ANALYSIS OF INCIDENT OF FOREST AND LAND FIRE IN INDONESIA (2015-2017) IN FIRE PRONE PROVINCE

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ABSTRAK

HIKMATUL FADHILA. Analisis Kejadian Kebakaran Hutan dan Lahan di Indonesia Tahun 2015–2017 di Enam Provinsi Rawan Kebakaran. Dibimbing oleh ATI DWI NURHAYATI.

Kebakaran hutan dan lahan merupakan salah satu fenomena alam yang sering terjadi di Indonesia. Hal ini menyebabkan berkurangnya luas hutan di Indonesia serta memberikan dampak seperti kerugian ekonomi dan gangguan kesehatan. Kejadian kebakaran hutan dan lahan di Indonesia tahun 2015 seluas 2.6 juta ha. Penelitian ini bertujuan untuk menganalisis kejadian kebakaran hutan dan lahan di Indonesia yang terjadi dalam tiga tahun terakhir (2015–2017) di Provinsi Riau, Jambi, Sumatera Selatan, Kalimantan Barat, Kalimantan Tengah, dan Kalimantan Selatan. Penelitian ini mengunakan data sekunder berupa data hotspot kebakaran hutan dan lahan tahun 2015–2017 dari satelit Terra/Aqua, data curah hujan tahun 2015–2017 dari BMKG, serta data upaya pengendalian kebakaran hutan dan lahan yang dilakukan oleh KLHK (Kementerian Lingkungan Hidup dan Kehutanan). Hasil penelitian menunjukkan bahwa pada tahun 2015 memiliki jumlah hotspot tertinggi dalam tiga tahun terakhir (2015–2017). Curah hujan sangat mempengaruhi jumlah hotspot. Upaya pengendalian kebakaran hutan dan lahan yang dilakukan oleh KLHK berupa pencegahan, pemadaman, dan penanganan pasca kebakaran..

Keywords: curah hujan, hotspot, kebakaran hutan, pengendalian kebakaran hutan.

ABSTRACT

HIKMATUL FADHILA. Analysis of Incident of Forest and Land Fire in Indonesia (2015–2017) in Fire Prone Provinces. Supervised by ATI DWI NURHAYATI.

Forest and land fires has become a common natural phenomenon in Indonesia, brings a significant loss of forest area in Indonesia, economic losses and health problems. Forest and land fires in 2015 has an area of 2.6 million hectare. The aim of this study is to analyze incidents of forest and land fires in Indonesia in the last three years (2015–2017) in Riau, Jambi, South Sumatra, West Kalimantan, Central Kalimantan, and South Kalimantan provinces. This study used a hotspot data in 2015–2017 from Terra/Aqua satellite, precipitation data in 2015–2017 from BMKG, and data of forest and land fires control efforts undertaken by the Ministry of Environment and Forestry. This study show that has the highest number of hotspots in the last three years (2015–2017) was occurred in 2015. The rainfall greatly affects the number of hotspots.

Key words: rainfall, hotspot, forest fire, forest fire control.

ANALYSIS OF INCIDENT OF FOREST AND LAND FIRE IN INDONESIA (2015-2017) IN FIRE PRONE PROVINCE

HIKMATUL FADHILA

Undergraduate Thesis
as one of the requirements for obtaining a Bachelor of
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FOREWORD

Praise and gratitude the author prays to the presence of God Almighty for His grace and mercy the author can complete this scientific work. The title of this scientific paper is the analysis of forest fires in 2015–2017 in six provinces prone to forest fires. This paper was prepared as a requirement for obtaining a bachelor's degree in forestry.

The author's thanks are conveyed to Mrs. Ati Dwi Nurhayati SHut MSi as the supervisor. A big thank you to the writer's big family, especially the late mother and father, who have provided moral and material support and encouragement to the author. Thank you also to my silvicultural friends from batch 51 and friends in one guidance, hafiz and rafif, who have worked together to complete this final project. The authors also thank the friends, puput, bonita, opi, desty, elfa, and friends whose names cannot be mentioned one by one who have provided support and motivation to the author. The author also conveys appreciation to LAPAN (National Aeronautics and Space Agency) and KLHK (Ministry of Environment and Forestry) who have assisted in data collection.

Hopefully this scientific work useful.

Bogor, May 2018

Wisdom of Fadhila

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INTRODUCTION

Background

The forest area in Indonesia is decreasing day by day. The area of forest area in Indonesia in 2015 reached 126 million ha (Center for Data and Information of KLHK 2016). Forest area in Indonesia decreased in 2016 to 125 million ha (MoEF Data and Information Center 2017). The decline in forest area is due to deforestation and land degradation. One of the causes of land degradation is forest fires. Forest and land fires are events that burn forest and land areas uncontrollably so that fires can spread according to the direction of the wind.

99% of the causes of forest and land fires in Indonesia are caused by humans (Syaufina 2008). These forest and land fires are caused directly or indirectly, such as land preparation by burning, social, economic problems, and so on. Forest and land fires have a negative impact on regional and national development, and also have a direct impact on environmental and community health conditions, loss of biodiversity and germplasm sources, and livelihoods. Another negative impact is disrupting the transportation and industrial sectors.

Indonesia has experienced quite large forest and land fires in 1981/1982, 1997/1998, 2007, 2013 and 2015. Based on the experience of forest and land fires in 2015, the President of the Republic of Indonesia has issued a presidential directive since 2016 in the form of a early emergency alert, inviting the community to participate in preventing forest and land fires, air operations alert, law enforcement, improving forest and land governance, and coordination between central and local governments (KLHK 2017).

The incidence of forest and land fires in Indonesia in 2015 was 2.6 million ha (Endrawati et al 2017). The 2015 fires caused an economic loss of USD 16 billion (World Bank Group 2016). Another impact of these forest fires is health problems for humans. The incidence of forest and land fires in 2015 was very high but in 2016 and 2017 the incidence of forest and land fires decreased significantly.

Formulation of the problem

The biggest forest and land fires that occurred in the last three years (2015–2017) were in 2015. The impacts caused by forest and land fires in 2015 were very large, including economic, ecological, and environmental losses.

social. In 2016 and 2017 the incidence of forest and land fires decreased significantly. This is claimed by the Ministry of Environment and Forestry as a success in efforts to control forest and land fires in Indonesia. The high incidence of forest and land fires in 2015 was also triggered by the long dry season and the El Nino phenomenon, so that the incidence of forest and land fires can be linked to rainfall.

Research purposes

This study aims to analyze the incidence of forest and land fires in Indonesia that occurred in the last three years (2015–2017) in six provinces prone to forest and land fires.

Benefits of research

The results of this study are expected to provide information regarding the incidence of forest and land fires in 2015–2017 and their control efforts.

LITERATURE REVIEW

Forest fires

Definition of Forest Fire

According to Brown and Davis (1973) forest fires are a process of rapid reaction of oxygen with other elements and are characterized by the presence of heat, light, and usually light up. This burning process spreads freely and consumes natural forest fuels, such as: litter, humus, twigs, dead wood, weeds, shrubs, leaves and fresh trees.

The Principle of the Fire Triangle

Fire is a natural physical phenomenon resulting from the rapid combination of oxygen with a fuel in the form of heat, light and flame. These three components are needed for fire to ignite and undergo the combustion process (Countryman 1975). First there must be a combustible fuel available, then sufficient heat is used to raise the temperature of the fuel to the point of ignition, and air to supply oxygen to keep the combustion process going and to maintain a sufficient heat supply to allow proper ignition of the fuel hard to burn.

The three elements, namely fuel, heat and oxygen, which allow a fire to start, are called the fire triangle.

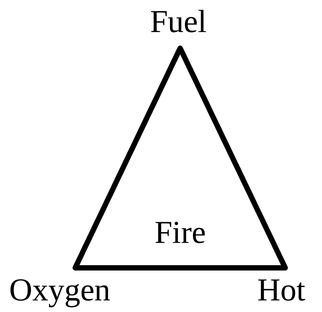

Figure 1 Principle of the fire triangle

Fire can only occur when the three components above are at the same time. Based on this, the basic principle in controlling forest fires is done by deciding on one of the three components. The common way is to reduce the role of the fuel and heat components which can be done by various techniques.

Factors Affecting Forest Fires

According to Wibowo (2003) the main factors that influence the behavior of forest fires are fuel (moisture content, quantity, size, and composition of fuel), weather conditions (temperature, rainfall, humidity, and wind) and topography.

a. Fuel

The moisture content of the fuel determines the ease with which the fuel can be ignited, the speed of the combustion process, the speed of fire propagation, and the ease of fire fighting efforts. The rate of fire propagation increases directly and proportionally with the increase in the amount of available fuel if other factors are constant. The smaller the size of the fuel, the faster the fire will spread as long as the fuel is available. The fire will spread faster if the surface area of the fuel is greater with the same quantity of fuel. If the fuel is not solid, the heat is transferred through the process of convection and radiation, while in solid fuel the conduction process is less efficient.

b. Weather (temperature, humidity, rainfall and wind)

The temperature of the fuel and the surrounding air are important factors that indirectly affect fire behavior. Increasing the temperature will reduce the humidity of the air and increase the drying process of the fuel so that the water content of the fuel decreases. Air humidity and rainfall are closely related to the fire season because they are related to the flammability of the fuel and its relationship to other weather factors. In dead fuel such as litter, the water content is largely determined by the humidity conditions of the surrounding air. The fuel will absorb water from the humid air and release moisture into the dry air.

Another factor is the wind. Wind affects fire behavior by lowering air humidity and accelerating the drying process of fuel, accelerating the combustion process by increasing the supply of oxygen, accelerating the spread of fire by bringing heat and fire jumps, and directing flames to unburned fuel.

c. Topography

The fire will move faster up the slope because the heat generated by the fire is closer to the ground, lowering the moisture content and increasing the temperature of the fuel in front of it. The results of research in Australia show that the speed of fire propagation increases linearly with increasing slope. The rate of fire propagation in fires that occur in flat topography will be doubled at a slope of 10° and will increase fourfold at a slope of 20°. The propagation of fire will decrease its speed towards the bottom of the slope (Wibowo 2003).

Forest and Land Fire Control

Forest and land fire control activities are in the form of prevention, suppression, and post-fire handling activities. Prevention is an effort made in the phase before the incident took place. Activities carried out in preventing forest and land fires include making fire hazard maps, monitoring fire-prone symptoms, preparing firefighting teams, building control towers, building firebreaks, counseling, and forming forest and land fire fighting organizations. Extinguishing techniques can be carried out according to the fire conditions that occur. The thing that must be done is to calculate the best way to extinguish the fire by carrying out an inspection of the entire burned area. Rehabilitation techniques for ex-fired land must be carried out as an effort to deal with post-fires (Purbowaseso 2004).

Hotspots (Hotspots)

Hot spot is a term for a point that has a temperature higher than the threshold value determined by satellite digital data. The digital data used comes from the NOAA-AVHRR (National Oceanic Atmospheric Administration, Advanced Very High Resolution Radiometer) satellite. The threshold value used in determining a hotspot is 315 K (420C) for daytime signal capture and 310 K (370C) for night signal capture (MoF-JICA 2002).

The Terra/Aqua satellite is part of NASA (Nastional Aeronautics and Space Administration) which consists of MODIS (Moderate–resolution Imaging Spectroradiomete) which can observe phenomena on land, sea and atmosphere (Asrar and Dokken 1993). The Terra/Aqua satellite has a resolution of 0.25–1 km which produces global coverage every 1-2 times a day with a sweep pattern of ±550 at an orbital altitude of 705 km above sea level and a sweep width of 2 330 km (NASA 2013). The Terra satellite orbits the earth from north to south and crosses the equator in the morning, while the Aqua satellite moves from south to north and crosses the equator in the afternoon/evening. On this satellite there is a MODIS sensor consisting of 36 bands and spatial resolutions of 250 m, 500 m, and 1000 m (Sipayung et al 2016).

Rainfall

Rain is a physical process that results from weather phenomena. The influence of physiographical factors in Indonesia and its surroundings on climate/weather elements has resulted in 3 (three) types of rainfall, namely: equatorial type, monsoon type and local type. There are several important physical factors that contribute to the process of rain occurring in the territory of Indonesia, including latitude, altitude, wind patterns (trade and monsoon winds), the distribution of land and water landscapes, and high mountains and mountains. These factors will affect the variation and type of rainfall.

Indonesia is located between two large oceans, namely the Pacific Ocean to the northeast and the Indonesian Ocean to the southwest. These two oceans are sources of moist air that brings a lot of rain to the territory of Indonesia. During the day the evaporation process from the surface of these two oceans will significantly increase the humidity of the air above.

The existence of two continents flanking the Indonesian archipelago, namely the Asian continent and the Australian continent, will affect the pattern of wind movement in Indonesian territory. Wind direction is very important role in influencing rainfall patterns. If the wind blows from the Pacific Ocean and the Indonesian Ocean, then the wind will bring moist air to the Indonesian territory and result in high rainfall in the Indonesian territory, whereas if the wind blows from the mainland of the Asian Continent and the Australian Continent, the wind contains only a small amount of steam. water and not much rain.

Rainfall patterns in Indonesia are also influenced by the presence of mountain ranges. Mountains are a physical barrier to wind movement. Orographic rain will occur when moist air is pushed up because its movement is blocked by the presence of mountains. Rainfall on the windward side will be high and on the leeward side of the mountains the rainfall will be very low (Tukidi 2010).

METHOD

Time and place

This research was conducted at the Forest Fire Laboratory, Faculty of Forestry, Bogor Agricultural University in January–February 2018.

Tools and materials

The tools used are stationery and laptops with several programs such as Microsoft Word and Microsoft Excel. The materials used in this study were forest fire hotspot data for 2015–2017 from LAPAN (National Aeronautics and Space Agency), rainfall data for 2015–2017 from BMKG (Meteorology, Climatology, and Geophysics Agency), and control data.

forest and land fires in Indonesia from the KLHK (Ministry of Environment and Forestry).

Six provinces prone to forest and land fires were designated by the Ministry of Environment and Forestry in 2015 based on the high number of hotspots and consideration of the haze caused by forest and land fires, namely Riau, Jambi, South Sumatra, West Kalimantan, Central Kalimantan and South Kalimantan (KLHK 2015).

Research procedure

The research was conducted by collecting secondary data in the form of data on forest and land fire hotspots in 2015–2017 using the Terra/Aqua satellite, rainfall data for 2015–2017 from the BMKG, and data on efforts to control forest and land fires in Indonesia carried out by the Ministry of Environment and Forestry. The data analysis method used is a comparative analysis quantitative method that compares the same phenomenon in different subject groups. Qualitative data analysis methods are also used for data processing secondary activities of the Ministry of Environment and Forestry in dealing with forest fires in Indonesia.

RESULTS AND DISCUSSION

General Condition of Location

Riau Province is geographically located between 01° 05' 00” South Latitude–02° 25' 00” South Latitude and 100° 00' 00”–105° 05' 00” East Longitude. The area of Riau Province is 107 932.71 km2 which stretches from the slopes of Bukit Barisan to the Malacca Strait which consists of a land area of 87 712.05 km2 and an ocean area of 18 782.56 km2. Riau Province has a wet tropical climate with average rainfall ranging from 1 000–3 000 mm which is influenced by the dry season and rainy season. The topography of Riau Province is in the form of lowland and slightly bumpy areas. Riau Province has four types of soil, namely organosol glei humus soil, red yellow padsolic soil from alluvium, red yellow padsolic soil from sedimentary rock and red yellow podzolic soil from sedimentary rock and igneous rock. Several areas in Riau Province are also scattered with peat soil with the total area of peatland in Riau Province is 4 043 602 ha and is found in almost all districts,

Jambi Province is geographically located between 00 45'–20 45' South Latitude and 1010 10'–1040 55' East Longitude. The topography of Jambi Province is in the form of lowland and slightly wavy areas with a height in several cities in the Jambi Province starting from 0 m above sea level (from sea level) to approximately 3700 m above sea level. Most of the land in Jambi Province consists of land formed from alluvium formations (sediments), in some places there are neogene interludes, for example along the Tembesi River and Batanghari River in Tebo, Batanghari, Muaro Jambi and Jambi City Regencies. These soil types are mainly found in areas along the coast to the middle of the mainland which is formed as a young land that is not mountainous and even some parts consist of swampy land (Arifianto 2017).

South Sumatra Province is part of Sumatra Island which has an area of 91 774.99 km2 which is located at 1° South Latitude – 4° South Latitude and 102° East Longitude – 106° East Longitude. South Sumatra Province has a land area of 8 701 741 ha. The province of South Sumatra is included in a tropical climate with an average annual rainfall of 2 000–4 000 mm which is influenced by the rainy season and dry season. Land cover in South Sumatra Province is dominated by peatlands, but much of the land is also dominated by reeds and shrubs. Geomorphological conditions in the form of peat wetland types which are quite extensive dominate four districts, namely Musi Banyuasin, Banyuasin, Ogan Ilir and Ogan Komering Ilir regencies (Fauzan 2013).

Kalimantan Province West is geographically located between 20 08' Lu–30 05' South Latitude and 1080 30'–1140 10' East Longitude. West Kalimantan Province has an area of 14.68 million ha. West Kalimantan has a wet tropical climate with high rainfall throughout the year and high humidity, which is a characteristic of tropical forested areas. West Kalimantan is also crossed by the equator so that it has high air temperatures. Most of West Kalimantan is lowland, about 36% and 19.5% of West Kalimantan is a flooded area in the form of swamps mixed with peat and mangrove forests. The main soil types in West Kalimantan are red-yellow podsolic, alluvial, orgosol gley humus, podsol, latosol and regosol. Most of the land cover area in West Kalimantan is forest by 42.32% and grasslands/shrubs/alangs by 34.11% (Famurianty 2011). Central Kalimantan has an area of 157 983 km2. The province of Central Kalimantan with the capital city of Palangka Raya is located between 0° 45' North Latitude–3° 30' South Latitude and 111°-116° East Longitude. The forest area in Central Kalimantan Province is 12 675 364 ha. Most of Central Kalimantan is a lowland area with a relatively flat topography, hills, and mountains with a predominance of steep topography. The highest point in the Central Kalimantan region is Mount Batu Sambang with an altitude of up to 1660 m above sea level (Directorate General of Development of Disadvantaged Regions 2016).

South Kalimantan Province has an area of 37 530.52 km2 or almost 7% of the total area of Kalimantan Island. Geographically, South Kalimantan Province is 1140 19' 13"–1160 33' 28" east longitude and 10 21' 49"–40 10' 14" south latitude. South Kalimantan is bordered on the west by the Province of Central Kalimantan, on the west by the Makassar Strait, on the north by the Province of East Kalimantan, and on the south by the Java Sea. The province of South Kalimantan is a lowland area with an altitude of less than 100 m above sea level with a slightly steep to sloping and flat land slope class. The area of South Kalimantan is composed of pre-tertiary, tertiary, and alluvial rocks. The province of South Kalimantan has a tropical climate with air temperatures ranging from 23.30C to 32.

Hotspots and Rainfall

Hot spot is the terminology of a pixel that has a higher temperature than the surrounding area or location captured by digital satellite data sensors (Kayoman 2010). Hotspots can be used as an indicator of the possibility of a fire (Adinugroho et al 2005). Monitoring the hotspot using remote sensing method using satellite. The use of hotspot data for forest fire detection is considered more effective because it can reach areas that cannot be monitored by humans.

In Figure 2 it can be seen that the number of hotspots in fire-prone provinces was the highest for the last 3 years in 2015. The number of hotspots decreased significantly in 2016 and 2017. According to the Ministry of Environment and Forestry (2017), the number of hotspots decreased in 2017 when compared to 2015 was the result of the efforts of the Ministry of Environment and Forestry in dealing with forest fires in Indonesia.

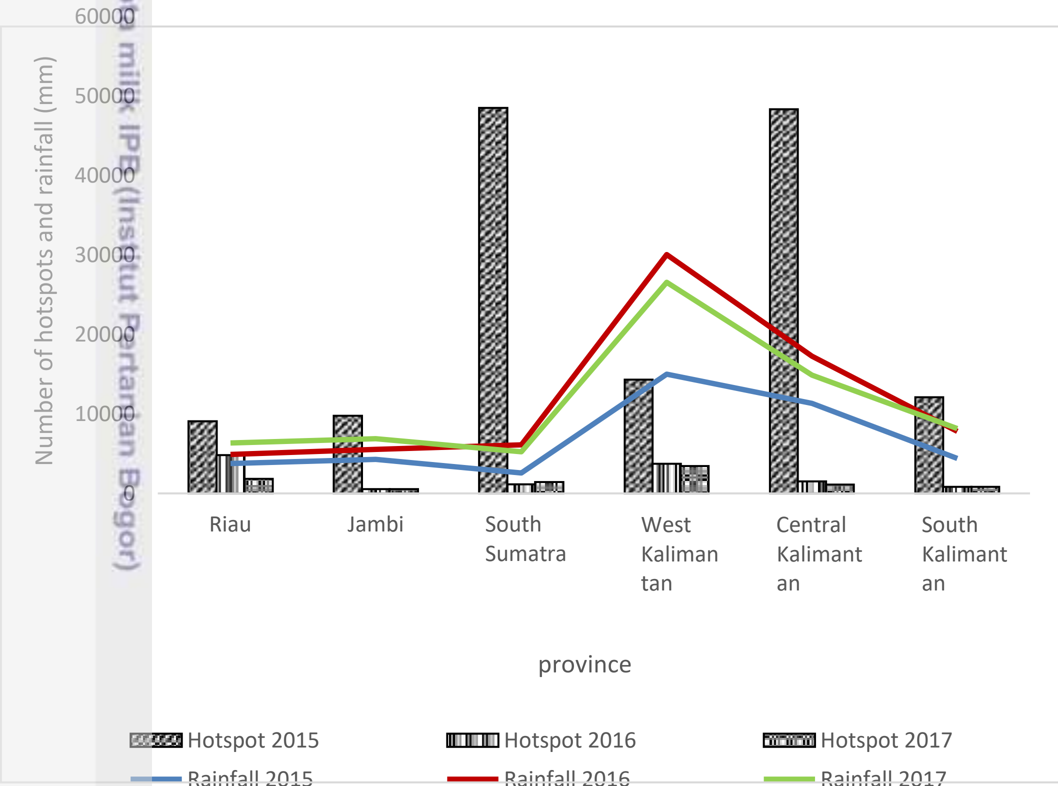

Figure 2 Number of hotspots and rainfall in fire-prone provinces in 2015–2017

The highest number of hotspots in 2015 was in South Sumatra Province with 48 502 and the lowest was in Riau Province with 9 070. The number of hotspots decreased in 2016 and 2017. In 2016 the highest number of hotspots was in Riau Province, namely 4 810 and the lowest in Jambi Province as many as 527. In 2017 the highest number of hotspots was 3 456 in West Kalimantan Province. The lowest number of hotspots in 2107 was in Jambi Province with a total of 528.

One that affects the number of hotspots is rainfall. The amount of moisture content of forest fuel in an area can be determined by the weather and climate

climate. The climate element that has a high correlation with the incidence of forest fires is rainfall (Soares and Sampaio 2000). The average amount of rainfall that falls in various places in Indonesia is between 500 mm – > 5,000 mm/year, so actually not all parts of Indonesia have a wet tropical climate (Tukidi 2010). In 2015–2017, South Sumatra Province had the lowest rainfall among other fire-prone provinces (Figure 3). In 2015 South Sumatra Province had low rainfall which was inversely proportional to the high number of hotspots. Thus, it can be seen that if the rainfall is low, the number of hotspots will increase. Vice versa, if the rainfall is high, the number of hotspots will decrease.

Riau Province

In Figure 3 it can be seen that the number of hotspots in Riau Province in 2015 was the highest compared to 2016 and 2017.

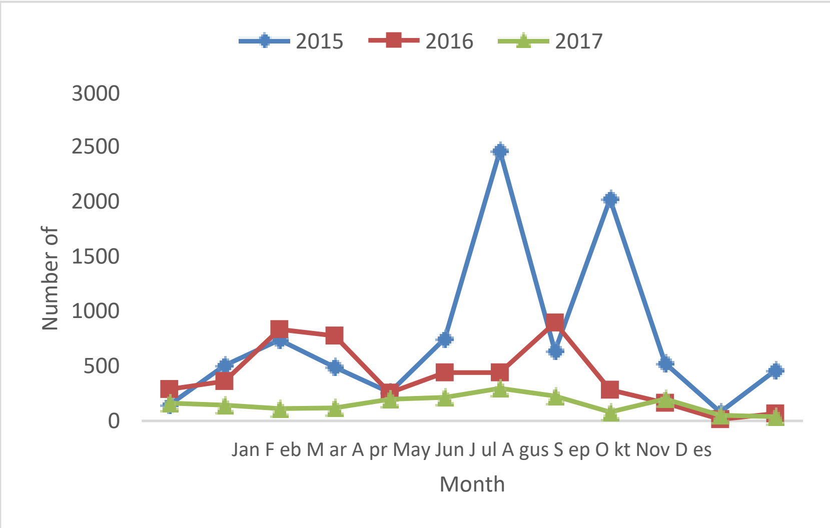

Figure 3 Number of monthly hotspots in Riau Province in 2015–2017

In 2015 the highest number of hotspots was in July, which was 2 464 and decreased in August, but increased again in September. In 2016 the highest number of hotspots was in August as many as 895 and began to decline in July by 439. The highest number of hotspots in 2017 was in July as many as 295 and decreased in August. In Riau province, it can be seen that the number of hotspots in the last three years began to increase in February–March and July–August. Thus it can be said that Riau Province has two peak fire seasons. This is due to low rainfall in February and July.

The number of hotspots is strongly influenced by rainfall. In Figure 4 it can be seen that the lowest rainfall in 2017 was in February.

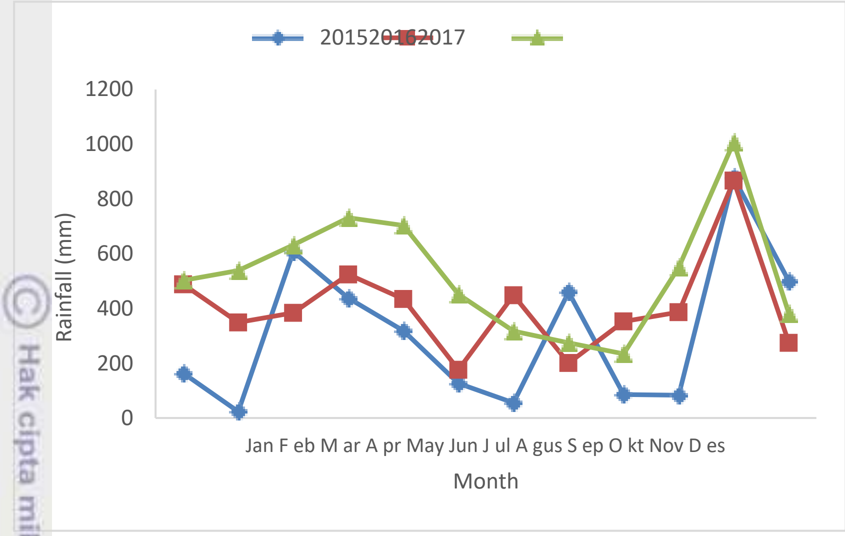

Figure 4 Monthly rainfall in Riau Province in 2015–2017

Rainfall in Riau Province in July 2015 was 56.1 mm, which is the second lowest rainfall after February of 23.9 mm. The rainfall in August 2016 was 200.3 mm which is the second lowest rainfall after June of 176.3 mm. In 2016 the lowest rainfall was in September and increased in October and November, but decreased in December.

Brigdalkarhut (Forest Fire Control Brigade) was formed in Riau Province to assist in controlling forest and land fires with a total of 5 Daops (operational areas) Manggala Agni under BBKSDA Riau with 213 members as well as members of the Brigdalkarhut assigned to BTN (Balai Taman National) Bukit Tiga Puluh and BTN Tesso Nillo. Members of the Brigdalkarhut at BTN Bukit Tiga Puluh and BTN Tesso Nillo are more focused on dealing with fire incidents in national park areas, while Manggala Agni is devoted to dealing with fire incidents in conservation areas and outside conservation areas.

The Manggala Agni Daops in Riau Province is equipped with infrastructure for fighting land and forest fires, but the number of members and infrastructure is still inadequate when viewed from the area burned. Efforts to control forest fires in Riau Province in 2015 included the construction of canal blocking in the Giam Siak Kecil Biosphere Reserve by BBKSDA Riau. TMC and water bombing were also carried out in Riau province which began in 2015.

Jambi Province

The number of hotspots in Jambi Province in 2015 was the highest number of hotspots in the last three years (2015–2017). In 2016 and 2017 the number of hotspots decreased very significantly as shown in Figure 5.

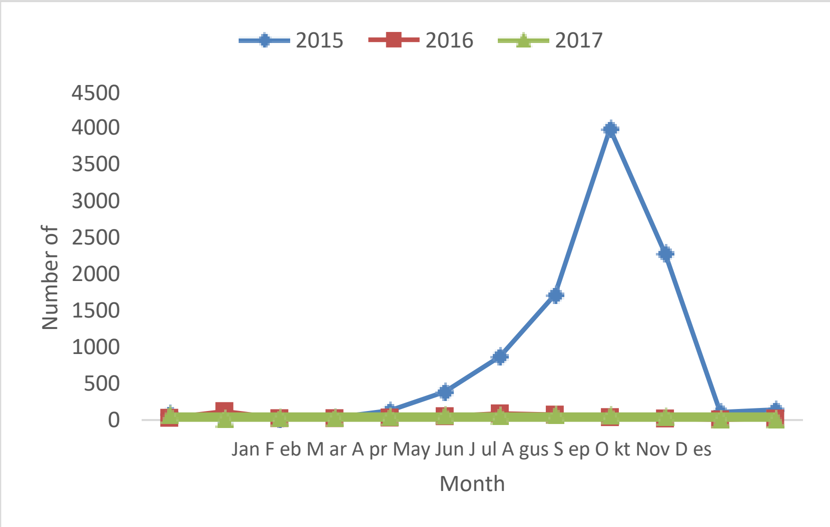

Figure 5 Number of monthly hotspots in Jambi Province in 2015–2017

Hot spot 2015 began to increase in May and reached its peak in September of 3 989, then decreased again in October. The decline in the number of hotspots occurred in 2016 with the highest number of hotspots in February as many as 119. In 2017 Jambi Province had the highest number of hotspots in August as many as 73 with the number of hotspots not much different each month.

Rainfall affects the number of hotspots. The monthly rainfall graph of Jambi Province can be seen as follows.

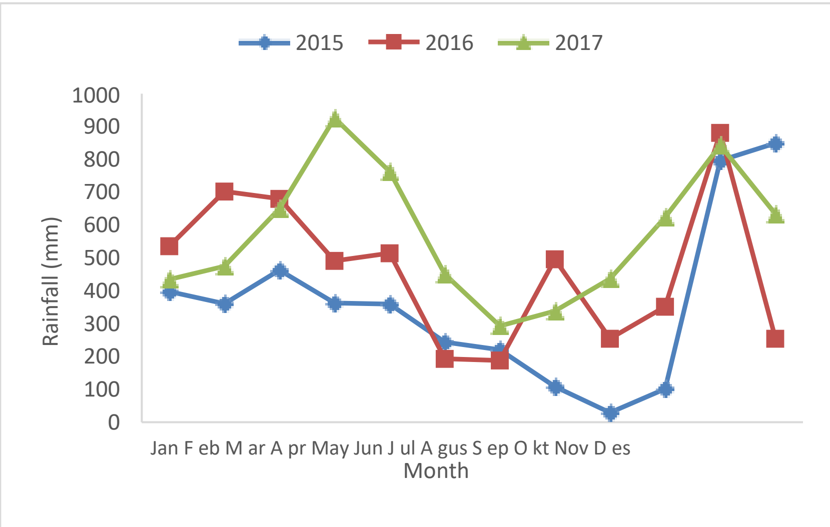

Figure 6 Monthly rainfall in Jambi Province in 2015–2017

Rainfall in Jambi province in 2017 increased compared to 2015 (Figure 6). In 2015 the lowest rainfall was in September of 29.1 mm which increased in August to reach its peak in November. The lowest rainfall in 2016 was in July of 187.7 mm which fluctuated until its peak in November. In 2017 the lowest rainfall was in July of 292.8 mm and continued to increase until November 2017.

Brigdalkarhut was formed in Jambi Province to help control forest and land fires. The number of Manggala Agni members at the Jambi BKSDA is 272 spread over 5 daops and the Brigdalkarhut team at BTN Kerinci Sebelat as many as 30 people, BTN Bukit Dua Belas as many as 30 people and BTN Berbak as many as 30 people who focus on handling fire incidents in the national park area. Control efforts carried out by the Ministry of Environment and Forestry in 2015 in Jambi Province were in the form of building canal blocks in 3 locations including Manis Mato, Sei Cemara, and Betara Villages. In addition, there are 10 pump units from the Ministry of Environment and Forestry. Weather Modification Technology (TMC) and water bombing were also carried out starting in 2015.

South Sumatera Province

South Sumatra Province had the highest number of hotspots in 2015 in the last three years (2015–2017). The number of hotspots decreased in 2016 and experienced a slight increase in 2017.

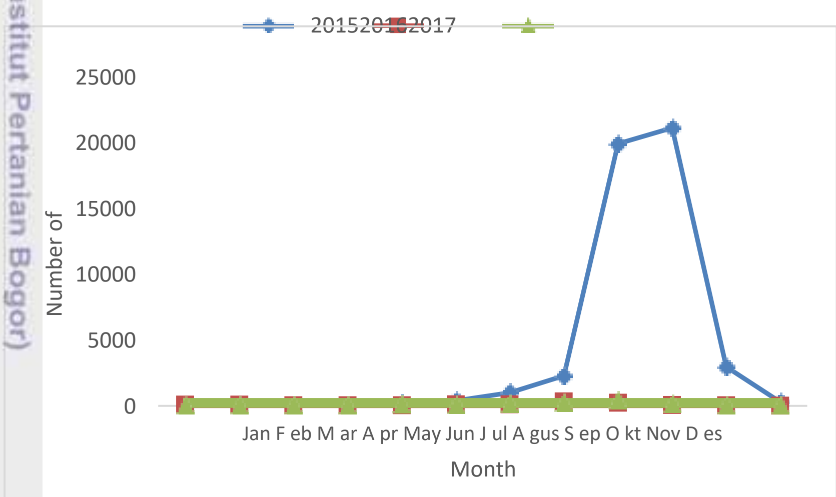

Figure 7 Number of monthly hotspots in South Sumatra Province in 2015–2017

In Figure 7 it can be seen that the highest number of hotspots in 2015 was in October as many as 21 158. In 2015 hotspots began to increase from July to October. In 2016, the highest number of hotspots was in August as many as 317 and decreased until December. In 2017 the highest number of hotspots was in September as many as 426 but decreased in the following month.

Rainfall greatly affects the number of hotspots. In Figure 8 you can see a graph of monthly rainfall in the province of South Sumatra.

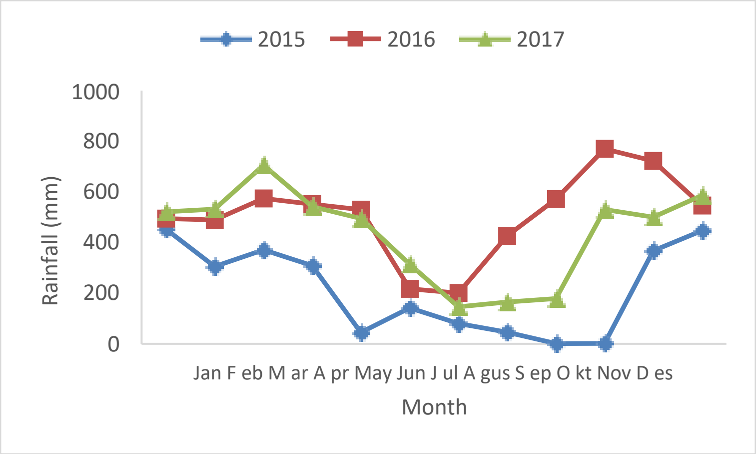

Figure 8 Monthly rainfall in South Sumatra Province in 2015–2017

The rainfall in 2015 was lower than the annual rainfall 2017. Rainfall in October 2015 was 2.3 mm, which is low compared to other months. In 2016, the lowest rainfall was in June of 217.1 mm. The lowest rainfall in 2017 was in July which continued to increase until October.

The control of forest and land fires in South Sumatra Province is carried out by Brigdalkarhut. Manggala Agni at BKSDA South Sumatra is located in 4 Daops with a total of 240 personnel. In addition, there is a Brigdalkarhut team at BTN Sembilang as many as 30 people who focus on dealing with fire incidents in the Sembilang TN area. Efforts to control forest fires in South Sumatra province in the form of TMC were started in 2015 and water bombing was also carried out starting in 2015.

West Kalimantan Province

In Figure 9 it can be seen that the number of hotspots in 2015 in West Kalimantan Province was the highest compared to 2016 and 2017.

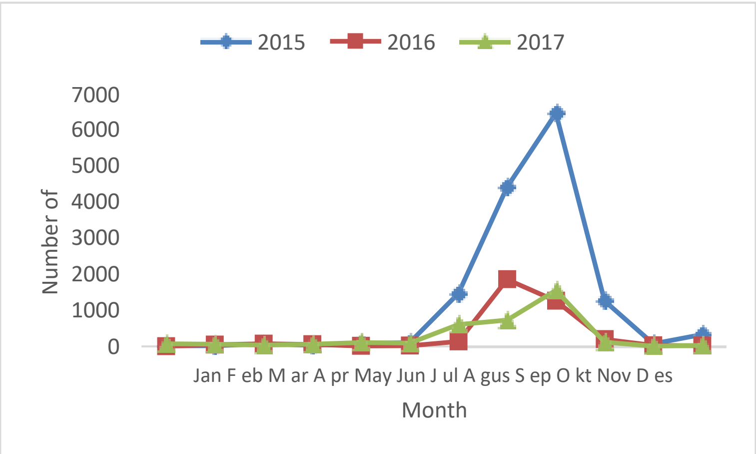

Figure 9 Number of monthly hotspots in West Kalimantan Province in 2015–2017

In 2015 the number of hotspots began to increase in July to a peak in September of 6 446 (Figure 9). The highest number of hotspots in 2016 was in August as many as 1851 and decreased in September, where an increase in the number of hotspots occurred starting in July. In 2017 the number of hotspots began to increase in July and continued to increase until September.

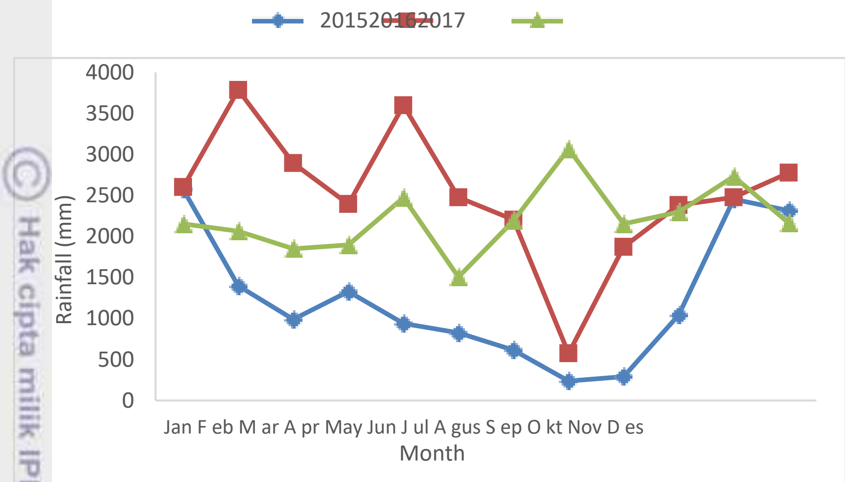

Figure 10 Monthly rainfall in West Kalimantan Province in 2015–2017

Rainfall in 2015 was lower than in 2017 (Figure 10). Rainfall in September 2015 was 290.7 mm which was the second lowest rainfall in 2015 after August of 236.8mm. In 2016, the lowest rainfall was in August at 575 mm. The rainfall in September 2017 is 2 153.6mm.

Brigdalkarhut is also located in West Kalimantan Province which is in charge of controlling forest and land fires. Manggala Agni resources contained in the West Kalimantan BKSDA and Lake Sentarum BTN are 259 personnel. The Brigdalkarhut team in the Betung Kerihun National Park Center consists of 30 people, 30 people from Gunung Palung BTN and 30 people from Bukit Baka Bukit Raya BTN. However, the number of Manggala Agni personnel is still not sufficient for fire-prone areas. In addition, the facilities and infrastructure used to control forest and land fires are still inadequate. The mitigation efforts carried out by the Ministry of Environment and Forestry in 2015 were the same as several other fire-prone provinces in the form of TMC and water bombing which began in 2015.

Central Kalimantan Province

Figure 11 shows that Central Kalimantan Province has the highest number of hotspots in 2015 in the last three years (2015–2017).

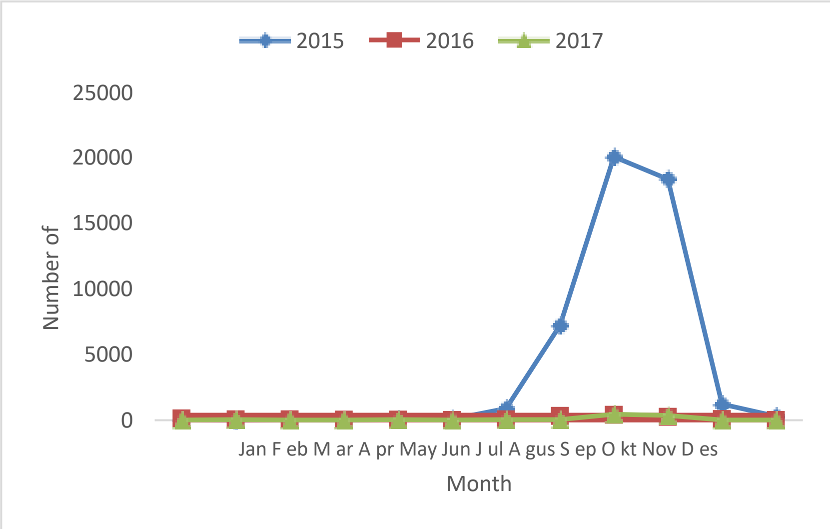

Figure 11 Number of monthly hotspots in Central Kalimantan Province in 2015–2017

In 2015 an increase in the number of hotspots began to be seen in July with the highest number of hotspots in September as many as 20 051. The highest number of hotspots in 2016 and 2017 was in September. In Central Kalimantan Province, it can be seen that September was the month with the highest number of hotspots in the last three years (2015–2017).

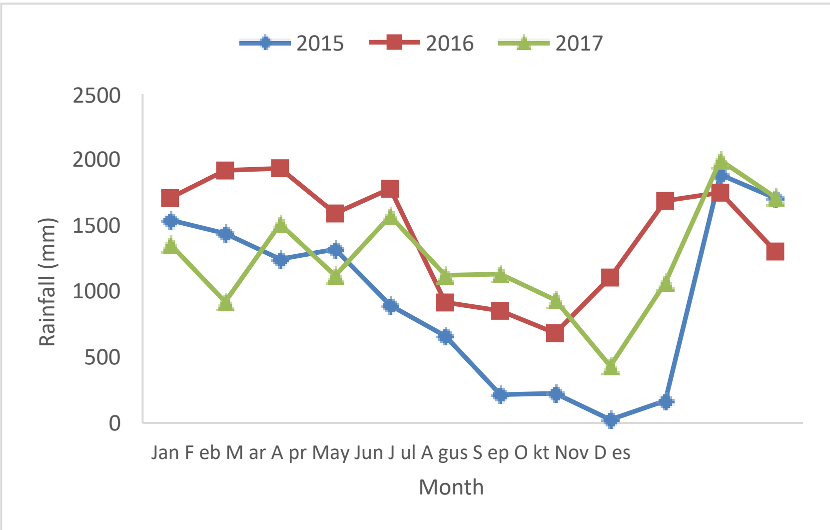

Figure 12 Monthly rainfall in Central Kalimantan Province in 2015–2017

In 2015 the lowest rainfall was in September of 23.7 mm (Figure 12). The lowest rainfall in 2016 was in August at 682.1 mm. Rainfall in September as the month with the highest number of hotspots in 2016 was 1 105.3 mm. Highest number of hotspots in 2017 was in September with rainfall in that month of 431.6 mm while the lowest was in January with rainfall of 1 357.9 mm.

Central Kalimantan province also has Manggala Agni under the Central Kalimantan BKSDA with 189 members spread over 4 daops. In addition, there is also a Brigdalkarhut team that focuses on dealing with fires in the national park area, namely at Tanjung Puting BTN as many as 30 people and at Sebangau BTN as many as 30 people. The number of members of the Brigdalkarhut is not sufficient because Central Kalimantan Province is a province that is prone to forest and land fires, so it is necessary to add members. The same is true of inadequate facilities and infrastructure for controlling forest and land fires. Efforts to control forest fires in Central Kalimantan province in 2015 were in the form of building canals and reservoirs as well as inundation of burned areas in Tumbang Nusa Village, Jabiren Raya District, Pulang Pisau Regency. In addition, Weather Modification Technology (TMC) and water bombing were also carried out starting in 2015.

South Kalimantan Province

In Figure 13 it can be seen that the number of hotspots in South Kalimantan Province in 2015 was the highest compared to 2016 and 2017.

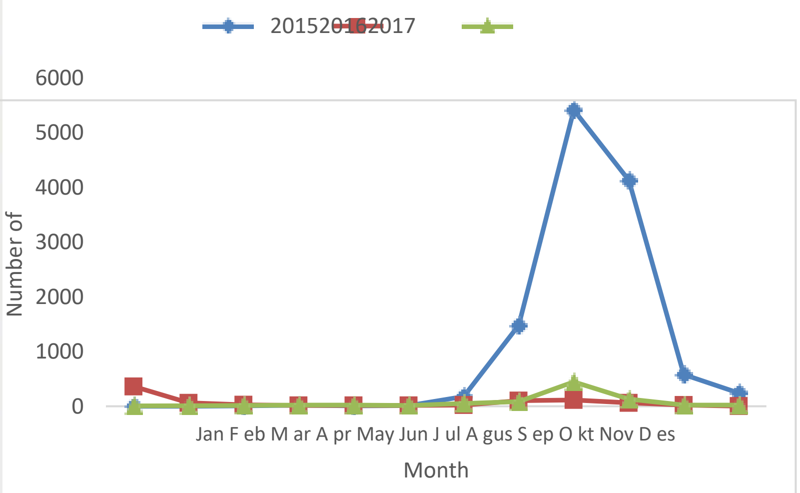

Figure 13 Number of monthly hotspots in South Kalimantan Province in 2015–2017

In 2015, the highest number of hotspots was in September, which was 5,411 and decreased in October. The highest number of hotspots in 2016 was in January and began to increase again in August and September. In 2017 the highest number of hotspots was in September as many as 445 with a much higher number of hotspots compared to other months.

The graph of monthly rainfall in the province of Central Kalimantan in 2015–2017 can be seen as follows.

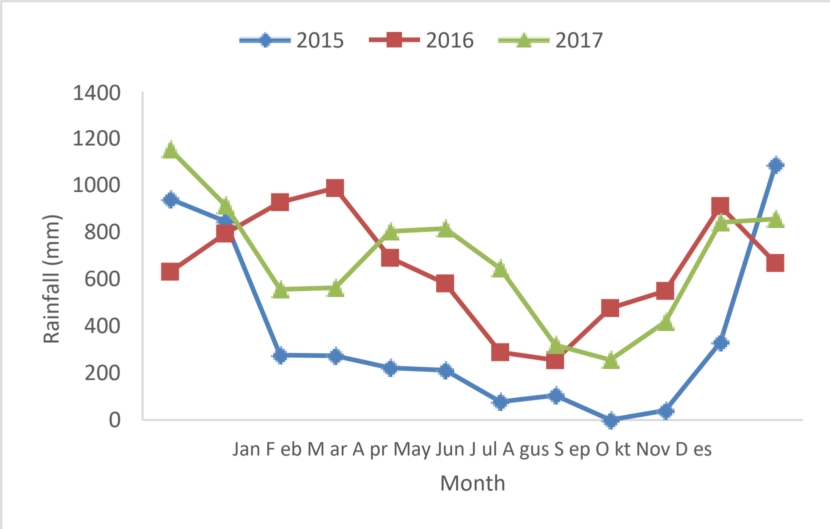

Figure 14 Monthly rainfall in South Kalimantan Province in 2015–2017

In Figure 14 it can be seen that the rainfall in 2015 was lower than 2017. The lowest rainfall in 2015 was in September. The lowest rainfall in 2016 was in August which continued to increase until November. In 2017, the lowest rainfall was in September which increased until November. In 2016 and 2017 rainfall decreased in December compared to the previous month.

Manggala Agni was also formed in the province of South Kalimantan. Manggala Agni at BKSDA South Kalimantan consists of 178 people spread over 3 daops. There is a plan to build 10 canal blocks by BNPB (National Disaster Management Agency), KLHK and local government, as many as 10 units of 100 m long, normalization of water channels along 1000 m, construction of 2 wooden waterblocks and construction of 10 ponds and construction of canal blocking as one of the activities. an effort to control forest and land fires in 2015. Weather Modification Technology (TMC) Water bombing was also carried out.

Forest and Land Fire Control Efforts

Prevention

Prevention efforts that have been carried out in 2015 include coordination with various agencies through Ministerial Letters, development of early detection and warning, coordination meetings, working visits in fire-prone provinces, construction of canal blocking, and regulations related to forest and land fire control.

The KLHK (Ministry of Environment and Forestry) did not carry out working visits in fire-prone provinces in 2016. However, there are several additional prevention efforts such as the determination of the alert status emergency services by the Regional Government, integrated patrols, functional patrols, and the establishment of a task force for forest and land fire prevention in fire-prone provinces. Integrated patrols to prevent forest and land fires have been carried out since February 2016 in forest and forest fire-prone provinces. The activities carried out by the team during the integrated patrol were conducting hotspot ground checks, socialization, counseling, measuring the water level on peatlands, identifying water sources and early extinguishing if they found forest and land fires.

Efforts to control forest fires in 2017 began with planning. Forest and land fire control planning describes programs, activities and targets both long term, medium term and short term that must be achieved in reducing forest and land fires. In addition to planning, it is very important to prepare regulations related to forest and land fire control as the basis for implementing activities from the national level to the site. Additional prevention efforts carried out in 2017 were air patrols, PLTB (Land Preparation without Burning), and Weather Modification Technology (TMC) which were carried out before the dry season.

Figure 15 Air patrol using Indonesian Air Force aircraft in Riau Province
(Source: KLHK 2017)

blackout

Extinguishing efforts in 2015 were in the form of ground and air fires. The ground fighting operation was carried out by Manggala Agni and the community as many as 22 146 people in six fire-prone provinces.

(a) (b)

Figure 16 Ground blackout by Manggala Agni: (a) Jambi (b) West Kalimantan.
(Source: KLHK 2015)

The air suppression carried out was in the form of Weather Modification Technology (TMC), water bombing, and chemical extinguishing. TMC is carried out to sow clouds so that clouds can form and produce rain so that the fuel on land can be wet and not flammable. TMC was carried out in all fire-prone provinces using 5 planes with a total amount of salt sown in fire-prone provinces of 373.5 tons. Water bombing is an effort that is carried out when ground suppression operations can no longer be carried out because the location of the fire is far from water sources, the topography does not allow for land extinguishing, access to the fire location is not available and the fires that occur are already very large. Air operations through water bombing use 23 helicopters and 1 aircraft. The total water dropped in fire-prone provinces at the time of extinguishing using water bombing was 147 054 450 liters.

Extinguishing using environmentally friendly chemicals was also carried out in 2015. 1000 liters of flame freeze chemicals (liquid) and 581.4 kg of peat fire X powder were used for extinguishing by Manggala Agni and 2000 liters of Miracle Foam Alpha Plus from Japan.

(a) (b)

Figure 17 (a) condition of burned area in South Sumatra (b) Condition of burnt area in South Sumatra after extinguishing using flame freeze.
(Source: KLHK 2015)

Ground fighting operations in 2016 were carried out by Manggala Agni, BPBD (Regional Disaster Management Agency), Regional Government (Local Government), TNI, Police, Company Fire Teams, Volunteers, and 25 415 people in the community in land and forest fire prone provinces. Air suppression operations in 2016 were also carried out with a total of 29 aircraft operating in areas prone to forest and land fires, which were used 27 units for water bombing and 2 units for TMC. Extinguishing using chemicals was not carried out in 2016.

Efforts to extinguish the fire in 2017 were carried out independently by Manggala Agni and together with members of the TNI, Police, BPBD, Fire Care Community, as well as firefighters from the company. Air fires in the form of water bombing and TMC in fire-prone provinces in 2017 were carried out using 26 aircraft.

Post Fire Handling

Post-fire management in 2015 was more focused on law enforcement activities and dealing with health and education impacts. The post-fire response efforts in 2016 were not much different from 2015. The government revitalized the facilities and infrastructure for controlling forest and land fires in 2016.

Handling activities after forest and land fires in 2017 included monitoring of ex-fired areas, inventory of forest and land fire areas, assessment of losses and coordination of post-forest and land fires handling including coordination related to law enforcement.

Figure 18 Fire area that has been lined with police lines
(Source: KLHK 2017)

Based on this explanation, it is undeniable that the Ministry of Environment and Forestry also contributed to the reduction in the number of hotspots in 2017. However, this is not solely due to the efforts made by the Ministry of Environment and Forestry but also the influence of rainfall which is inversely proportional to the number of hotspots as described above. on. The higher the rainfall, the number of hotspots will decrease. And vice versa, the less the rainfall, the more hotspots will increase.

CONCLUSIONS AND SUGGESTIONS

Conclusion

- The incidence of forest and land fires in Indonesia in 2015 was the worst fire incident in the last three years based on the number of hotspots and the area burned.
- There was a decrease in the number of hotspots in 2016–2017, this was due to high rainfall during the 2 periods compared to 2015.
- Based on data analysis, forest and land fires began to increase in July and peaked in September, then decreased again in November.

- Efforts to control forest and land fires carried out by the Ministry of Environment and Forestry are good, which of course is also supported by weather conditions that affect them.

Suggestion

It is recommended that efforts to prevent forest and land fires be further enhanced during the dry season. An early warning system for forest and land fires needs to be implemented in all areas, especially areas prone to forest and land fires. The law enforcement process needs to be applied to all parties involved in forest and land fires.

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Annex 1 Annual rainfall of fire-prone provinces year 2015–2017

Province	Year	bulk rain (mm) J	F	M	A	M	J	J	A	S	O	N	D	Σ
Riau	2015	163.9	23.9	607.5	438.3	318.3	127.3	56.1	459.7	86.1	83.4	878.8	499.4	3 742.7
Jambi		397.6	360.2	462.4	362.3	359.6	243.2	220	108.1	29.1	101.6	796.1	849.2	4 289.4
South Sumatra		453	304.9	370.8	309.1	45	142.6	80	45.6	1	2.3	367.2	447.6	2 569.1
West Kalimantan		2 573.7	1 399.1	987.2	1 325.5	938.3	822.9	615.7	236.8	290.7	1 041.4	2 454.5	2 314.7	15 000.5
Central Kalimantan		1 542.6	1 439.5	1 245.6	1 319.6	893.2	659.1	213.7	225.1	23.7	169.2	1 887.1	1 706	11 324.4
South Kalimantan		941.4	846.1	276.5	274.3	222.1	211.6	77.9	104.1	0	40.6	331.4	1 087.9	4 413.9
Riau	2016	488.3	348.6	384.1	524.4	435	176.3	448	200.3	352.8	386.6	866.7	274.1	4 885.2
Jambi		536	702	679.8	491	514.2	192.8	187.7	496.3	254.2	351.8	880.9	254.2	55 40.9
South Sumatra		493.5	489.5	573.2	551	529.9	217.1	199.8	425.9	571	769.4	722.3	546	6 088.6
West Kalimantan		2 602.7	3 785	2 894.4	2 394.1	3 597.1	2 478.4	2 205.5	575	1 871.5	2 382.6	2 476.9	2 775.2	30 038.4
Central Kalimantan		1 709.7	1 918.5	1 934.9	1 592.9	1 781.4	915.9	852.4	682.1	1 105.3	1 688.7	1 751.3	1 303.7	17 236.8
South Kalimantan		632.7	794.1	928.5	988.6	691.3	581.6	288.7	255.1	477.4	550.1	911.7	669.4	7 769.2
Riau	2017	501.7	538.9	632	730.9	703.8	451.7	317	274	234.1	549.8	1 007	380.4	6 321.3
Jambi		434.8	474	649.9	925.6	762.7	449.9	292.8	338.3	436.1	623.5	842.7	633	6 863.3
South Sumatra		521.7	532.2	705.3	542	495.6	314.6	146	165	179.1	530.3	5000.7	585.8	5 218.3
West Kalimantan		2 154.8	2 062.6	1 850.1	1 897.7	2 474.2	1 504.3	2 193.2	3 066.5	2 153.6	2 296	2 731.2	2 161.1	26 545.3
Central Kalimantan		1 357.9	919.5	1 512.6	1 119.4	1 574.4	1 123.9	1 132.1	935.9	431.6	1 067.4	1 997.3	1 713.4	14 885.4
South Kalimantan		1 152.8	916.5	557.9	564.1	804.2	816.6	645.5	320.4	256.7	418.8	842	857.2	8 152.7

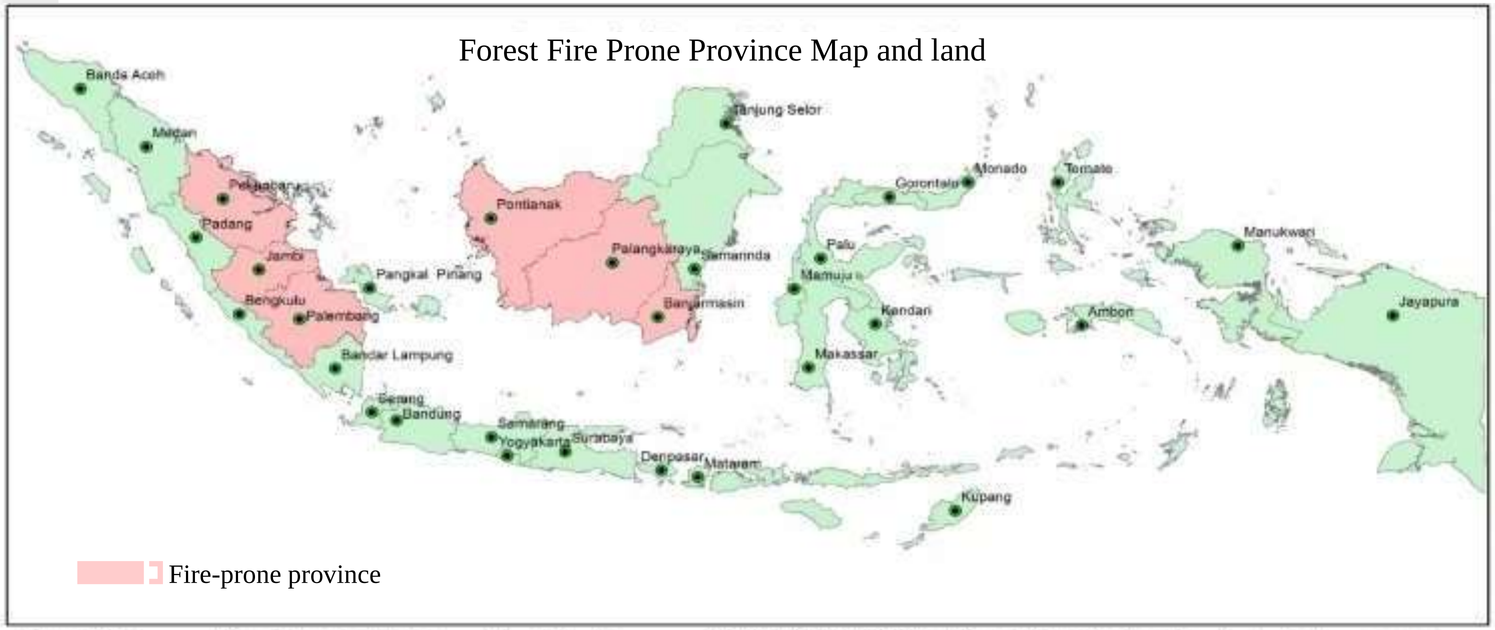
Description = highest
= lowest

Annex 2 Number of hotspots in fire-prone provinces 2015–2017

Province	Year	Amount *hot spot*												Amount
		J	F	M	A	M	J	J	A	S	O	N	D	
Riau	2015	145	503	738	489	258	751	2 464	635	2 023	526	79	459	9 070
Jambi		82	17	18	35	128	387	869	1 715	3 989	2 281	109	142	9 772
South Sumatra		27	59	48	43	203	393	1 022	2 308	19 945	21 158	2 981	315	48 502
West Kalimantan		14	22	72	29	81	106	1 464	4 405	6 446	1 256	76	326	14 297
Central Kalimantan		32	20	38	28	56	100	882	7 223	20 051	18 342	1 231	315	48 318
South Kalimantan		2	2	7	18	11	13	179	1 483	5 411	4 128	580	242	12 076
Riau	2016	287	360	835	776	257	439	439	895	282	161	12	67	4 810
Jambi		31	119	26	24	33	50	89	71	36	20	6	22	527
South Sumatra		87	85	45	46	28	101	119	317	220	70	31	10	1 159
West Kalimantan		6	46	71	53	13	21	139	1 851	1 261	199	25	18	3 703
Central Kalimantan		137	61	55	31	44	28	58	337	394	257	78	17	1 497
South Kalimantan		362	59	25	15	16	16	20	101	112	61	23	1	811
Riau	2017	160	143	111	116	195	211	295	223	77	198	48	35	1 812
Jambi		70	20	35	27	44	65	61	73	64	48	8	13	528
South Sumatra		52	39	43	60	109	93	151	238	426	132	39	33	1 415
West Kalimantan		69	60	37	63	105	87	602	726	1 548	118	9	32	3 456
Central Kalimantan		14	42	21	25	48	23	48	48	455	353	15	24	1 116
South Kalimantan		6	7	16	19	23	12	48	82	445	134	19	21	832

Description = highest
= lowest

Appendix 5 Map of Provinces Prone to Forest and Land Fires



Provinsi Riau :
1. Bengkalis
2. Indragiri Hilir
3. IndraGiri Hulu
4. Kampar
5. Kepulauan Meranti
6. Kota Dumai
7. Kota Pekanbaru
8. Kuantan Singingi
9. Pelalawan
10. Rokan Hilir
11. Rokan Hulu
12. Siak

Provinsi Sumatera Selatan :
1. Banyuasin
2. Empat Lawang
3. Kota Lubuklinggau
4. Kota Pagaralam
5. Kota Palembang
6. Kota Prabumulih
7. Lahat
8. Muaraenim
9. Musibanyuasin
10. Musirawas
11. Ogan Hilir
12. Ogan Komering Ilir
13. Ogan Komering Ulu
14. Ogan Komering Ulu Selatan
15. Ogan Komering Ulu Timur

Provinsi Jambi :
1. Batanghari
2. Bungo
3. Kerinci
4. Kota Jambi
5. Kota Sungai Penuh
6. Merangin
7. Muarojambi
8. Sarolangun
9. Tanjungjabung Barat
10. Tanjungjabung Timur

Provinsi Kalimantan Barat :
1. Bengkayang
2. Kapuas Hulu
3. Kayong Utara
4. Ketapang
5. Kota Pontianak
6. Kota Singkawang
7. Kuburaya
8. Landak
9. Melawi
10. Pontianak
11. Sambas
12. Sanggau
13. Sekadau
14. Sintang

Provinsi Kalimantan Tengah :
1. Barito Selatan
2. Barito Timur
3. Barito Utara
4. Gunungmas
5. Kapuas
6. Katingan
7. Kota Palangkaraya
8. Kotawaringin Barat
9. Kotawaringin Timur
10. Lamandau
11. Murungraya
12. Pulangpisau
13. Seruyan
14. Sukamara

Provinsi Kalimantan Selatan :
1. Balangan
2. Banjar
3. Baritokuala
4. Hulusungai Selatan
5. Hulusungai Tengah
6. Hulusungai Utara
7. Kota Banjarbaru
8. Kota Banjarmasin
9. Kotabaru
10. Tabalong
11. Tanahbumbu
12. Tanahlaut
13. Tapin

Annex 3 Number of fire-prone provincial hotspots in 2015-2017

No	province	Number of Hotspots		
		2015	2016	2017
1	Riau	9 070	4 810	1 812
2	Jambi	9 772	527	528
3	South Sumatra	48 502	1 159	1 415
4	West Kalimantan	14 297	3 703	3 456
5	Central Kalimantan	48 318	1 497	1 116
6	South Kalimantan	12 076	811	832

Annex 4 Annual rainfall in fire-prone provinces in 2015-2017

Province	Annual Rainfall (mm)		
	2015	2016	2017
Riau	3 742.7	5 540.9	6 321.2
Jambi	4 289.4	6 088.6	6 863.3
South Sumatra	2 569.1	4 885.2	5 218.3
West Kalimantan	15 000.5	30 038.4	26 545.3
Central Kalimantan	11 324.4	17 236.8	14 885.4
South Kalimantan	4 413.9	7 769.2	8 152.7

BIOGRAPHY

The author was born in Pariaman on July 17, 1996 to Zulkarnaini's father (late) and Masnita's mother. The author is the eldest daughter of two children. In 2014 the author graduated from SMA Negeri 1 Pariaman and in the same year the author passed the selection to enter the Bogor Agricultural Institute (IPB) through the Joint Selection for State University Entrance (SBMPTN) and was accepted at the Silviculture Department, Faculty of Forestry.

While attending lectures, the author was active as a member of the TGC Professional Association (Tree Grower Community) in 2015/2016. The author has also been active in the IFSA (International Forestry Student Association) organization in 2015–2017. In July–August 2016 the author participated in the General Practice of Forestry and Professional Work Practice in August 2017 at KPH Lawu Ds with the title of special practice of Vegetation Analysis Post Fire in Mount Lawu.