USING RED-EDGE BAND TO CLASSIFY EUCALYPTUS PLANTING AREA IN SOME PART OF NAKHON RATCHASIMA AND BURIRAM PROVINCE

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ABSTRACT: Eucalyptus, one of the rapid growth key economic crops in Thailand, can be produced into wooden sheet within 4-5 years. It can be utilized in many ways such as to be used as a material for making paper pulp, construction pole, charcoal, etc. Presently, Eucalyptus plantation is popularly promoted among the agriculturists in the North Eastern area and nearby in order to sufficiently serve the market. Classification and evaluation of the Eucalyptus plantation areas using high resolution satellite imagery is difficult because the spectral reflectance of all vegetation have almost the same characteristics for example forest, sugar cane, and cassava. The purpose of this study is to classify Eucalyptus from other plants in Lumthamainchai District, Nakornratchasima Province and Khoo Muang Distirct, Buriram Province having plenty of Eucalyptus plantation. Object Based Classification and Vegetation Index (NDVI) of normal Red Edge and Near Infrared Band were used in comparison with NDVI of Red Edge and Near Infrared-1 Band from WorldView-2 satellite.

By dividing the classified Eucalyptus Planting areas into twenty 1 X 1 sq.km. grid cells, an Accuracy Assessment was performed by comparing the result with the data collected from ground survey. The study has found that the NDVI of Eucalyptus is between 0.412-0.584 while the Red Edge NDVI of Eucalyptus is between 0.029-0.124. The classification accuracy using NDVI and Red Edge NDVI are 63.46% and 67.47% respectively. Therefore, Eucalyptus plantation areas classification using Red Edge NDVI is more accurate than using normal NDVI because of the narrow spectrum. However, this method provides less accuracy. Other classification methods need to be developed and integrated with this method in order to increase the accuracy.

1. INTRODUCTION

Nowadays, the high-resolution satellite data is widespread and concrete to be applied in Agriculture and Land Use. Suchlike the well-known high-resolution satellites, WorldView-1 satellite which has only panchromatic imagery acquisition at nadir with 50 cm. resolution. WorldView-2 has two optical instruments which are capable to capture panchromatic image with 46 cm. resolution and multispectral with 1.84 meter resolution at nadir. Moreover, the multispectral imagery acquisition of WorldView-2 has more potentiality to acquire the image up to 8 bands. It does not only acquire the spectral bands (Blue, Green, Red, and Infrared) but it can acquire the spectral bands (Coastal and Red Edge bands) which are suitable for vegetation classification also.

Consequently, this research is to study the effectiveness of Vegetation Index (NDVI) comparing with normal 4 bands (Nir, Red) and 8 bands (Nir, Red-Edge) by using WorldView-2 satellite data to analyze of Eucalyptus plantation areas. Due to the reflectance of these plants is quite similar, therefore it will be useful for vegetation classification (both of these plants). In addition, the satellite data will be used in plantation areas afterward properly.

2. OBJECTIVE

2.1 To study the similarity and the difference of vegetation classification (Eucalyptus plantation areas) between 4 and8 bands by applying Vegetation Index analysis.

2.2 To apply the conducted data and enable to be used properly in plantation areas afterward.

3. STUDY AREA

The study area covers 200 square kilometers in part of 2 provinces in northeast of Thailand, namely Lumthamainchai district in Nakhonratchasima province and Kumueang district in Buriram province. Locations are situated at Latitude of 15˚ 16′18″N to 15˚ 21′12″ N and longitude of 102˚ 55′6″E to 103˚ 0′6″E at approximately 200 meters above mean sea level. The plantation in this area are diverse, mostly cassava and eucalyptus, others are rice, sugarcane, Para rubber, etc. (fig. 1)

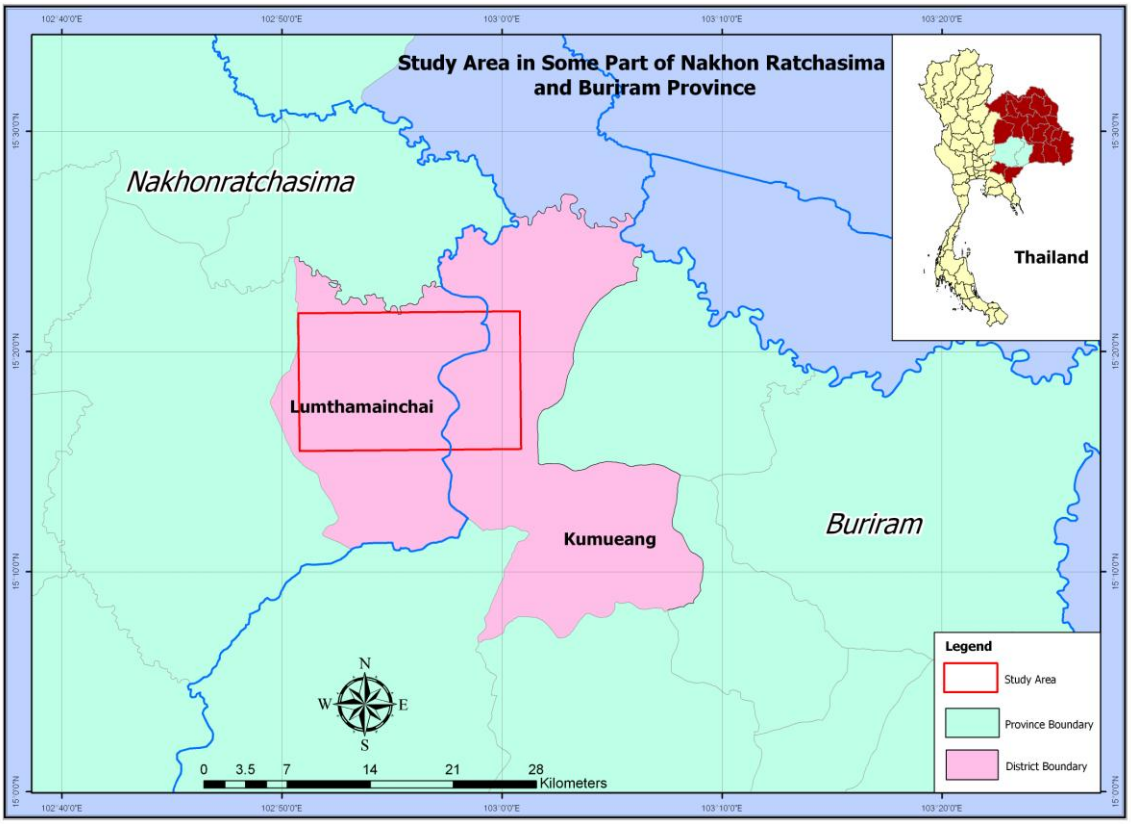

Figure 1 Study Area

4. DATA USED

Data used in the process include:

4.1 Primary Data

Primary data used in this study are cloud free WorldView-2 satellite imageries. There are panchromatic image (450-800 nm) and multispectral image (coastal 400-450 nm, blue 450-510 nm, green 510-580 nm, yellow 584-625 nm, red 630-690 nm, red edge 705-745 nm, NIR1 770-895 nm and NIR2 860-1040 nm) acquired on 9th February 2011. All Worldview-2 images were pan-sharpened, enhanced and geometrically corrected.

4.2 Additional Data

Additional data used in the study are as follows:
4.2.1 Aerial photo in large scale from Ministry of Agriculture and Cooperatives.
4.2.2 Administrative boundary from the Department of Provincial Administration.
4.2.3 Landuse map of year 2009-2010 from Land Development Department.
4.2.4 GISTDA's landuse survey point collected in the year 2010 covering Nakhonratchasima and Buriram province, Thailand.
4.2.5 Ground truth data in the year 2011 from handheld GPS equipment.

5. METHODOLOGY

5.1 Pre-Classification

5.1.1 WorldView-2 images of the study area were supported by DigitalGlobe. These images were collected with both panchromatic and multispectral modes.

5.1.2 The 0.5 meter resolution pan-sharpened images of WorldView-2 were created by fusing a high-resolution pan-chromatic WorldView-2 imagery at 0.5 meter resolution with multispectral WorldView-2 imagery at 2 meter resolution. Four traditional bands (Blue, green, red and near-infrared1) and 4 new bands (coastal, yellow, red-edge and near-infrared were utilized.

5.1.3 Geometric correction was performed to get the accurate references for colored ortho aerial photography images. An image-to-map registration method was implemented in the study. Second Order Polynomials equation was applied for Geometric Correction. An accurate data model resulted from the correction processes along with nearest neighbor re-sampling method were used in order to create a new accurate satellite image and reduced pixel size to 0.5x0.5 meters. Geometric error from this approach is less than 1 pixel.

5.2 Analysis

5.2.1 The pan-sharpened image segmentation is re-classified following the object-based classification method.

5.2.2 Analyzed the eucalyptus plantation by applying 2 types of the Vegetation Index (VI) calculation which are NDVI and Red-edge NDVI. The equations are as follows;
The Normalized Difference Vegetation Index (NDVI)

$$NDVI = \frac{NIR-RED}{NIR+RED}$$

Normalized Difference Vegetation Index with Red-Edge Band

$$\text{Red-Edge NDVI} = \frac{NIR-RED\ Edge}{NIR+\ RED\ Edge}$$

5.2.3 Overlaid the results of the 2 indexes with the landuse data of 2009 to 2010 and observe the digital number (DN) of cassava and eucalyptus in each segment for classification.

5.2.4 Classified the 2 indexes from the selected DN .

5.3 Post-processing

5.3.1 Ground surveying with the classified data to verify the accuracy of the Eucalyptus plantation, which are specified from NDVI and Red-edge NDVI (fig. 3)

5.3.2 Selecting of the study areas, referenced from the result of the two plants classification, are divided on 1 by 1 km – grid. Thus, there are 20 square grids per one image. The NOAA's simple random sampling method is used. (fig. 4)

5.3.3 Verifying the accuracy of the classified data and ground surveying data by using this equation

$$\%\ \text{Accuracy} = \frac{(\text{Number of control point} - \text{Number of inaccurate control point})}{\text{Number of control point}} \times 100$$

5.3.4 Summarizing the classification result from NDVI and Red-edge NDVI of Eucalyptus plants

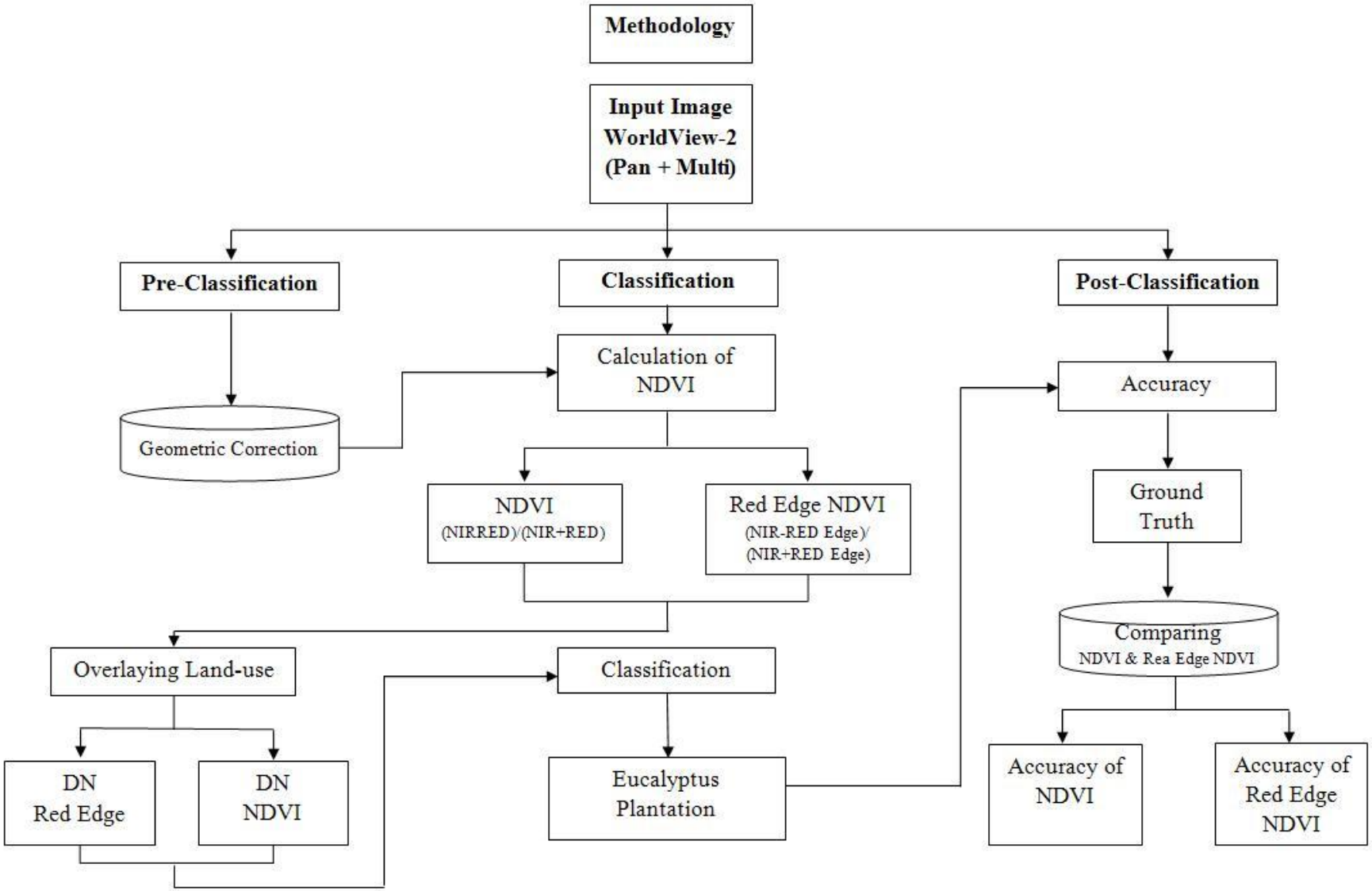

Figure 2 Methodology

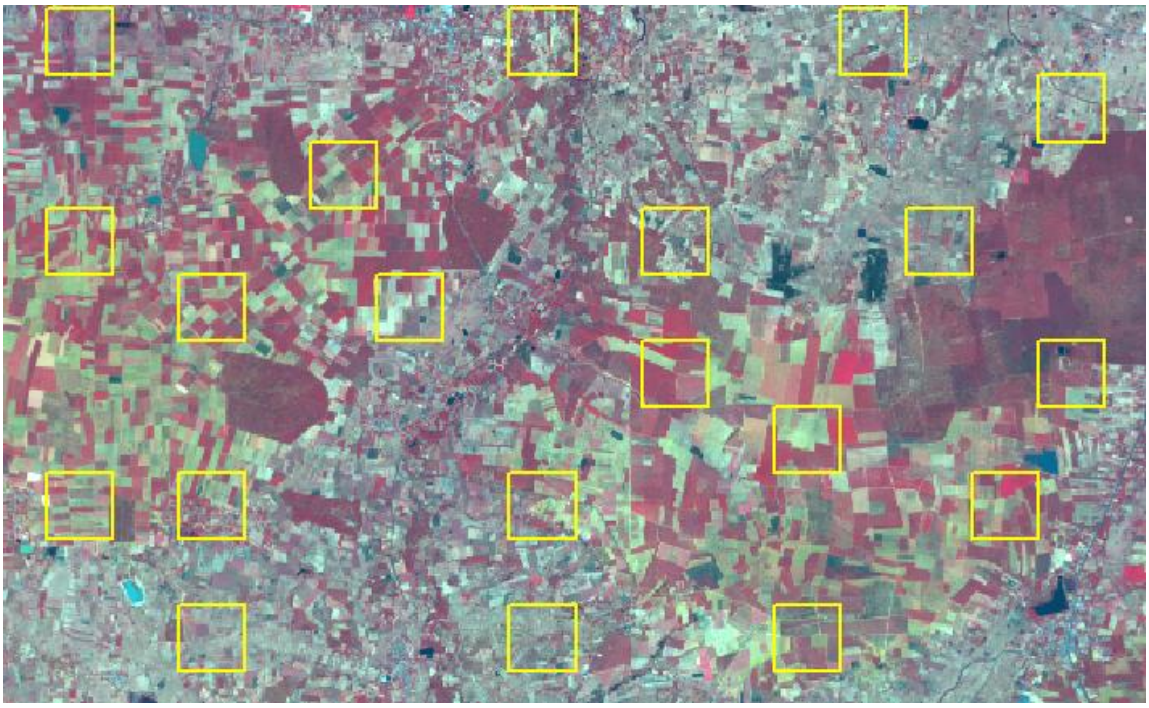

Figure 3 Ground Survey Verification Boxes

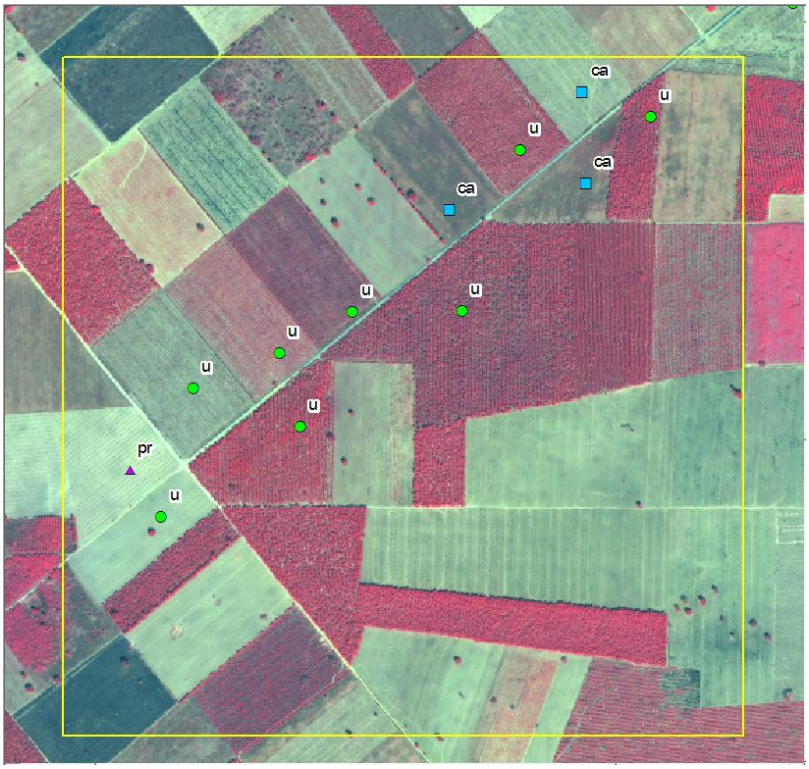

Figure 4 Land Use Ground Survey

6. Result

6.1 The finding of the study is the NDVI calculation showing the range of the data in the study area from -0.330201 0.738334 while the Red-edge NDVI calculation shows the range of the data from -0.321290 to 0.378034 The range of Red-edge NDVI data is narrower than the NDVI data. (Fig. 5-6)

Figure 5 NDVI calculation and range

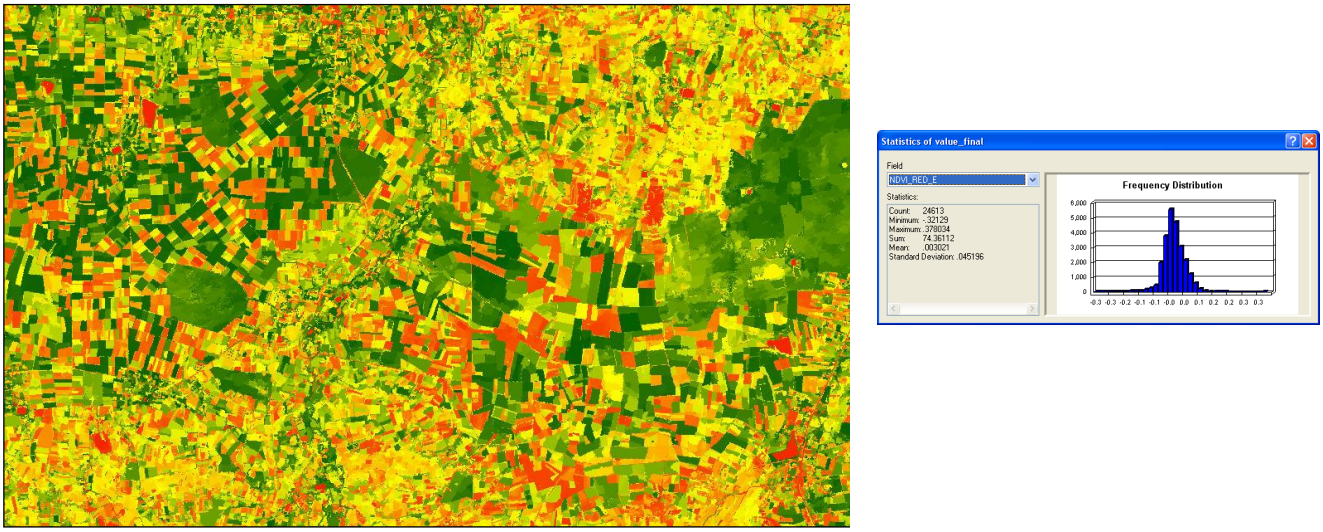

Figure 6 Red-edge NDVI calculation and range

6.2 The classification of the eucalyptus, in each equation from the land use data, the NDVI of eucalyptus ranges from 0.412 to 0.584 , and the red-edge NDVI ranges from 0.029 to 0.124 (Fig. 7-8)

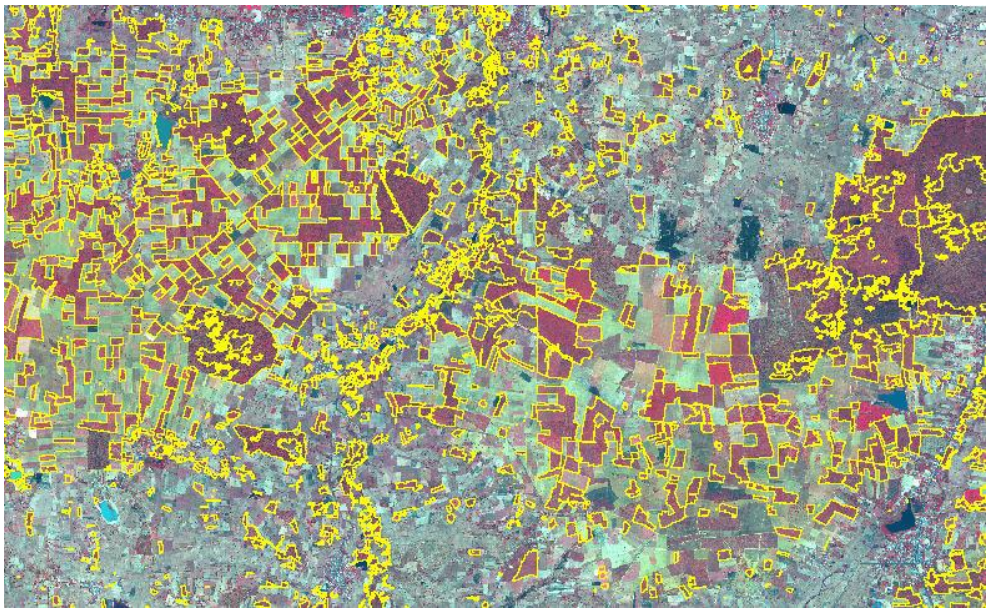

Figure 7 The classification of the NDVI

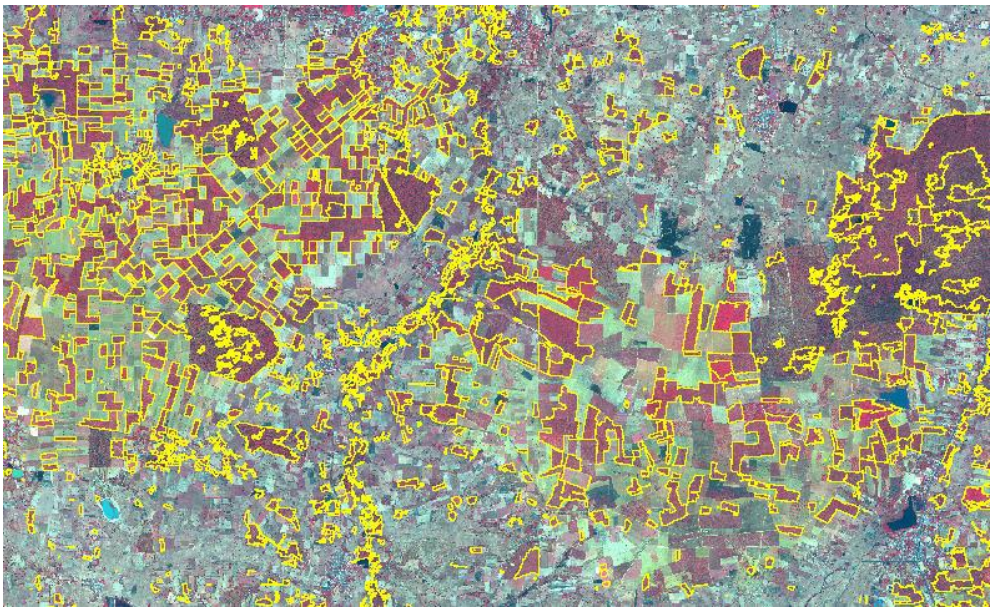

Figure 8 The classification of the red-edge NDVI

6.3 The classification of cassava and eucalyptus by using the results from the equations reveals that the NDVI is accurate 63.46% ([375-137/375]*100) , and the red-edge NDVI is accurate 67.47% ([375-122/375]*100)

7. CONCLUSION

7.1 In this study, applying WorldView-2 data in eucalyptus classification, using NDVI and red-edge NDVI calculation method, with object-based analysis reveals eucalyptus classification by red-edge NDVI is more accurate than the traditional NDVI because of the narrower spectrum and the high capability in plant classification.7.2 For the next study, other equations and spectrum should be used for eucalyptus or other plants classification.

8. ACKNOWLEDGEMENT

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