POTENTIAL USE OF LANDSAT IMAGERY IN DISCRIMINATING MANGROVE FOREST VARIATIONS

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Abstract: Remote sensing technologyhas been widely used in various applications including in forestry.Among others, it has been used to monitor forest changes, tree and tree species mapping, biomass and carbon stock. However, there is still lack of studies being done on the potential use of remote sensing technology in mapping forest area base on their growth stage.This paper highlighted results from a study to investigate and assess the potential use of Landsat TM imagery in discriminating mangrove area that have been logged and replanted with selected mangrove species. MatangMangrove Forest Reserve,which is globally known as the best managed mangrove forest,was selected as a test site.Several steps such as radiometric correction, segmentation, classification were carried out to produce a classification map based on mangrove growth stages. The classification accuracies of 88% and 92% were achieved in this study using two segmentation parameters. This study has shown the potential use of Landsat imagery in discriminating mangrove forest variations.

Keyword: Mangrove, Landsat, Segmentation, Classification

Introduction

Mangrove forest is a forest of salt-tolerant tropical shrubs or s growing in areas such as river estuaries or tidal marshes that are covered by the sea at high tide (Hamdan et. al., 2012). This area is among the most productive and biologically complex ecosystems on Earth. In 2008, it is estimated that the mangroves area in Malaysia is about 0.58 million hectares, where 0.1 million hectares of mangroves area were mostly located along the west coastal lines of peninsular Malaysia.

Matang Forest Reserve is well known as the best managed mangroves in the world for the last 100 years. It also one of the earliest forests in Malaysia to be placed under reservation in order to preserve its continual functions for forestry purposes. Final felling of mature *Rhizophora*trees in Matang Forest Reserve is primarily being used for the manufacture of

charcoal to be exported to other countries such as Japan. The intermediate felling, which are first and second thinning, of mangrove trees in 15 to 25 years after felling activities were used as a poles product. These poles are used as piling materials in the local housing and construction industries (Azahar and NikMohd Shah, 2003).

Monitoring the changes in mangrove area, especially their growth, can help planners to plan and manage their mangrove towards better sustainable forest management practices. Many studies have been carried out regarding the use of remote sensing technology in forestry application (Liu et. al., 2008; Vo et. al., 2013; Che Ku Akmar et. al., 2009). Some of the studies utilized this technology in monitoring mangrove changes (Howari et. al., 2009; Hernandez-Cornejo, et. al., 2005; Sremongkontip et. al., 2000), species discrimination (Koedsin and Vaiphasa, 2013; Heumann, 2011; Ajithkumar, et. al., 2008), and others (Blasco et. al., 1998;Kairo et. al., 2002; Sirikulchayanon et.al., 2008). However, the study on mangrove discrimination is still lacking. Thus, this study will investigate the potential use of Landsat imagery in discriminating mangroves area base on their growth stages.

Methodology

The methodology of this study comprise of several steps such as data collection, radiometric correction, segmentation, sample site selection, classification and accuracy assessment as shown in Figure 1.

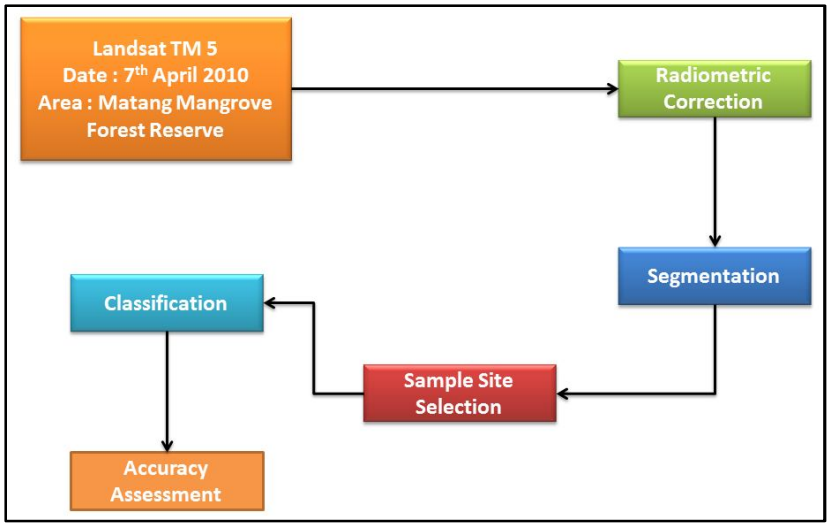

Figure 1: Methodology flowchart

Two types of data will be used in this study. The primary data, which is ground data will be usedas a reference data for classifying remote sensing data. This data contains information on year of felling at certain block or compartment in Matang Forest Reserve. This information will be acquired in a working plan's book published by Perak Forestry Department. The secondary data, which is Landsat-5 TM imagery acquired in April 2010will

also be used in this study. This is to test its capability in discriminating mangrove area based on their growth stages through classification method.

Radiometric correction will be applied to Landsat image. This process is to reduce the atmospheric effects that occur in the image. The original pixel values ranged from 0 to 255 will be scaled to 0 to 1. This process will improve the accuracy of the output study as it reduces the atmospheric effects andminimizing misclassification during the classification process.

The segmentation process will be applied after radiometric correction process was made. Segmentation is a process of grouping and segmenting pixels with their neighbouring pixels based on the pixels value or edge detected from that image. So, one area such as mangrove will represent as one object or entity, which has one average pixel value. The segmented image depends on the segmentation's parameters. This study will test two parameters and the resulted images from these parameters were then classified.

Sample site or training sample selection will be carried out to the segmented images. Seven classes, which are mangrove, dipterocarp, urban and built-up, water and open area, were chosen for classification process. For mangrove area, the classification were then classified base on the growth stage after harvesting, range from 0 to 10 years, 10 to 20 years, and 20 to 30 years. The selection of training sample will be based on the primary data.

The classification process will took place after training sample selection process completed. Classification is a process assigning the segmented images to the class that have almost similar object, which was selected during the previous process. Support Vector Machine (SVM) will be used in this study to classify the images as previous studies have shown the potential of this technique in discriminating features as compare to other techniques. Lastly, the accuracy assessment evaluation and analysis will be carried out to see the potential use of Landsat imagery in discriminating mangrove forest variations base on growth stages.

Result and discussion

Figure 2 shows the results from two different segmentation parameters. It shows that different results were achieved although only one parameter is, which is *merge* parameter, is different. First image that was segmented with lower *merge* value setting, as shown in Figure 2a, results in more objects or entity is generated as compared to the second image segmented with higher merge value setting as shown in Figure 2b. The result from segment 3 and merge 98 (Figure 2b) gives better visual result as compared to another parameter (Figure 2b). However, it is not the indicator that it will gives better classification accuracy as the segmented image for lower segmentation parameter (Figure 2a).

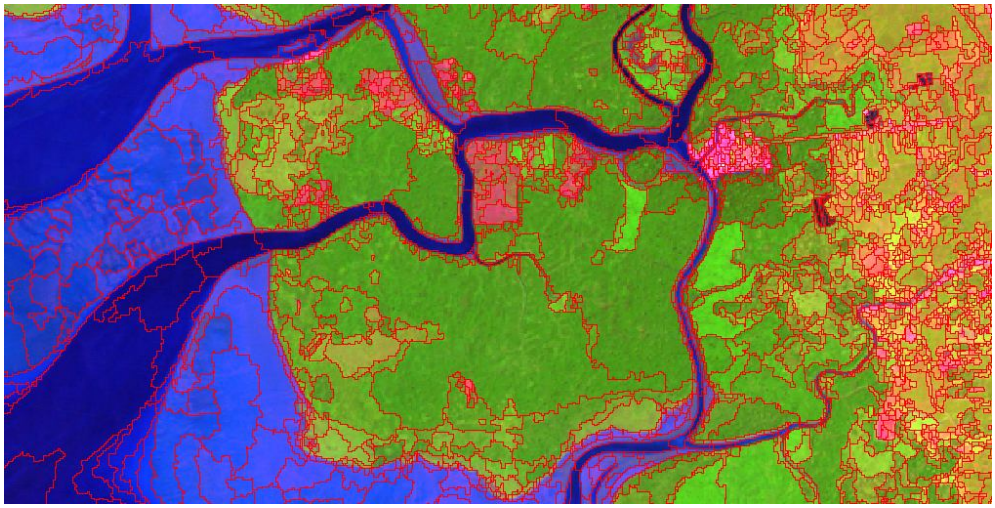

Figure 2a Segmentation Parameter : Method: *Edge Detection* Segment: *3* Merge: *90*

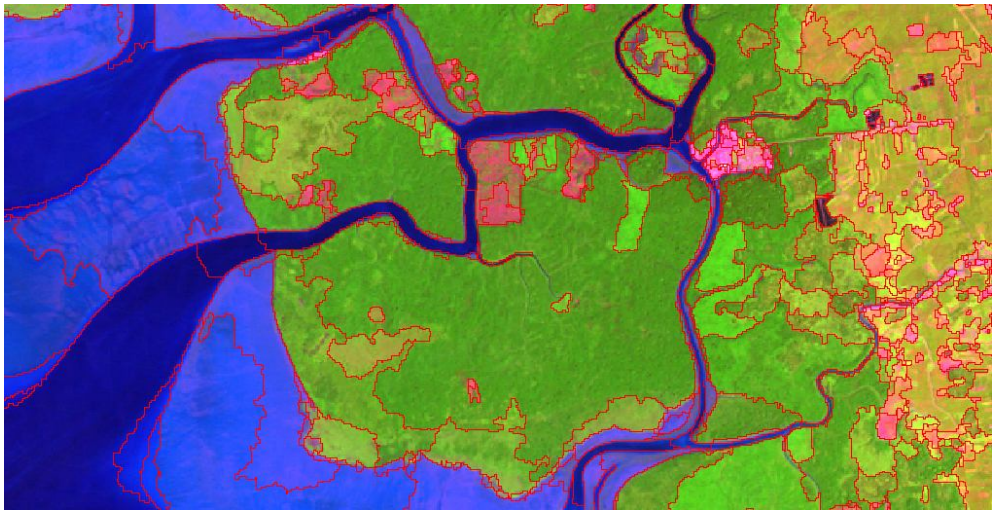

Figure 2b Segmentation Parameter : Method: *Edge Detection* Segment: *3* Merge: *98*

Figure 2: Comparison of two segmentation parameters setting

The results of classification for both segmented image are shown in Figure 3. Both of the segmented images gave an accuracy of 92% and 88% respectively. First image gave higher classification accuracy than the accuracy of the second image. This has shown that general segmentation has reduced the information in the image causing loss of information. On the other hand, the first image somehow minimizes the loss of information, which gave better result than the second image. Although both of the classification accuracies not achieved above 95% accuracy, these data can give better result in classifying mangrove area based on growth stages.

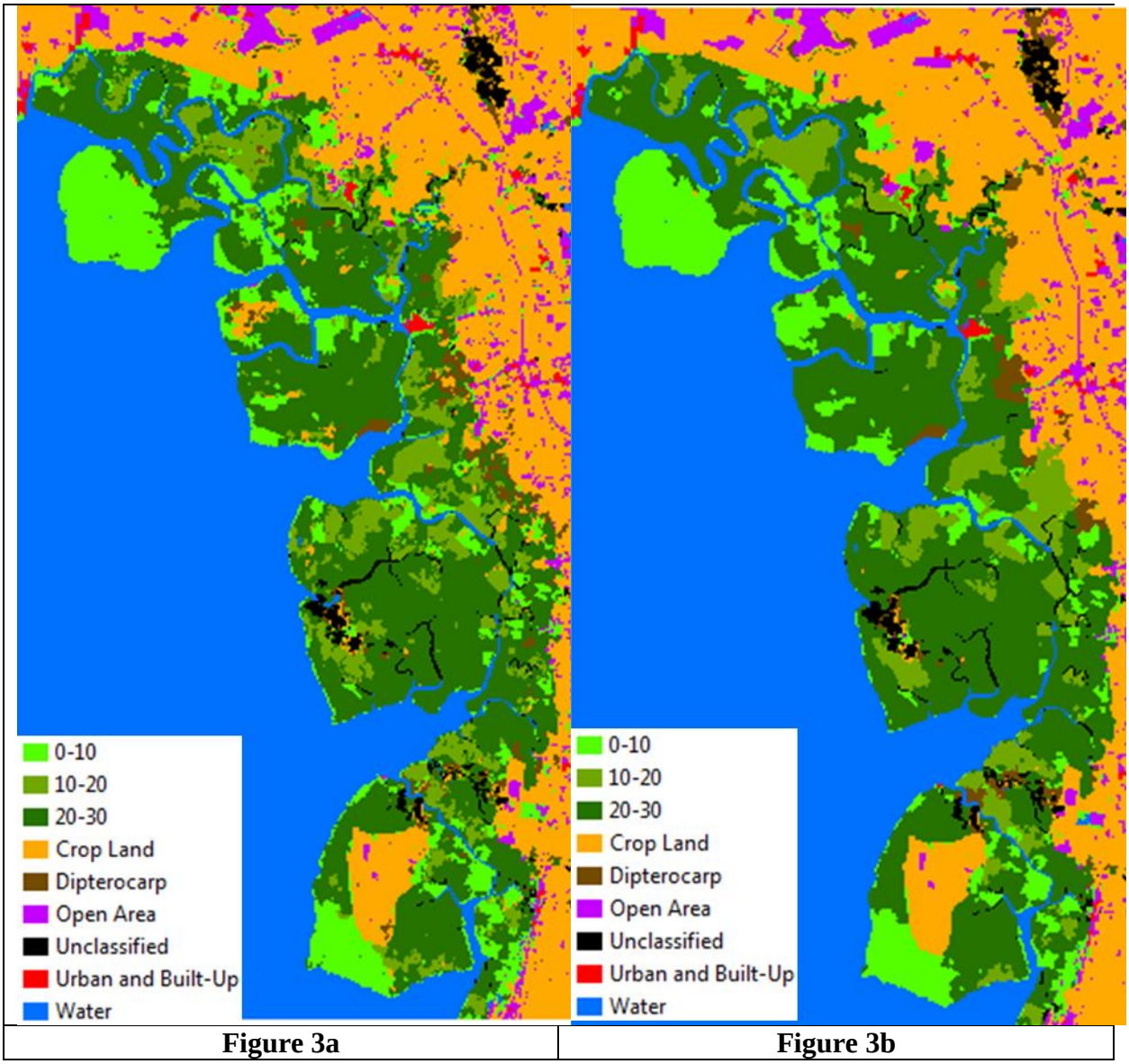

Figure 3a	Figure 3b

Figure 3: Classification accuracies of two segmented images

Conclusion

This study investigates the potential use of Landsat imageryin discriminating mangrove area base on their growth stages. This multispectral image, which contains seven bands, gave higher classification accuracy, thus giving the indicator that this type of data has the potential to discriminate mangrove area based on growth stages.This study is important as to monitor mangrove area based on growth stages for better management practices. Further studies will explore the possibilities of this image to differentiate mangrove area for each year based on classification and statistical methods.

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