IRSAJ
International Remote Sensing Applied Journal
e_ISSN =2775-3409
p_ISSN =_____- _____
Vol 3 No 2| Dec 2022

MAPPING OF FOREST AND LAND FIRE HAZARDOUS USING LANDSAT 8 SATELLITE IMAGERY WITH LAND SURFACE TEMPERATURE (LST) AND NORMALIZED BURN RATIO (NBR) METHODS

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ABSTRACT: This study aims (1) to determine the distribution of Land Surface Temperature (LST) in the Baso District in 2022 (2) to determine the Normalized Burn Ratio (NBR) in Baso District in 2022 (3) to map areas prone to forest and land fires by utilizing the Land Surface Temperature (LST) and Normalized Burn Ratio (NBR) algorithms in Baso District in 2022.
This study uses the Land Surface Temperature (LST) method to determine the distribution of land surface temperatures in the Baso District in 2022. The Normalized Burn Ratio (NBR) method is used to identify areas that are burned and then weighted overlay using Arcgis to obtain data on land and forest fire vulnerability. in Baso District.
The results of this study are (1) showing a minimum temperature value of 13.6ºC maximum temperature of 34.5oC and an average temperature of 26oC (2) showing the results of the distribution of areas with a value of -1 which are identified as burnt or those with bad vegetation of 2.5 and areas with a value of 0 indicating vegetation a good area of 7,636 Ha (3) on the mapping of areas prone to forest and land fires after the Weighted Overlay was carried out found 4 classes of vulnerability levels not prone to forest and land fires, moderately prone, prone and very prone to forest and land fires.
Keywords: Land Surface Temperature(LST), Normalized Burn Ratio (NBR) Weighted Overlay

1. INTRODUCTION

Forest and land fires occur almost every year in Indonesia, especially in Sumatra and Kalimantan (Yulianti et.al., 2013). Forests and land tenure have become widespread issues in Southeast Asia, with large areas of forest being destroyed over the last few decades (Hafni, 2017). These fires also cause damage to land cover, economic losses, and social problems (Yusuf et.al., 2019)

Repairing fire damage takes a long time, especially if it returns to forest and land. Until now, forest and land fires have recurred in Indonesia, one of which occurred in Baso District, Agam Regency, West Sumatra Province. Information on fire-prone areas is very important information needed by fire managers in their forest and land fire protection activities. This study aims to map forest fire-prone areas in Baso District, Agam Regency.

Measuring areas prone to forest and land fires directly in the field in large areas that are difficult to reach and expensive will require a long time. Another method that can be used to provide information on areas prone to forest and land fires is relatively faster. simultaneously in areas that are quite large and difficult to reach, costs that are relatively cheaper and use a level of accuracy that can be accounted for by utilizing remote sensing imagery. to identify areas prone to forest and land fires that provide good results with high accuracy.

2. RESEARCH METHODS

2.1 Research sites

Baso sub-district is one of the 16 sub-districts within the administrative area of Agam Regency. Baso District is located at position 100° 27' 57.9" East Longitude and - 0° 17' 10.32" South Latitude with the distance from the Capital City of Agam Regency +85 Km Geographically, the area of Baso District is 70.30 Km2. The topography is wavy and hilly with slopes very steep. Baso District is located at an altitude of between 725 to 1,525 m above sea level. The air temperature in Baso District is between 20°C and 28°C. The air humidity is 88%, the wind speed is between 4 to 20 km/hour and the average solar radiation is 58%. The rainfall for the Baso sub-district is between 3,500 and 4,000 mm/year without a dry month. The Baso sub-district is passed by 3 water bodies, Agam stem, Jabua stem and Aia stem.

IRSAJ
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e_ISSN =2775-3409
p_ISSN =_____- ____
Vol 3 No 2| Dec 2022

2.2 Data analysis technique

2.2.1 Satellite Imagery and Image Processing
Landsat 8 satellite imagery downloaded via USGS Earth explorer is then processed with the ENVI tool to carry out a radiometric correction, then further analysis is carried out usingArcGISs 10.3.

2.2.2 Identification of Land Surface Temperature (LST)
The data on the satellite image when it is just downloaded is still in the form of a Digital Number, so it has to go through several conversion stages to get the actual surface temperature value. with the following equation:

Changing the Digital Number (DN) value to TOA radiance (radiance value)

$L\lambda = ML \times Qcal + AL$

Information :
$L\lambda$= TOA radiance (radiance value)
ML = Band-specific multiplicative rescaling factor (found in metadata) AL = Band-specific additive rescaling factor (found in metadata)
Qcal = DN at each pixel in the Landsat image band

Converts the radiance value to brightness temperature

$Q = K\ 2\ /\{a \log(k1/ L\lambda+1)\}$

Information:
T = Brightness temperature
$L\lambda$ = TOA radians
K1 = thermal constant band 10 or 11 (found in metadata)
K 2 = band 10 or 11 thermal constant (found in metadata)

2.2.3 Identification of Normalized Burn Ratio (NBR)
To identify burned areas. The equation used in the NBR value method ranges from -1 – 1, a low NBR value towards -1 indicates that the area is a former fire and vice versa if the NBR value is high towards 1 then the area has fairly good vegetation

NBR = NIR-SWIR/NIR+SWIR
Information
NBR = Normalized Burning Ratio
NON= Spectral Value of Near Infrared channel
SWIR= Spectral wavelength value

1. RESULTS

3.1 Land Surface Temperature (LST) of Baso District in 2022

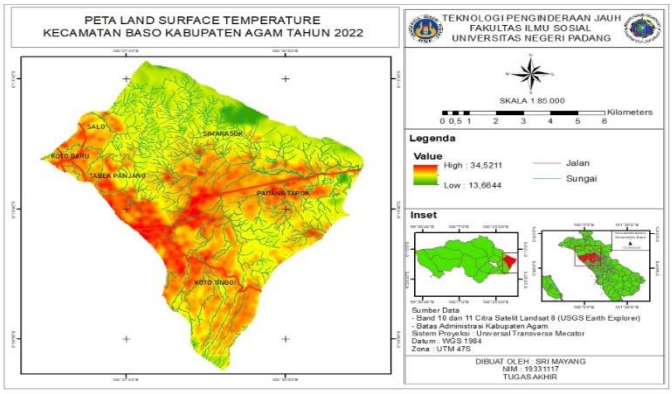

FIG. 1 Land Surface Temperature (LST) of Baso District in 2022

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As a result of the distribution of ground surface temperature in Baso District, the minimum temperature value is located in the northern part of Baso District (Simarasok) and a small part of East Baso (Padang Tarok) with high vegetation density, while the maximum temperature is dominated in the western part of Baso (Tabek Panjang). With low vegetation density caused by increased built-up land such as housing and proximity to highways which causes the area to absorb heat more quickly, the ground surface temperature in Baso District is by the following table:

Table 1 Soil Surface Temperature in Baso District

No	Surface Temperature	Celsius (oC)
1	Maximum temperature	34.5
2	Average Temperature	25,9
3	Minimum Temperature	13,6

Source: Processing Results

3.2 Normalized Burn Ratio (NBR) for Baso District in 2022

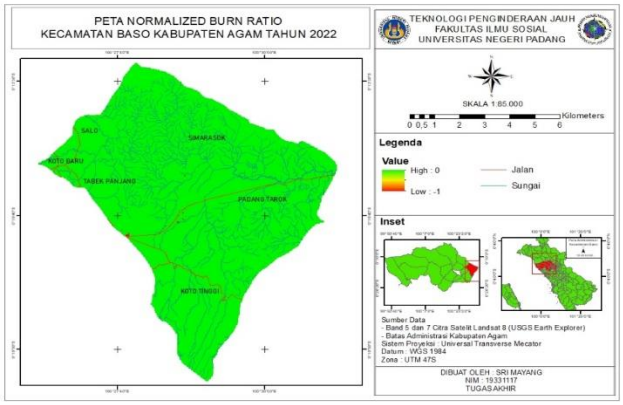

Fig 2 Normalized Burn Ratio (NBR) for Baso District in 2022

The results of the distribution of the Normalized Burn Ratio (NBR) area have a value of -1 which is identified as burning or those with poor vegetation scattered hotspots indicating that the area is very prone to forest and land fires in several areas including Nagari Tabek Panjang Nagari Koto Tangah and Nagari Samarasok whereas those with a value of 0 indicating good vegetation are found in all Nagari in Baso District. **The distribution of the Normalized Burn Ratio (NBR) in Baso sub-districts is according to the following table**

Table 2 Normalized Burn Ratio (NBR)

No	Classification Class	Area (Ha)
1	-1 (Fire scars)	2,5
2	0 (Area with Good Vegetation)	7,636

Source: Processing Results

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3.3 Forest and Land Fire Vulnerability Map using LST and NBR algorithms in Baso District, Baso District, 2022

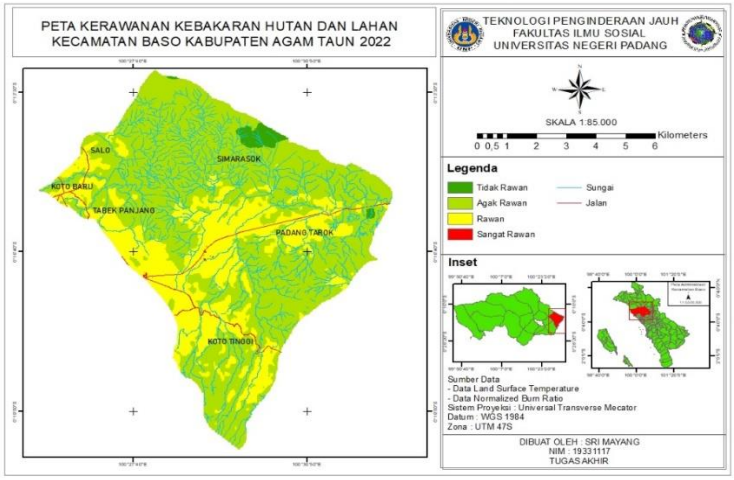

Fig. 3 Forest and Land Fire Vulnerability Map using LST and NBR algorithms in Baso District, Baso District, 2022 Map

The final results of the forest and land fire hazard maps derived from Weighted Overlay of Land Surface Temperature (LST) data, Normalized Burn Ratio (NBR) data can be seen that there are 4 class levels including not prone to forest fires and land, moderately prone, prone and very prone to forest and land fires The vulnerability of forest and land fires by the following table:

Table 3 Area of Vulnerability to Forest and Land Fires

No	Vulnerability Level	Area (Ha)
1	Not prone	113,1
2	Somewhat prone	5293.3
3	Prone	2229.5
4	Very vulnerable	1,8

Source: Processing Results

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2. RESULT

Land Surface Temperature or ground surface temperature is the thermal emission from the soil including vegetation and bare ground surface which can affect the vulnerability of forest and land fires, this is in line with the statement expressed by Wan and Synder (1996), Land Surface Temperature or ground surface temperature can affect vulnerability forest and land fires according to the statement expressed by (Becker and Li 1990) and corroborated by the opinion of Tursilowati (2007)

*Normalized Burn Ratio*used to highlight burned areas and estimate the severity of fire that greatly affects the vulnerability of forest and land fires, this is in line with the statement expressed by Key and Benson (2005), Normalized Burn Ratio greatly affects the vulnerability of forest and land fires by the statement by Wulder and Franklin (2006) and strengthened by the opinion of Suwarsono (2012)

3. CONCLUSION

1. The research results have produced information about the distribution of Land Surface Temperature (LST) in Baso District in 2022 to obtain a minimum temperature value of 13.6oC and a maximum temperature of 34.5oC with an average temperature of 25.98oC. The minimum temperature value is located in the northern part of Baso District (Simarasok) and a small part of East Baso (Padang Tarok).

2. The results of this study have produced information about the distribution of normalized burn ratio (NBR) in Baso District in 2022 there are vulnerable values -1 and 0, -1 is a burnt area with an area of 2.5 Ha while 0 is an area that has good vegetation area of 7,636 Ha
3. The results of this study have been able to produce a Forest and Land Fire Vulnerability Map in Baso District in 2022 with four hazard classes, low vulnerability or not prone to forest and land fires covering an area of 113.1 Ha in several areas in Nagari Simarasok and Padang Tarok, somewhat A vulnerable area of 5,293.3 Ha is found in all areas in Baso District, the level of vulnerability is 2,229.4 Ha and the highest level or very prone to forest and land fires of 1.8 Ha is in the Nagari Tabek Panjang and Padang Tarok areas.

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