IMPACT ASSESSMENT OVER THE BURNED AREAS OF AUSTRALIAN BUSHFIRE 2019 – 2020 USING NDVI METHOD WITHARC GIS IN THE SHIRE OF EAST GIPPSLAND, VICTORIA – REGION OFAUSTRALIA

Abstract

This Research study was taken to quantify the amount of forest burned during the bushfire in Shire of east Gippsland. The study is based on images from before and after the event. For data visualization of the study, Landsat 8 Multispectral imageries have been used from USGS Earth Explorer. NDVI method has been used to analyze the data of both before fire dated on 8th October of 2019 and after fire dated on 28th June 2020. As Graphical representation is used to elaborate the effect took place during the event. Arc GIS10.8 software has been used to analyse the data. The result signifies that large amount of the forest has been destroyed during the event, making this as one of the worst disasters happened in recent years.

Keywords: Bushfire, Arc GIS Multispectral Images, NDVI

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I. INTRODUCTION

Bushfires are one of the most destructive forces of nature, bushfires can burn using grass, scrub or forest or a combination of these for fuel. Unless quickly controlled, bush fires can become large, spreading to affect forests, wildlife, agriculture and other buildings, and human life. These bushfires are very much common during the summer seasons of Australia due to its hot and dry climate. Some parts of Australia are very much prone to these fires especially the southern eastern parts of Australia. On 21 November 2019, lightning strikes ignited a series of fires in East Gippsland, initially endangering the communities of Buchan, Buchan South and Sunny Point. On 30 December 2019, there were three active fires in East Gippsland with a combined area of more than 130,000 hectares 320,000 acres. On 20th February 2020, the huge East Gippsland bushfire that had burned for three months was declared contained.

II. STUDYAREA

The study area is located in the southern eastern part of Australia and lies on the latitude and longitude of 37.4976° S and 148.1893° E respectively. The Shire of East Gippsland is a local government area in the state of Victoria and roughly covers an area around 20,940 square kilometers. It has an elevation of about 150m from the Mean Sea Level (MSL). The climate in East Gipps land is temperate, with patterns of precipitation and temperature influenced by geography, topography, altitude and proximity to the coast.

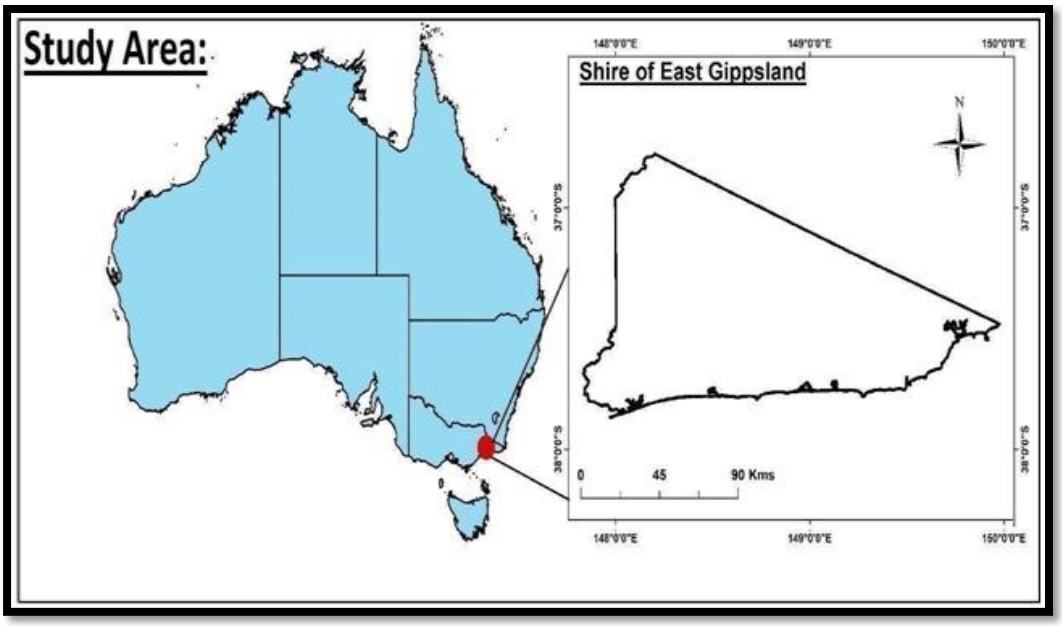

Figure 1: Map Showing the Studyarea of Shire of East Gippsland

III. MATERIALSAND METHODS

NASA's (National Aeronautics and Space Administration) Landsat 8 OLI – TIRS multispectral imageries of 30m resolution (Sivakumar et al 2017, Ghoshetal 2015) were obtained from the USGS website namely EARTH EXPLORER, which aretaken on 8thOctober of 2019 (Before Fire) and 28th June 2020 (After Fire). Below Table 1 gives the spectral bands and their properties of Landsat 8 image.

The obtained imageries are further registered in the Arc GIS environment to prepare the basemap for the study area. Both the Landsat datasets loaded into the ArcGIS (v10.2) to process the bands and get the land use classes for each image. By the RGB composite module in Arc GIS, the True (Natural) color composite (Fig2 a & b) and False color composite maps (Fig 3 a & b) were produced using the bands of red, green and blue for each Landsat data set. This True color composite and False color composite maps are used to derive the impact assessment over the study area, which differentiates the affected and unaffected areas.

Table1: Spectral Band and their Properties of Solar Irradiance, Wavelength and Resolution

Spectral Band	Solar Irradiance	Wavelength	Resolution
Band 1 Coastal/Aerosol	2031W/(m^{2}µm)	0.443–0.453 µm	30m
Band 2 Blue	1925W/(m^{2}µm)	0.450–0.515 µm	30m
Band 3 Green	1826W/(m^{2}µm)	0.525–0.600 µm	30m
Band 4 Red	1574W/(m^{2}µm)	0.630–0.680 µm	30m
Band 5 NearInfrared	995W/(m^{2}µm)	0.845–0.885 µm	30m
Band 6 Short Wavelength Infrared	242W/(m^{2}µm)	1.560–1.660 µm	30m
Band 7 Short Wavelength Infrared	82.5W/(m^{2}µm)	2.100–2.300µm	30m
Band 8 Panchromatic	1739W/(m^{2}µm)	0.500–0.680 µm	15m
Band 9 Cirrus	361W/(m^{2}µm)	0.1360– 0.1390µm	30m

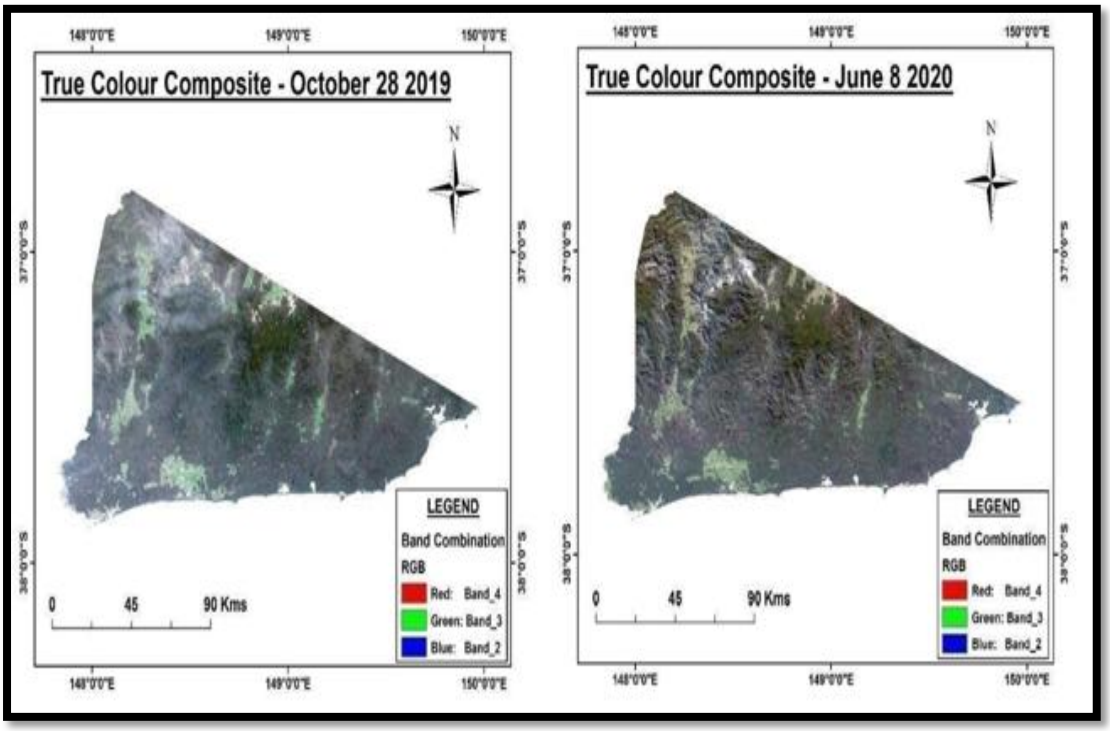

Figure: 2 (a) & (b).28th October 2019 & 8th June 2020 True Color Composite Maps with the Band Combination of (4 3 2)

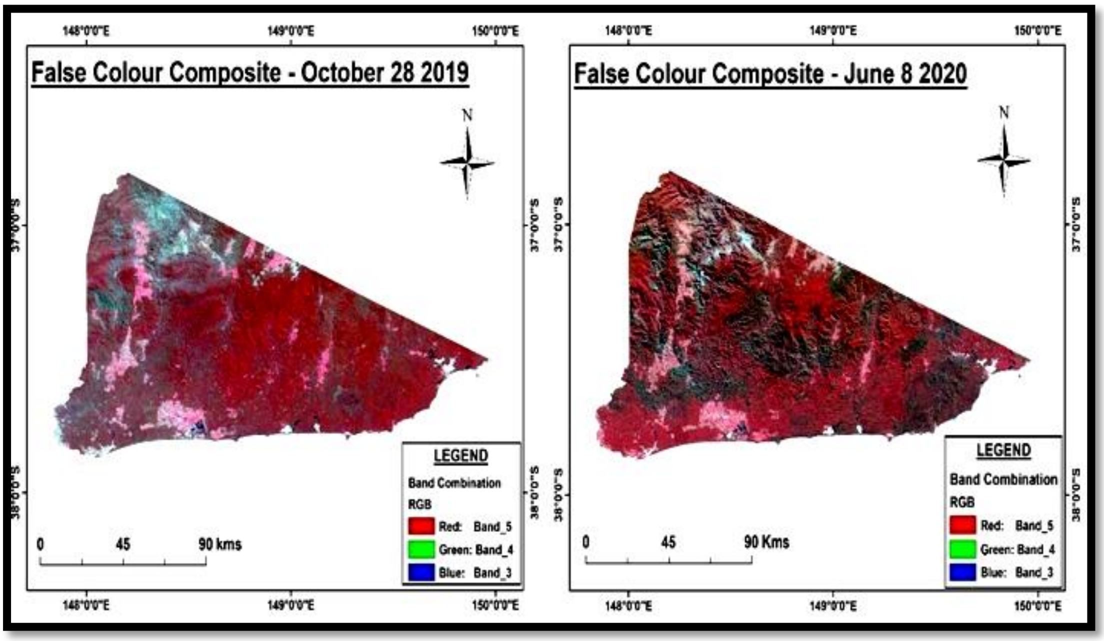

Figure 3: (a) & (b) 28th October 2019 & 8th June 2020 False Color Composite Maps with the Band Combination of(5 4 3)

IV. NDVI CHANGE DETECTION

NDVI (Normalized Difference Vegetation Index) change detection is carried out to analyze and establish the data's vegetative changes. The normalized difference vegetation index (NDVI) is a simple graphical indicator that can be used to analyze remote sensing measurements, often from a space platform, assessing whether or not the target being observed contains live green vegetation. This method can be analyzed with a formula given below, as for LANDSAT- 8 imageries Band5 (Near infrared band) and Band4 (Red band) are used. **NDVI= (Band5–Band4)/(Band5 +Band4)**

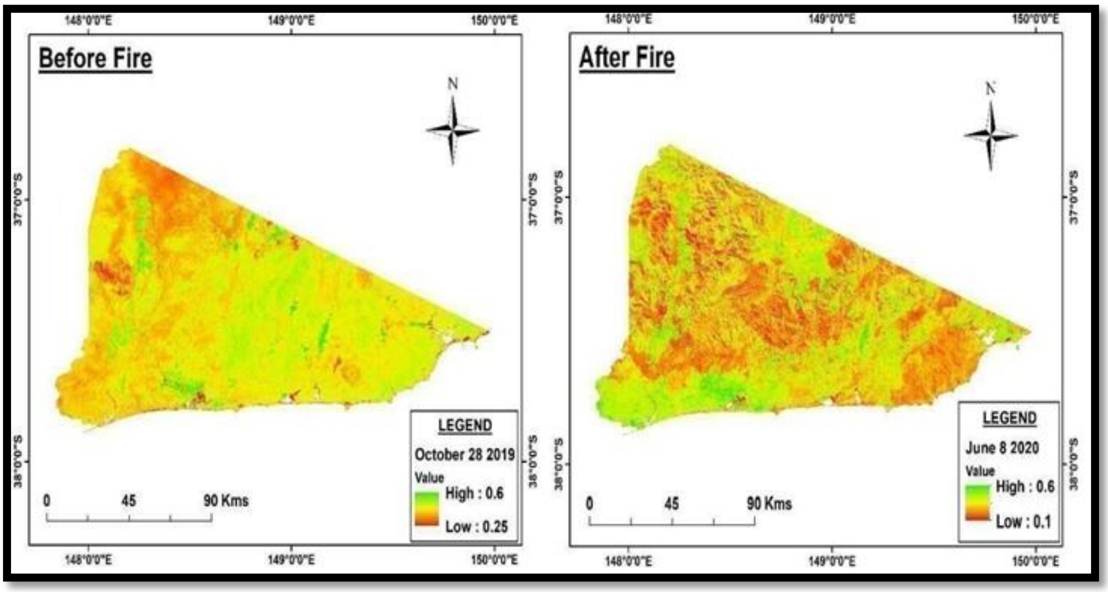

Figure 4: (a) & (b) NDVI Detection of Before and After Fire

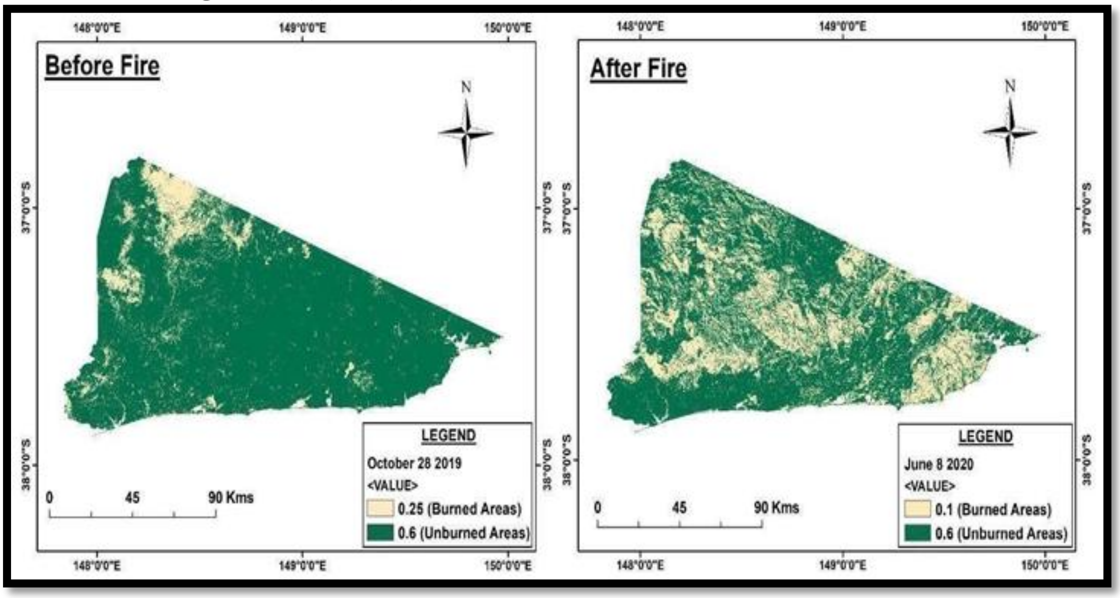

Figure 5: (a) & (b) NDVI Detection over the Burned Areas and Unburned area

The analysis on the data from Before and After fire Fig4(a)&(b) shows the range on the intensity of the fire as for Before fire the value ranges from 0.6 High to 0.25 Low and for After fire the value ranges from 0.6 High to 0.1 Low. A more distinctive analysis using color index indicating the Burned and Unburned areas Fig 5(a) &(b) shows a good view of impact happened around the study area.

V. RESULTSAND DISCUSSION

Using the field calculator tool, the area of each land class is calculated for further analysis to identify the effect statistically. The results of the NDVI classification change are givenin the Table 2 &3 for both before and after Fire. As the areas affected are interpreted by two objectives as Burned areas and unburned areas. As further the resulted data are also identified by using Bar graph is shown in Figure 9& 10. On October 28 2019 of Before Fire the Burned areas are calculated as 14408.12 km^2, and unburned areas are calculated as 109610.6km^2.

Table2: Number of Areas Affected using NDVI Classification in Square Kilometers of before Fire

Sl. no	OBJECTIVES (Before Fire)	AREA (in sq.kms)
1	Burned Areas	14408.12
2	Unburned Areas	109610.6

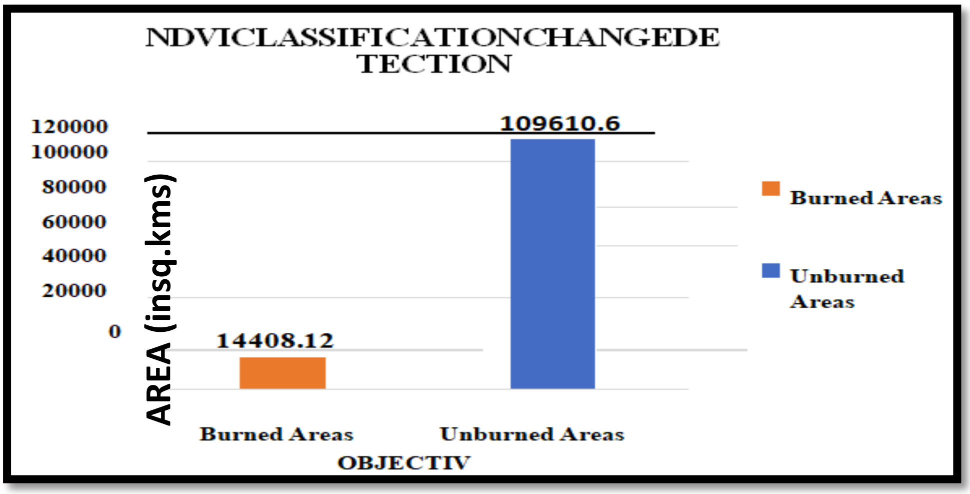

Figure 9: Bar Graph of NDVI Classification of before Fire (October282019) Establishing the Amount of Area Affected in the Study Area

As, On June 8 2020 of after fire the Burned areas are calculated as 45802.13km2, and unburned areas are calculated as 78451.92 km2. As it identifies that Burned areas is very much increased thus the intensity of the Bushfire affected much of the areas.

Table3: Number of Areas affected using NDVI Classification in square kilometers of after Fire

Sl. no	Objectives	Area (In sq.Kms)
1	Burned Areas	45802.13
2	Unburned Areas	78451.92

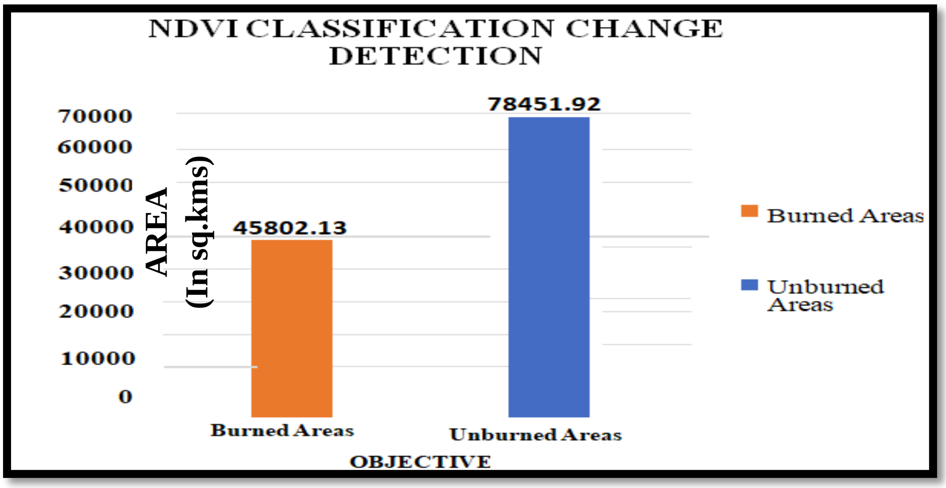

Figure 10: Bar Graph of NDVI Classification of After Fire (June 8 2020) Establishing the Amount of Areas Affected in the Study Area

VI. CONCLUSION

Bushfire are considered to be more vital when it got increased with aspects of more windand dry climate which spreads the effect of the fire more quickly and more vigorously. Asthe results of the above study concludes that the burned areas are so much increased due to these effect so intensified fire and wind and also the dry climate/weather played a huge cause. Thus, these geospatial based methods are very much useful to identify the cause and damages of these kinds of catastrophically events, where human scan not be able toexamine directly. Thus, from the above study, it can be inferred that in current scenario due to global warming and climate change, weather/climate play's important roleon forest fire/bushfire events and its spread especially during summer season therefore its forecast should be warranted on daily basis during forest fire period. Still, lots of Forest fire/Bushfire events are occurring rapidly across the world, as 24/7 datasets of satellite images can be used to identify the prone areas creates ways to cease it from spreading. Thus, an integrated approach would ensure its prevention and mitigation such that the forest and the environment are safeguarded. Forests play a very vital role in reducing carbon emissions across the world, so the government and authorities should take an oath to safe guard them from these disastrous events.

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