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Geospatial Study on Forest Fire Disasters – A GIS Approach

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ABSTRACT

The science and technology is reaching to greater heights in recent decades, that the scientists are also not anticipated that it would change the facet of human life. However, disasters are challenging scientific community and its intensity and numbers of events are increasing in recent years. Disasters are classified into two types, i.e., natural and man-made. Ancient human beings were used fire to cook their food. Once they were habituated to eat cooked food, their digestive system started working properly which resulted in wise thinking. One of the most risky fiascos is fire. Notwithstanding its immediate risk on living souls', fire consumes woods. Trees that are giving oxygen to people, in this way, trees are viewed as lungs for solid life. Consistently, huge number of rapidly spreading fires happening all around the world they consume forested lands, causing unfriendly environmental and social effects. Early admonition and prompt reactions are the main available resources to battle such kind of calamities. This exploration work centers guileless techniques which are utilized to recognize forest fire susceptibility index (FFSI) and fire examination in Greater Visakhapatnam municipal corporation.

Keywords: neural network, remote sensing, geographic information system, disaster management, forest fire susceptibility index.

INTRODUCTION

The science and technology is reaching to greater heights in recent decades, that the scientists are also not anticipated that it would change the facet of human life. However, disasters are challenging scientific community and its intensity and numbers of events are increasing in recent years [1]. Disasters are classified into two types, i.e., natural and man-made. Ancient human beings were used fire to cook their food. Once they were habituated to eat cooked food, their digestive system started working properly which resulted in wise thinking [2]. The consequences of logical research planning to the advancement of a DSS for overseeing woodland fires. The framework gives a progression of programming instruments for the appraisal of the engendering and fighting of forest fires dependent on Arc/Info, ArcView, Arc Spatial Analyst, Arc Avenue, and Visual C++ advances (Bonazountas et al., 2007). The framework coordinates GIS advancements under similar information condition and uses a typical UI to deliver an incorporated PC framework dependent on self-loader satellite picture preparing (fuel maps), financial hazard demonstrating and probabilistic models that would fill in as

a valuable instrument for forest fire counteractive action, arranging and the board. Its execution has been shown by means of constant mode precise data on the position and advancement of the fire [3]. The framework can help crisis evaluation, the board and battling of the occurrence. A site show and approval has been cultivated for the island of Evoia, Greece, a territory especially powerless against woodland fires because of its biological qualities and winning breeze designs [4].

The forest fires are typically occasional and different areas have distinctive ordinary and pinnacle fire seasons. In the fields of northern and focal India, the majority of the woodland fires happen among February and June. In the slopes of northern India fire season begins later and a large portion of the flames are accounted for among April and June (Verble et al., 2012). In the southern piece of the nation, fire season reaches out from January to May. In the Himalayan district, fires are normal in May [5]. Determining and pattern examination: essentially one can make utilization of chronicled information identified with consumed territory to anticipate future backwoods fires. These techniques can likewise give the capacity to gauge the consumed territory and the length of flame field [6]. Affiliation rule digging for forecast of continuous woods fire advancement: This depends on spatial backwoods information like the slants or position of the incline just as climate information (precipitation, wind speed and heading, temperature) and fuel type, to foresee the spreading of the fire (Glave et al., 2005). It will add the capacity to make coherent conditions, for example, in the event that a fire happens in W, it is probably going to spread towards S and permits woods fire contenders to get an ideal arrangement. Example Detection for arrangement of flame occasions: utilizing spatio-fleeting information to find consecutive examples that happen as often as possible, and thus being able to produce consistent guidelines. Group investigation and distinguishing proof of flame spots: Spatiotemporal bunching may find the cells (problem areas) that have a high likelihood of beginning a fire. The segregation of flame spots will have immediate ramifications on the likelihood of forest fires.

FOREST FIRE DISASTER MANAGEMENT IN ANDHRA PRADESH

The flames happening in Andhra Pradesh are greatest ground fires in nature. Nonetheless, the fire catastrophe in March 2014 in Tirumala, on 22nd November, 2016 in Seshachalam woodlands and on twentieth April, 2018 in Tirumala Tirupati Devasthanams (TTD) was capable number of backwoods fires. The fire spread to tree crown over a huge region. The ground fire or surface fire for the most part happens among February and May. Walk is the most helpless month for the backwoods fires. The ground fire make far and wide harm the ground greenery. The youthful recovery is genuinely impacted by the fire, these flames are for the most part man-made.

As well as, the Greater Visakhapatnam Municipal Corporation (GVMC) experienced such countless woodland fires from the year 2011 to 2018. So woodland fire catastrophe the board is essential in Andhra Pradesh, India. Be that as it may, in mid July to August 2018, a progression of enormous fierce blazes ejected across California and 30th November, 2018, in number breezes prompted one more round of huge, disastrous flames to emit across the state.

Needs of fire management

The pace of forest fires in the nation is on the turn of events and more reach is singed every year. The genuine justification behind this mistake is the piecemeal strategy to deal with the issue. Both the public concentration and the particular assets expected for keeping up a productive boondocks fire the chiefs program are deficient in the country. Basic backwoods fire the board fragments like critical fire centers, coordination among Ministries, financing, human resource improvement, fire research, fire the executives, and extension projects are missing. Figure 1 shows Flowchart (Methodology) for backwoods fire recognition and the executives in GVMC.

Thinking about, making a few genuine improvements in the backwoods fire the board system for the nation is significant. The Ministry of Environment and Forests, Government of India, has engineered a National Master Plan for Forest Fire Control [6]. This game plan proposes to show an especially organized and made fire-association program that combines the going with portions: Anticipation of human-made fires through guidance and normal change. It will consolidate silvicultural exercises, building works, person's advantage, and guidance and execution. It is suggested that more consideration should be given to person's advantage through Joint Forest Fire

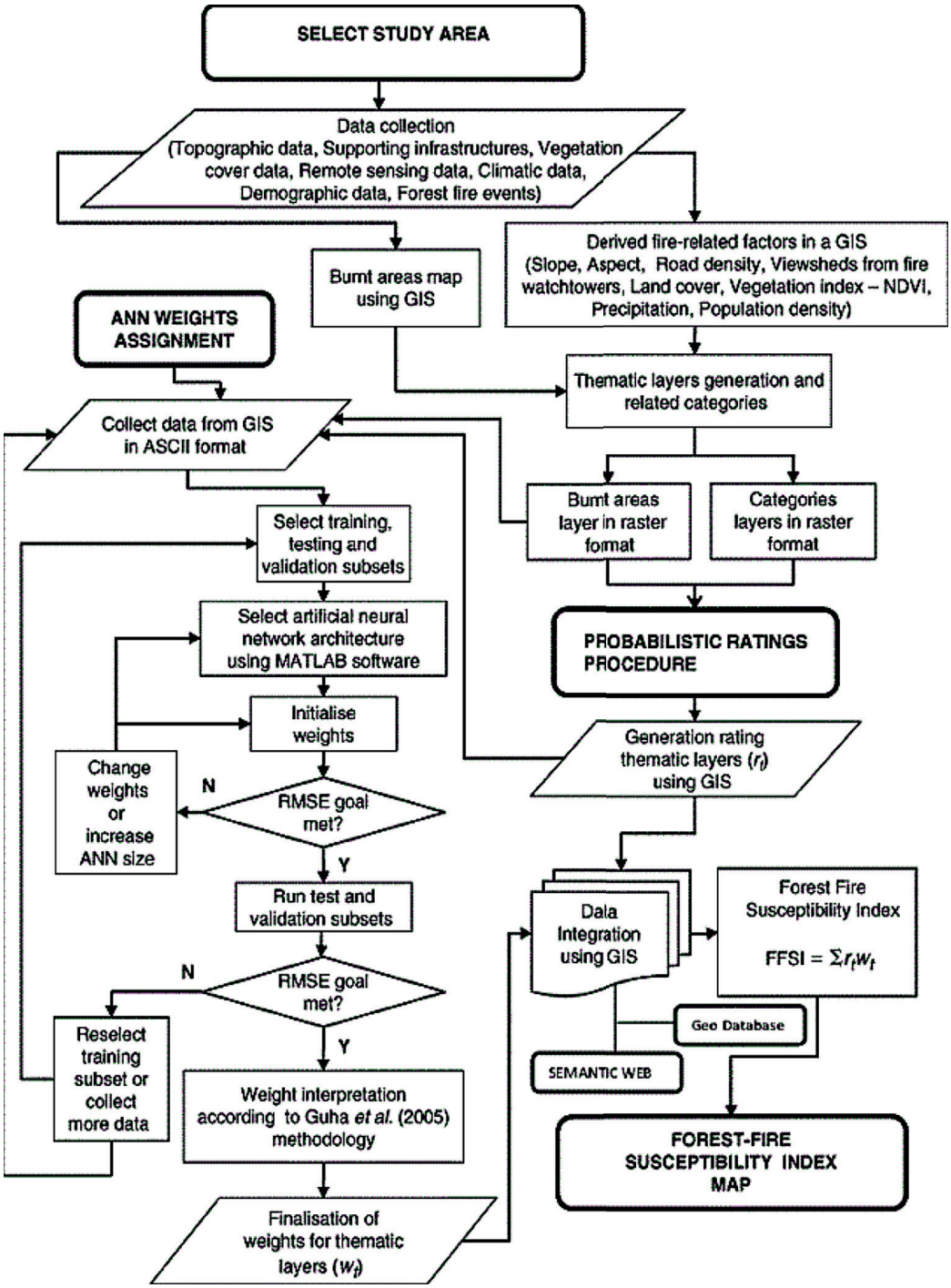

Figure 1. Flowchart (Methodology) for forest fire detection and management in GVMC

Management for fire counteraction. Speedy recognizable proof of flames through an inside and out composed arrangement of perception centers, useful ground watching, and correspondence frameworks. Remote distinguishing advancement be determined due significance in fire acknowledgment. For reasonable fire the board and association, a National Fire Danger Rating System (NFDRS) and Fire Forecasting System are to be made in the country:

- quick beginning attack measures.
- dynamic subsequent action.
- presenting a woods fuel change structure at key core interests.
- fire fighting resources.

All of the above sections has an imperative impact in the accomplishment of the whole gameplan of fire the leaders. Special highlight is to be given to explore, getting ready, and upgrade.

Demographic pressure and poor socio-economic conditions

The expanding statistic weight has been the central point for deforestation. The development in populace has expanded the interest for livelihood. Shortage of other employment assets, particularly in country ranges has constrained individuals to adventure regular assets, especially the forests. Alongside statistic weight, destitution has been another essential element, in charge of timberland corruption. According to the development mission of India around 37% of the nation populace is compelled to make due below poverty line. Poor in the nation are constrained to exploit common assets for their survival [7]. Dependency on forests for fuel, wood, moving, intrusions are the issues that are straightforwardly connected with the poverty shown in Figure 2.

STUDY AREA

The review region, Greater Visakhapatnam Municipal Corporation (GVMC) is the biggest metropolitan organization in Andhra Pradesh, which covers almost 600 km2. The city is well known for ventures the travel industry and woodland cover. Concentrate on region has roughly 100 sq.km timberland cover which is in civil ward. The Kambalakonda Reserved Forest, the review region, spreads north of 7,146 hectares (71 sq.km) situated in Greater Visakhapatnam Municipal Corporation (GVMC), Andhra Pradesh, India. The timberland region covers under the Eastern Ghats has uncommon types of endemic vegetation and furthermore live in by woods creatures like panther, yelping deer, woodland boat, spotted deer, sambar and monkeys. It has closeness to the city (GVMC) and serious level of biotic obstruction. The review region is situated between 17.34° to 17.47° N scope and 83.04° to 83.20° E longitude, limited by GVMC on the north part Pendurthi (Figure 3).

In GVMC region, the Kailasapuram and Simhachalam slopes denotified as non-timberlands had been encountering by various backwoods fires over the most recent quite a long while. On March, 2015, Simhachalam slopes had encountered the greatest fire [8]. The Kailasapuram slope likewise had an enormous fire on December, 2015. These two episodes occurred in non-timberland region in the city. The vegetation in these slopes are having congruity to the Kambalakonda Reserved Forests

In 2015, Kambalakonda Reserve Forests had experienced a number of forest fires due to anthropogenic activity. In general, timberland fires in the region are mostly occurs from February to May. Study area had experienced eight times forest fires in February, 34 times in March, 5 times in April, 5 times in May from May 2013 to May 2015. In this manner, in light of temperature

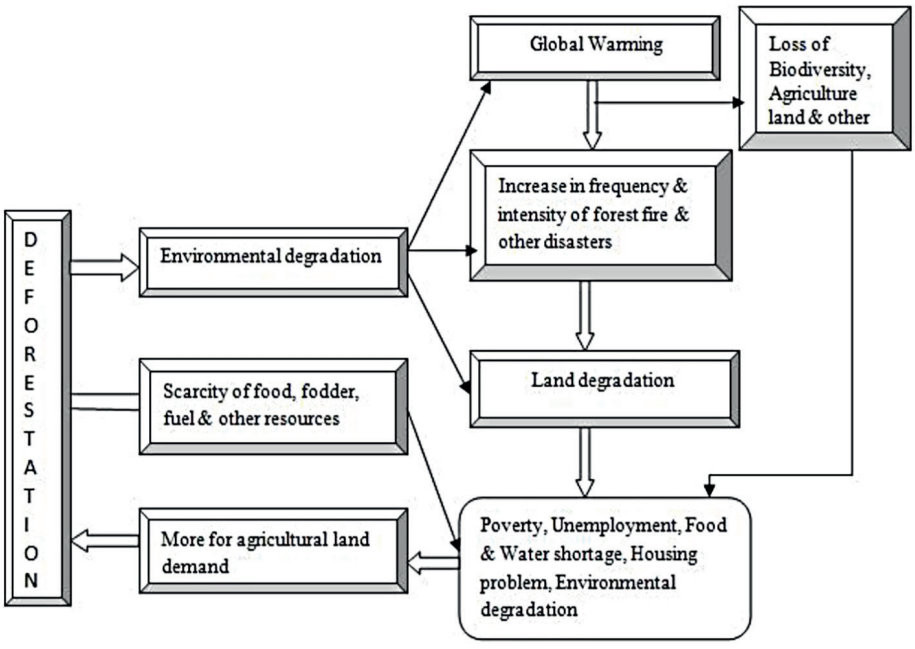

Figure 2. Difficult effects of deforestation

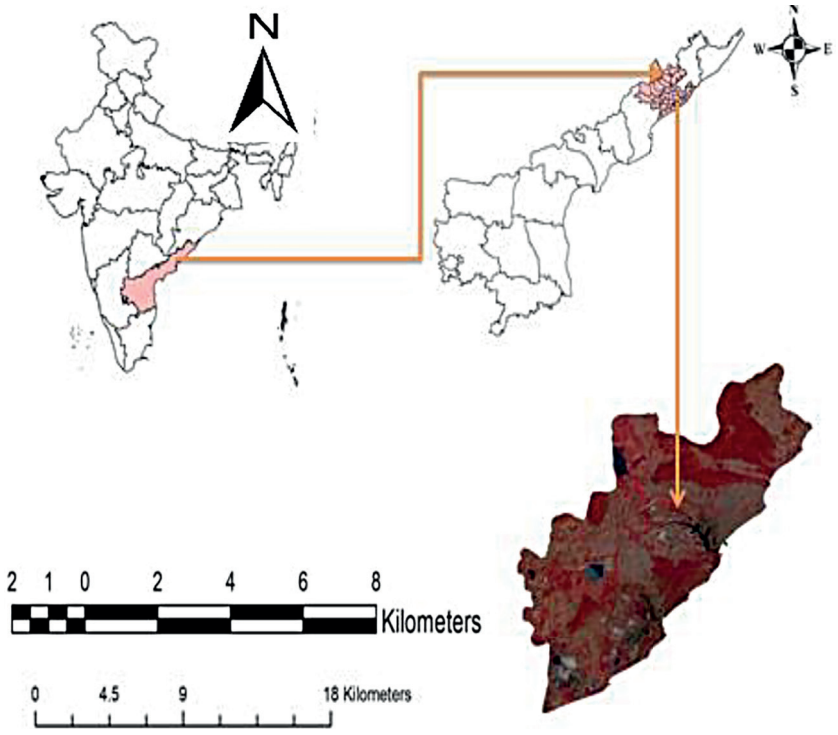

Figure 3. Location map of the study area GVMC

conditions most likely woodland fire was done in the long stretch of March. Temperature is the fundamental offender for forest fires in the long stretch of March. In November 2014, Kambalakonda had been experienced forest fire; it is attributed to Karthika Pournami festival where people light the lamps as part of their vegetation beliefs which might be the reason for fire [9] [10]. That was the biggest forest fire disaster in Visakhapatnam, where NDRF teams, fire engines and naval helicopters were involved to manage the forest fire. In addition, similar forest (notified as non-fotest) cover in the hill ranges of Kailasagiri and Yarada Konda, often experience forest fires. Mostly these fires are anthropogenic origin. Hence, the GVMC is considered as study area in this study [11] [12].

In comparison to 12 districts in Andhra Pradesh, the Visakhapatnam district has high rate of forest fire, these are particularly happening in Kambalakonda Reserved Forest, adjacent Simhachalam forest and Kailasapuram area. In general, the fire rate was the long stretch in the month of May [13] [14]. The Simhachalam Konda has covered by lush backwoods. It is a natural habitat to Cheetahs and different animals. This backwoods area comes under the GVMC. Figure 4 shows Sentinel-2A satellite map of the study area GVMC, Visakhapatnam.

FOREST FIRES IN GVMC

Figure 5 shows an overview of forest cover in Kambalakonda, Visakhapatnam. Initially, the fire seemed under control, however, at 13:30 hrs the wind speed increased and the fire picked up (Figure 6). About 1,00,000 litres of water was utilized to splash the fire and an aggregate of 42 transports were done by these helicopters [15]. A major forest fire, which burnt a backwoods up to 30 km in Visakhapatnam on 6th November, 2014 and it was controlled by Indian Air Force's MI-17 V5 helicopter, with a request of the State Government, the IAF sent the MI-17 V5 helicopters which were outfitted with putting out fires hardware known as the 'Bambi Bucket', which can hold up to 3,500 litres of water (Figure 7). Where the IAF choppers were utilized to combat woodland fires. Massive and widespread forest fires had been devouring the pristine forests 30 km east of Visakhapatnam and causing widespread destruction to the flora and fauna. As well as number of fires attacked in the year 2014 in GVMC. Figure 7 describes Air Force's 'Bambi Bucket' Helps Control Raging Fire in Simhachalam and Kailasagiri hills [10]. Similarly, Figure 8. shows Kaparada Konda fire on 31st October, 2014 in GVMC, Figure 9 shows Simhachalam hill fire on 6th March, 2018 and Figure 10 shows Indira Nagar Konda in GVMC on 8th December, 2018 [16] [17].

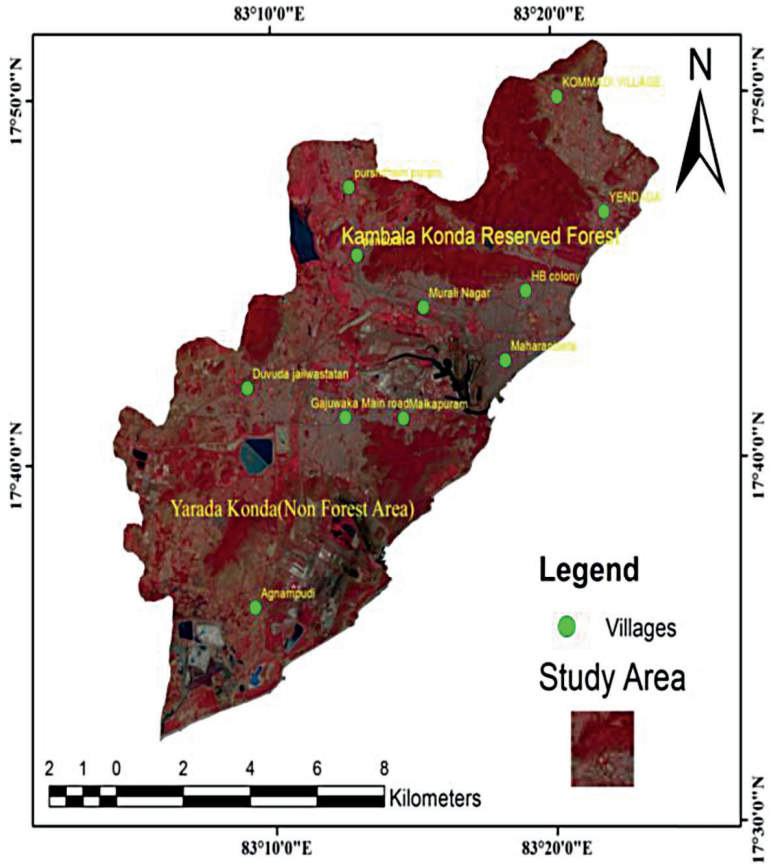

Figure 4. Sentinel-2A satellite map of the study area GVMC, Visakhapatnam

Figure 5. An overview of forest cover in Kambalakonda, Visakhapatnam

RESULTS AND DISCUSSIONS

Forest-fire susceptibility index (FFSI)

Taking into consideration of ten parameters namely, road density, view sheds, slope, aspect from fire watch towers, land use, NDVI, precipitation pattern, temperature, wind speed and population density, the FFSI has been generated which shows the forest fire prone areas [18]. In general, the forest is grown over the hills of moderate slopes. As the slopes increases, the density of forest also increased in Kambalakonda reserved forests and Simhachalam non-forest [19]. Remaining forest areas are very less and cover limited area. The forest density in other reserved forests is sparse and mostly scrubs nature. The aspect map reveals that NE and NW directions of are more

Figure 6. Gudilova fire near Kambalakonda Reserved forest on 6th November, 2014.

Figure 7. Air force's 'Bambi Bucket' helps control raging fire in Simhachalam Hills

Figure 8. KaparadaKonda fire in GVMC (Date: 31-10-2014)

Figure 9. Simhachalam hill fire on 6th March, 2018

Figure 10. Indira Nagar Konda in GVMC, (Date: 08-12-2018)

prone to forest fires. This is contrary with regard to anthropogenic conditions are concerned [20]. Other than Kambalakonda reserved forests, built-up is very close to the other forest areas. In Simhachalam non-forest hill, most of the built-up has encroached [21]. This could be the reason for more number of fires, particularly Kartheeka pournami festival, etc [22]. Road density and population density are the causative parameters for anthropogenic forest fires. Kartheeka vanabojalanu is popular in this area where urban people used to migrate to rural and forest areas and spend whole day which is responsible to accumulate huge paper and other wastes in the vegetated areas. When they cook food in this area also contributes direct fire which spreads as forest fires. Road density revealing that people can enter into the forests during Kartheeka vanabojalanu and other festivals. Table 1. Shows forest fire events in GVMC, Visakhapatnam. Weather parameters of rainfall, temperature and wind also contribute forest fires significantly. During the summer period, the temperatures shoot up to 400 to 450 C and wind velocity is slightly more during this period [23]. Simhachalam non-forest area appears as linear shape, with wind gap. Wind blows in this valley which ignites forest fires [24] [25]. These two parameters have direct control over the forest fires. View sheds from fire watch towers are selected based on these parameters to identity early warnings [26]. FFSI map is generated in North East 10.3 taking into consideration of ten parameters is shown in Figure 11 [27].

Table 1. Forest fire events in GVMC, Visakhapatnam

Fire accident	Forest / Non-forest area	Month & Year
Kailasasapuram Konda	Non-forest area	19-06-2012 at 9:25 AM
Kappa Rada Konda	Forest area	23-10-2014 at 6:45 PM
Kappa Rada Konda	Forest area	31-10-2014 at 8:40 PM
Murali Nagar Konda	Non-forest area	02-11-2014 at 2:45 PM
Port Hospital, Thatichetlapalem	Non-forest area	03-11-2014 at 12:45 PM
Gidilova Konda	Forest area	06-11-2014 at 4:00 PM
Gidilova Konda	Forest area	07-11-2014 at 4:00 PM
Bheemanna Dhora Konda	Non-forest area	07-11-2014 at 7:30 PM
Madhavadhara Konda	Non-forest area	29-11-2014 at 5:50 PM
Kailasasapuram Konda	Non-forest area	03-12-2014 at 1:45 PM
Jodivanipalem Konda	Non-forest area	04-12-2014 at 2:05 PM
Kappa Rada Konda	Forest area	13-12-2014 at 4:10 PM
Kappa Rada Konda	Forest area	14-12-2014 at 3:45 PM
Seeihamadhara Konda	Non-forest area	23-12-2014 at 1:05 PM
Seeihamadhara Konda	Non-forest area	24-12-2014 at 4:35 PM
Kailasasapuram Konda	Non-forest area	25-12-2014 at 4:05 PM
Kailasasapuram Konda	Non-forest area	15-01-2014 at 7:15 PM
Gambeeram Konda	Non-forest area	22-01-2015 at 7:30 PM
Gambeeram Konda	Non-forest area	24-01-2015 at 11:35 PM
Simhachalam Konda	Forest area	06-02-2015 at 2:59 PM
Simhachalam Konda	Forest area	20-02-2015 at 5:05 PM
Simhachalam Konda	Forest area	21-02-2015 at 2:10 PM
Kailasasapuram Konda	Non-forest area	25-02-2015 at 6:20 PM
Simhachalam Konda	Forest area	09-03-2015 at 4:05 PM
Enda da	Non-forest area	10-03-2015 at 1:00 PM
Forest Pedha Konda, Sontyarn	Forest area	15-03-2015 at 12:45 PM
Kailasagiri Konda	Non-forest area	21-04-2015 at 5:30 PM
Kailsapuram Konda	Non-forest area	03-12-2015 at 2:15 PM
Kapparada Konda	Forest area	16-12-2017 at 1:00 PM
Madhavadhara Konda	Non-forest area	03-03-2018 at 3:00 PM
Simhachalam Hills	Forest area	04-03-2018 at 6:00 PM
Simhachalam Hills	Forest area	06-03-2018 at 2:50 PM
Indira Nagar Colony Konda	Non-forest area	08-12-2018 at 5:00 PM

CONCLUSIONS

The fire conduct is displayed in this concentrate by surface examination utilizing PC vision frameworks. The Central Server gets fire impacted districts from the worker's advanced cell. The geotagged photographs would give terminated area organizes, and the photograph can be turned and utilized in various points to find accurate fire areas in view of Google Earth API. Object revelation computations process the position vector of a moving thing. Recieving wires or Satellite structures will understand the information from the fire area. Then the information will be examined in GIS for use in salvage activity and sends SMS cautions to neighborhood individuals about backwoods fires and a similar will be scattered to the APSDRF/NDRF group.

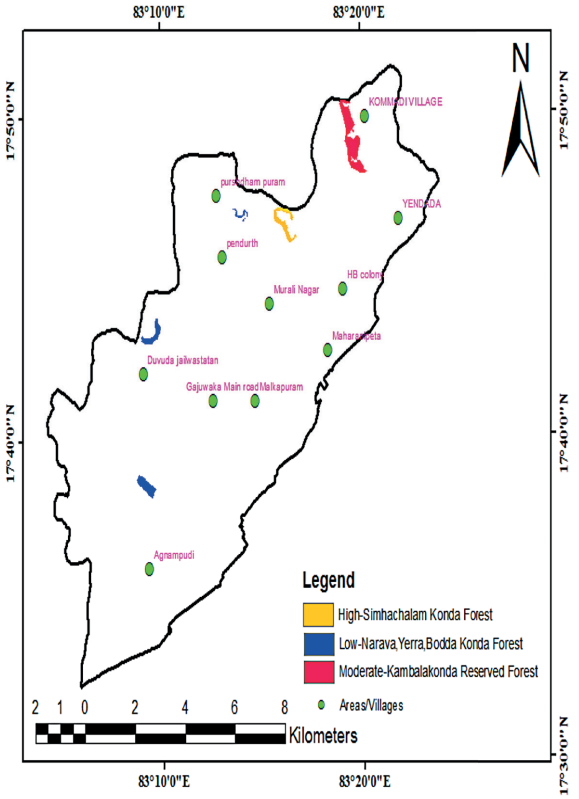

Figure 11. Forest-fire susceptibility index (FFSI) map

Woodland fires altogether affect environment and lives. The interest of predicting cautious fire locale in boondocks could help with ending administrative team by including drone as a robot. These are versatile, prudent and raised development remote distinguishing structures that usage drones as stages are critical for huge data openings and upgrading the limits of checked plane and satellite remote identifying systems. This study serves to developed a brilliant framework which depends on semantic brain systems administration to gauge about the consumed regions.

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