COMPARISON OF LAND USE AND LAND COVER CLASSIFICATION BETWEEN SATELLITE DATA FROM THEOS, ALOS AND LANDSAT – 5 : A CASE STUDY OF SRIRACHA DISTRICT IN CHON BURI PROVINCE.

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Abstract: This study aims to analyze and classify land use and land cover data from satellites: THEOS, ALOS, and LANDSAT – 5 TM and to compare the results obtained as a case study of Sriracha district in Chon Buri province. The data from the three satellites were first subjected to geometric correction using a 1:50,000 scale Topographic Map for reference. Then the geometrically corrected data were analyzed and classified into 5-land use and land cover classes consisting of 1) Water 2) Built – up area 3) Agriculture 4) forest and 5) other areas. Two methods were used for the purpose, namely: Head up Digitizing and Supervised Classification by Maximum Likelihood Classifier. Color Composition and Image Enhancement were additional image processing techniques applied to the data prior to Head up Digitizing classification. The classification results were accuracy assessed which were found to be 82.80% (Kappa = 0.77, Agreement Level = Good), 81.72% (Kappa = 0.74, Agreement Level = Good) and 76.13% (Kappa = 0.67, Agreement Level = Good), respectively for ALOS, THEOS and LANDSAT – 5 TM. The Supervised Classification by Maximum Likelihood Classifier was applied to the geometrically corrected data. The results obtained were accuracy assessed and were found to be 75.91% (Kappa = 0.67, Agreement Level = Good) , 71.18% (Kappa = 0.61, Agreement Level = Good) และ 68.60% (Kappa = 0.59, Agreement Level = Moderate), respectively for ALOS, THEOS and LANDSAT – 5 TM.

INTRODUCTION

Remote Sensing technologies can be used to acquire spatially variable data for several applications. These technologies can provide data to help to solve problems, and can often be accomplished at a lower relative cost than many other traditional methods. The basic principle in using remote sensing data for landuse or landcover change detection is that the process can identify change between two or more dates that is uncharacteristic of normal variation. Many researchers have addressed the problem of accurately monitoring landuse and landcover change in a wide variety of environments. (Giri, Zhu, & Reed, 2005)

In this work aimed to apply remote sensing procedures to classify landuse and landcover of THEOS, ALOS and LANDSAT-5 data. For the LANDSAT-5 and ALOS data were successfully used, but THEOS data is a new satellite data and not yet widely used, especially in Thai users. Therefore, comparison of THEOS data and successfully satellite; LANDSAT-5 and ALOS will give users the confidence to use THEOS data.

The objectives of this study focus on: to analyze and classify land use and land cover data from satellites: THEOS, ALOS, and LANDSAT – 5 TM and to compare the results obtained as a case study of Sriracha district in Chon Buri province.

METHODS AND EQUATION

The procedures in this study comprised an. Using multitemporal satellite data with . details of the procedures of materials and methods are described as follows:

2.1 The study area, Sriracha district, covers an area of 623.7 sq km. , approximately 80 kilometers southeast of Bangkok, is part of a narrow coastal plain lying between the Damrek range of hills to the northeast and the Gulf of Thailand to the south. Sriracha was formed by alluvial deposits laid down over millions of years. Nine thousand years ago, when sea level was 100 meters below its present height, this part of Thailand was a low-lying flatland that stretched hundreds of kilometers beyond the present coastline.

2.2 Data sources

2.2.1 Multitemporal satellite data used in this study consisted of THEOS, ALOS and LANDSAT-5 data of the year 2008-2009

2.2.2 Topographic maps (1:50,000) of the Royal Thai Survey Department

2.2.3 Digital map of soil series group available from Land Development Department

2.2.4 Ortho imagery from aerial photograph available from Centre for Agricultural Information

2.3 Preprocessing of satellite data

Analysis of the satellite data was performed, including geometric correction, transforming the images coordinates to the ground control point selected from the corresponding point of the topographic maps and the performing a resampling of the pixel with nearest neighbor algorithm. A process of histogram equalization and matching was performed for better discrimination. The RGB color composite images were produced on screen and used for digitization.

To reduce the effects of atmospheric conditions, radiance values were converted to ground reflectance through a procedure developed by Card 1993. The two images were coregistered to UTM coordinates. Twenty ground control points were selected to generate coefficients for a second order polynomial, and a nearest-neighbor method was used to resample the two images. Coregistration accuracy of the two images is under 0.3 pixels in both x and y directions.

2.4 Digital Image Processing

In order to undertake the operations listed in this section, it is necessary to have access to Image Processing software. While it is known primarily as a GIS software system, it also offers a full suite of image processing capabilities.

2.4.1 Geometric Correction is necessary to preprocess remotely sensed data and remove geometric distortion si that individual picture elements (pixel) are in their proper planimetric (x,y) map locations. This allows image derived from satellite to be related to other thematic information in GIS. Geometrically corrected imagery can be used to extract distance, polygon area, and direction information. Basically there are two types of geocorrection to be carried out. First one is Image to Map geocorrection and another is image to image geocorrection.

2.4.2 For the Image to Map geocorrection system can be corrected using ground control points. The GCPs should be spread evenly over the image, covering the whole image, and be placed as much as possible into the corners of the image, to give best coverage for calculating the transformation.

2.4.3 For the Image to image geocorrection is the matching of one image to another so the same geographic area is positioned coincident with respect to the other. This type of geometric correction is used when it is not necessary to have each pixel assigned a unique x,y coordinate in a map projection. In case the image should be combined with data in another coordinate system, then a transformation has to be applied. This results in a new image where the pixel are stored in a new row/ column geometry, which is related to the other georeference. This new image is created by applying an interpolation method call resampling. The interpolation method is used to compute the radiometric values of the pixels, in the new image based on the DN values in the original image.

2.4.4 Subset of Image covering the study area in Sriracha district.

2.4.5 Color Composition: The spectral information stored in the separate bands can be integrated by combining them into a color composite. Many combinations of bands are possible. The spectral information is combined by displaying each individual band in one of three primary colors: Red, Green and Blue.

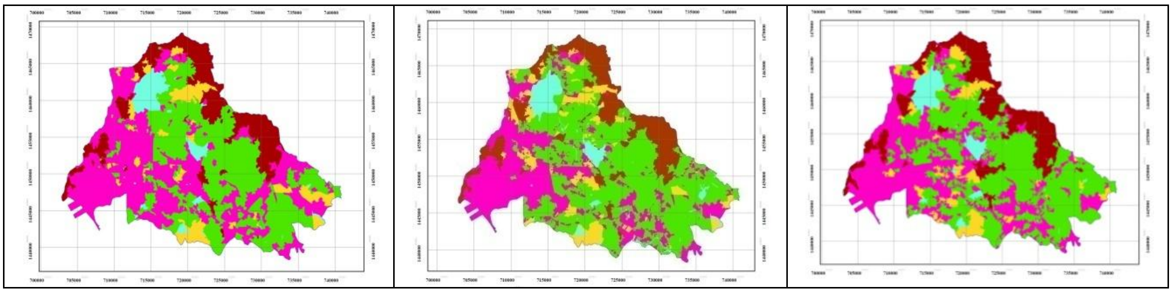
2.4.6 Image Enhancement deals with the procedures of making a raw image better interpretable for a particular application. Commonly used enhancement techniques are described which improve the visual impact of the raw remotely sensed data for the human eye. The objective of image enhancement is to create new images from the original image data, in order to increase the amount of information that can be visually interpreted.

2.4.7 Image classification: In order to extract information from the satellite images, the relationship between pixel values and land cover types must be found. In this study classified into 5 land use and land cover classes consisting of 1) Water 2) Built – up area 3) Agriculture 4) forest and 5) other areas. Two methods were used for the purpose, namely: Head up Digitizing and Supervised Classification by Maximum Likelihood Classifier. Head up digitizing method which done using the directly manual on-screen digitizing. The procedure began with overlaying of the subvision digital map onto the georeferenced digitized from the image and summing its total amount according to subdivision. Supervised classification method is much more widely used. The process is divided into two phases: a training phase, where the user trains the computer, by assigning for a limited number of pixels to what access they belong in this particular image, followed by the decision making phase, where the computer assigns a class label to all image pixels, by looking for each pixel to which of the trained classes this pixel is most similar. In this study select the classified image of the Maximum Likelihood classifier algorithm (MLC).

2.4.8 Classification accuracy assessment: The accuracy of results yielded Producer's and User's accuracies for each class, and an overall accuracy of the classifier. Producer's accuracy is a measure of how accurately the analyst classified the image data by category. The producer's accuracy details the errors of omission. An error omission results when a pixel is incorrectly classified into another category. The pixel is omitted from its correct class. User's accuracy is a measure of how well the classification performed in the field by category (rows). The user's accuracy details errors of commission. An error of commission results when a pixel is committed to an incorrect class. Overall accuracy is the number of incorrect observations divided by the number of correct. This is very crude measure of accuracy. Kappa Coefficient is a discrete multivariate technique to interpret the results of a contingency matrix. The Kappa statistic incorporates the off diagonal observations of the rows and columns as well as the diagonal to give a more robust assessment of accuracy than overall accuracy measures. The Kappa statistic is computed as the summation of the diagonal multiplied by the summation of each row multiplied by the summation of each column divided by the summation of each row multiplied by the summation of each column.

RESULTS AND DISCUSSION

For this study, the classification results of Head up digitizing method from satellites; Landsat-5, ALOS, and THEOS data were implemented in 5 classes for detection land use. The result of Head up digitizing accuracies was found as shown in figure 1 and table 1.



LANDSAT-5 ALOS THEOS

Figure 1: The classification results of Head up digitized from satellites; LANDSAT-5, ALOS and THEOS

Table 1: Classification results of Head up digitized from satellites; LANDSAT-5, ALOS and THEOS

Landuse type	Satellite data					
	LANDSAT – 5 (December, 18, 2008)		ALOS (January, 15, 2009)		THEOS (December, 30, 2008)	
	Sq km	%	Sq km	%	Sq km	%
1) Water	28.5	4.57	35.6	5.71	30.2	4.84
2) Build-up area	231.7	37.15	163.6	26.23	198.8	31.87
3) Agriculture	225.1	36.09	279.5	44.81	252.0	40.40
4) Forest	94.1	15.09	94.0	15.07	100.4	16.10
5) Other areas	44.3	7.10	51.9	8.18	42.3	6.78
Total	623.7	100.00	623.7	100.00	623.7	100.00

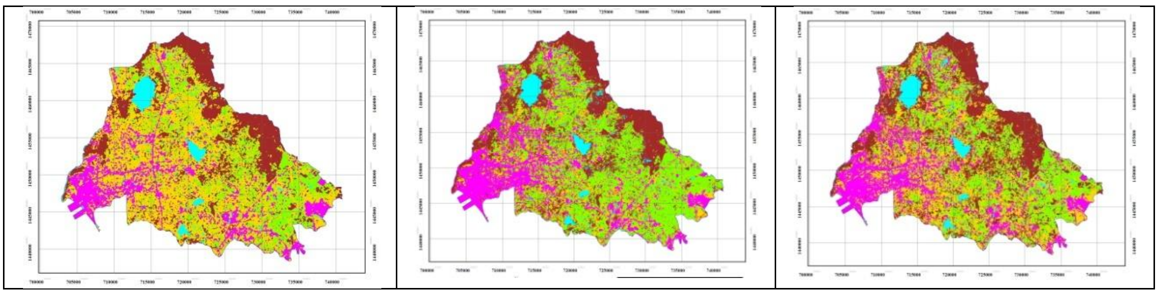
From the figure 1 and table 1 presents the Classification results of Head up digitized method from three satellites; LANDSAT-5, ALOS and THEOS. For the comparison only the Head up digitized method is applied to classify into 5 classes, such as water, build-up area, agriculture, forest and other areas. As shown in the matrix (table 1), the water class from ALOS satellite provided greater classify, up to 5.71% while THEOS and LANDSAT-5 satellite produced classify of 4.84% and 4.57%, respectively. For the build-up area class found that LANDSAT-5 satellite provided greater classify, up to 37.15% while THEOS and ALOS satellite produced classify of 31.87% and 26.23%, respectively. For the agriculture class from ALOS satellite provided greater classify, up to 44.81% while THEOS and LANDSAT-5 satellite produced classify of 40.40% and 36.09%, respectively. For the forest class from THEOS satellite provided greater classify, up to 16.10% while LANDSAT-5 and ALOS satellite produced classify of 15.09% and 15.07%, respectively. Finally, the other areas class from ALOS satellite provided greater classify, up to 8.18% while LANDSAT-5 and THEOS satellite produced classify of 7.10% and 6.78%, respectively.

Table 2: A result comparison of the accuracy assessment for Head up digitizing method in three satellites.

Landuse type	**Satellite data**		
	LANDSAT – 5 (December, 18, 2008)	**ALOS (January, 15, 2009)**	**THEOS (December, 30, 2008)**
1) Water	61.11 %	77.78 %	77.78 %
2) Build-up area	83.07 %	83.60 %	91.01 %
3) Agriculture	78.76 %	91.15 %	81.41 %
4) Forest	81.01 %	81.01 %	78.48 %
5) Other areas	45.83 %	66.67 %	54.17 %
Total	76.13 %	82.80 %	81.72 %
Kappa coefficient	0.67	0.77	0.74

From the table 2 presents the accuracy assessment for Head up digitizing method in three satellites; LANDSAT-5, ALOS and THEOS found that the accuracy assessment for water class from ALOS and THEOS satellites were 77.78% and LANDSAT-5 was 61.11%. For the build-up area class found that the accuracy assessment from THEOS, ALOS and LANDSAT-5 satellites were 91.01%, 83.60% and 83.07%, respectively.
For the agriculture class found that the accuracy assessment from ALOS, THEOS and LANDSAT-5 satellites were 91.15%, 81.41% and 78.76%, respectively. The accuracy assessment for forest class from ALOS and LANDSAT-5 satellites were 81.01% and THEOS was 78.48%. For the other areas class found that the accuracy assessment from ALOS, THEOS and LANDSAT-5 satellites were 66.67%, 54.17% and 45.83%, respectively.
Overall accuracy and Kappa coefficient of ALOS were 82.80% and 0.77. Overall accuracy and Kappa coefficient of THEOS were 81.72% and 0.74. And overall accuracy and Kappa coefficient of LANDSAT-5 were 76.13% and 0.67.

Figure 3: Classification results of the Maximum Likelihood classifier algorithm (MLC) from satellites; LANDSAT-5, ALOS and THEOS



LANDSAT-5 ALOS THEOS

Table 3: Classification results of the Maximum Likelihood classifier algorithm (MLC) from satellites; LANDSAT-5, ALOS and THEOS

Landuse type	Satellite data					
	LANDSAT – 5 (December, 18, 2008)		ALOS (January, 15, 2009)		THEOS (December, 30, 2008)	
	Sq km	%	Sq km	%	Sq km	%
1) Water	23.3	3.74	24.5	3.93	23.2	3.72
2) Build-up area	99.5	15.95	217.8	34.92	154.0	24.69
3) Agriculture	126.0	20.20	125.7	20.15	125.1	20.06
4) Forest	129.2	20.72	156.1	25.03	166.2	26.65
5) Other areas	245.7	39.39	99.6	15.97	155.2	24.88
Total	623.7	100.00	623.7	100.00	623.7	100.00

From the figure 3 and table 3 presents the Classification results of the Maximum likelihood classifier method from three satellites; LANDSAT-5, ALOS and THEOS. For the comparison of MLC method is shown in the matrix (table 3), the water class from ALOS satellite provided greater classify, up to 3.74% while LANDSAT-5 and THEOS satellite produced classify of 3.74% and 3.72%, respectively. For the build-up area class found that ALOS satellite provided greater classify, up to 34.92% while THEOS and LANDSAT-5 satellite produced classify of 24.69% and 15.69%, respectively. For the agriculture class from LANDSAT-5 satellite provided greater classify, up to 20.20% while ALOS and THEOS satellite produced classify of 20.15% and 20.06%, respectively. For the forest class from THEOS satellite provided greater classify, up to 26.65% while ALOS and LANDSAT-5 satellite produced classify of 25.03% and 20.72%, respectively. Finally, the other areas class from LANDSAT-5 satellite provided greater classify, up to 39.39% while THEOS and ALOS satellite produced classify of 24.88% and 15.97%, respectively.

Table 4: A result comparison of the accuracy assessment for MLC method in three satellites.

Landuse type	Satellite data		
	LANDSAT – 5 (December, 18, 2008)	ALOS (January, 15, 2009)	THEOS (December, 30, 2008)
1) Water	77.78 %	61.11 %	58.33 %
2) Build-up area	64.55 %	76.72 %	79.36 %
3) Agriculture	53.98 %	75.22 %	60.17 %
4) Forest	82.28 %	84.81 %	73.42 %
5) Other areas	89.58 %	70.83 %	70.83 %
Total	68.60 %	75.91 %	71.18 %
Kappa coefficient	0.59	0.67	0.61

From the table 4 presents the accuracy assessment for MLC method in three satellites; LANDSAT-5, ALOS and THEOS found that the accuracy assessment for water class from LANDSAT-5, ALOS and THEOS satellites were 77.78%, 61.11% and 58.33%, respectively. For the build-up area class found that the accuracy assessment from THEOS, ALOS and LANDSAT-5 satellites were 79.36%, 76.72% and 64.55%, respectively. For the agriculture class found that the accuracy assessment from ALOS, THEOS and LANDSAT-5 satellites were 75.22%, 60.17% and 53.98%, respectively. For the forest class found that the accuracy assessment from ALOS, LANDSAT-5 and THEOS satellites were 84.81%, 82.28% and 73.42%, respectively. For the other areas class found that the accuracy assessment from LANDSAT-5, THEOS and ALOS satellites were 89.58%, 70.83% and 70.83%, respectively. Overall accuracy and Kappa coefficient of ALOS were 75.91% and 0.67. Overall accuracy and Kappa coefficient of THEOS were 71.18% and 0.61. And overall accuracy and Kappa coefficient of LANDSAT-5 were 68.60% and 0.59.

CONCLUSIONS & RECOMMENDATIONS

For the classification of Maximum Likelihood Classifier method is a widely used classification, it could not perform satisfactorily in deriving accurate and reliable classification of build-up areas. In this study has been tested in level 1 of land use because of the complexity of accuracy assessment, so in the next study should consider many factors, such as the hardness of field collection, the expending of time and money. The implement of accuracy assessment should depend on the improvement of accuracy assessment techniques.

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