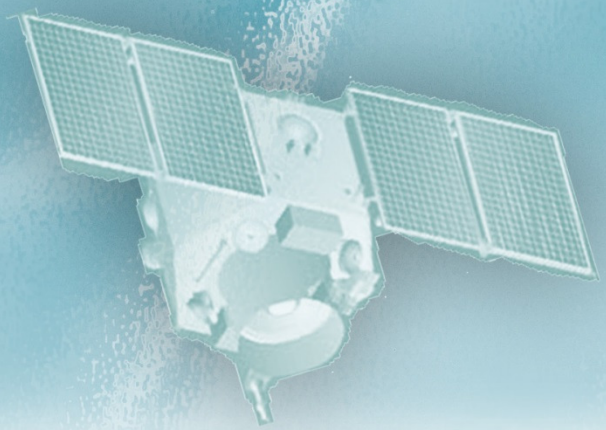

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OBJECT BASED APPROACHES FOR IDENTIFICATION OF LAND USE/LAND COVER CHANGES USING MULTITEMPORAL LANDSAT IMAGERY IN BANDUNG, WEST JAVA, INDONESIA

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ABSTRACT

Bandung is one of the major city in Indonesia with high growth economic and population. Economic and population growth can effect to land use/land cover change. Information of land use/land cover changes is very important for planning and disaster mitigation. The land use/land cover changes can detected by satellite imagery. Object based classification system, a promising method for image classification. This paper discuss the application of Landsat satellite remote sensing image in 1994 until 2013 to identify land use/land cover changes using object based classification approach in Bandung, West Java, Indonesia. The methodology consist of satellite data acquisition, pre-processing, field survey, classification of land use/land cover using object based approach, ground check and analysis. The result shows the land use/land cover changes in Bandung, West Java, Indonesia.

Keywords : Object based, Landsat multitemporal, land use/land cover changes.

INTRODUCTION

Many researchers, to identify land use/land cover using statistical parametric and per pixel method such as DeFries et al. (1998), DeFries et al. (2000), Hansen et al. (2000), Hansen and Reed (2000), Zhan et al. (2000), Kalluri et. al. (2000), Zhan et. al. (2002), Giri et. al (2004), Schwarz and Zimmermann (2005), Ballantine et. al (2005), Hill et. al (2006), Pisek and Chen (2007), Wardlow and Egbert (2007) and Wardlow et. al (2007).

According to Horvitz et al. (1988) in 1940, in the computing has evolved expert systems and artificial intelligence for decision-making. The expert system works with a real identification as human perception. This is the same with objects in the real world. All objects definied based on layer value, texture, form and context. This method is known as the Object Based Image Analysis (OBIA). According to Stow et al. (2003) OBIA produce more accurate, more detail and efficient if comparison with per pixel. Method.

In this study, OBIA will be used to classify Landsat satellite image in Bandung Basin. Bandung Basin is a region with increasing population and economic that cause land cover change and environmental problems (Hardjasaputra, 2007). Therefore information of land cover change in Bandung Basin will be very useful in determining the policy of sustainable environmental management in the Bandung Basin. The purpose of this study is to identify land cover change based on OBIA using Landsat Imagery. The result is expected identification of land cover change in Bandung Basin with a high accuracy and up to date as information that can be used in sustainable environmental management.

MATERIALS AND METHODS

In this study used Landsat mutitemporal satellite image bands 1,2,3,4,5 and 7 with the index path 122 and row 065. Landsat data used in this study is Landsat 5 TM on March, 14 1994, Landsat 7 TM on May 12, 2001, and Landsat 8 on September, 10 2013. Landsat data in this study from the United States Geological Survey (USGS) which can found at the link http://earthexplorer.usgs.gov/. Especially for the Landsat 8 satellite imagery, it is a new satellite, launch in February 11, 2013 to bring the sensor Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS), the band recorded a total of 11 bands, with the composition of the OLI bands 1-7 and 9, in the panchromatic band 8 and TIRS in bands 10 and 11.

The methodology consist of satellite data acquisition, pre-processing image, field survey, classification of land use/land cover using object based approach, ground check and analysis, the methodology can be seen in figure 1.

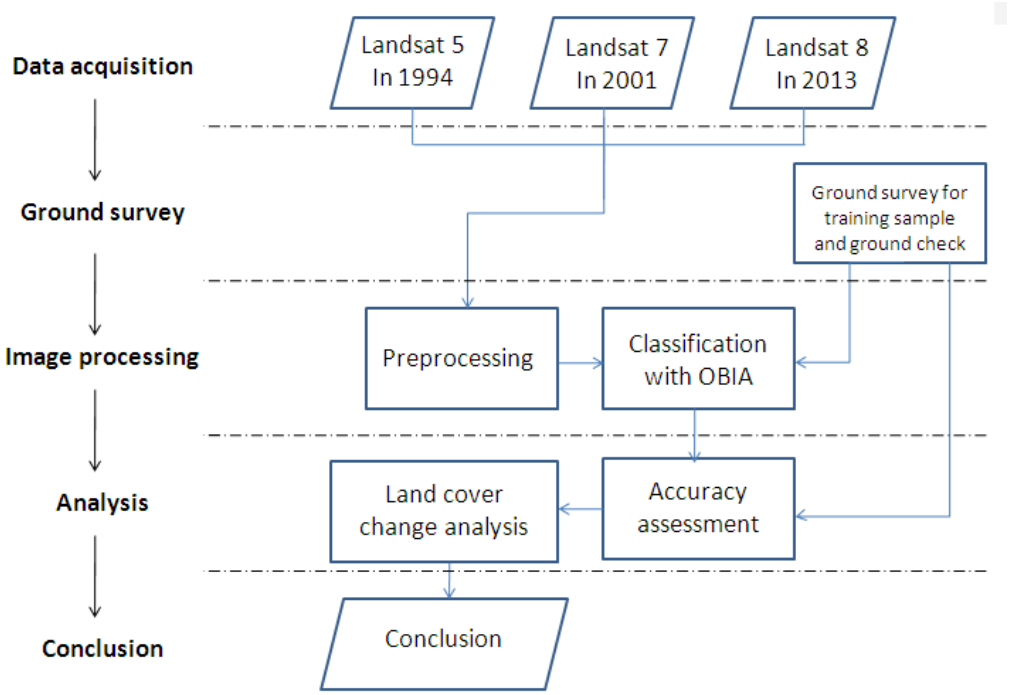


Figure 1. Methodology in this study

Ground survey refers to McCoy (2005), sample distribution using clustered pattern systems that distribution of sample based on land cover pattern. According to McCoy (2005) clustered pattern systems has the advantages. The advantages are we have been known land cover pattern so the identification of land cover and access to the site will be easier and more efficient. Distribution of sample also based on high-resolution satellite imagery, distribution of sample focus in Punclut/Caringan tilu (A), Rancaekek (B), Bandung kota (C), Kopo, Banjaran, Ciwidey and Ciparay (D), and Cililin (D). Distribution of sample can be seen in figure 2.

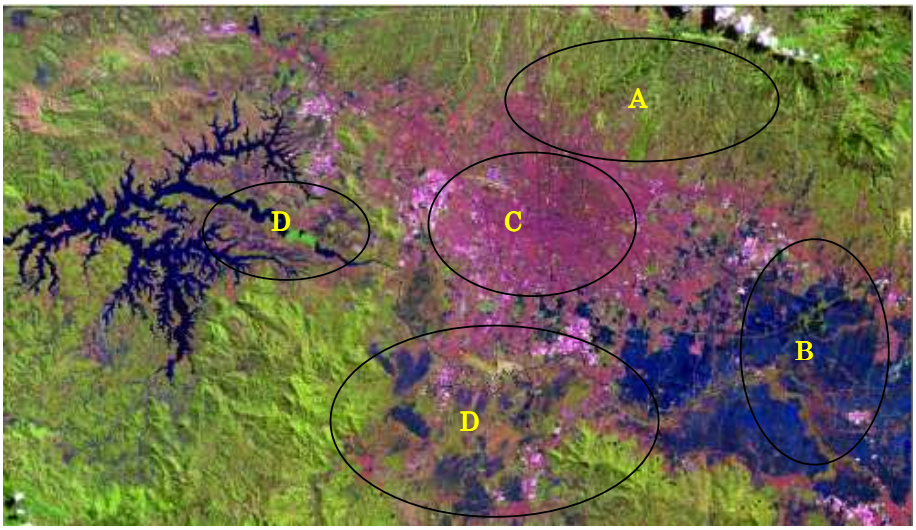
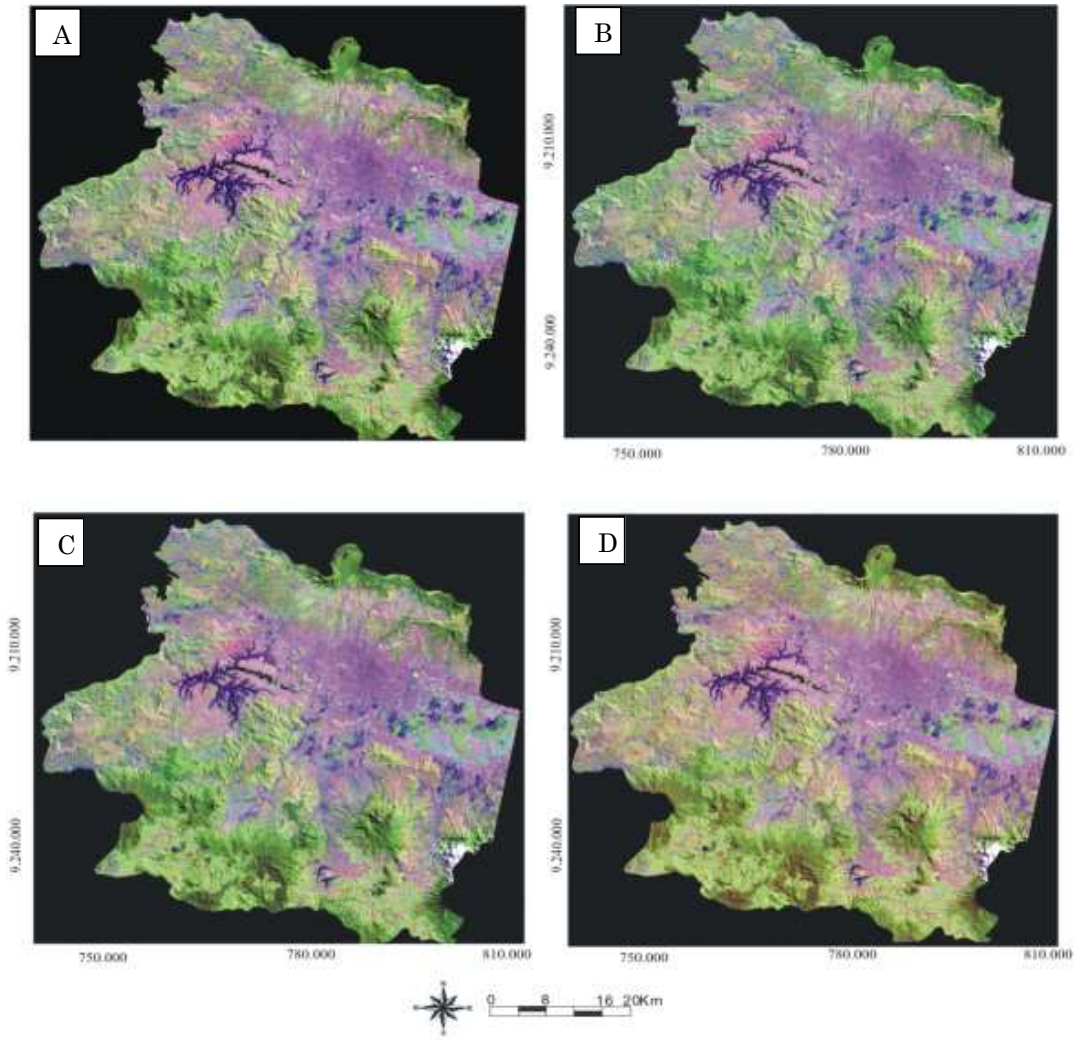


Figure 2. Distribution of sample

Pre-processing of Landsat focused on geometric and radiometric. Geometric correction was done by image registration. Reference used is the base map (RBI Map) on 1:25,000 scales. Control point based on geographic elements in study area such as river, street etc. Transformation and resampling method used affine and nearest neighbor. Radiometric correction focus to reduce the atmospheric effects and topographic effects. To Reduce atmospheric effect refers to Huang et al. (2001). To reduce topography effect refers to Riano et al. (2003). Pre-processing can be seen in Figure 3.

In Figure 3. first Landsat images (A) check by the base map (RBI Map) on 1:25,000 scales. The result only less than one pixel. It means Landsat data already have the same coordinates with base map 1:25.000 scale and if the comparison between other satellites images in this study, not more than one pixel, therefore it is assumed in this study, Landsat imagery can be used directly and not necessary geometric correction. Radiometric correction focused on reducing the atmospheric effects. To reduce atmospheric effect can be done by converting the DN (digital number) into the spectral radiant and spectral radiant into spectral reflectance values. Results of atmospheric correction can be seen on figure 3 (C). To reduce the influence of topography refers to Riano et al. (2003) that can be done with illumination models. Illumination models require slope and aspect derived from DEM (digital elevation model). DEM is used as input to calculate incident angle. Incident angle is the angle formed by the sun with the normal line. Results of tophography correction can be seen on figure 3 (D)



For classification using OBIA, firstly the image is segmented into objects. The image segmentation algorithm used in this study followed the fractal net evolution approach, which is embedded in Definiens Developer. The outcome of the segmentation algorithm is controlled by a scale factor and a heterogeneity criterion. The scale factor is indirectly related to the average size of the objects to be detected (Mathieu et al. 2007). The segmentation algorithm is a bottom up region merging technique, which is initialized with each pixel in the image as a separate segment. In subsequent steps, segments are merged based on their level of similarity. Parameters are defined by the user for the scale, spectral properties and shape properties. These image segments have to be calculated on several hierarchical levels in a “trial and error” process to result in final image segments to represent single objects of interest (Moeller et al. 2004). The process is conducted as follows; to input image, to segment multispectral image, to determine image object hierarchy, to create class hierarchy, to classify it using training samples with standard nearest neighbor, to classify base segmentation, to repeat steps for best result, and finally to merge classification result (Laliberte et al. 2004).

RESULTS AND DISCUSSION

Basically, segmentation is the process of creating a polygon object from the image. The method used for segmentation by multiresolution segmentation. Polygon created based on some parameters of the segmentation scale parameter, color, shape factor, compactness, and smoothness. In this study parameter value for segmentation is scale parameter = 10, color = 0.9, shape factor = 0.1, compactness = 0.5 and smoothness = 0.5. Result of image segmentation can see in the figure 4.

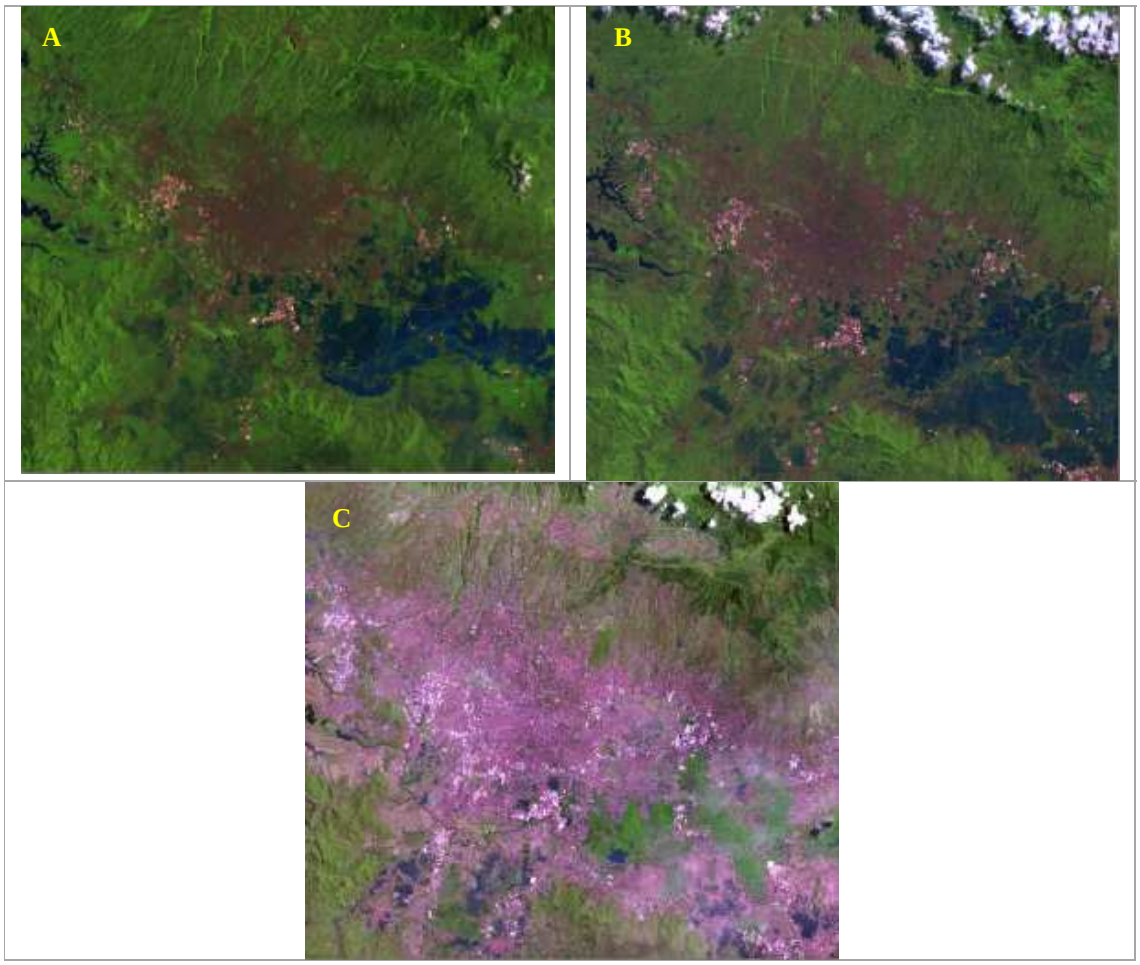


Figure 4. Image segmentation in study area
A.Landsat in 1994, B. Landsat in 2001 and C. Landsat in 2013

In this study classification system refer to Di Gregorio (2005), based on Di Gregorio in the first phase, land cover consist of cultivated and managed terrestrial areas, natural and semi-natural terrestrial vegetation, cultivated aquatic or regularly flooded areas, natural and semi-natural aquatic or regularly flooded vegetation, artificial surfaces and associated areas, bare areas, artificial water bodies, and natural water bodies. In this case, classification using OBIA only simple algorithm, just only is using digital number rule. Result of image classification using OBIA can be seen in figure 5.

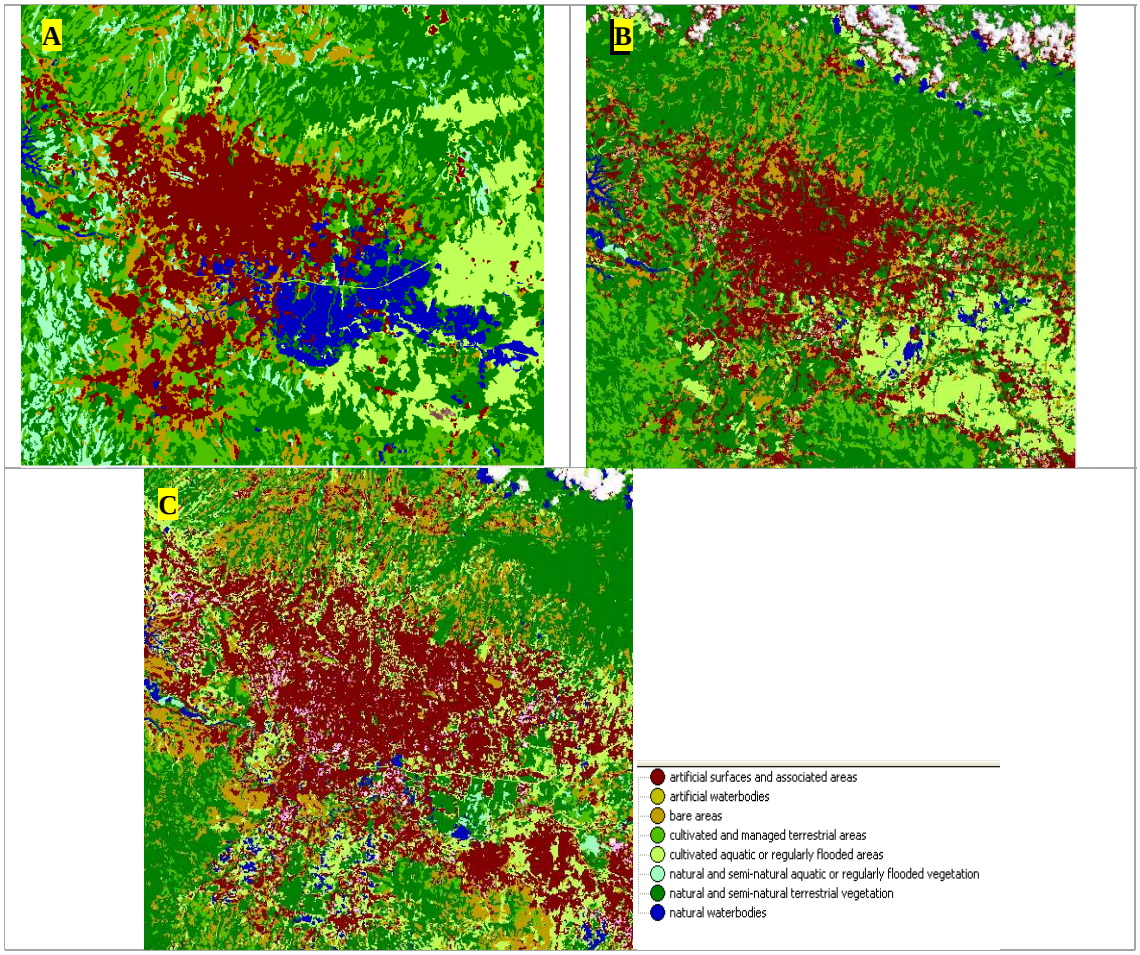


Figure 5. Image classification in study area
A. in 1994, B. in 2001 and C. in 2013

Based on figure 5, land cover type of artificial surface such as urban area, industrial and bare areas is increasing but in the future research this condition must be checked again, because accuracy assessment refer to Congalton (1999) in this case only moderate accuration. Potential factors that affect the accuracy of image classification are miss training sample in multitemporal data. Furthermore for the next research to improve accuracy assessment will use OBIA with many rules for classification of land cover and to analys the impact of land cover change for environmental disasster in Bandung Basin.

CONCLUSION AND FUTURE RESEARCH

1. In this study get information about land cover change in Bandung Basin, cover type of artificial surface such as urban area, industrial and bare areas indicated increasing
2. Accuracy assessment in this case only moderate accuracy, potential factors that affect the accuracy of image classification are miss training sample in multitemporal data.
3. Furthermore for the next research to improve accuracy assessment will use OBIA with many rules for classification of land cover and to analys the impact of land cover change for environmental disasster in Bandung Basin.

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