65	2540.86
Sirsi	2083.66	2807.5	2907.82	1972.47	1951.26
Joida	2020.46	3342.19	3290.89	1997.98	2279.27
Yellapur	1544.45	2032.63	2214	1553.48	1496.35
Ankola	2743.55	3631.09	3389.41	2604.51	2932.55
Bhatkal	3606.58	4404.51	3682.89	3298.56	3225.29
Haliyal	926.75	1308.97	1335.21	802.53	726.3
Honnavar	3205.5	3664.82	3177.57	3044.16	3013.08
Karwar	2356.28	3806.62	3814.74	2830.03	2909.97
Kumta	2816.75	3987.71	3524.96	2822.7	3015.15
Mundgod	861.61	1222.97	1306.42	1074.47	832.54

(Source: Karnataka State Natural Disaster Monitoring Centre, 2017).

relation about the intensity of forest fire occurrence in Uttar Kannada district.

Conclusion

GIS is the useful tool for mapping the forest fire zone which in-turn helps to plan for protecting the area against the forest fire. The results showed that the fire intensity zone is concentrated towards north and north east part of the Uttara Kannada district due to the dry deciduous nature of the forest which is comprises of haliyal, part of Mundgod and Joida talukas. The fire intensity is less in remaining part of the district due to semi evergreen and evergreen forest. The mapping of forest fire zone would help to take precautionary measures to control the forest fire there by reducing the loss of biodiversity.

Acknowledgement

Authors thankful to Forest Survey of India for providing the fire spot spatial location of Uttara Kannada district for mapping forest fire intensity zones.

उत्तर कन्नड़, जिले में जी आई एस तकनीकों का उपयोग करके वन अग्नि क्षेत्र सीमांकन

ए.जी. कोप्पड़, पवन टिखिली एवं संध्या शास्त्री

सारांश

उत्तर कन्नड़ जिले के विभिन्न तालुकाओं में वनाग्नियों की तीव्रता का मूल्यांकन करने के लिए यह अध्ययन किया गया। 2012–16 से उत्तर कन्नड़ जिले अग्नि स्पॉटों को राज्य वन रिपोर्ट 2016, भारतीय वन सर्वेक्षण से लिया गया। अग्नि स्पॉटों के स्थानों (अक्षांस एवं देशान्तर) को शेप फाइल में रूपान्तरित किया गया। अग्नि स्पॉटों को 2012 से 2016 तक मानचित्र में दर्शाया गया। पांच साल की अवधि में वनाग्नि तीव्रता को पृथक मानचित्र में प्रदर्शित किया गया और अग्नि तीव्रता को बहुत निम्न सें उच्च तक दर्शाया गया है। परिणामों ने दर्शाया कि उच्च अग्नि तीव्रता क्षेत्र मुंडगोड हलियाल तालुका और जिओडा के भाग को कवर करके उत्तर कन्नड़ जिले के उत्तर एवं उत्तर पूर्व भाग में पाया गया है। मध्यम अग्नि तीव्रता क्षेत्र मुंडगोड, येल्लापुर और जिओडा के भाग में कवर किया गया। शेष तालुकास निम्न से बहुत निम्न वनाग्नि तीव्रता की हैं। मुंडगोड हलियाल और जिओडा तालुका के भाग में उच्च वनाग्नि क्षेत्र शुष्क पर्णपाती वन के कारण हैं।

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