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THE EFFECT OF PEATLAND CONVERSION ON SURFACE TEMPERATURE IN BENGKALIS REGENCY - RIAU PROVINCE

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ABSTRACT: This study aims to determine the effect of peatland conversion on surface temperature In Bengkalis Regency, Riau Province. Data obtained from Landsat imagery in 1988, 1996, 2000 and spot imagery 6 in 2016. The methods used to determine land cover and surface temperature are spatial analysis methods using GIS and Remote Sensing, while determining the correlation between land cover and surface temperature using simple linear regression. Peatlands in Bengkalis Regency around 580,631, 64 Ha (66,38% of Bengkalis Regency), the forest cover on peatland in 1988 covered 464.504,7 Ha (79,99%), non forest covered 115.069,5 Ha (19, 81%), in 1996 forests covered 448.473, 9 Ha (71,65%), non forest 131.114 Ha (22,58%). In 2000 forest covered 416.043,9 Ha, (71,65%) non forest covered 163.450,9 Ha (39,81%). In 2016 the forest covered 23.168,4 Ha (39,81%) and non forest 347.853,4 Ha (59,90%). The protected peatlands with thickness of ≥ 300 Cm covered 242.680,37 Ha (41,79% of the peatland in Bengkalis Regency), in 1988 the forest cover on the protected peatland covered 224,814.9 Ha (92,68%) and non forest covered 17.865,47 Ha (7,32%), but in 2016 the forest covered 148.171,72 Ha (61.21%) and non forest 94.501,65 Ha (38,79%), so that the forest cover on peatland converted from 1988 to 2016 was 233.336,7 Ha (40,19% of the total area of peatland) and the protected peatlands converted 76.643,18 Ha (31,58% of the area protected or 13% of the whole area of peatland). The forest Change on 1 Km^2 of peatland caused the increasing on average 0,51 ^oC of surface temperature.

Keywords: Peatland, Land Cover, Conversion Peatland, and Surface Temperature

1. INTRODUCTION

Bengkalis Regency is an area that consists mainly of peatland, there are protected peatland and cultivated peatland. Peatlands are land that must be protected because peatlands have a relatively high carbon content. Peatlands cover only 3% of the land area in the whole world, but store 550 Gigaton C, equivalent to 30% of soil carbon, 75% of all atmospheric carbon, equivalent to all the carbon contained by biomass (total mass of living things) land and equivalent to twice the carbon stores of all forests throughout the world [1]. Tropical peatlands in Southeast Asia are around 250.000 Km2 covering almost 60 percent of the total area of tropical peatlands [2].

The area of peatland in Indonesia is more than 20 Millions Ha, 6.29 Million Ha is in Sumatra, while 4.044 millions ha are in Riau Province. Riau Province contributes 45% peatland in Indonesia where most of it is for Industrial Timber Plantation (HTI), in which at present its condition is threatened. The hot spot data from the last 5 years shows the source of forest and land fires in Riau has shifted from mineral land to peatland. [3] Fire is widely used in the land clearing and preparation of agriculture and plantations on a small and large scale [4,5]. land preparation by fires is considered to improve the efficiency of productions costs. But in practice, land preparation by fires on peatlands is difficult to control because peat material is flammable and the thickness varies [6].

Most of the fires occurring in peat forests are classified serious due to the characteristics of peat which is composed of litters of organic materials with vegetation above and are potential for fuel. The forest fires that occur in peatlands will increase the amount of CO2 in the atmosphere so that the availability of carbon in peat declines. [7]

Peatland serves as a supporting habitat for biodiversity, its ability to store very large water can reach 90% of its volume, so that peatland functions as a hydrological buffer zone for the surrounding area, namely preventing floods in the rainy season, supplying water in the dry season and preventing sea water intrusion [8]. Rieley and Page [9] [23] [24] [25] Peatlands have hydrological and ecological functions ranging from regulating water flow to providing shelter for endangered animal species. There are several perspectives and issues of land use, one of which is land as an ecosystem or land as a resource (land as natural resorces) where land value is divided into two, i.e cological role and ecological physical product results with the issue of land use are maintaining the ecological role of the land and

managing the use of natural resources to maintain the balance of natural resource use [10].

Conversion of peat land causes the rate of C emissions to increase compared to the process of tethering C (C-sequestration) and in the peatlands of growing plants, besides being able to tether C, it is also potential to release C [11] [26] [27] [28]. Adger & Brown, 1995 in Agus, 2008 [11] explain the plants that grow on peatlands can also play a role in releasing CH through roots and stems. The faster the growth of plants on peatlands is expected to be the higher the rate of CH emissions. The rate of CH production also increases when accumulation of litter and organic matter below the anaerobic zone increases [11] [29] [30], so that surface temperatures increase too. In addition to the rate of CH increases, changes in land use from forest to agriculture. Martono [12] explain that changes in land cover have a significant effect (significance) on micro climate. Each type of land cover has different minimum and maximum temperatures. In addition, the peatland utilization for agriculture changes the natural hydrological system, which causes the condition of peatlands to be drier and susceptible to fire during the dry season [13]. Drained peatlands are the main fire location every year. It is very difficult to change wetlands for the use of alternative sustainable activities [14].

During the past two decades in current management practices, Indonesia's peatlands have been seriously degraded due to fire, deforestation and anthropogenic drainage [6,15]. Riau is a province in Indonesia where forest and peat fires mostly occur. Impacts of the disasters, such as respiratory illness, school closing and flight delay, are very alarming for the communities. The disastersare caused by burning of peatlands which are going to be used as lands for palm oil plantation [16]. Based on Eyes on the Forest report hot spots detected in Riau Province during July 2006 reached 1.419 of which 786 points (55.39%) were found in 338 points (23,82%) in HTI concessions, and 295 points (20,79%) on oil palm plantations. From the total heat point in Riau Province 56% of the hot spots are peatlands [17].

Bengkalis Regency is one of the Regency in Riau Province that has peatlands of 580.631,64 Ha (66,38% of the total area of Bengkalis Regency) [18]. Fires that occur on peat land in Bengkalis Regency have an impact on the society. In 2005 there were 2.104 Pneumonia sufferers, the highest number in Riau Province [19].

Apart from having an impact on public health, it also impacts on burning flora and fauna. In the 2002-2008 period, the potential of burning flora and fauna was in Bukit Batu Subdistrict (Bukit Batu Wildlife Reserve) covering an area of 21.500 Ha, the flora potential was kelat, meranti, bitangur, suntai, punak, bananas, forest durian, balam, and others, while the potential of burned fauna are estuarine crocodiles, camouflage tigers, siamang, long-tailed macaques, monkeys, hornbills, wild pigs. Whereas the Merbau Subdistrict (Tanjung Padang Tasik Wildlife Reserve) burned an area of 4,925 Ha. The potential of the flora that are burned are kelat, keranti, suntai, punak, kempas, forest orchids and so on, with the potential of pangola estuarine crocodile fauna, langur, long-tailed macaques, pontong storks, hornbills, ferrets, and others. [20]. On the basis of the above matters the author conducted an investigation and research with the title "The Effect of Peatland Conversion on Surface Temperature in Bengkalis Regency Riau Province".

2. METHODS

The method used to determine land cover and surface temperature is a spatial analysis method using GIS and Remote Sensing, while determining the correlation between land cover and surface temperature using simple linear regression. This research was conducted in Bengkalis Regency, Riau Province. Research time is 3 months from April to June 2018. The data type is a passive physical ratio data which is a geographical reference to the representation of objects on earth. Spatial data in the form of Landsat 5 images in 1988, 1996, 2000 and landsat 8 image in 2016 were sourced from USGS and spot image 6 of Bengkalis Regency from Department of Environment and Forestry of Riau Province. Next is the peat depth map of Center for Agricultural Land Research and Development, 2011, and administrative map of Bengkalis Regency.

The population in this study are all land cover in Bengkalis Regency including peat land and the distribution of surface temperature based on the transformation results of the satellite imagery of Bengkalis Regency. Samples are used to perform accuracy tests on satellite images and see how the relationship between peatland conversion and surface temperature, while the sampling technique in this study is to take a Purposive Sampling approach with sample determination with certain considerations, based on research purposes. The data analysis technique used is using.

2.1 Digital and visual Classification

Guided classification with supervised model maximum likelihood technique and maximum likelihood supervised classification is a classification based on pixel values that have been categorized as objects or made in training samples for each land cover object. Furthermore, using visual interpretation which is the interpretation of remote sensing data based on the introduction of

spatial characteristics/object Object characteristics can be identified based on 11 basic characteristics or variations namely shapes, sizes, patterns, shadows, hues, textures, sites [21], height, location, site associations and situations [22].

2.2 Analysis of Surface Temperature

Analysis of surface temperature using band 10 on Landsat 8 Oli, while Landsat 5 images using band 6 can be used to indicate land surface temperature. Simply put, there are several steps taken to analyze the surface temperature of the land, which is a spectral value to a radians value, change the radians to degrees of kelvin temperature, and change the temperature of the kelvin to Celsius.

2.3 Analysis of Map Overlay

Map overlays are used to assess landcover changes on peatlands. Overlayed landcovers in 1988, 1996, 2000 and 2016, found changes in land cover on peat and protected peatlands.

2.4 Regression Analysis

Using simple linear regression. Simple linear regression is used to measure the influence of one predictor variable (independent variable) on the dependent variable.

3 RESULTS

Bengkalis Regency is one of the regencies in Riau Province which is in a strategic location, which is directly adjacent to the Malacca Strait. Its astronomical location is between 207′2″ LU–0055′33,6″LU and 100057′57,6″BT-102030′25,2″BT. Bengkalis Regency consists of land and sea [23].

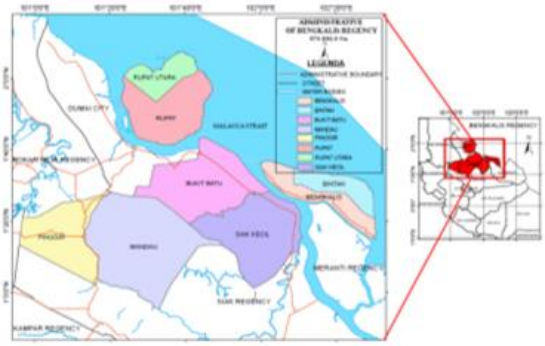

Fig 1. Map of Bengkalis Regency Administrative

3.1 Peatland Conversion in Bengkalis Regency

The following are details of peatland based on depth.

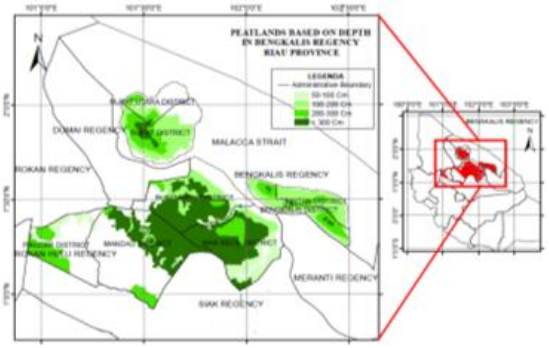

Fig 2. Peatlands based on depth

Peatlands with depths of 10-300 Cm are cultivated peatland, Peatland with dept 50-100 Cm=58.013,97 Ha (9,99%), peatland with depth 100-200 Cm=157.442,87 Ha (27,11%), peatland with depth 200-300 Cm=242.680,37 Ha (41,79%). while peatland depths exceeding 300 Cm are protected peatland and should not be converted. Peatland with depth more than 300 Cm= 242.680,37(41,79%).

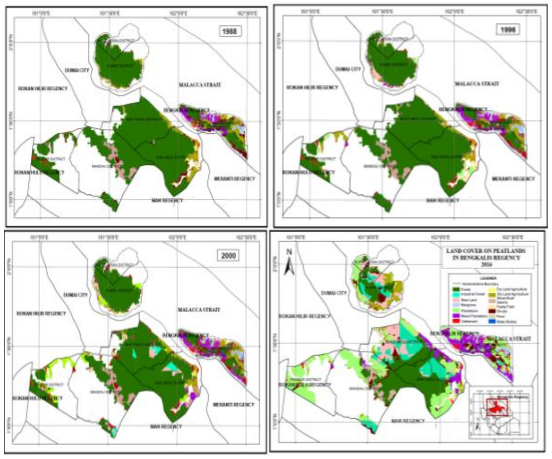

Fig 4. Land cover Bengkalis Regency

In the grafik above from the table above the forest cover from 1988-2016 the amount of forest cover decreased and conversely the amount of non-forest cover increased. peatlands in Bengkalis Regency covering an area of 580.631,64 Ha (66,38% of the total area of Bengkalis Regency), with details of forest cover on peatlands in 1988 covering an area of 464.504,7 Ha (79,99%), non-forest covering an area of 115.069,5 Ha (19,81%), then in 1996 the forest was 448.473,9 Ha (71,65%), the total forest area was 131.114 Ha (22,58%), in 2000 the forest was 416.043,9 Ha, (71,65%) of non-forest covering 163.450,9 Ha (39,81%) and in 2016 forest cover was 231.168,4 Ha (39,81%) and non-forest area was 347.853,4 Ha (59.90%), so that the forest cover area converted to peatland from 1988 to 2016 is 233.336,7 Ha (40,19% of peatland area).

Protected peatland with a thickness of ≥ 300 cm located in Bengkalis Regency covering an area of 242.680,37 Hectares (41.79% of the total peatland area in Bengkalis Regency), with details of forest cover on protected peatlands in 1988 covering an area of 224.814,9 Ha (92 , 68%) non-forest covering an area of 17.865,47 Ha (7,32%), in 1996 the forest was covering an area of 224.790,4 Ha (92,67%), non-forest 17.889,97 Ha (7,33%), in 2000 cover forest area of 213.602,89 Ha (88.06%), non-forest area of 29.077,48 Ha (11,94%), and in 2016 the forest cover area was 148.171,72 Ha (61,21%), and non-forest area was 94.501,65 Ha (38,79%), so that the forest cover area on protected peat land converted from 1988 to 2016 is 76.643,18 Ha (13% of the total peatland area or 31,58% of total protected peatland) peatland conversion occurs in Bengkalis Regency.

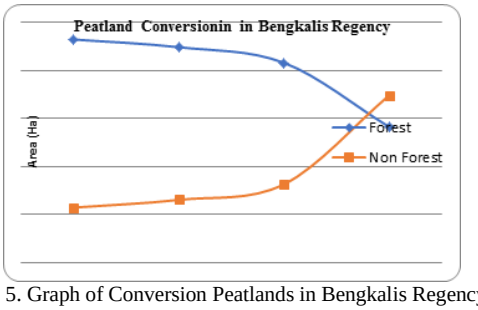

Fig 5. Graph of Conversion Peatlands in Bengkalis Regency, Riau Province

In the grafik above from the table above the forest cover from 1988-2016 the amount of forest cover decreased and conversely the amount of non-forest cover increased. peatlands in Bengkalis Regency covering an area of 580.631,64 Ha (66,38% of the total area of Bengkalis Regency), with details of forest cover on peatlands in 1988 covering an area of 464.504,7 Ha (79,99%), non-forest covering an area of 115.069,5 Ha (19,81%), then in 1996 the forest was 448.473,9 Ha (71,65%), the total forest area was 131.114 Ha (22,58%), in 2000 the forest was 416.043,9 Ha, (71,65%) of non-forest covering 163.450,9 Ha (39,81%) and in 2016 forest cover was 231.168,4 Ha (39,81%) and non-forest area was 347.853,4 Ha (59.90%), so that the forest cover area converted to peatland from 1988 to 2016 is 233.336,7 Ha (40,19% of peatland area).

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The following is a change in land cover area in protected peatland.

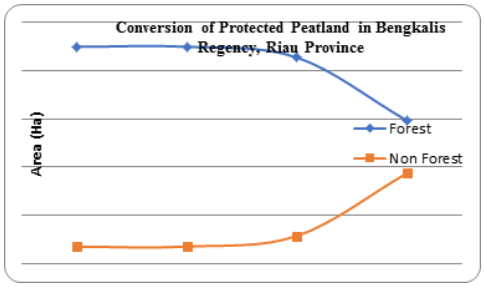

Fig 6. Graph of Conversion of Protected Peatlands in Bengkalis Regency, Riau Province

In the grafik above the conversion of protected peatlands in Bengkalis Regency increased from 1988-2016. Peatland covering an area 580.631,64 Ha (66,38% of the total area of Bengkalis Regency), with details of forest cover on peatlands in 1988 covering an area of 464.504,7 Ha (79,99%), non-forest covering an area of 115.069,5 Ha (19,81%), then in 1996 the forest was 448.473,9 Ha (71,65%), the total forest area was 131.114 Ha (22,58%), in 2000 the forest was 416.043,9 Ha, (71,65%) of non-forest covering 163.450,9 Ha (39,81%) and in 2016 forest cover was 231.168,4 Ha (39,81%) and non-forest area was 347.853,4 Ha (59.90%), so that the forest cover area converted to peatland from 1988 to 2016 is 233.336,7 Ha (40,19% of peatland area).

Protected peatland with a thickness of ≥ 300 cm located in Bengkalis Regency covering an area of 242.680,37 Hectares (41.79% of the total peatland area in Bengkalis Regency), with details of forest cover on protected peatlands in 1988 covering an area of 224.814,9 Ha (92 , 68%) non-forest covering an area of 17.865,47 Ha (7,32%), in 1996 the forest was covering an area of 224.790,4 Ha (92,67%), non-forest 17.889,97 Ha (7,33%), in 2000 cover forest area of 213.602,89 Ha (88.06%), non-forest area of 29.077,48 Ha (11,94%), and in 2016 the forest cover area was 148.171,72 Ha (61,21%), and non-forest area was 94.501,65 Ha (38,79%), so that the forest cover area on protected peat land converted from 1988 to 2016 is 76.643,18 Ha (13% of the total peatland area or 31,58% of total protected peatland).

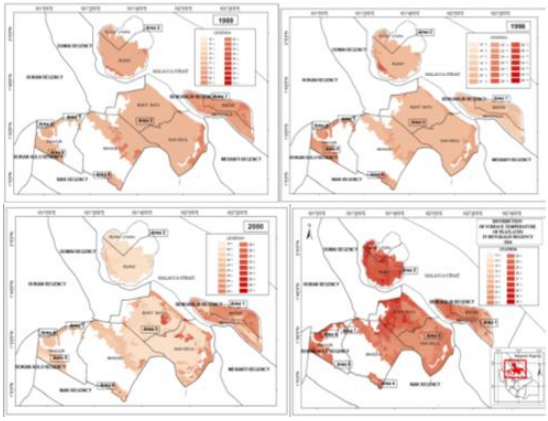

Fig 7. Surface Temperature in Bengkalis Regency, Riau Province

One of the factors that influence the distribution of surface temperature is the type of land cover, Martono (1996) in his study states that changes in land cover have a (significant) influence on the microclimate. To determine changes in surface temperature caused by changes in forest cover, a sample is made as in the map below as many as 7 samples made in 1988, 1996, 2000 and 2016 with the same sample each year. Overall changes in forest cover in 1988, 1996, 2000 and 2016, changes in area cover caused surface temperature to rise.

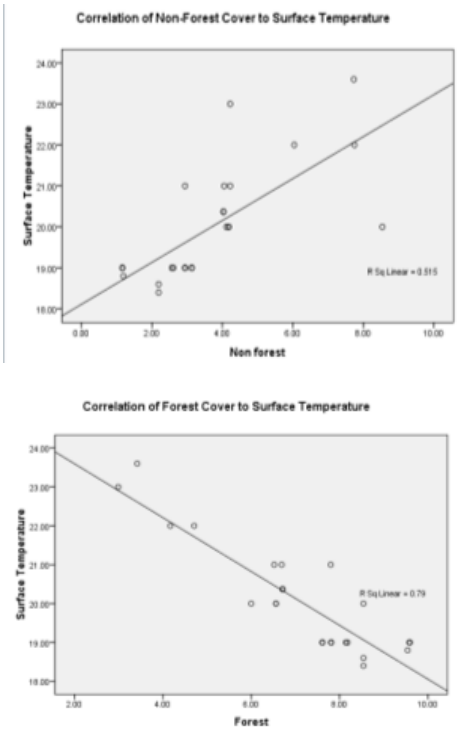

Fig 8. Correlation of Non-Forest and Forest to Surface Temperature

Correlation of non-forest cover to surface temperature on peatlands show a strong relationship with the correlation value (R) which is 0,718[a] and the value of R Square 0,51 which means that variations in changes in forest area, affect the condition of the surrounding surface temperature which is equal to 51% and is influenced by other factors. The higher the change in land cover from forest to non-forest, so the surface temperature rises too. linear regression equation

$$Y = 18,11 + 0,51X$$

In this equation the constant of X is 0,51 which means the forest change to non-forest on 1 Km^2 of peatland caused the increasing on average 0,51 ^oC of surface temperature. Correlation of non-forest cover to surface temperature on peatlands show a strong relationship, the correlation value (R) which is 0,889[a] and the value of R Square 0,79 which means that variations in changes in forest area, affect the condition of the surrounding surface temperature is equal to 79% and is influenced by other factors. Linear regression equation

$$Y= 24,98-0,69X$$

In this equation the constant of X is -0,69 which means that the forest cover on 1 Km^2 of peatland caused decrease in surface temperature on average 0,69 ^0C.

Changes in forest cover that trigger an increase in surface temperature. Agus [11] conversion of peat land causes the rate of C emissions to increase compared to the process of tethering C (C-sequestration). In the growing peatlands, besides being able to tether C, it is also potential to release C. Because plants that grow on peatlands can also play a role in releasing CH through roots and stems [11]. The faster the growth of plants on peatland is thought to be the higher the rate of CH emissions. The rate of CH production also increases when the accumulation of litter and organic matter below the anaerobic zone increases [11], so that surface temperatures also increase.

4 CONCLUSION

Peatlands in Bengkalis Regency are 580.631,64 Ha (66,38% of the total area of Bengkalis Regency), the forest cover area converted to peatland from 1988 to 2016 was 233.336,7 Ha (40,19% of the area of peat land). The protected Peatland located in Bengkalis Regency is 242.680,37 Ha. Area of forest cover on protected peat land converted from 1988 to 2016 is an area of 76,643, 18 Ha (13% of the total area of peat land or 31.58% of the total protected peatland). The forest Change on 1 Km^2 of peatland caused the increasing on average 0,51 ^oC of surface temperature.

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