Landuse Exploration for Major Crops using Satellite Images

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Abstract: This study was focused on land use exploration for 2 major economic crops, rubber tree and oil palm, mostly grown in southern part of Thailand. Rubber growing occupies 10 million hectares countrywide, wilt 8 million grown in the South. Palm growing occupies 1.3 million hectares countrywide, 1.25 million hectares takes place in the South. Such 2 kinds of crop require natural growing conditions similarly such as clay soil, suitable irrigation, soil depth greater than 75 cm and sufficient rain fall of at least 1,350 millimeter per year.

Using satellite image application for agriculture, some factors were considered, time of data recording, sensors and wave band which are appropriate for characteristic of each crops and offer the good result of classification accurately.

LANDSAT satellite images, taken in 2004, covering 14 southern provinces were implemented in this project. Due to cloud cover in different time of the year, satellite images taken in March to April were chosen for upper part of the study area, and ones taken in July to September for the lower area. They were then enhanced using image processing techniques and categorized data according to amphoe and provincial boundary in order to display data and established database by amphoe and provinces. For analysis techniques, unsupervised classification using Maximum Likelihood and comparison of band 453 were implemented. The result of work showed accuracy of classification as follows: 90.79% for producer accuracy of oil palm, 90.34% for rubber tree, 86.86% for user accuracy of oil palm and 97.52% for rubber tree.

The result of study indicated that the difference of crop classification between information from satellite image application and one from local agency were only 15% different. The information obtained form the study is subsequently placed in georeferenced database which will be integrated into overall production database of amphoe and provinces for change monitoring in the future.

Keywords: Land Use Exploration, Satellite Image, Unsupervised classification, Maximum Likelihood, Accuracy

1. Introduction

Rubber is the important economic crop with the forth exported value, in perioded 2 years make rubber’s demand increased in world market.

Oil palm is the importance economic crop, planted in the south of Thailand because of it’s more benefit than other crop, persuaded agriculturalist expanded area excluding the government’s policy to expanded area for oil palm area. Besides, forecasted of demand increasing in oil palm according to oil palm price in world market.

According to importance of 2 major economic crops made be surveying for planted area to predict produce plan and developing technologies for efficiency product.

2. Objectives

The first objective is to survey study and analyze rubber and oil palm area from satellite imagery, the finally objective is to create physical database of rubber and oil palm area in southern of Thailand

3. Study area

The study area is located in southern of Thailand, consist 14 province namely; Krabi Chumphorn Trang Nakonsrithammarat Naratidwat Pattani Pangnga Pattalung Phuket Yala Ranong Songkhla Satun and Suratthani. These sites cover with an area of 70, 715.2 square kilometers. The biggest province is Suratthani and the smallest is Phuket.
The topographical characteristics are hill and mountain with rainy season. The soil characteristic is clay which properties are good drainage, and high fertilization. The land use types usually used for agricultural area such as crop and orchards.(see fig.1)

![Fig.1 Study area of LANDSAT for analyze major crop area](image)

### 4. Methodologies

The methodologies started to pre-process LANDSAT image and topography map for analysis and classification. Therefore, the classification of LANDSAT image selected both unsupervised and supervised classification shown on 3 steps are as follows:

- **4.1 Pre-processing**
  Data acquisition and data collection, this study using LANDSAT image were to determine crop. The first, pre-processing is GCP collection by image to image from topomap scale 1: 50,000, enhanced for differentiate easily by Linear conversion. Next, mosaicing whole image by selected from same or nearest period to decreased contrast between imagery.

- **4.2 Processing**
  Classification by unsupervised classification (KCLUS-classifier) to differentiate data after that supervised classification (MLC-classifier) within PCI Geometica program. Next, using training area from previous classifier, using represent training area that collected from ground truth by GPS to ensure that landuse was correctly.

![Fig.2 Shown as oil palm area close by mangrove while oil palm should not allocated there, so ground check can help analyze correctly](image1)

![Fig.3 Shown as oil palm plantation with trail Among plot area in real place](image2)
Ground truth to check accuracy of planted area of rubber and oil palm because of these data consist of date of harvesting, crop type, climate condition etc; to assign training area is importance step, so to ensure that training area was represent each landuse, should test training area shown as fig.4. Scatter plot of oil palm and rubber training area was separately post classification and finally crop mapping rubber and oil palm plantation mapping and crop area report.

Fig. 4 Scatter Plot of average reflectance of training area (oil palm, rubber) each band

![Scatter Plot of average reflectance band 4 and band 5 of oil palm in Suratthani Province from LANDSAT image](image1)

![Scatter Plot of average reflectance band 4 and band 5 of rubber in Suratthani Province from LANDSAT image](image2)

Each statistic value of training area made different scatter plot even though same landuse, oil palm training area can derived DN 160-200 by band 4 and DN 80-120 by band 5, while rubber training area give DN 170-230 and DN 100-150 by band 4 and band 5 respectively.

Fig. 5 Correlation’s reflectance of training area (oil palm, rubber) each band

![Correlation’s reflectance of training area (oil palm) band 4](image3)

![Correlation’s reflectance of training area (oil palm) band 5](image4)

![Correlation’s reflectance of training area (oil palm) band 3](image5)
From Fig 1 shown distributed histogram of each band that use for oil palm and rubber, DN value of band4 for each crop was normal curve, these range can separated oil palm and rubber from other landuse. Furthermore some plot of rubber sprout for transplanting shown open area and sometimes switch of the other crop thus make separated difficulty, while oil palm showed darked green and dense canopy with systematic transport trial, therefore easily to differential from the other crop.

Post classification – after classification should adjust result due to discontinuously of pixel data from classify step impact on some data was dispersed. In this study use clustering data esessially oil palm and rubber plantation.
5. Result and Discussion

LANDSAT imagery were used to analyze many landuse types in this study focused on 2 major crops: oil palm and rubber plantation. Mostly oil palm is shown white, rubber shown orange (Fig. 7-right). Next, counted area found that Suratthani was the most grown crop. However, southern characteristics are hills and mountains with rainy season obstacles to select clearly images besides the forest area in southern closed by oil palm and rubber plantation, so in analysis necessary to cooperate with wildlife sanctuaries, conservative forest boundary. Furthermore, in the long term, should study continuously for monitoring growth production including cleared cutting and returned plant.

![Fig. 7 LANDSAT (RGB:453) Imagery and classification](image)

<table>
<thead>
<tr>
<th>Province</th>
<th>Rubber (sq. km.)</th>
<th>Oil palm (sq. km.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Krabi</td>
<td>1006.44</td>
<td>1391.63</td>
</tr>
<tr>
<td>Chumphorn</td>
<td>637.00</td>
<td>372.66</td>
</tr>
<tr>
<td>Trang</td>
<td>157.37</td>
<td>279.24</td>
</tr>
<tr>
<td>Nakornsritammarat</td>
<td>1026.368</td>
<td>71.16</td>
</tr>
<tr>
<td>Narathiwat</td>
<td>2262.69</td>
<td>7.73</td>
</tr>
<tr>
<td>Pattani</td>
<td>653.24</td>
<td>-</td>
</tr>
<tr>
<td>Pangnga</td>
<td>923.01</td>
<td>149.63</td>
</tr>
<tr>
<td>Pattalung</td>
<td>669.11</td>
<td>-</td>
</tr>
<tr>
<td>Phuket</td>
<td>141.30</td>
<td>0.37</td>
</tr>
<tr>
<td>Yala</td>
<td>1678.35</td>
<td>-</td>
</tr>
<tr>
<td>Ranong</td>
<td>283.88</td>
<td>51.528</td>
</tr>
<tr>
<td>Songkhla</td>
<td>1551.09</td>
<td>6.84</td>
</tr>
<tr>
<td>Satun</td>
<td>661.04</td>
<td>863.26</td>
</tr>
<tr>
<td>Suratthani</td>
<td>2862.72</td>
<td>926.71</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15929.66</strong></td>
<td><strong>4156.80</strong></td>
</tr>
</tbody>
</table>

From the analysis results of oil palm and rubber area by Unsupervised classification and Supervised classification found that LANDSAT band 453:RGB imagery can separate oil palm and rubber absolutely and revised result that was field check already can overlay with amphoe and province administrator boundary to separated to provincial. (see Table 1)
Table 2  Confused Metrix of Rubber and Oil palm area of Southern in Thailand

<table>
<thead>
<tr>
<th>Referenced Data</th>
<th>Analyze data</th>
<th>Sum</th>
<th>Producer Accuracy</th>
<th>User Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oil Palm</td>
<td>Rubber</td>
<td>Others</td>
<td></td>
</tr>
<tr>
<td>Oil palm</td>
<td>4253</td>
<td>166</td>
<td>144</td>
<td>4563</td>
</tr>
<tr>
<td>Rubber</td>
<td>118</td>
<td>4198</td>
<td>247</td>
<td>4563</td>
</tr>
<tr>
<td>Others</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>4371</td>
<td>4364</td>
<td>391</td>
<td>9126</td>
</tr>
</tbody>
</table>

Overall Percentage of Accuracy 92.60

6. conclusion

According to this study based on the multi-temporal LANDSAT-5 TM imagery, shown two crop-oil palm and rubber in southern of Thailand found that the physical of area impact on landuse for oil palm and rubber, mostly of oil palm was located in Krabi Suratthani Satun Chumporn and Trang but rubber located on the western such as Naratiwat Yala Pangnga Trang and Pattalung. Besides somewhere was limited by topological characteristics example Pangnga Ranong was mountainful so have no plain for agriculture, while somewhere was swamp so separation landuse must compared with other data and several information. From the study result found that whole rubber area in the south of Thailand was 15929.66 sq.km. (22% of whole region), oil palm area was 4156.8 sq.km. (5.88 % of whole region) summation of oil palm and rubber area was 28.4 % of whole region, be most of area in Thailand.

References