IGRSM 2018

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24-25 April 2018

Berjaya Times Square Hotel, Kuala Lumpur, Malaysia

Geospatial Enablement

BOOK OF ABSTRACT

PARALLEL SESSION SCHEDULE

Day 1: Tuesday, 24 April 2018 (Parallel Session 1)
Time : 14:30-16:30

*Theme : **1A: Geospatial I***

ID	TITLE	AUTHORS	COUNTRY
PID5	Regional geological mapping in Northern Victoria Land, Antarctica using multispectral remote sensing satellite data	*Amin Beiranvand Pour, Yongcheol Park, Mazlan Hashim and Jong Kuk Hong*	Malaysia
PID10	Discovering of high potential zones for gold mineralization using remote sensing satellite data: Mersing, Johor Bahru, SE Malaysia	*Amin Beiranvand Pour and Mazlan Hashim*	Malaysia
PID46	Generating the digital elevation model through aerial technique	*Faiz Arif, Khairul Nizam Abdul Maulud and Abdul Aziz Ab Rahman*	Malaysia
PID79	The role of geospatial technology in plant pests and diseases: an overview	*Norraisha Md Sabtu, Nurul Hawani Idris and Mohamad Hafis Izran Ishak*	Malaysia
PID117	Urban growth pattern with urban flood and temperature vulnerability using AI: a case study of Delhi	*Gaurav Singh, Shafia Ahmad and Bharath H. Aithal*	India
PID129	Topological information from buildings in CityGML	*Syahiirah Salleh and Uznir Ujang*	Malaysia
PID147	The effect of reclamation land on water clarity using remote sensing	*Aisah Taufik Hidayat Abdullah, Nurulamani Rosman and Ismail Ahmad Abir*	Malaysia
PID171	Human elicited features in retail site analytics	*Hui-Jia Yee, Choo-Yee Ting and Chung Ching Ho*	Malaysia

Day 2: Wednesday, 25 April 2018 (Parallel Session 3)

Time : 11.00 – 13:00

*Theme : **3A: Oil Palm Special Session II***

ID	TITLE	AUTHORS	COUNTRY
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PID42	Sentinel-2 time series analysis to monitor oil palm plantation extension in Indonesia	*Christine Pohl, Bambang Sulistyo, Dominik Schilder, Mohammad Abdel Razak and John L. van Genderen*	Germany Indonesia Netherlands
PID45	Supporting smallholder oil palm plantation management by open source GIS	*Christine Pohl, Bambang Sulistyo, Stefanie Jaehnig, Mohammad Abdel Razak and John van Genderen*	Germany Indonesia Malaysia Netherlands
PID75	Estimation the age of oil palm based on optical remote sensing image in Landak Regency, West Kalimantan Indonesia	*Anggun Tridawati, Soni Darmawan and Armijon*	Indonesia
PID82	Synergy of L and C band radar data for estimating aboveground biomass of oil palm in Peninsular Malaysia	*Nazarin Ezzaty Mohd Najib, Kasturi Devi Kanniah and Arthur Cracknell.*	Malaysia United Kingdom
PID95	A multi-level convolutional neural network based oil palm tree detection method for high-resolution remote sensing images	*Weijia Li, Haohuan Fu and Le Yu*	China
PID150	Oil palm bio-physical suitability assessment in Indonesia and Malaysia over 2003-2015	*Pegah Hashemvand Khiabani and Wataru Takeuchi*	Japan
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PID75

Estimation the age of oil palm based on optical remote sensing image in Landak Regency, West Kalimantan Indonesia

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Abstract

The expansion of oil palm production can fully develop local economies and reduce poverty. Age of the oil palm is one of the most important factors that plays a significant role in the productivity of the oil palm. The main objective of this study is to show the potential use of optical remote sensing image. We used Landsat 8 Operational Land Imager (OLI) to estimate the age of oil palm. The approach used in this study was to analyze the relationship between NDVI (Normalized Difference Vegetation Index) and age of oil palm in variation of age by using logarithmic regression. Methodology consist on collecting of Landsat 8 OLI, radiometric and geometric correction, regression, and estimating the age of oil palm. The study shows that NDVI have positive correlation which R2 = 0,66 and equation y = 0,0425 ln (x)+0,7322 means the higher NDVI value the higher the age. The result of this study show that the majority of age in the study area is 0-5 years.

1. Introduction

Oil palm plantations are the largest oil-producing plant and are included in the multipurpose plant category as a contributing economy and reducing the poverty. There are two types of oil palm, palm kernel oil and crude palm oil, and their uses as a food source [1]. Oil palm plantations are commonly found in Southeast Asia, especially in Indonesia [2]. West Kalimantan Province is one of the provinces in Indonesia which has a very high natural resource potential in the field of oil palm. Oil palm area in West Kalimantan reaches 530,575 ha with the following proportion: management of mostly private plantation (299,248 ha), smallholding (189,255 ha), and PTPN (42,072 ha). Development of oil palm production in West Kalimantan from 2014 to 2016 can be seen on Figure 1.

Based on Figure 1 we can see that oil palm production in Landak Regency is increasing every year. The abundance of oil palm production makes an urgent need for monitoring the activities of oil palm plantations. Oil palm fields have patterns and textures that are different from other objects located in the area. When compared with the surrounding objects, this oil palm plantation has a pattern that is in groups and lined regularly [6]. The oil palm pattern makes it distinguish from the other plant in satellite imagery. Remote sensing is a proven method that can be used in monitoring agricultural areas [7]. It also can assist in making decisions about the management of oil palm plantations [2].

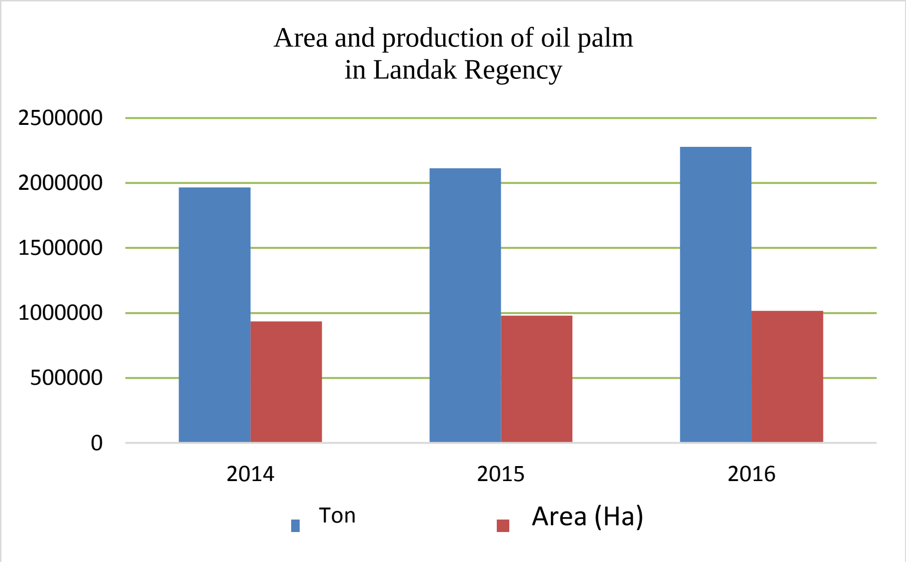

Figure 1. Area and production of oil palm in 2014-2016 [3]

Oil palm age is one of the factors that support the growth and production process of oil palm [4]. The oil palm age also have the potential to be used in precision farming whereas the collecting oil palm data is relatively time consuming and costly [5]. Several studies have been conducted to map the oil palm age by previous studies [5,8,9,10,11,12 ,13,14]. [5] used remote sensing technology to investigate the oil palm age based on UK-DMC 2 and ALOS PALSAR image. [5] found that oil palm age is an important factors influencing fruit bunches production. [13] utilized Landsat 8 OLI remote sensing image for mapping oil palm age by using infrared index method, the result on this study is there is correlation of Infrared Index with R^2 = 0,816. [14] conducted a study of several vegetation index in mapping the composition of the canopy cover of oil palm plantation followed by tasselled cap transformation.

The aims in this study are to analyse the relationship between NDVI (Normalized Difference Vegetation Index) and oil palm age in variation of age by using logarithmic regression and to estimate the distribution of oil palm age.

2. Materials and Methods

Methodology on this study are collecting of Landsat 8 OLI, vector data of oil palm age, and bing satellite map, preprocessing divided into two corrections they are radiometric and geometric correction, making of regions of interest for each of oil palm age, making of relationship analysis between NDVI and oil palm age, and estimating of oil palm age. Methodology on this study can be seen on Figure 2.

2.1. Data collection

In collecting of data, we divided into three data. They are primary data, secondary data, and supporting data. We used Landsat Image 8 OLI that was launched on July 17, 2013 (Figure 3) with spatial resolution 30 m as primary data derived from official website of USGS (U.S. Geological Survey) by accessing glovis.us gs.gov. This image is used as the base for geometric and radiometric correction, making of region of interest, and spectral transformation to produce map of oil palm age.

We collected vector data of oil palm age area as secondary data derived from National Institut of Aeronautics and Space (LAPAN). Vector data of oil palm age range from 1 to 8 years and 24 to 29 years (2013 data). This data is used as reference in making of Regions of Interest on the year of planting in the NDVI value which will be correlated with oil palm age. We also collected Bing

Satellite map 2013 as suporting data derived from Universal Map Downloader. Bing Satellite Map has better resolution (0,6 m) than Landsat satellite imagery and therefore is used as a reference image for geometric correction.

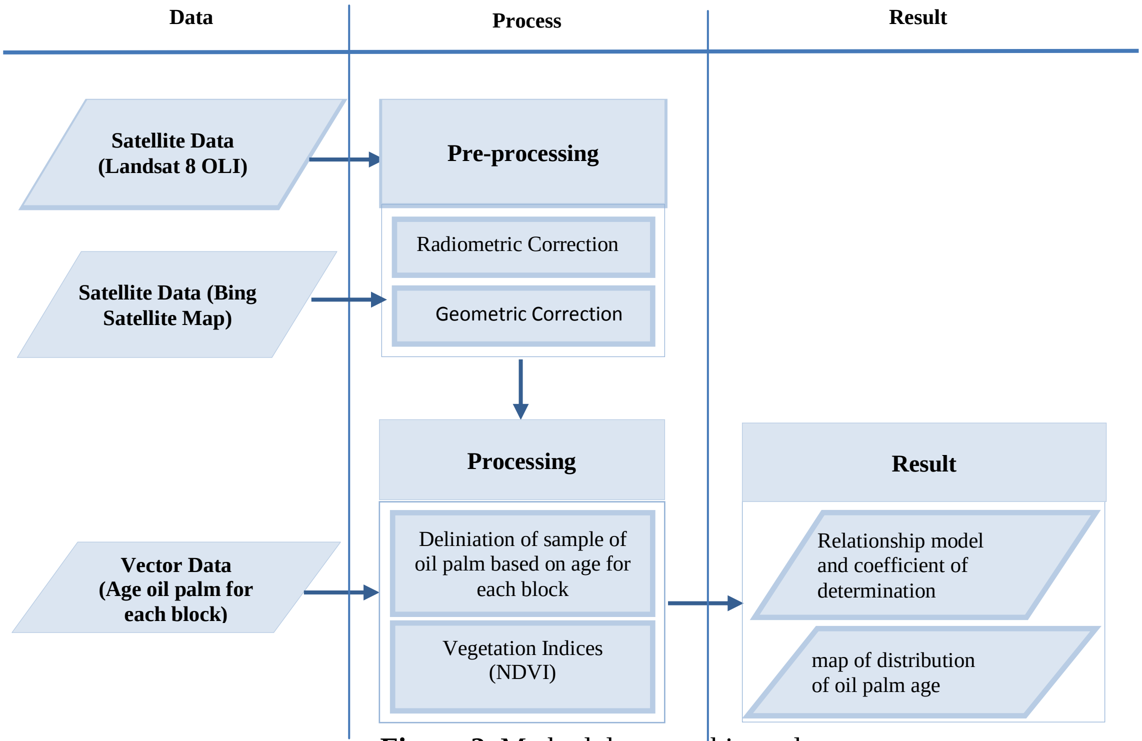

Figure 2. Methodology on this study

2.2. Preprocessing

2.2.1. Radiometric Correction. Radiometric correction in this study is to change the value of DN to radian (at sensor radiance) and then change the value of radian to reflectance (at sensor reflectance) by using MODTRAN4 method which already available at ENVI software with name FLAASH (Fast Line-of -sight Atmospheric Analysis of Spectral Hypercubes).

This model uses the standard equations of pixel spectral radiance received with a standard planar lambertian, based on the solar spectrum by the sensor written in equation 1 [15]:

$$L = \frac{A\rho}{1-\rho_\varepsilon S} + \frac{B\rho_\varepsilon}{1-\rho_e S} L_a \tag{1}$$

Where, L is spectral radiance on the sensor; ρ is surface reflectance on pixels; ρ_e is average surface reflectance; S is albedo in the atmosphere; $L_a$is radiance scattering behind the atmosphere; A, B is coefficients of atmospheric and geometric conditions; $\frac{A\rho}{1-\rho_e S}$ is the reflected energy of the object; $\frac{B\rho_e}{1-\rho_e S}$ is energy radiance which is dissipated by the atmosphere.

The A, B and S are determined from MODTRAN4 calculations using observation angles, sun angles and altitudes. FLAASH uses average radians to estimate reflectance with equation 2 [15]:

$$L_e = \frac{(A+B)\rho_e}{1-\rho_e S} + L_a \tag{2}$$

2.2.2. Geometric Correction. The Landsat 8 OLI image derived from USGS has a level on terrain corrected LIT format, where is this level is only need to determine the coordinate projection system in Landsat 8 OLI Image and also need to do radiometric image calibration. However, in this study, accurate validation must be performed by using the point of Independent Control Point (ICP) which is done evenly throughout the study area. The level of accuracy of ICP can be seen from the Root Mean Square error of RMSE calculation on ICP shown in equation 3:

$$RMSe_{icp} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_i - \hat{X}_i\right)^2 + \left(Y_i - \hat{Y}_i\right)^2}{n}} \tag{3}$$

where $(\hat{X}, \hat{Y})$ is the corrected image coordinates and (X, Y) is the coordinates of the reference image.

2.3 Spectral Transformation

The Landsat 8 OLI image in this study should be a spectral transformation technique combining several bands to produce a new image that accentuates the density aspect and the greenness of vegetation. The vegetation index used in this study is NDVI (Normalized Difference Vegetation Index).

This index has an effectiveness for predicting surface properties when the vegetation canopy is less dense and less rare. The formula for calculating the NDVI value can be seen in the equation 4:

$$NDVI = (NIR - RED) \div (NIR) \tag{4}$$

2.4. Identification and Extraction of Information (Region of Interest)

Oil palm plantation have patterns and textures that are different from other objects in the area. When we compared with the surrounding objects, this oil palm plantation has a pattern that is in groups and lined regularly [11]. This unique pattern makes oil palms distinguish from other trees or forest in satellite imagery. Patterns are very organized. It make the process of identification and extraction of statistical information age of plants easier. We create region of interest by considering area of oil palm age. The method used in determining the sample is random sampling method. The number of samples is different for each age, where the smaller the area of age the less the number of samples, as well as the larger area of age, the more samples needed. We identify and extract of spectral image values of each age block used to find the functional relationship between age and NDVI value derived from Landsat 8 OLI. Distribution oil palm age based on vector data can be seen on Figure 3.

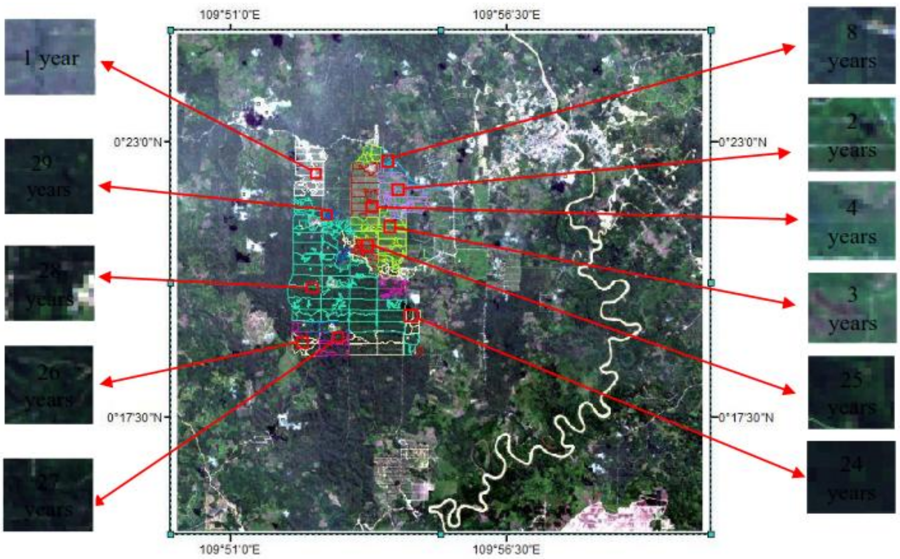

Figure 3. Vector data of oil palm age derived from LAPAN

2.5 Regression Analysis
The regression method used in this study is logarithmic regression because oil palm age data in this study are not linear. Generally, the logarithmic transformation variable in the regression model is used for a nonlinear relationship between the independent variable and the dependent variable [16]. Regression model indicated by coefficient of determination (R^2). The coefficient of determination on regression model is interpreted as how strong the ability of all independent variables in explaining the variance of the dependent variable. Coefficient of determination is between 0 to 1. A low coefficient of determination means a very limited variety of dependent variables and if coefficient of determination close to 1 means that the independent variables can provide all the information needed to predict the dependent variable [17]. Based on regression model and coefficient determination we can get information about relationships between NDVI and oil palm age.

3. Results and discussion

3.1 Models and relationships between NDVI and oil palm age
On this study we get variables such as age, derived from field survey (LAPAN) and NDVI value derived from Landsat 8 OLI 2013. The relationship between NDVI value and oil palm age showed by Scatterplot. Scatterplot is a graph commonly used to see a relationship pattern between two variables.

We investigate relationship between NDVI value and oil palm age on the study area. We collected information of age and NDVI value from 11 block in study area. The relationship between oil palm age and NDVI is presented by Scatterplot in Figure 4.

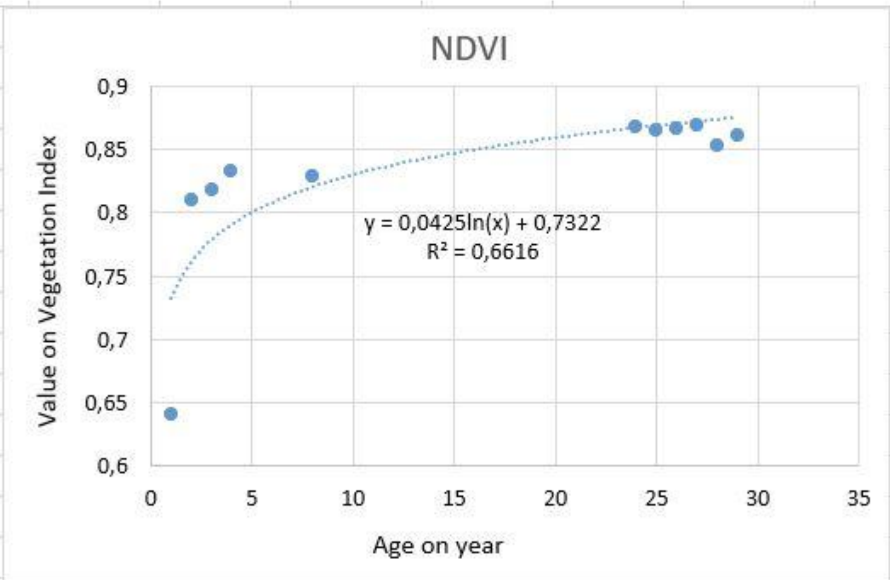

Figure 4. Relationship between oil palm age and NDVI

Based on Figure 4, The result of regression produce model and coefficient of determination which R^2= 0,66 shows that the equation can show 66% relation between NDVI value and oil palm age. The resulting formula is $y = 0,0425\ln(x) + 0,732$. We can see that NDVI extracted from Landsat 8 showed a strong positive correlation with oil palm age. It has indicated that the higher NDVI value the higher the age. NDVI is an index that reflects the degree of greenness. The green leaves give better reflections in the near-infrared wavelength range than in visible wavelength ranges.

At the age of 2 years, 3 years, 4 years and 8 years we can see from the scatterplot that the increase of NDVI value experienced a very good improvement and increased continuously. According [18] at the age of 1-2 years the plant undergoes a pruning process of production, the pruning done at the age of 20-28 months by cutting certain leaves as preparation for the harvest. The value of NDVI at the age of 1 years is low because at the age of 1 years palm oil plant leaves have not dangled down and still stand up to the top. Lastly, for age 24 - 29 years increase of NDVI value experienced a very good improvement and increased continuously, most of the leaves begin old and dry and then fall to the ground, but in general still lush. In this study, the oil palm plots are shown to be healthy and the optimum age of the palm trees shows high NDVI values.

3.2. Spatial distribution of oil palm age based on Landsat 8 OLI

Map of distribution of oil palm age is map that informs the spatial distribution of oil palm age in the Landak regency, west Kalimantan Province, Indonesia. Map of oil palm age is based on equation of regression analysis between NDVI extracted from landsat and oil palm age. Equation of regression showed in Table 1.

Table 1. Equation of regression between NDVI and oil palm age

Vegetation Index	Model	R^2
NDVI	$y = 0,0425\ln(x) + 0,732$	0.66

Based on Table 1, we got spatial distribution of oil palm age in Landak regency, west Kalimantan province, Indonesia can be seen on Figure 5 and percentage of large area on this study can be seen on Table 2. We classify oil palm age into 8 classes they are non oil palm, 0 – 5 years, 5 – 10 years, 10 – 15 years, 15 – 20 years, 20 – 25 years, 25 – 30 years, and more than 30 years. We also calculated large area of oil palm in Landak Regency, west Kalimantan province in Indonesia around 29091,15 ha.

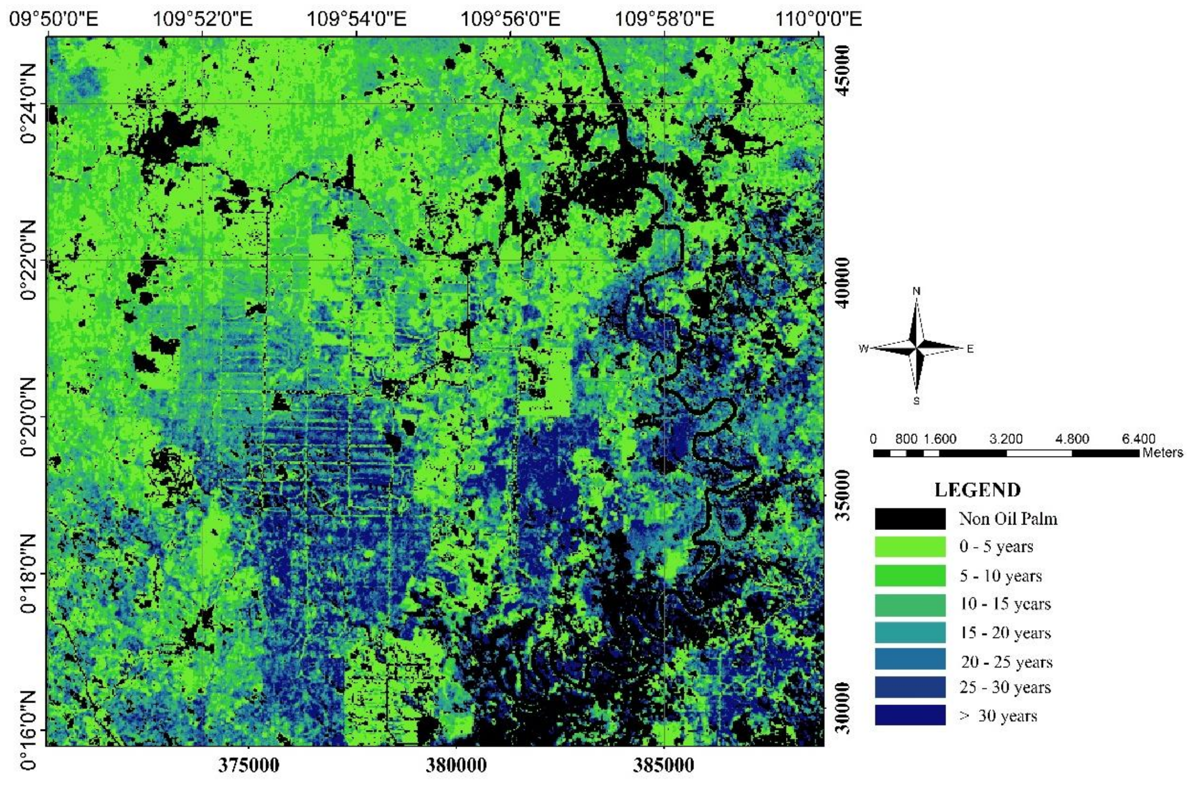

Figure 5. Map of oil palm age

Table 2. Percentage of large area of oil palm age

Oil palm age (years)	NDVI	
	Area (Ha)	Percentage
0 – 5	8884.71	31.44%
5 – 10	5635.62	19.94%
10 – 15	4035.78	14.28%
15 – 20	4035.78	11.31%
20 – 25	2498.31	8.84%
25 – 30	1829.25	6.47%
>30	2171.70	7.68%

Based on Figure 5 and Table 2, we got information that majority of oil palm age in Landak regency, west kalimantan province, Indonesia is 0 - 5 year (8884.71 ha) with percentage 3,44%, and minority of oil palm age is 25 - 30 year (1829.25) with percentage 6,47%.

4. Conclusions

The study has showed estimation of oil palm age based on Landsat 8 OLI. The relationships between oil palm age and NDVI on this study is strong which (R^2) of 0,66. NDVI and oil palm age have a positive relationship with the equation $y = 0,0425\ln(x) + 0,732$ means the higher NDVI value the higher the age. Furthermore, the equation is used for mapping the spatial distribution of oil palm age informing that the majority of age in the study area is 0 - 5 year and the minority of oil palm age in the study area is 25-30 year. For future works we will collect various years of production data from the plantation to estimate the production of oil palm.

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