EXPERT CLASSIFICATION FOR EUCALYPTUS PLANTATION USING LANDSAT-5 DATA : A CASE STUDY OF LAM THAMENCHAI DISTRICT, NAKHON RATCHASIMA PROVINCE, THAILAND

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Abstract: This study aims to develop an expert classification technique to identify eucalyptus plantation areas of Lam Thamenchai District, Nakhon Ratchasima province in Thailand.

Multi-date LANDSAT-5 data acquired in January and March 2011, were used in development of the expert classification technique, since Landsat-5 data is found that these can be useful for providing information on Land use and Land cover classification. All imageries are finished on the digital image pre-processing steps. In addition, the important numerical data sets, including NDVI data, NDWI data, band ratio data and result from unsupervised classification data using Isodata method, are created to be the rule set for classification the eucalyptus plantation areas. Moreover, spectral signature of eucalyptus plantation derived from LANDSAT - 5 is also applied to make the new rule set more reliable. The result is compared with the result derived from maximum likelihood classification method, which is found that the result from the new technique is more accurate than the traditional method.

In conclusion, the expert classification technique considering both spectral signature and other significant numeric indicators, is a proficient method to efficiently discriminate eucalyptus plantation area of Lam Thamenchai District, Nakhon Ratchasima province in Thailand.

INTRODUCTION

At this time in Thailand, Eucalyptus plantation was extended around country and increase area continually because Eucalyptus is fast growing tree and worthy for several purposes. In 1997, Royal Forest Department survey Eucalyptus plantation area found that in Thailand had Eucalyptus plantation area about 942.40 km.^{2} In the Northeast was the most area about 368.00 km.^{2} The following was the East about 200.00 km.^{2} And the province which had the most large area for Eucalyptus for trading was Chachoengsao 67.20 km.^{2} The following was Prachinburi 38.40 km.^{2} And Nakhon Ratchasima 33.60 km.^{2} In 2001, Land Development Department had researched that Eucalyptus plantation area of Thailand about 3,854.04 km^2 had separated into Eucalyptus plantation in The National Forest about 1,206.93. km^2 and private sector about 2,647.11 km.^{2} And the province which had the most large area was Kanchanaburi about 355.20 km.^{2} The following was Sakaeo about 320.00 km^2 and Nakhonphanom about 222.40 km^2 (Department of Agriculture, 2010) This affected the number of the people who wanted to plant the Eucalyptus had continually increased. Therefore, at this time, it's important to know the amount of the Eucalyptus plantation area to approximate the product. We had many methods to make a research; one was the Remote Sensing in form of Supervised Classification, the method of Maximum Likelihood Classification. But for this study we tested for finding the way to classify the Eucalyptus plantation area, we used the method of Expert classification technique. The important numerical data sets, including NDVI data, NDWI data, band ratio data and result from unsupervised classification data using Isodata method. According to this study we used the information from Landsat 5 satellite only. The purpose of this study was to develop an expert classification technique to identify eucalyptus plantation areas of Lam Thamenchai District, Nakhon Ratchasima province in Thailand and studied the feature of the signature of Eucalyptus.

DESCRIPTION OF THE STUDY AREA

Lam Thamenchai District, Nakhon Ratchasima province ,northeastern Thailand. The area is approximately 308.5 km^2 (119.1 sq mi).

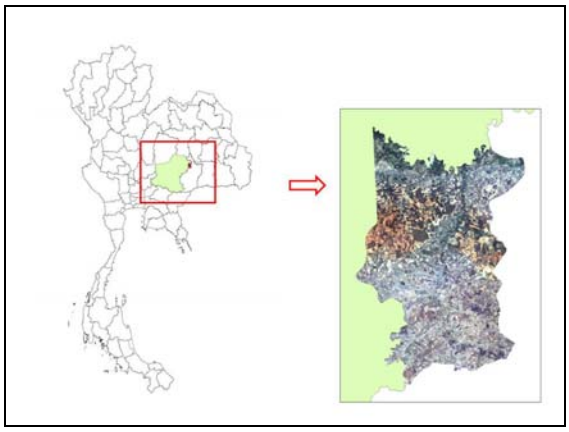


Figure 1: The position of the study area.

METHODS AND EQUATION

1. Radiometric correction.

Both LANDSAT5TM satellite images were acquired on January 02, 2011 and March 07, 2011. The preprocessing are radiometric correction and using model in **Figure 2**.

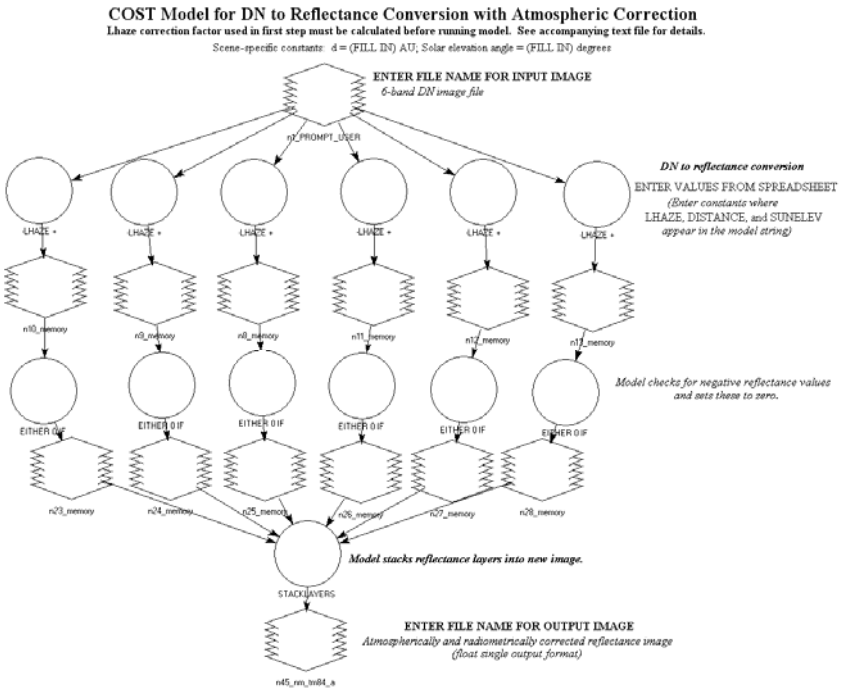


Figure 2: Cost Model (http://arsc.arid.arizona.edu/resources/image_processing/landsat/ls5-atmo.html)

2. Geometric Correction

Geometric correction was Image to Image technique. The rectified image, which has been through Ortho-Rectification process, has been used as the reference image. Ground control points were set for at least 30 points per image, and these points need to be spread all over the image. The image was rectified with an equation of polynomial level 1. RMS Error was set to be no more than 1 pixel. Nearest Neighbor was used as a randomizing method. The output image was set to have a resolution of 25x25 meter.

3. Image Classification

Classification from expert classification technique, create Image Objects by Multi resolution segmentation on Definiens Developer. It is initial segmentation is the subdivision of an image into separated regions represented by basic unclassified image and scale parameter as 10 (shape 0.4 and compactness 0.6). The object was created automatically from defining parameter in the program and process out as a group of objects. These objects were grouped with pixels according to their statistics. Homogeneous or similar pixels were grouped and set up the rule set to be used for classifying land use types such as vegetation and non vegetation. Then the image was classify with model by using a expert classification technique (numerical data sets, including NDVI data, NDWI data, band ratio data) to classify Eucalyptus area.

Classification from Maximum Likelihood Classification method. First, Classify with using Isodata method. Next Supervised Classification with Maximum Likelihood Classification method using data from training area 21 areas in this study area to classify Eucalyptus area. (**Figure 5**).

4. Analysis and Check for accuracy

After classify with both method data from the result check for accuracy with random sampling method (50 areas) and comparison are accuracy data. Finally, using training area are 21 areas around study areas for put spectral reflectance data from both images. Use the results data plot the graph and considering both spectral signature.

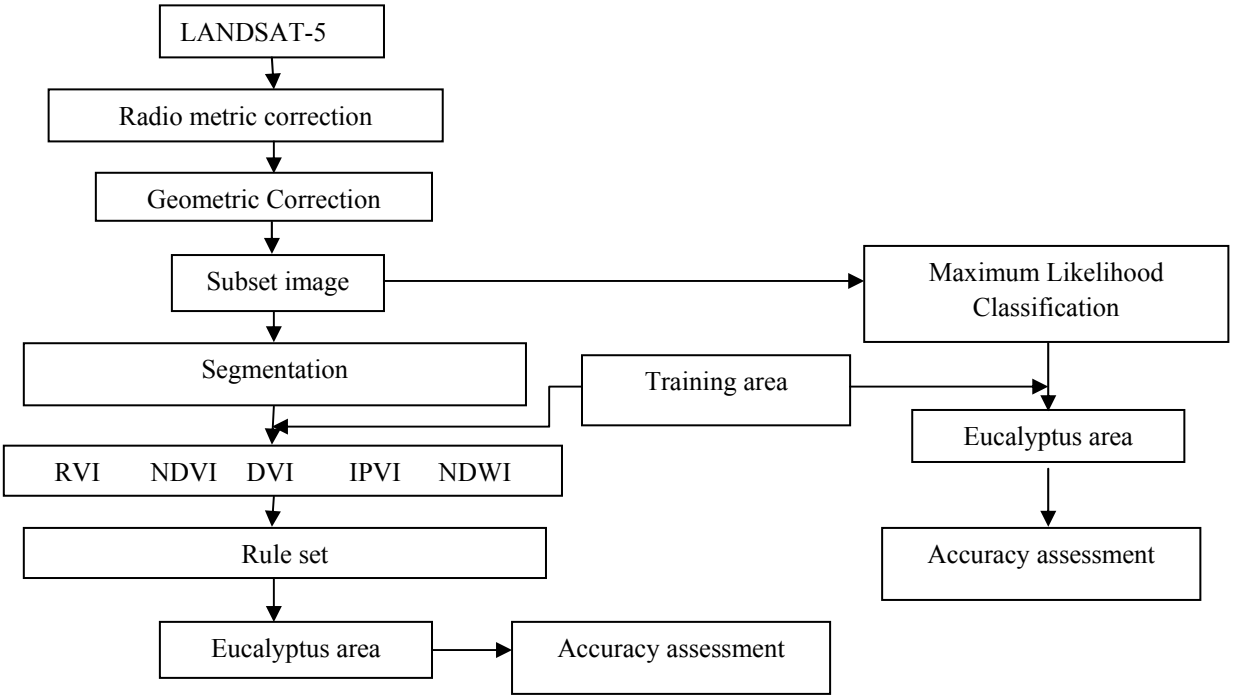


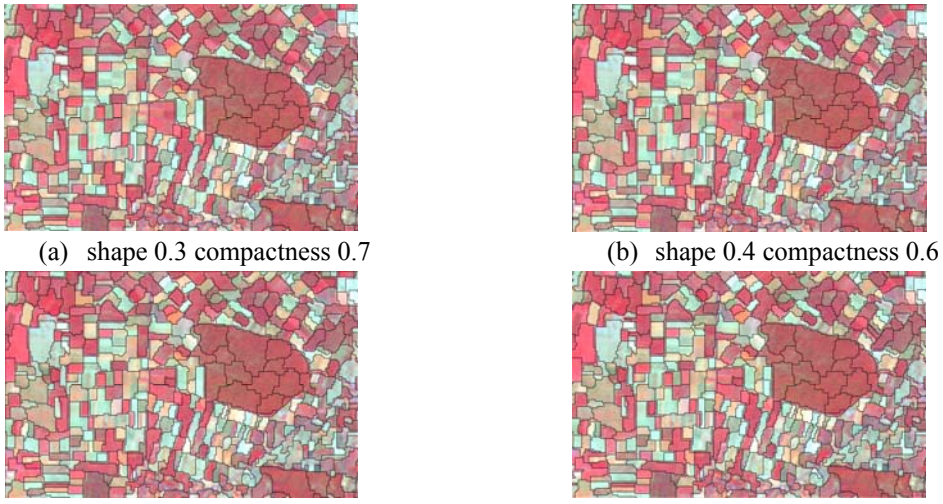
Figure 3: The process

Table 1: equation ; copied and modified from (Davidson and Csillag, 2001).

Index	Formula	Values Range	Sources
DVI	NIR-R	∞	Richardson and Everitt (1992)
RVI	NIR/R	0 to ∞	Jordan (1969)
NDVI	(NIR-R)/(NIR+R)	-1 to +1	Rouse et al., (1973)
IPVI	NIR/(NIR+R)	0 to +1	Crippen (1990)
NDWI	(NIR-SWIR)/(NIR+ SWIR)	-1 to +1	Gao (1996)

RESULTS

1. The results with segmentation Landsat 5 data 2 date use shape 0.4 and compactness 0.6, shape 0.3 and compactness 0.7, shape 0.2 and compactness 0.8 and shape 0.1 and compactness 0.9 Figure that segmentation is the most exhaustive polygon and for shape 0.4, compactness 0.9 is the most rough. Therefore, this study needs for shape 0.4 and compactness 0.6 because it needs the value of the shape to support Segmentation (**Figure 4**).
2. Results classification from Maximum Likelihood Classification method (**Figure 6**).
   In the first date, The results from this method classify Eucalyptus area are 0.87 km^2. Accuracy assessment is 52% (Correct 26 points from 50 points).
   Second date, The results from this method classify Eucalyptus area are 1.13 km^2. Accuracy assessment is 60% (Correct 30 points from 50 points).
3. Classification from expert classification technique (**Figure 7**).
   In January, The results from this method classify Eucalyptus area are 1.43 km^2.Accuracy assessment is 70%(Correct 35 points from 50 points).
   In March, The results from this method classify Eucalyptus area are 1.29 km^2.Accuracy assessment is 68 %(Correct 34 points from 50 points).
4. From these 2 graphs in Figure 8 presented that the graph which imported the value to classify occurred the different states, especially in band 5.



(a) shape 0.3 compactness 0.7 (b) shape 0.4 compactness 0.6

(c) shape 0.2 compactness 0.8 (d) shape 0.1 compactness 0.9

Figure 4 : Segmentation

Figure 5: Point for Training area(a) Point for Accuracy assessment (b)

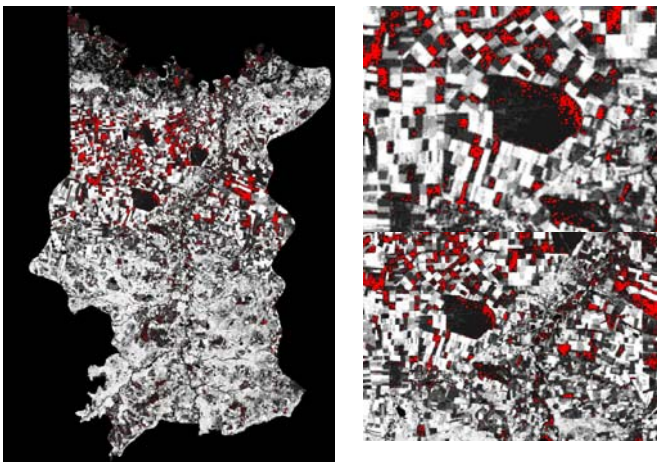


Figure 6: Classification from Maximum Likelihood Classification method

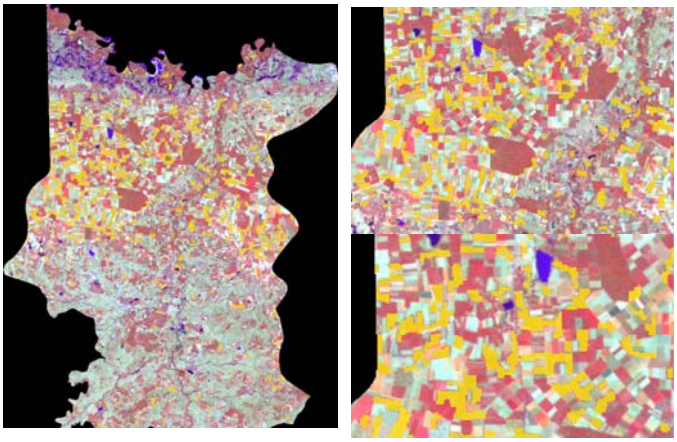
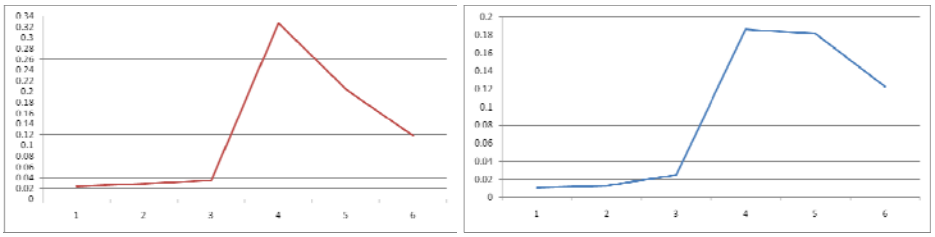


Figure 7: Classification from expert classification technique



(a) January **(b) March**

Figure 8: Both graph spectral signature

(a) January **(b) March**

Figure 9: Landsat 5 data in January and March

DISCUSSION

To use the expert classification to classify the Eucalyptus plantation area is better than used the Maximum Likelihood Classification method. However, the result was not quite accurate. When we oversaw it the accuracy of these 2 periods, in January were 50% and 70% and in March was 60% and 68%. This presented that if we classified the various kinds of plants, we needed another variable.

CONCLUSIONS & RECOMMENDATIONS

For the classification of Maximum Likeihood Classification method should classify the large land cover and should not use to classify the various kinds of plants. And for the expert classification which uses the Rule set to classify, was able to classify some parts of the Eucalyptus plantation area. However, we should more study and concern about another relative factors to consider such as the climate or the terrain. Therefore, from **Figure 9**. shows that since January, the studied area was flooded, and in March the flood was decrease. Even if we lately solved the Radio metric correction, we still could not use the rule set together for these 2 periods and the result of the classification was quite different. For the training area that we got only example of plantation area which including growing eucalyptus which crown cover the area but not including the beginning planting and also unconsidered about species of Eucalyptus.

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