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Fire area zonation in Karang Intan district of South Kalimantan Province

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Abstract

The decline in forest function has occurred in the forests of South Kalimantan due to fires occurring every year during the dry season. Therefore, efforts are needed to prevent land and forest fires to avoid negative impacts. One of the efforts to prevent land and forest fires is through fire-prone areas zoning map. The purpose of this research was to identify the land and forest fire risk in Karang Intan District so that the fire risk map can be determined. This research was carried out using the Spatial analysis method. From the overlay analysis result, it can be seen that the fire-prone areas zonation in Karang Intan District consists of 4 (four) risk level, medium risk level (1137 ha), high-risk level (3684 ha), very high-risk level (12224 ha) and water body (371 ha). Farmland land cover predominantly high-risk level (3948 ha). Land cover and elevation affect the risk level of land and forest fires in Karang Intan District.

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Introduction

The intensity of the land and forest fires incidences are increasing from year to year, along with all the negative impacts that are also felt increasingly, demanding us to know how big the potential for land and forest fires, especially in the South Kalimantan Province.

The most important influences are the location and the source or the cause of land and forest fires. These things are important to understanding the preparation of tackling and dealing with forest and land fires disaster.

The locations of the fire in question include hotspots and the number or intensity of hotspots by a certain area. For example, the number of hotspots per administrative area, such as a village or a district. Things that can cause forest fires, among others: (1) Forest with high enough hotspots in summer or long dry season, (2) Clearing land into agricultural land by slash and burn, (3) Activities that leave fire marks in the forest such as bonfires, (4) Throw cigarette butts indiscriminately in the forest.

According to South Kalimantan's Natural Resources Conservation Center (Balai KSDA), the number of annual hotspots in 2015 is 1,291 hotspots and the highest is in Banjar Regency with 185 hotspots. From all the districts in Banjar Regency, Karang Intan District is the area that has the most hotspots. According to NASA FIRMS Modis Thermal Anomalies/Fire Locations data, for 2000-2017 Karang Intan had 394 hotspots. Based on data from Manggala Agni (2016) The area that burned during 2014 in Karang Intan district was 309 ha.

The unavailability of forest fires risk map causes the land and forest fire control activities to be constrained in understanding forest fire dynamics to determine priority actions in forest fire prevention activities.

The awareness of the community becomes unfocused and not right on the target. So that manggala agni in hotspots patrol and fire prevention activities cannot be planned within the effective location and time frame.

Based on this condition, a fire risk map is required as a reference for land and forest fire prevention measures. Therefore, this research was carried out with a purpose to identify the land and forest fires risk in Karang Intan District so that the fire risk zonation can be determined.

Materials and methods

The study was conducted in Karang Intan District, Banjar Regency, South Kalimantan Province. The materials used in this study are spatial data, which consists of the administration data of Banjar Regency and Land cover data.

The tools used in this research are (1) Computer and internet network for downloading and processing data; (2) The GIS software, ArcGIS for Desktop 10.3.1 provided by the Environmental Systems Research Institute (ESRI) for spatial data processing; (3) GPS Receiver for field data verification; (4) Digital camera for field documentation.

Works procedure

Land Cover Data: The land cover data used was the result of Landsat image interpretation 8.

The format used is the shapefile, so it already has geographic information.

DEM Data: The DEM data was to be derived to elevation and slope levels data. DEM format is a raster or grid data from RADAR image data management. The resolution used is 30 m.

Rainfall Data:The rainfall data used was sourced from various weather stations data in South Kalimantan. The format used is a shapefile, so it already has geographic information.

Data Management

Land Cover Level: Land cover from Landsat 8 Image on various levels of land cover interpretation result.

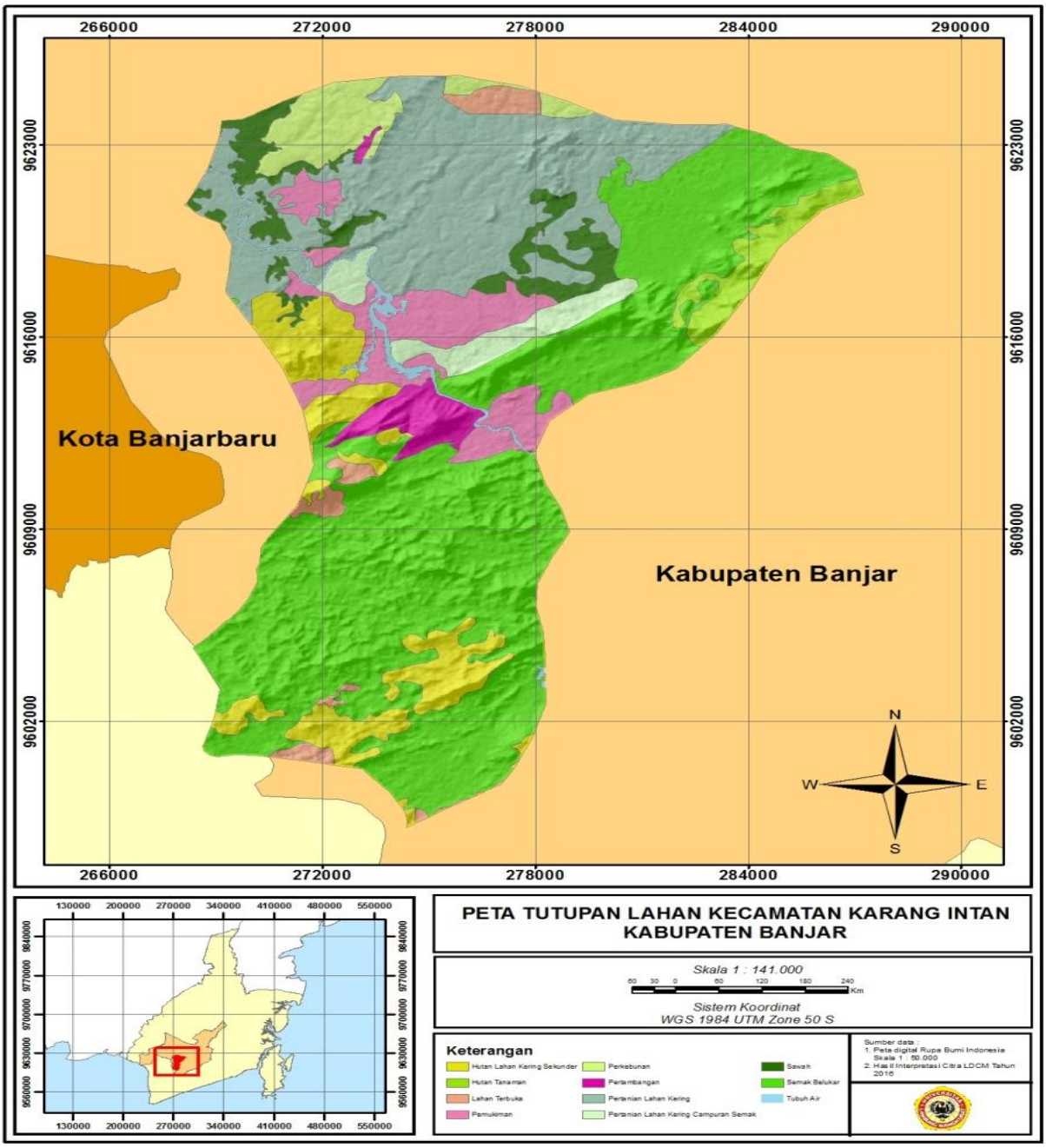

Fig. 1. Karang Intan District of Banjar Regency Map.

The assumption used was that there are differences in the forest fires risk in each type of different land covers. A score of 1 indicates the highest fire risk while score 7 indicates the lowest risk. The land cover level scores were determined based on Table 1.

Elevation Level (Asl): The determination of level scores of altitude from sea level is determined on the assumption that the higher the place, the less the fire risk. Score 1 shows the highest fire risk while score 6 indicates the lowest risk.

The elevation data is derived from DEM using the Spatial Analysis > Reclassify procedure. The determination of the elevation level scores was determined using Table 2.

The determination of the elevation level score is determined based on the assumption that the steeper a place will have less fire risk.

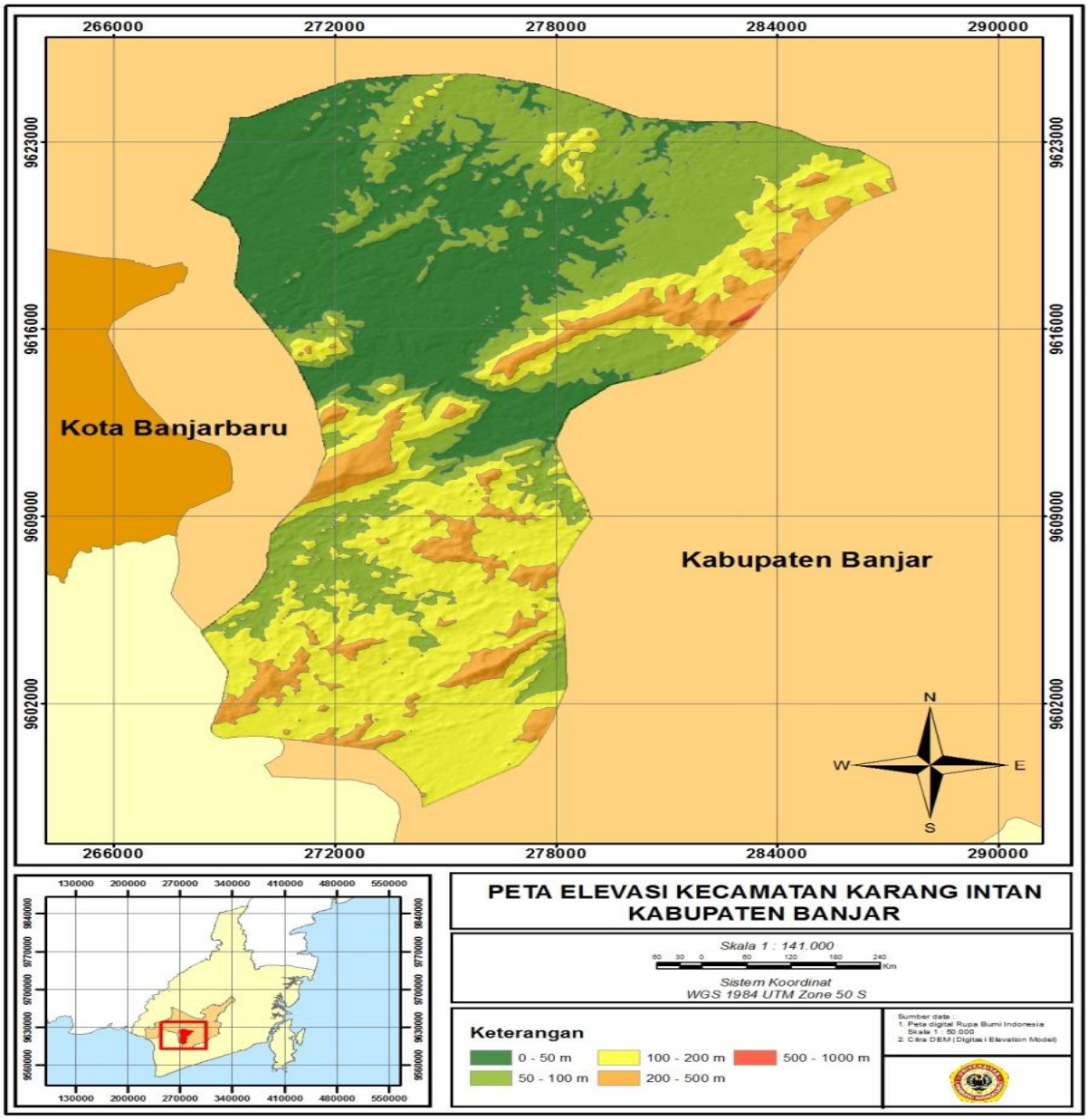

Fig. 2. Elevation Map of Karang Intan District.

It relates to or the intensity of human activity in the place concerned. Average Rainfall Level: Average annual rainfall is classified into 6 levels. The classification and weighting are presented in Table 3.

The weight value of 1 (one) indicates the lowest rainfall area and has the highest potential in the of land and forest fire risk score and vice versa for 6 which means that it has the lowest potential in the of land and forest fire risk score.

Overlay Analysis:From the various supported and available maps, the overlay was done against the themes related to the assessment of land and forest fire risk zones in the research area.

The overlayed maps are: Vegetation/land use map, Altitude above sea level (asl) map, and Average annual rainfall map. Thus generating the land and forest fire risk zone (area) map and finally become a map of land and forest fire risk zones in the sample (footage) district area.The identification/analyzation of land and forest fire risk zones based on their components or determining factors into 4 (four) risk levels which are low, medium, high and very high based on the predetermined scores.

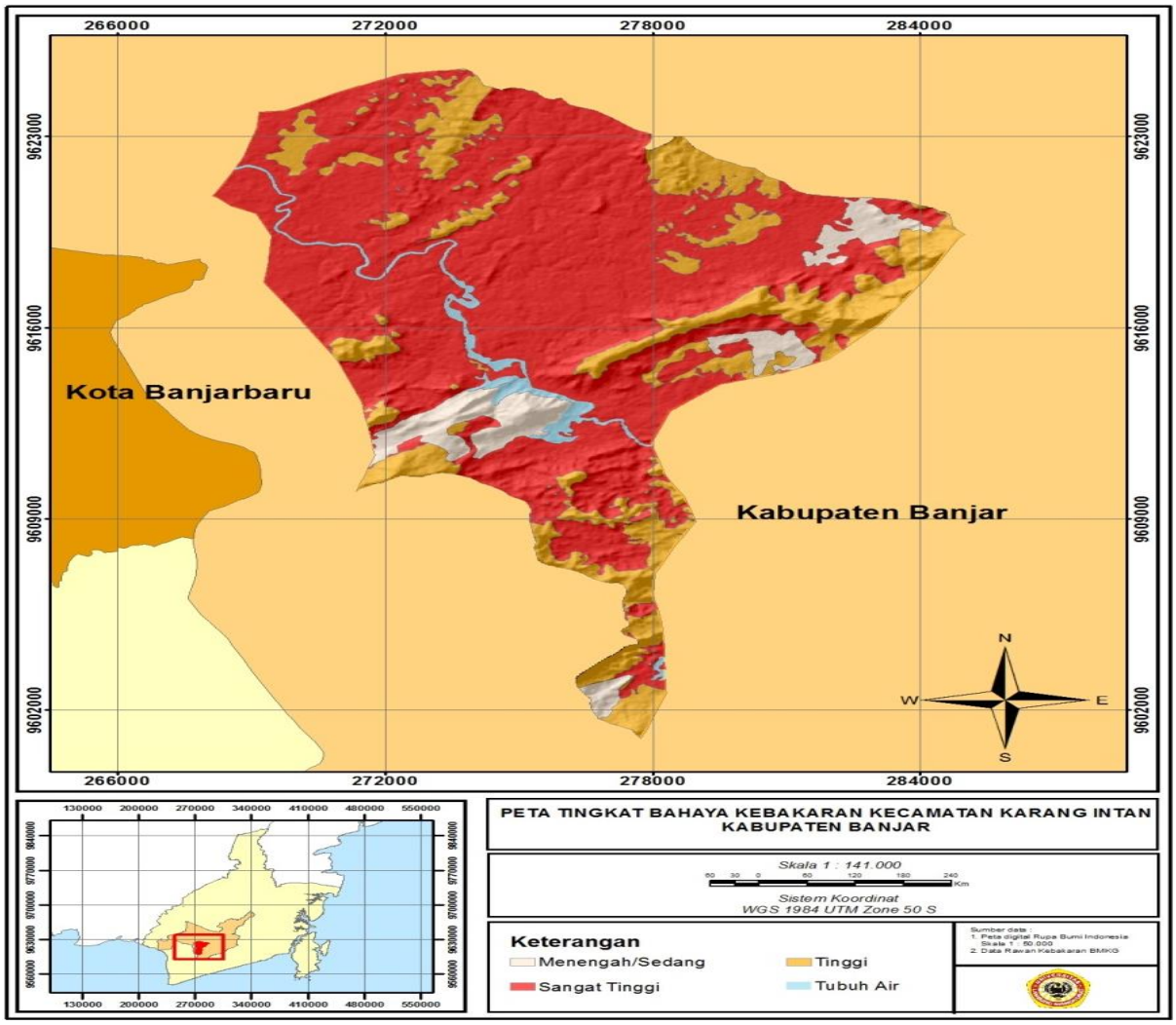

Fig. 3. Fire Dangers Rating Level Map of Karang Intan District.

The models are based on Sudmono and Karsidi (1997) and Ruecker (2002) based on the theory of *The US Nation Wildfire Coordinating Group* (1995) in Sabaraji (2005) formulated as follows:

$$B = V + T + CH$$

Where : B = Land and Forest Fire Risk Zone
V = Vegetation Type/Land Use (1,2,3,4,5,6)
T = Elevation (1,2,3,4,5,6)
CH = Average Annual Rainfall (1,2,3,4,5,6)

The land and forest level risk zone were mapped with Geoprocessing facility with the input of rainfall, elevation, and land cover vegetation themes.

The three themes were combined using mergetogether, then the scoring was summed on each theme with *Field Calculator*. Using *dissolve* analysis, a theme that fits the land and forest fire risk level scoring will be chosen.

The risk level of a region/zone will be determined by the value of various combinations of the various parameters, so that land and forest fire risk condition of the region/zone will be identifiable in the area concerned. The risk based on combinations of the above factors are presented in 4 level: low, medium, high, and very high.

The land and forest fire risk levels are determined by the summation of all values/weights of the constituent parameters in the range presented in Table 4.

The presentation of land and forest fire risk zone identification result based on four levels of fire risk, was made in detail based on the location of the research area.

Results and discussion

General Condition of Research Area

Area Location: Karang Intan District is one of the districts in Banjar Regency. Karang Intan District area is 285.15 km. Administratively, the boundaries of Karang Intan district are:

1. North : Pengaron District
2. East : Aranio District
3. South : Tanah Laut District
4. West : Martapura District dan Banjarbaru City

Land cover of Karang Intan District is shown in Table 5. Based on Landsat Image 8 with 30 m resolution, land cover map in Karang Intan District can be seen in Fig. 1 below:

Rainfall: Based on the climate data and rainfall from Meteorology and Geophysics Agency Class I Banjarbaru (2018), Karang Intan District has an average annual rainfall of 2,500-3,000 mm/year and has a score of 3.

Elevation: The level of the land elevation was obtained from 30 m resolution SRTM. Based on the derivation, Karang Intan District has diverse elevation. The Elevation Map of Karang Intan District can be seen in Fig. 2 below.

Table 1. Land Cover Level Scores.

No	Land Cover	Score
1	Shrublands, Dryland Farming, Settlement/Transmigration, Rice Fields	1
2	Swamps, Secondary Dryland Forests, Industrial Plantations, Dryland Farms + Bushes	2
3	Secondary Swamp Forest, Plantation	3
4	Primary Dryland Forest, Primary Swamp Forest	4
5	Secondary Mangrove Forest	5
6	Primary Mangrove Forest, Mining	6
7	Open Land Pond, Airport	7

Source: *Ruecker in Sabaraji* (2005).

Table 2. Elevation Level Scores.

No	Elevation	Score	Information
1	< 50 m	1	
2	50 m – 100 m	2	
3	100 m – 200 m	3	
4	200 m – 500 m	4	
5	500 m – 1.000 m	5	
6	>1.000 m	6	

Land and Forest Fire Risk Level in Karang Intan District

The level of land and forest fire risk in Karang Intan District is based on the mapping of land cover, rainfall and land slope (elevation) parameters, to give a description of the fire-prone areas. Land and forest fire control activities will be more effective if areas that are prone to fire are known. Zoning map of fire-prone areas in Karang Intan District can be seen in Figure 3 below.

The result of parameters overlap mapping (land cover, elevation, and rainfall), 3 (three) fire risk levels were obtained as Fire risk level (Table 6).

Table 3. Average Annual Rainfall Level Score and Weight.

No	Average Annual Rainfall	Score
1	< 2000 mm	1
2	2000 – 2500	2
3	2500 – 3000	3
4	3000 – 3500	4
5	3500 – 4000	5
6	4000 – 4500	6

Source: Ruecker dan Sabaraji (2005).

Based on the landscape (Fig 1 and Table 5), Karang Intan District is dominated by dryland farming and shrubs. The upstream of Riam Kanan Sub Basins, topographically, is part of the Meratus Mountain series, so the elevation is quite high (reaching 1,000 meters above sea level even more) and still dominated by Dryland Forest. While the downstream of Riam Kanan Sub Basins are urban and agricultural areas.

Table 4. Land and Forest Fire Risk Level Scores.

No.	Risk Level	Score
1	Low	>15 – 19
2	Medium	>11 – 15
3	High	>7 – 11
4	Very High	3 – 7

Source : Ruecker in Sabaraji (2005).

From the meteorological aspect, the spatial distribution of rainfall in Karang Intan District is not too varied. Given Karang Intan District is a region that is not so wide, so rainfall from one part of the region to another is relatively not much different. In relative terms, the fire hazard level in Karang Intan District is not dependent on rainfall.

When viewed from the Fire Risk Level Map of Karang Intan District (Fig 3), the picture shows that the highest level of fire risk is in lowland areas. When viewed from the parameters used in the fire risk extraction method in this study, the resulting fire risk tends to be more affected by land cover and elevation types, since rainfall is almost evenly distributed in all areas, except slightly downstream. Based on the overlay analysis accordingly land and forest fires with (very high) potentials are located in Awang Bangkal Barat (1114 ha), Awang Bangkal Timur (1082 ha), Bi'ih (838 ha), Jingah Habang Ilir (144 ha), Jingah Habang Ulu (159 ha), Karang Intan (369 ha), Kiram (58 ha), Loktangga (282 ha), Mali-Mali (298 ha), Mandiangin Barat (1354 ha), Mandiangin Timur (1050 ha), Mandi Kapau Barat (409 ha), Mandi Kapau Timur (802 ha), Padang Panjang (738 ha), Pandak Daun (193 ha), Pasar Lama (177 ha), Penyambaran (108 ha), Pulau Nyiur (896 ha), Abirau (133 ha), Balau (37 ha), Lihung (280 ha), Sungai Alang (321 ha), Sungai Arfat (370 ha), Sungai Asam (527 ha), Sungai Besar (116 ha), Sungai Landas (102 ha).

Associated with the elevation of a place, it has become common knowledge that the higher a place from the sea surface, then the air temperature will decrease. This is known as a vertical temperature gradient. Consequently, the lower the temperature, the air can store/retain more moisture. This can prevent or at least reduce the potential of fire.

When viewed from land cover parameters, land cover types that contribute greatly to high fire risk level are

dryland agriculture (3948 ha), shrubs (2904 ha), settlements (1804 ha), secondary dryland forest (882 Ha). This is in accordance with the occurrence of land and forest fires occurring in the field recorded through hotspot data.

Table 5. Land Cover of Karang Intan District.

No	Land cover	Wide (ha)
1	Secondary Dryland Forests	2314
2	Plantation Forest	719
3	Open Field	548
4	Settlement	1874
5	Plantation	1008
6	Mining	6111
7	Dryland Farming	6507
8	Rice Fields	1271
9	Shrubs	12472
10	Water Body	245

Rainfall is a meteorological parameter that cannot be controlled by humans, while topography (elevation) is a physical parameter of a landscape that is generally unconformable. Even if it can, it will require time, effort, and enormous expense. So that land and forest fire control efforts are generally more focused on how to organize land use in a region. In other words, it emphasizes the aspect of spatial arrangement. Because land use will eventually form the biophysical element of a land surface or land cover.

Table 6. Fire risk levels.

No	Fire Risk Level	Wide (ha)
1	Medium	1137
2	High	3684
3	Very High	12224
4	Water Body	371

Conclusion

Zoning level of fire risk in Karang Intan District consists of 4 (four) levels which are medium risk level (1137 ha), high-risk level (3684 ha), very high-risk level (12224 ha) and water body (371 ha). The very high level is dominated by the agricultural land cover (3948 ha).

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