Analysis On Land Cover In Municipality Of Malang With Landsat 8 Image Through Unsupervised Classification

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Abstract. Remote sensing technology has been widely used in the geographic information system in order to obtain data more quickly, accurately and affordably. One of the advantages of using remote sensing imagery (satellite imagery) is to analyze land cover and land use. Satellite image data used in this study were images from the Landsat 8 satellite combined with the data from the Municipality of Malang government. The satellite image was taken in July 2016. Furthermore, the method used in this study was unsupervised classification. Based on the analysis towards the satellite images and field observations, 29% of the land in the Municipality of Malang was plantation, 22% of the area was rice field, 12% was residential area, 10% was land with shrubs, and the remaining 2% was water (lake/reservoir). The shortcoming of the methods was 25% of the land in the area was unidentified because it was covered by cloud. It is expected that future researchers involve cloud removal processing to minimize unidentified area.

1. Introduction

Land cover refers to description of vegetation and man-made construction that covers the surface of the land. The construction is visible directly from the remote sensing image. The objective of land cover observation is to predict human activities and land use. Some issues on land cover observation are preparation of vertical use, and minimum size of mapping areas. Furthermore, land use and land cover mapping becomes the bases for establishing new policies and designing output maps that generate some generalized information according to the scale and purpose of the application.

Townshend and Justice state that land cover is a physical (visual) embodiment of vegetation, natural objects, and cultural elements present on the earth's surface regardless of human activities on those objects [1]. In addition, Barret and Curtis explain that the earth's surface is partly composed of natural features (land cover) such as vegetation and snow as well as results of human activities (land use) [2].

Land cover data are obtained from aerial photographs and changes towards the photographs are known from multitemporal airborne images. Aerial photo interpretation technique is one of the aspects of the remote sensing systems. Remote sensing is the science and art of obtaining information about objects, regions or symptoms by analyzing data obtained by particular set of equipment without direct contact with the objects, areas, or symptoms being observed [3].

Aerial photography has been widely used as a source of information in many applications. In order to use aerial photographs, an individual should have ability to observe the entire sign associated
with the object or phenomenon being observed [4]. These signs are called recognition keys or commonly referred to as interpretive elements. These elements include: hue/ color, texture, shape, size, pattern, site, association, and convergence of evidence. To be able to make clear and user-friendly land cover interpretation, a working guide for land cover classification using satellite data is required. Satellite sensor system technology and digital signal processing algorithms facilitate faster, detailed and accurate retrieval of information related to the Earth surface.

Remote sensing application provides information about vegetation, reflection of the greenish level as drought predictor. In addition to vegetation, remote sensing can also convey other information such as growth of population and development that result in environmental degradation, environmental damage, decrease of natural resources and change in land use. These information can be obtained through unsupervised classification techniques as preliminary information for designing geographic information system of a region.

2. Methodology

The setting of the study was the Municipality of Malang. The data were the Administrative Boundary Map of the Municipality of Malang (Peta Tata Batas Administrasi Pemerintahan Kabupaten Malang) and Landsat 8 image taken on July 4, 2016 from the official website of NASA, http://glovis.usgs.gov/. These data were then used for land cover analysis. The research procedures were as follow:

2.1. Data Input

It referred to input of the satellite images and administrative boundary shapefile. The data were used for the reference towards which areas to observe, geometric correction as well as panning during image processing.

2.2. Image Processing

The steps in Landsat 8 image processing were as follow:

- **Image restoration**
  The purpose of image restoration was to eliminate radiometric and geometric error. The following step was panning the satellite image so that the researcher was able to classify them accurately.

- **Subset Image**
  Subset image referred to the process of classifying areas that became the objects of the study. The areas were called Area of Interest (AOI).

- **Image Classification**
  Prior to classification, the researcher should make spectral classes and characteristics of the spectral classes. The basis for classification was the actual land cover condition in the field and limited to the purpose of classification. The study used unsupervised classification. There were 6 types of land cover classification in the study, namely:
  a. Lake or reservoir,
  b. Ricefield,
  c. Dry land Farming (Plantation),
  d. Residential Area,
  e. Bushes,
  f. No data (cloud and cloud shadow).

2.3. Land Cover Analysis

The result of the land cover overlay was map describing change in land cover and a table. The following procedure was to provide description or interpretation towards the data. The steps were data reduction, data display (in the form of chart and text) and drawing conclusion.

3. Results And Discussion

3.1. Image Conversion
The Landsat 8 satellite images downloaded were satellite images consisting of several bands resulting from satellite censor recording. The images had *.tiff extension and could not be analyzed yet. In order to analyze the images, image conversion of which objective was combining several bands of images to a file with *.ers extension was conducted.

The study used Landsat satellite image with RGB 654 composite in which the three composites belonged to visible spectrum range and near-infrared and had wavelength that matched band 4, band 5 and band 3 pada citra satelit landsat 7 ETM+ landsat satellite image.

![Figure 1. Band 654 and Band 8 Combination](image1)

![Figure 2. Layout from the Image Subset](image2)

### 3.2. Landsat 8 Satellite Image Pan-Sharpening

Landsat 8 image was enhanced by combining band 8 (panchromatic) into RGB composite image. Band 8 had significance role in image processing due to its high spatial resolution. Out of 11 bands Landsat 8 had, band 8 had the highest spatial resolution, 15 m per pixel. Band 1 to band 6 only had 30 m spatial resolution. Combining band 8 (panchromatic) into RGB image composite was one method for sharpening image known as pan-sharpening. The result of the pan-sharpening was road network in villages located in the Municipality of Malang. Vegetation was grown on both sides of the road.

### 3.3. Image Cropping

The stage referred to cropping the image based on the Area of Interest (AOI). The goal was to simplify the analysis by focusing on certain areas that became object of the study and eliminating those that did not.

The study combined the satellite images and the vector data, the administrative boundaries of the Municipality of Malang where the study was conducted.

### 3.4. Image Classification

The process began by clarifying classes or areas researcher wished to observe or clarifying number of classes. Unsupervised classification would categorize all pixels into classes by displaying the same spectral or spectral characteristics. Results of the classification were influenced by the parameters the researcher had specified in unsupervised classification dialog box. Unsupervised classification would make statistical calculation to divide dataset into classes the researcher had determined earlier.

Result of the unsupervised classification was interpreted using the actual data in the field to determine the classes describing the actual area or region. Based on the information, the researchers may decide to combine or remove the classes. The following stage was to color and name each of the classes.
Based on the classified images, it was concluded that the land management in the Municipality of Malang was pretty good. Based on the satellite image, most of the area was covered by plantation area and only certain part of the area became residential area. The following table showed the result of the Landsat 8 satellite image towards the land cover in the Municipality of Malang.

| No | Classification                               | Total Area  |
|----|---------------------------------------------|-------------|
| 1  | Lake or reservoir                            | 0.0162      |
| 2  | Ricefield,                                   | 0.2233      |
| 3  | Dry land farming (Plantation)                | 0.0999      |
| 4  | Residential area,                            | 0.1228      |
| 5  | Bushes,                                      | 0.2865      |
| 6  | No data (cloud and cloud shadow)             | 0.2514      |

Figure 3. Result of Classification

Figure 4. Validation Reclassification Map

Figure 5. Image Classification Legend

Figure 6. Land Cover Percentage in the Municipality of Malang
4. Conclusion

Distortion is inseparable part of remote sensing imagery data management. Therefore, the conclusions of the study are Satellite image requires geometric and radiometric correction in order to provide valid data or at least an image similar to the actual object. Objective of classification is to enable users to see an image in homogenous method. That way they can extract the information more quickly and easily;

Remote sensing imagery is closely related to how much data are available and how much distortion the data has. Therefore, taking primary data is vital to guarantee validity of the data (image). Cloud removal method should be conducted before classification to eliminate the no data that are covered by cloud. Most productive areas in the Municipality of Malang are used for plantation.

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