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MAPPING OF AREAS OF FOREST AND LAND FIRE VULNERABILITY IN THE SANIANG BAKAR AREA, X KOTO DISTRICT, SOLOK DISTRICT

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ABSTRACT: This research uses quantitative descriptive analysis which has the title "Mapping Areas of Forest and Land Fire Vulnerability in the Saniang Bakar Area, X Koto District, Solok Regency." This research aims to determine the distribution of forest and land fire vulnerability based on the influence of each parameter: land cover, Rain intensity, soil type, height in the Saniang Baka area, research results based on each parameter of land cover which is quite large, fires are dominated by forests covering an area of 4946.5 ha and shrubs covering an area of 3810.2 ha, the rain intensity parameter is dominated by the very low category. around 200 mm/year, the majority of soil type parameters are Andisols, the height parameters are generally dominated by the sloping category. Understanding the distribution of land surface temperatures using the Land Surface Temperature (LST) algorithm in the Saniang Baka area shows a minimum temperature value of 14.8OC, a maximum temperature of 45.6OC and an average temperature of 30.6OC. The results of the analysis used in the Saniang Bakar area have a general level of vulnerability to forest and land fires in the high category with an area of around 2358.64 Ha.

Keywords: Land Surface Temperature(LST), Weighted Overlay

1. INTRODUCTION

Forest and land fires have a significant impact on human losses, both material and immaterial. The government has made great efforts to resolve this problem through policy support, institutional support and funding support. However, this incident still recurs throughout the year. In fact, the forest and land fires in Jambi Province in 2015 have opened the eyes of all parties to the seriousness of the threats and impacts they cause. The impact of forest and land fires is felt directly by all elements of society who are exposed to the haze (Supriyanto, 2018).

The impact of fire that is felt by humans is in the form of economic losses, namely the loss of benefits from forest potential, such as stands of forest trees which are usually used to meet their needs for building materials, foodstuffs and medicines, as well as animals to meet their needs for animal protein and recreation. Other losses include ecological losses, namely the reduction in forest area, the unavailability of clean air produced by forest vegetation and the loss of the forest's function as a regulator of water management and prevention of erosion (Fachmi Rasyid, 2014).

Repairing fire damage takes a long time, especially if it returns to forests and land, so that forest and land fires occur again in Indonesia, one of which occurred in the Saniang Bakar area, X Koto Solok District, West Sumatra Province. Information on fire-prone areas is very important information needed by fire managers in forest and land fire protection activities. This research aims to map the zoning of areas prone to forest fires in X Koto District, Solok Regency.

The Saniang Bakar area, Solok Regency, is one of the areas in X Koto sub-district, Solok Regency, West Sumatra Province. This sub-district is located at coordinates 0°40'24.41"S South Latitude and 100°30'59.00"E East Longitude. Based on its geographical position, this sub-district has territorial boundaries, namely, to the north it borders Junjung Sirih District, to the south it borders Nagari Koto Sani and Sumani, to the west it borders Solok Regency, to the east it borders with Nagari Singkarak. This sub-district is located 400 meters above sea level, with a rainfall intensity of 1500 mm/year, this settlement is influenced by a nagari surrounded by hills, which is called Tunjung Forest.

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The data used to carry out this research is Landsat 8 image data, the Landsat 8 satellite is a satellite launched on February 11 2013 which is the latest generation satellite, namely the Landsat Data Continuty Mission (LDCM). This satellite circles the earth every 99 minutes and covers the same area every 16 days except for the highest polar latitudes. Landsat 8 has 2 sensors, namely the Operational Land Imager (OLI) sensor consisting of 9 channels (bands) including a high resolution panchromatic band and a Thermal Infra Red Sensor (TIRS) with 2 Thermal bands (Sampurno & Thoriq, 2016). The Landsat 8 satellite is processed to obtain Normalized Difference Vegetation Index (NDVI) values and administrative boundary data, then the data is weighted overlay using Arcgis software.

In general, the Normalized Difference Vegetation Index (NDVI), which combines red and infrared spectra, is an index that is widely used to identify burned land (Viedma et al, 1997). Meanwhile, developments in terms of methods for identifying burned land/forest have been carried out, including through the single band method (Near IR, Mid Ir, Brightness temperature thermal spectral), band ratios, vegetation index through the Normalized Difference Vegetation Inedx (NDVI) method, Land Surface Temperature (LST) (Eptinga et al, 2005, Escuin, 2007).

In an effort to identify areas prone to forest and land fires, to overcome forest and land fires in the Saniang Baka area, these impacts can be seen by land changes captured through satellite imagery. The identification results are then used to see changes in vegetation in the area. Identification can be a reference in the future for preventing and managing forest and land fires, especially in areas with the highest impact. In connection with the need for information on forest and land fires and remote sensing techniques that are able to identify areas covering a wide area and quickly, it is necessary to carry out research on Mapping Areas of Forest and Land Fire Vulnerability Levels in the Saniang Bakar Area, X Koto District, Solok Regency.

2. RESEARCH METHODS

2.1 Research site

This research is located in the Saniang Baka area, X Koto District, Solok Regency, West Sumatra Province with an area of 0°40'24.41"S South Latitude and 100°30'59.00"E East Longitude.

2.2 Tools and materials

The type used in this research is quantitative research. The data used is secondary data, namely Landsat 8 satellite imagery downloaded on EarthExplorer and administrative boundary maps downloaded on Inageoportal.

2.3 Data Processing Stage

2.3.1 Initial processing

At this stage, radiometric correction is carried out to correct errors or distortions caused by imperfect operation and sensors, attenuation of electromagnetic waves by the atmosphere, variations in data collection angles, variations in elimination angles, reflection angles and others that can occur during collection, transmission and recording. data. As well as carrying out atmospheric corrections to restore the image, the reflected value of the image recorded by the sensor on the satellite will be disturbed by various atmospheric conditions until the reflected value of the pixels captured by the sensor no longer matches the value of the original object.

Next, cut the image using a shapefile with the research location, namely in the Saniang Baka area, Solok Regency.

2.3.2 Processing

2.3.2.1 Land Cover

The land cover value is determined by calculating the NDVI value

2.3.2.2 Air temperature

LST processing then carries out a transformation to obtain the surface temperature value of an area.

2.3.2.3 Rain Intensity

CH processing that utilizes rainfall intensity data from daily rainfall intensity data in

an area.

2.3.2.4 Type of soil

Processing to determine the type of soil has factors in soil formation, namely: mixing materials, relief, climate, organisms, and time. To determine the type of soil, researchers used data on soil types and geology to determine the types of soil in the area.

2.3.2.5 Height of Place

Processing elevation or land surface height can help researchers get to know an area better, knowing the condition of an area will help researchers maximize the potential of an area.

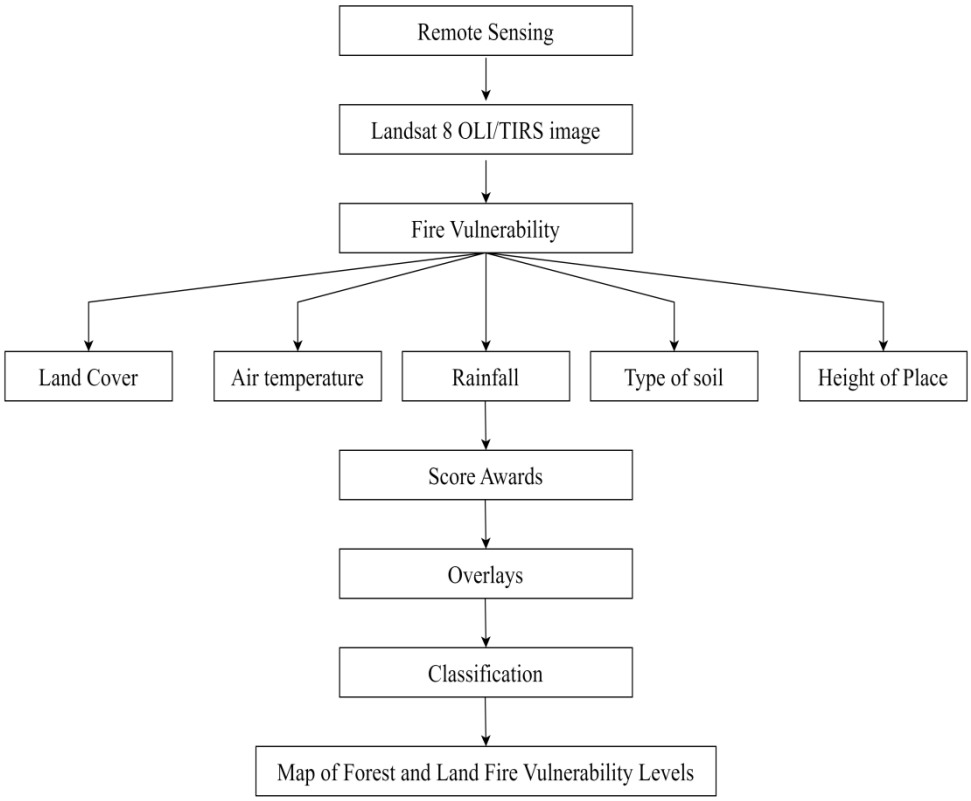
2.3.3 Identifying Landslide-Prone Areas for Forest and Land Fires

Vulnerability Identification is used as an intermediary medium in carrying out identification related to potential vulnerability to forest and land fires. This process is a weighting of the parameters that have been created. This process is called Weighted Overlay which is carried out to weight parameters that already have their respective classifications by carrying out a classification process, so that the process of identifying areas with levels of vulnerability to forest and land fires can be carried out. This process functions to analyze various types of parameters which are then combined into one unit that can represent all parameters.

2.3.4 Accuracy Test

Accuracy tests are carried out to assess the accuracy of land use classification data from processing using Landsat imagery. Accuracy testing is a process that shows the truth of the research carried out. Accuracy testing classification uses the Kappa Accuracy calculation method which considers kappa accuracy, namely user value calculations, manufacturer accuracy calculations, overall accuracy calculations and kappa accuracy calculations.

2.3.5 Flow chart



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3. RESEARCH RESULTS AND DISCUSSION

3.1 Analysis of areas prone to forest and land fires in the Saniang Baka area, X Koto District

3.1.1 Land Cover Parameters

The land cover map comes from Landsat 8 OLI/TIRS Satellite imagery in 2022 using the Supervised Classification method based on land cover classification according to Malingreu.

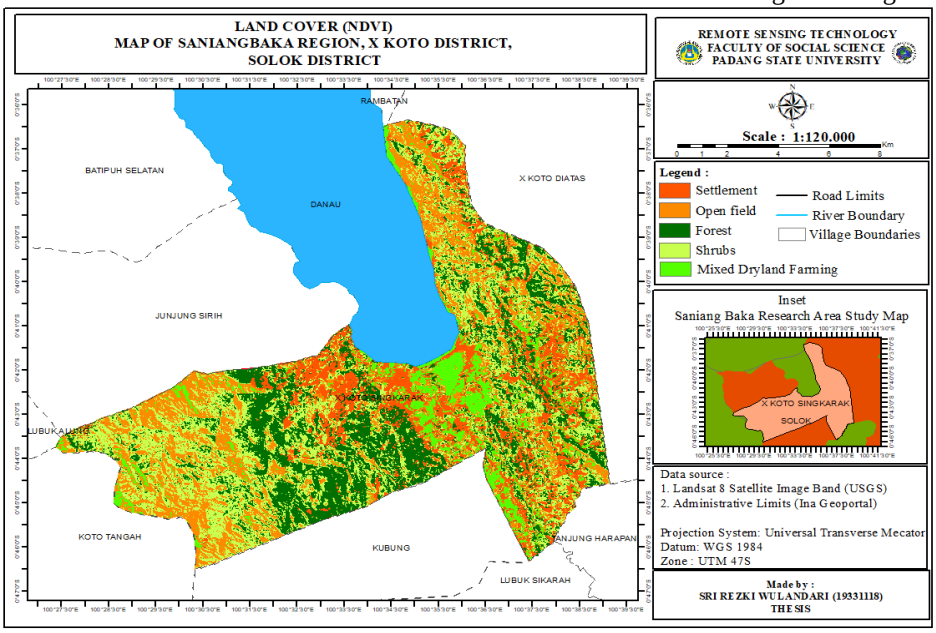

Figure 1. Land cover of the Saniang Bakar area

Using the Supervised Classification method based on land cover classification according to Malingreu. So the land cover of the Saniang Bakar area consists of 6 classes, such as Mixed Dry Land Agriculture, Settlements, Open Land, Forest and Shrub.

Table 1. Land Use Area

Land use	2022		
	Class	Area (Ha)	Location
Dryland farming	5	1317.6	Saniang Bakar
Settlement	3	3584.7	Saniang Bakar
Open field	4	2521.9	Saniang Bakar
Forest	1	4946.5	Saniang Bakar
Shrubs	2	3810.2	Saniang Bakar

3.1.2 Rain Intensity Parameters

The rain intensity data used comes from CHRIPS (Rainfall Estimate From Rain Gauge and Satellite Observations) data. The CHIRS data used in this research in 2023 were processed using the Arcgis 10.3 application using the IDW method. The rain intensity data is weighted according to its influence on forest and land fires in the Saniang Bakar area, X Koto District.

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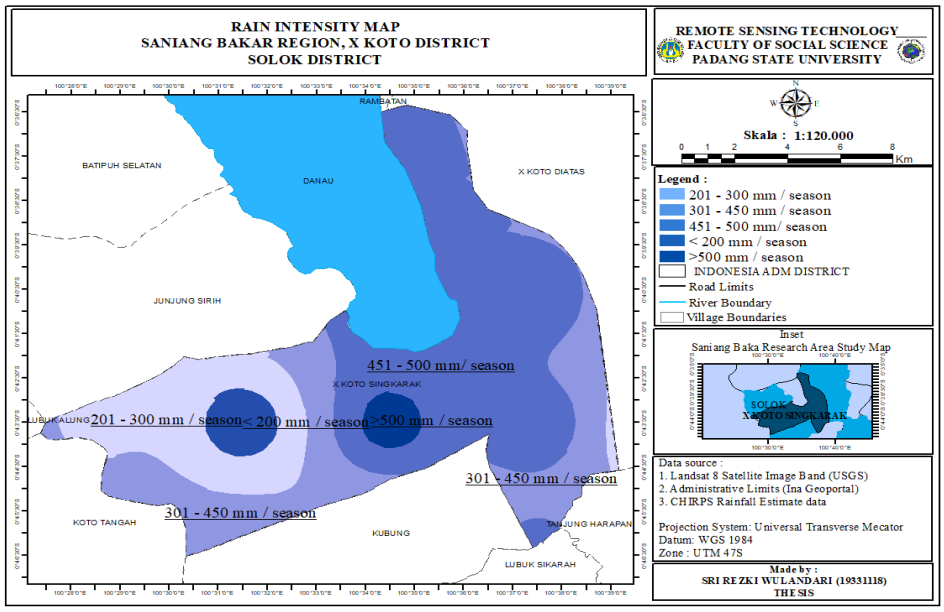

Figure 2. Map of rain intensity in the Saniang Bakar area

The intensity of rain in the Saniang Bakar area is mostly in the very wet category with an intensity of >600mm/year. The area of each rain distribution in the Saniang Bakar area along with their respective scores are as follows:

Table 2. Classification of Rain Intensity

Rain Intensity (mm/year)	2022			
	Area (Ha)	Honor	Location	Category
< 200 mm/year	605.18	1	Saniang Bakar	Very low
201 – 300 mm/year	3101.92	2	Saniang Bakar	Low
301 – 450 mm/year	4383.21	3	Muaro Pingai	Currently
451 – 500 mm/year	7689.41	4	Aripan	Wet
>500 mm/year	405.79	5	Koto Sani	Really wet

3.1.3 Soil Type Parameters

Soil type data was obtained from FAO/UNESCO (Fao Soil Map Of The World). In the form of a shapefile that is directly input into the Arcgis 10.3 software. Soil types can be identified based on legends and information contained in the Fao Soil Map of the World.

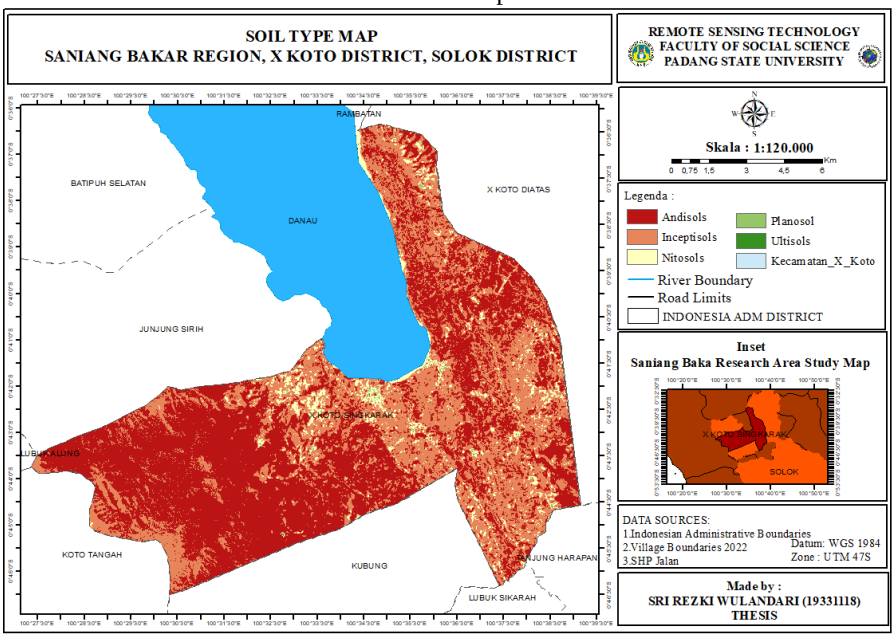

Figure 3. Map of Soil Types in the Saniang Bakar Area

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The types of soil found in the Saniang Bakar area are Andisold, Inceptisols, Nitosols, Planosols, and Ultisols.

Table 3. Soil Type Classification

Type of soil	2022	
	Area (Ha)	Score
Andisol	8839.32	10
Inceptisol	6569.14	
Nitosols	738.94	
Planosols	32.19	
Ultisols	1.5	

3.1.4 Height Parameters

The height of the settlement range is calculated using tols in ArcToolbox. The classification used according to USSSM (United Stated Soil System Management) as a score.

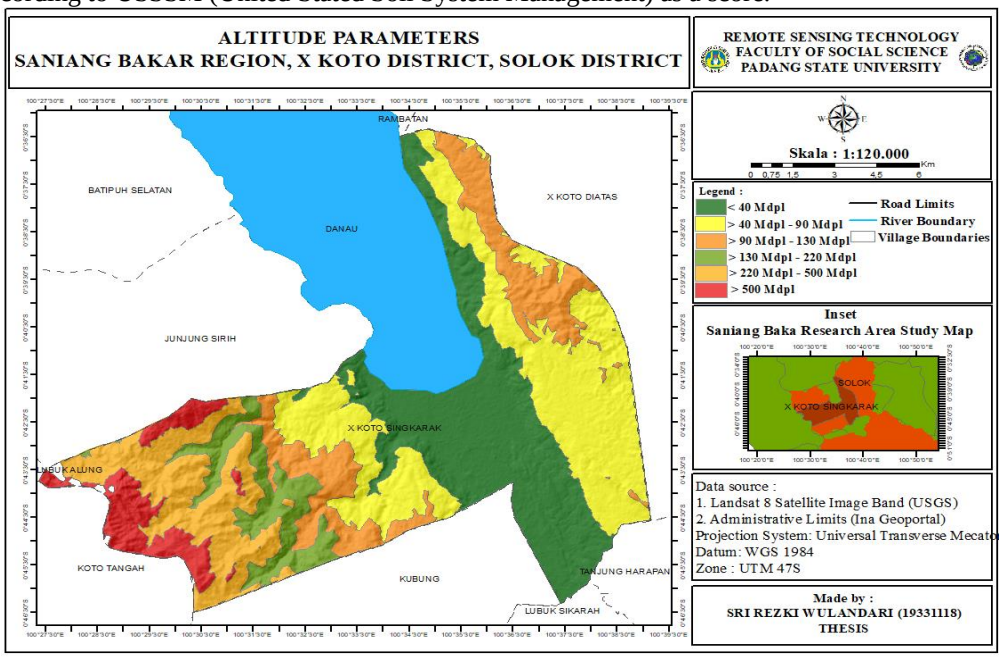

Figure 4. Altitude map of places in the Saniang Bakar area

The height in the research area is approximately more than 55% with a very steep category. Areas that have quite steep heights usually have a greater potential for vulnerability to forest and land fires compared to sloping areas.

Table 4. Altitude Classification

Height	2022			
	Area (Ha)	Honor	Location	Category
>40 meters above sea level	4391.1	1	Saniang Bakar	Flat
>40 – 90 masl	4954.85	2	Saniang Bakar	Sloping
>90 – 130 masl	2298.69	3	Muaro Pingai	Currently
>130 – 220 masl	1210.84	4	Aripan	Steep
>220 – 500 masl	2264.79	5	Koto Sani	Very Steep

3.2 Forest and Land Fire Hazard Map

The forest and land fire hazard map uses an overlay method combining 4 parameters, namely land cover, rain intensity, altitude and soil type. Below are each scoring parameters.

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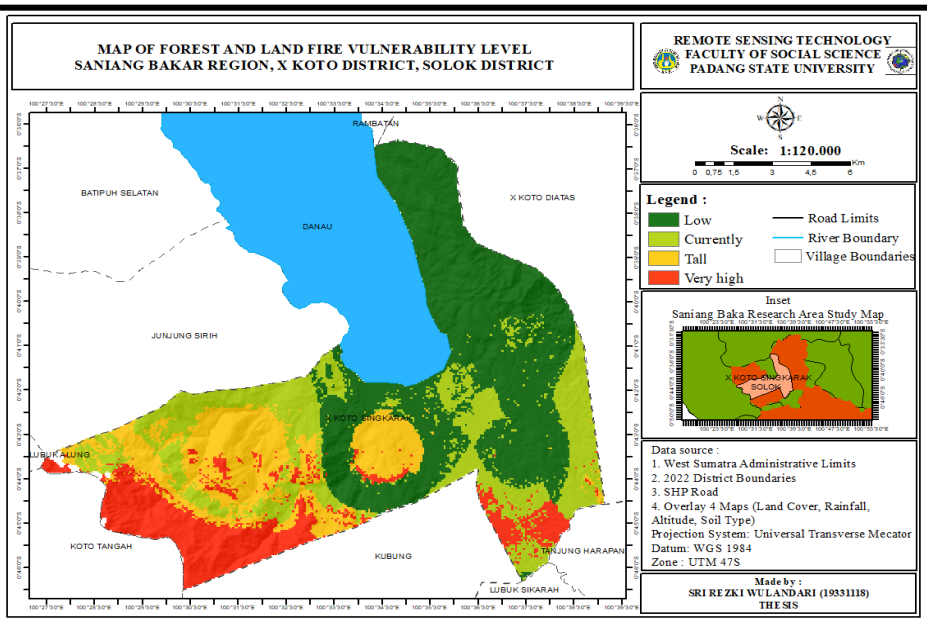

Figure 5. Map of forest and land fire vulnerability in the Saniang Burn area

So the classification of the level of vulnerability to forest and land fires is divided into four classifications, including: low, medium, high and very high.

Table 5. Parameter Scoring

Land Cover			
Class	Score	Weight	Total
Forest	1	0.3	0.3
Shrubs	2		0.6
Settlement	3		0.9
Open field	4		1,2
Dryland farming	5		1.5
Rain Intensity			
Class	Score	Weight	Total
< 200 mm/year	2	0.3	0.6
201 - 300 mm/year	3		0.9
301 - 450 mm/year	4		1,2
451 - 500 mm/year	5		1.5
> 500 mm/year	1		0.3
Height of Place			
Class	Score	Weight	Total
<40 masl	1	0.3	0.3
>40-90 Masl	2		0.6
>90-130 Masl	3		0.9
>130-220 Masl	4		1,2
>220-500 Masl	5		1.5
Type of soil			
Class	Score	Weight	Total
Andoisols	1	0.1	01
Inceptisols	2		0.2
Nitosols	3		0.3
Planosols	4		0.4
Ultisols	5		0.5

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3.3 Land Surface Temperature (LST) Distribution Map in the Saniang Bakar area

To convert to degrees Celsius, use the K-273 formula to convert Kelvin degrees to Celsius degrees (273°K is equivalent to 0°C). In the Arcgis software with the Raster Calculator tool, the results of the surface temperature are cut according to the research area and the symbology and layout of the map are adjusted to make it look more attractive. The results of temperature calculations using the Land Surface Temperature (LST) algorithm obtained a minimum temperature value of 14.8oC and a maximum temperature of 45.6oC with an average temperature of 30.6oC.

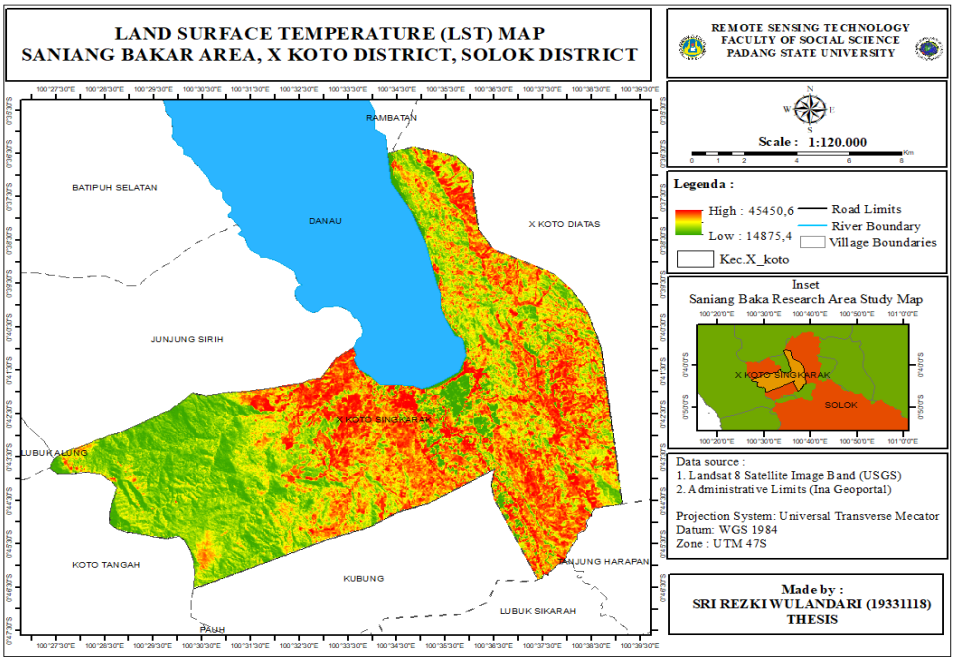

Figure 6. Land Surface Temperature Map

3.4 Accuracy Test

To find out the correct distribution of areas prone to forest and land fires resulting from processing with Landsat 8 imagery, point data is used as a reference for samples. The number of samples used was 25 sample points determined by random sampling. According to random sampling observations carried out based on the distribution of points on the map, there are points that are the same as the results of observations using Google Earth. Determination of sample size is determined using the following formula:

$$\text{No} = \frac{2^2 \; x \; 85 \; x \; 15}{15^2} \quad \frac{4 \; x \; 1275}{225} = 23$$

Table 4. Distribution of sample points based on land use class

Class	Sample Point
Low	7
Currently	6
Tall	5
Very high	5
Amount	23

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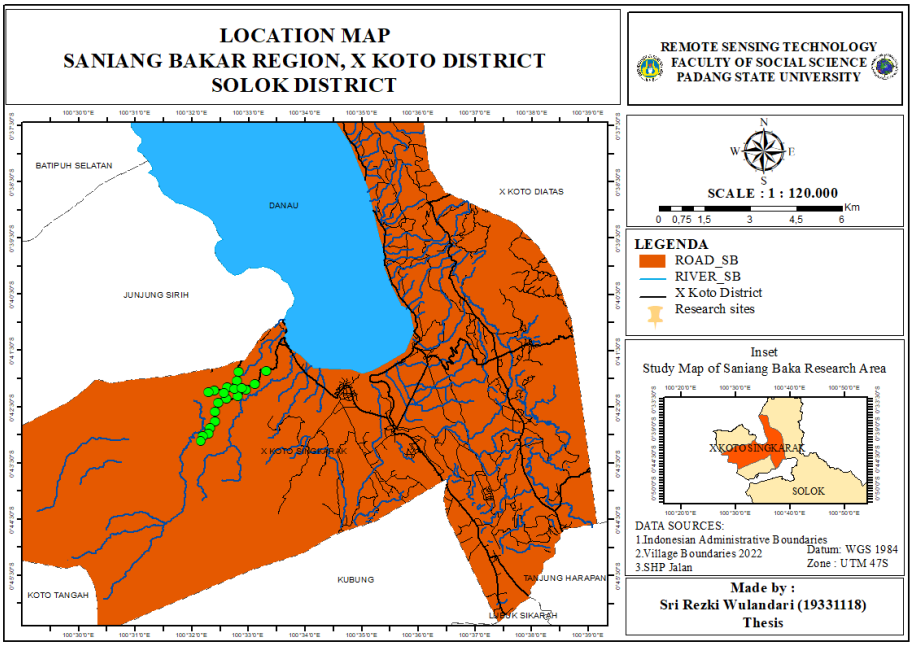

Figure 7. Map of accuracy test sample points

Table 5. Level of truth of land use interpretation

Class	Low	Currently	Tall	Very high	Total(User)
Low	7	0	0	0	7
Currently	1	5	0	0	6
Tall	0	2	3	0	5
Very high	0	0	0	5	5
Total (Producer)	8	7	3	5	23

In calculating the kappa accuracy, a value of 82.7% was obtained.

4 CONCLUSION

Result 3. Researchers have produced a map of forest and land fire vulnerability in the Saniang Bakar area, X Koto District in 2023 with four classes of vulnerability, low level of vulnerability with an area of 6783.84 Ha, medium level of vulnerability covering an area of 3922.61 Ha, high level of vulnerability covering an area of 2980.45 Ha. Ha, and a very high level of vulnerability with an area of 2358.64 Ha in the Nagari Saniang Bakar area. The level of vulnerability of Saniang Bakar is in the very high category with a land area of 2358.64 Ha. Accuracy test results using the kappa accuracy method in the Saniang Bakar area were 82.7%.

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