ALGORITHM DEVELOPMENT FOR OIL PALM PLANTATION IDENTIFICATION USING THEOS DATA : A CASE STUDY OF NONGYAI, CHONBURI PROVINCE, THAILAND

Worawit Akkanipat*, Darunee Promchot

Geo-Informatics Scientist,
Institute of Geo-informatics Technology Transfer and Knowledge Development,
Geo-Informatics and Space Technology Development Agency (Public organization)
120 The Government Complex Commemorating
His Majesty The King's 80th Birthday Anniversary, 5th December, B.E.2550(2007)
Building B 6th and 7th Floor,
Chaeng Wattana Road, Lak Si, Bangkok 10210, THAILAND
Tel: +66(0) -2141-4604; Fax. +66(0) -2143-9594 to 5
E-mail: worawit@gistda.or.th E-mail: darunee@gistda.or.th

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ABSTRACT: This paper aims to develop an oil palm identification method in Nongyai Chonburi Province the eastern region of Thailand. Oil Palm is a main economic crop of Thailand and its oil have potential more than another kind of oil crops. In this study, the authors use the satellite data of THEOS (Multispectral), the first Thailand remote sensing satellite, with capability in acquiring the visible and near infrared images, data acquired in January and December 2010, and classify oil palm plantation areas using object-base classification. With the specific area in the land use, the authors use appropriated parameters which are shape, size and color to setting segmentation parameters, coupling with image operation technique, in order to develop the algorithm on the oil palm identification and the physical relationships along with the field survey. The results show that the appropriated rule set to develop the algorithm for oil palm identification with suitable for THEOS data.

INTRODUCTION

Oil Palm is a main economic crop of Thailand and its oil have potential more than another kind of oil crops. In the recent years the area of oil palm in Thailand has increasing. The Information of oil palm area from Office of Agricultural Economics, the area of oil palm in Thailand year 2007 have 2,663,000 rai (4260.8 km^2) and yaer 2005 have 2,026,000 rai (3241.6 km^2) increasing 31.44 % (Office of Agricultural Economics, 2011).

Including Government policy to promote cultivation oil palm area. Government makes palm oil industrial strategic plan for advance towards leader in oil produce country besides palm oil is source of sustainable energy especially oil palm bring to produce biodiesel for transportation in Thailand.

Several studies and the traditional method of identifying economic crop distribution over large regions consist of pixel-based classification of satellite images. The result is incorrect because pixel-based image analysis is based on the information in each pixel and confuse of area to classify.

Object-based image classification was developed relatively recently, analysis base on information from a broad spectrum of different object features. More specifically, image objects are groups of pixels that are similar to one another based on a measure of spectral properties such as spectral values size, shape, and texture as well as context from a neighborhood surrounding the pixels.

OBJECTIVE

The aim of this study was to develop an oil palm identification method in Nongyai Chonburi Province the eastern region of Thailand using object-base classification method**.**

STUDY AREA

The study area is located in Chonburi province. It covers Nongyai district on the eastern region of Thailand. The area is approximately 456^2 kilometers. The east side of study area is a plain and the west side is a hill. Majority of land use is agricultural. The study area showed in figure 1.

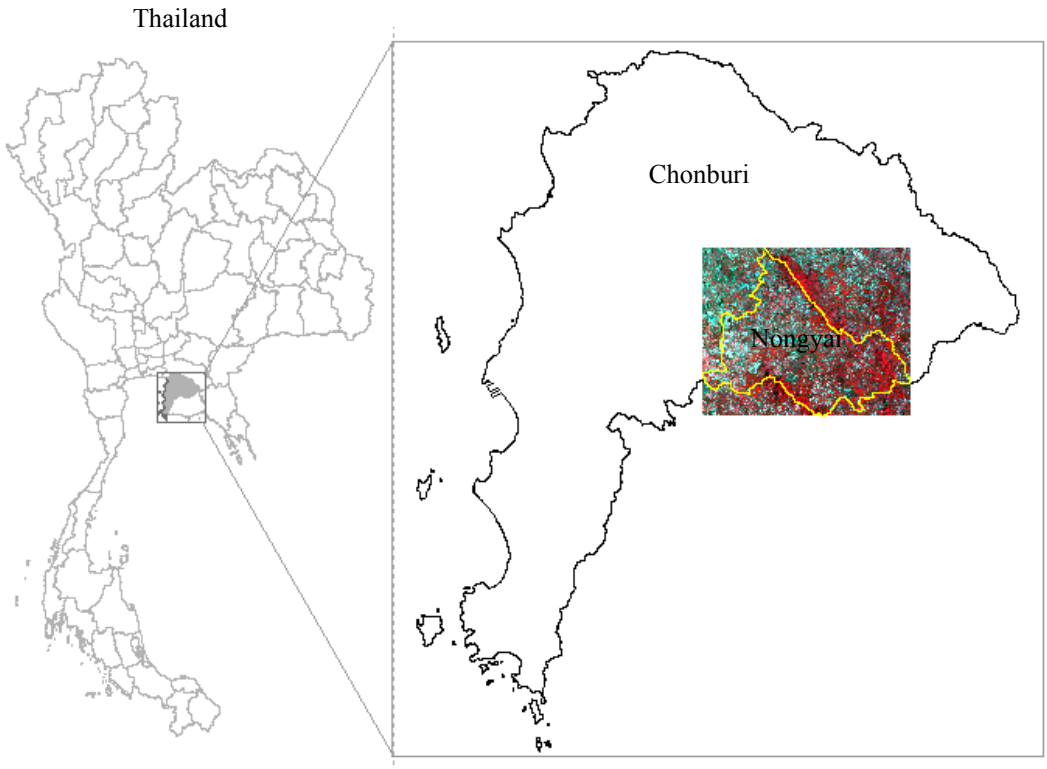


Figure 1. Study area.

DATA USED

The multispectral THEOS data used in this study were acquired on January 3, 2010 and December 28, 2010. The images acquired on January 3, 2010 with incidence angle of 9.58 degree and acquired on December 28, 2010 with incidence angle of 27.49 degree.

METHODOLOGY

The methodology involved pre-processing the image, building an object-base classification model and assessing the accuracy of the resulting map by comparing it with ground survey**.**

Pre-processing

The THEOS Data, which was received in DIMAP format level 2A, was first geometrically corrected and then the bands were calibrated.

Ground Survey from random sampling, the size area of each random sample is 600x600 m^2 (30 samples) to pick-up information on all the targets to define their spectral signature and to assessment image classification accuracy. The information of the area showed in table 1.

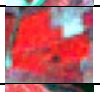
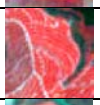
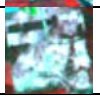
Object	Color	Shape	Smoothness	Compactness
Forest		Natural Feature	Unsmooth	Compact
Pine		Man-made	Smooth	Compact
Para Rubber		Natural Feature	Unsmooth	Compact
Palm		Man-made	Smooth	Compact
Pineapple		Man-made	Smooth	Incompact
Cassava		Natural Feature	Smooth	Incompact
Sugarcane		Man-made	Unsmooth	Incompact
Grassland		Natural Feature	Smooth	Incompact
Building		Man-made	Unsmooth	Incompact
Bareland		Man-made	Unsmooth	Incompact

Table 1. The information of area from ground survey.

Image Segmentation

Image Segmentation is used to subdivide the entire image represented by the pixel level domain or specific image objects from other domains into smaller image objects.

In this study the authors are select segmentation algorithm was multiresolution or spectral difference segmentation to subdivide the object of image. The suitable scale parameter and composition of homogeneity such as color, shape, smoothness, compactness to setting segmentation parameter is presented in Figure 2.

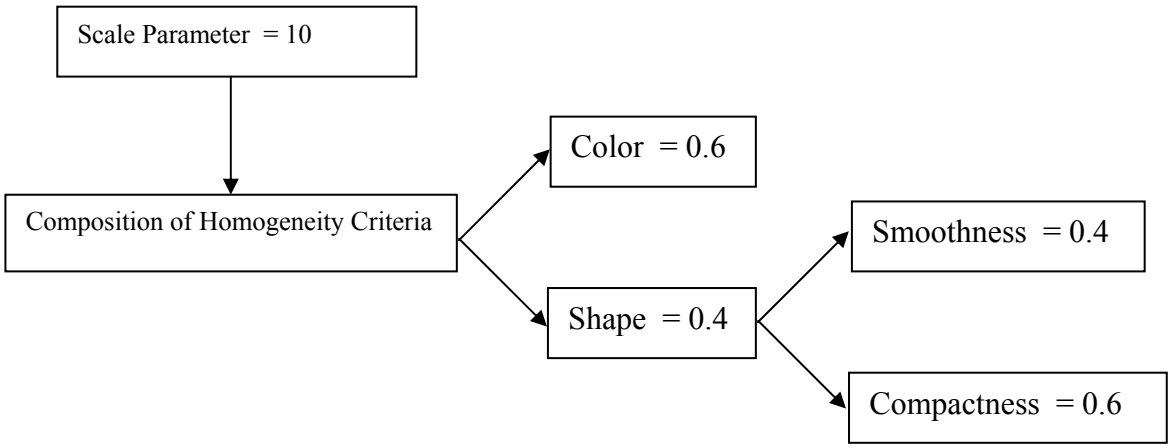
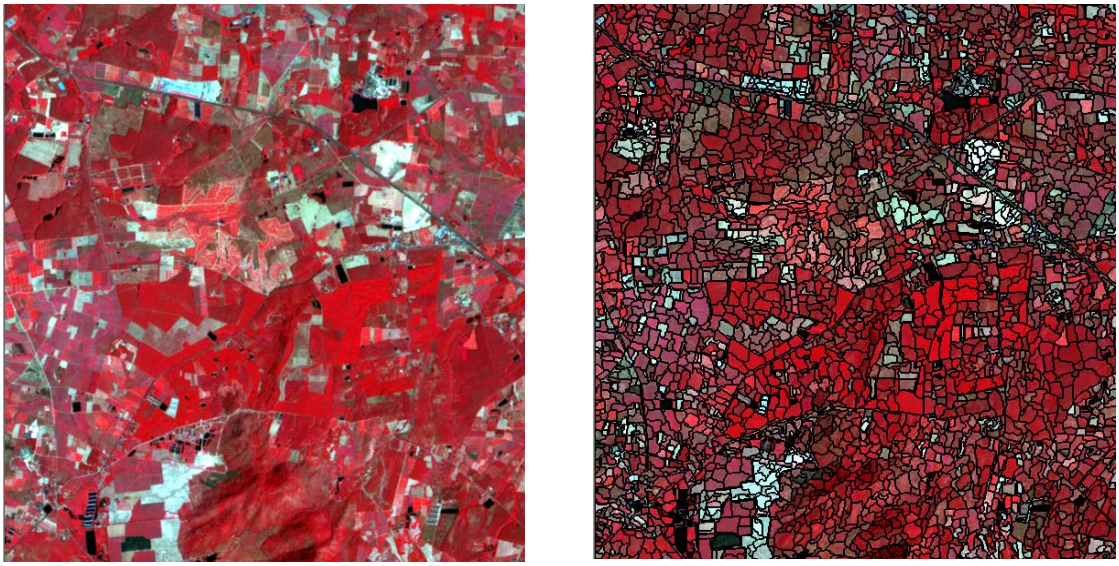


Figure 2**.** Multiresolution segmentation parameters**.**



Original image Segmentation image

Figure 3. The result from image segmentation

Object-based classification

The objects resulting from the segmentation at level 1 were classified into two different classes. Each class is defining by fuzzy set which consist of membership functions of the object features. Two classes are representing land area and water area. The threshold for the features was chosen to match the image segmentation results base on spectral and shape. The land use layer year 2010 from GISTDA database. There are many different land use classes for the classification. The land use class *forest* is only used for deletes forest area.

The second step, the authors make use of Standard Nearest Neighbor Classification to define samples for each class. A set of samples area was defined from ground survey. In addition to define oil palm plantation area the authors make use of layer values (max.dif.).In this way a new image objects level was created. Despite during the development of the ruleset, spectral confusion was noticed between class palm plantation area and other land use such as pararubber and forest, the combination of the object features such as spectral values together with contextual information, made it possible to avoid these confusions through the successive mapping. Therefore, we do not use many land use classes for result mapping but reclassify all land use class into the three classes; *oil palm plantation area, none oil palm plantation area* and *forest*

In addition the authors try to identify oil palm plantation area to compare the results with THEOS data acquired on January 3, 2010 and THEOS data acquired on December 28, 2010.

Accuracy assessment

Image classification accuracy assessment by using error matrix to compare oil palm plantation area resulting from object-base classification with ground survey data.

RESULTS

The oil palm plantation area resulting from the object-based classification of the THEOS image is presented in table 2.

Class	Number of Object	Area (km^2)
Palm plantation area	4,656	111.56
None palm plantation Area	18,333	344.44
Total	22,989	456

Table 2. Classification statistics of the THEOS image acquired on December 28, 2010.

Further work, use of multitemporal THEOS data, acquired on January 3, 2010. The oil palm area resulting from the object-based classification is presented in table 3.

Class	Number of Object	Area (km^2)
Palm plantation area	791	21.57
None palm plantation Area	18,961	434.43
Total	19,752	456

Table 3. Classification statistics of the THEOS image, acquired on January 3, 2010.

Image classification accuracy assessment of the oil palm area resulting from the object-based classification of the THEOS image acquired on December 28, 2010 and acquired on January 3, 2010 were compared with the ground survey .The classification accuracy evaluating from error matrix are 78 % and 31% respectively.

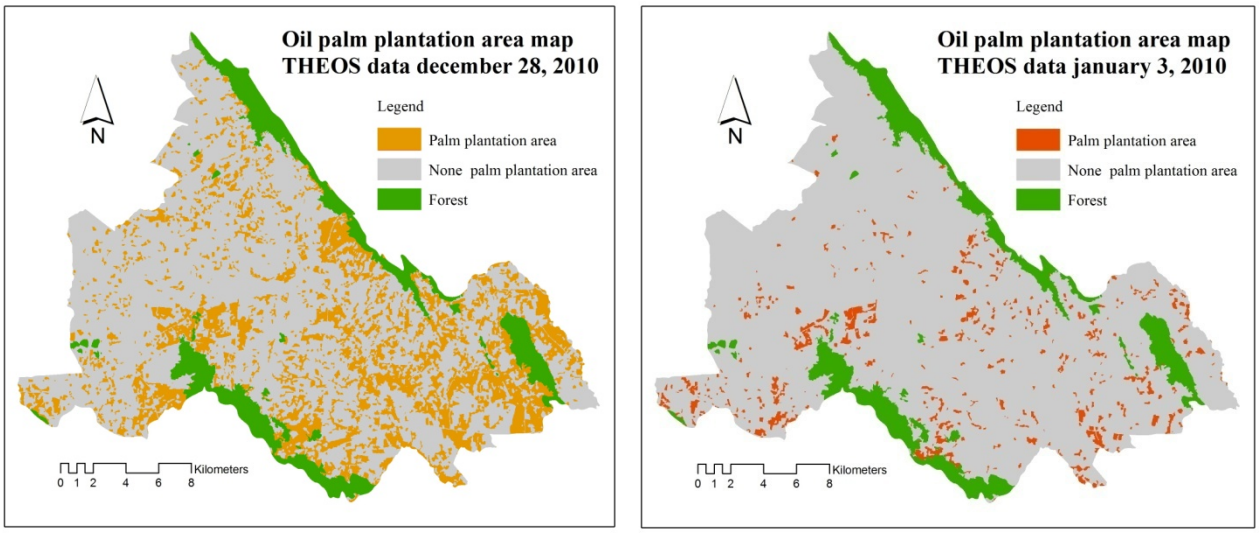


Figure4. Classification result map.

CONCUSION

This study shows the potential use of the object-oriented approach as a tool for effectively mapping oil palm area plantation. Object-base classification use of spectral information moreover shape color and nearest neighbor. The objected-oriented approach is more suitable than pixel-base approach on the high resolution imagery. The GIS data and other ancillary data integrated in the classification can improve the accuracy effectively.

Although the preliminary results of this attempt to apply the developed model to THEOS image appear to be promising, Further study, improve model to automatically classification for use in other THEOS image.

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