Making of Classification Land Cover Through Result of Visual Data Satellite Image Analysis Landsat 8 OLI: Case Study in Tapaktuan District, South Aceh District

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I. Introduction

Land is a natural resource that has an important role in its use to support human life. The form of land use is the use for settlements with population growth, so development activities also increase including in the field of settlement development. This has resulted in an increasing need for land for settlement development [1]. Land cover can be interpreted as a biophysical cover of the earth's surface that can be observed and is an activity of human treatment carried out on certain types of land cover to carry out production activities, changes, or maintenance in the area. [2] explain land use refers to the purpose of land functions, for example recreation areas, wildlife or agricultural habitats while land cover refers to the physical appearance of the earth's surface such as bodies of water, rocks, built up land, and others.

Tapaktuan is the capital and administrative center of South Aceh Regency, Nanggroe Aceh Darussalam, Indonesia, which is a district-level city area known as the Naga City. Tapaktuan is designated as a sub-district to be used for the expansion of the capital's land. Land limitations in South Aceh Regency can have positive or negative impacts, especially in terms of the ecology, economy and social aspects of the community. Consideration of land suitability is needed so that the development of settlements in Tapaktuan District is directed. The purpose of this study was to determine the level of land use change from 2014 to 2018 by using remote sensing technology in the form of Landsat-8 OLI satellite data through image classification methods by determining the training area of the image which then automatically categorizes all pixels in the image into land cover class. The results obtained are the results of the two image classification tests stating the accuracy of the interpretation of more than 80% and the results of the classification of land cover divided into seven forms of land use, namely plantations, forests, settlements, open land, and clouds. From these classes, the area of land cover change in Tapaktuan is increasing in size from year to year.

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for obtaining land cover information while it can be mapped such land cover Landsat Data Continuity Mission (LDCM), known as Landsat-8 which has 2 sensors namely the Operational Land Imager sensor (OLI) consists of 9 channels (bands) including high-resolution panchromatic bands, and Thermal Infrared Sensors (TIRS) with 2 thermal bands, Landsat satellite data is usually used in remote sensing for land cover classification [10]. The latest land cover map can be obtained easily [11]. Classification techniques have long been used in remote sensing by determining training areas in images which then automatically categorizes all pixels in the image into the land cover class [12].

II. Location and Data

This research was conducted in the area of South Aceh Regency located at 020 23'24" - 030 44" 24" LU and 960 57'36" - 970 56" 24" East, especially in Tapaktuan (Figure 1). The data used are OLI Landsat-8 satellite imagery with recording times of 2014 and 2018, City map vector of Tapaktuan scale 1: 5000, administrative map.

![Administrative Map of South Aceh Regency](image)

III. Method

After approving the data, The following are the stages of research implementation procedures (figure. 2).

a. The radiometric stage is carried out to convert data from the Digital Number (DN) format to radians or reflectants. Radiometric correction conducted in this study using the FLAASH model is aimed at improving the pixel value due to atmospheric disturbance. FLAASH model which also includes a radiative transfer code model based on the MODTRAN4 model has included an adjacency effect calculation to improve the reflectance value due to the effect of the reflection of objects around it [13]. Whereas stages of Geometric correction are performed to change the position of the image in accordance with the coordinates of the Tapaktuan map. Processing of geometric correction of this image is corrected image to image using Tapaktuan vector map overlapping using 7 Ground Control Points (GCP).

b. After the image is corrected, image interpretation is carried out, this stage is an activity of studying the image to identify the object depicted in the image with the results of the appearance of the object in the field and assessing the significance of the object. The interpretation elements referred to in this matter are hue and color, shape, size, texture, pattern, shadow, site, association.

c. Image classification stage is a method of grouping pixels based on their reflect values according to the selected sample area. the classification of pixels here is not yet known based on the average vector and matrix of variations of each spectral pattern of information class. Pixel based classification method used is a guided classification method by running the maximum likelihood algorithm automatically classifying land cover based on class samples, Pixels are put into one class that has a high probability which is divided into 6
classification classes including plantations/agriculture, forests, settlements, vacant land, water, shrubs, and clouds.

d. Accuracy tests are performed to evaluate the spectral response patterns of each land cover category, specifically the ability to separate each spectral. In the analysis of the classification of land changes, it will be found an area that has changed, that is the area in the second pixels of the classification image with the same location but has different classification attributes, whereas the unaltered area is pixels that are in both classification images with the same location and have the same classification attributes as well. The results of processing from land cover classification using confusion matrix calculations with the recommended accuracy is kappa accuracy, because overall accuracy in general is still over estimate. Image Landsat-8 OLI in 2014 and 2018 have been classified as land cover according to the area of the study site and then overlayed with vector maps, then carried out an assessment using Tapaktuan administrative maps.

![Flowchart Processing Data Stages](image)

**Figure 2. Flowchart Processing Data Stages**

IV. Results and Discussion

A. Results Correction Radiometric and Geometric

The results of radiometric corrections performed on Landsat-8 OLI images can be seen in Figure 4. can be explained that the minimum reflectance value ≠ 0 and maximum ≠ 1, if the lowest pixel value is greater than zero (> 0), then it is calculated as a bias (offset). The value of the bias indicates the influence of the atmosphere so it needs to be corrected. Furthermore, radiometric correction is done by removing the bias to reduce the overall spectral value of the original channel with their respective bias values.

After the radiometric process is obtained the result of minimum reflectance value = 0 and maximum = 1, so that the atmospheric correction process of the FLAASH method has been fulfilled (Figure 4.b). In the picture, it can be seen the difference in the image before (Figure 5.a) and the image after radiometric correction (Figure 5.b).
Geometric correction process has been carried out on Landsat-8 OLI images in 2014 and 2018 resulting in an overall RMS error value of 0.0523 OLI Landsat-8 images in 2014, and the overall RMS error on Landsat-8 OLI in 2018 is 0.0369. The geometric correction process in these two images meets the tolerance that the geometric correction error limit is less than 1 pixel (Table.1).

| Point | Error X (Pixel) | Error Y (Pixel) | RMS 2014 | Error X (Pixel) | Error Y (Pixel) | RMS 2018 |
|-------|----------------|----------------|----------|----------------|----------------|----------|
| 1     | 0.0349         | -0.0439        | 0.0561   | 0.0127         | 0.0020         | 0.0129   |
| 2     | 0.0356         | -0.0458        | 0.0580   | -0.0324        | -0.0053        | 0.0328   |
| 3     | -0.0344        | 0.0531         | 0.0632   | 0.0398         | -0.0137        | 0.0421   |
| 4     | -0.0585        | 0.0557         | 0.0808   | -0.0137        | 0.0555         | 0.0572   |
| 5     | -0.0045        | 0.0034         | 0.0056   | -0.0226        | -0.0254        | 0.0340   |
| 6     | -0.0064        | 0.0070         | 0.0095   | 0.0214         | -0.0341        | 0.0402   |
| 7     | 0.0333         | -0.0295        | 0.0445   | -0.0051        | 0.0210         | 0.0216   |
The results of the RMS error of the two Landsat-8 OLI images used in the study have values less than 1, so it can be concluded that the results meet the criteria of geometric correction. So that the image has become a geometrically corrected image. The distribution of GCP points for the Landsat-8 OLI imagery used can be seen in Figure 6.

**B. Results Test Classification**

Headings, Classification test using confusion matrix. Accuracy of classification and statistical kappa is calculated / estimated based on the sample and confusion matrix on the results of OLI landsat-8 image data classification using Maximum Likelihood class. The results of the Landsat image classification test in 2014 and 2018 are presented in Table 2

| Classification   | Confusion Matrik Landsat-8 OLI in 2014 | Confusion Matrik Landsat-8 OLI in 2018 |
|------------------|---------------------------------------|---------------------------------------|
|                  | Producer Accuracy (%) | Omission (%) | User accuracy (%) | Commission (%) | Producer Accuracy (%) | Omission (%) | User accuracy (%) | Commission (%) |
| Settlement       | 98.94 | 1.06 | 95.69 | 4.31 | 92.18 | 7.82 | 97.68 | 2.32 |
| Forest           | 96.94 | 3.06 | 99.17 | 0.83 | 99.05 | 0.95 | 99.84 | 0.16 |
| Plantation       | 88.99 | 11.01 | 65.26 | 34.74 | 87.27 | 12.73 | 49.37 | 50.63 |
| Open land        | 99.01 | 0.99 | 57.14 | 42.86 | 88.31 | 11.69 | 38.20 | 61.80 |
| Cloud            | 89.62 | 10.38 | 88.77 | 11.23 | 66.13 | 33.87 | 75.93 | 24.07 |
| Water            | 94.28 | 5.72 | 98.83 | 1.17 | 93.93 | 6.07 | 97.77 | 2.23 |
| Bush             | 100  | 0.00 | 37.78 | 62.22 | 78.95 | 21.05 | 17.44 | 82.56 |

| Overall Accurasy (%) | 96.2250 | 98.6190 |
| Kappa Coefficient    | 0.8713  | 0.8557  |

Landsat-8 OLI image matrix test in 2014 obtained by the Accurasy Producer for each land cover class was ≥ 85%, while User Accuracy is obtained in the range of 37% - 99.17%. And there is a point error identification in the bush and plantation classes. However, the Overall Accuracy value is 96.2250% and the Kappa Coefficient is 0.8713. While the results of OLI's Landsat-8 image matrix in 2018 obtained by Accurasy Producers in each land cover class ranged from 66.13% - 99.05%, while User Accuracy was obtained in the range of 17.44% - 99.84% and identification of point errors in the bush, plantation and open land classes. The Overall Accuracy value is 98.6190 and the Kappa Coefficient is 0.8557. from the results of the classification test of the two images meet the requirements set by USGS which states the accuracy of the interpretation of more than 80% (according Ardiansyah, 2015) [3] and the results of the Landsat-8 image classification in Tapaktuan District can be used to determine the expansion of the land cover.
C. Results Classification Image Landsat-8 OLI

Interpretation of Landsat-8 OLI imagery in 2014 and 2018 based on a combination of bands can be identified using land cover classification into 7 land use classes. The classes consist of Settlements, Open Land, Water, Forest, Plantation, Cloud, and Bush which are displayed in different colors (Figure 7). For example is a body of water is represented in blue, plantations are represented in bright green to dark green. The degree of brightness of the green color usually represents the density of the vegetation. High density forests will appear dark green.

Figure 7. Result Classification Landsat-8 OLI

Land use in the study area obtained from the results of data processing and classification of land cover divided into 7 forms of land use, namely Settlements, Open Land, Water, Forest, Plantation, Cloud, and Bush. For more details about land use in the study can be seen in the Table 2.

| Classification | Year 2014 Area (ha) | Year 2018 Area (ha) |
|----------------|---------------------|---------------------|
| Settlement     | 33,606              | 35,523              |
| Forest         | 701,352             | 892,602             |
| Plantation     | 190,656             | 83,835              |
| Open field     | 44,775              | 16,002              |
| Cloud          | 39,042              | 4,428               |
| Water          | 11,484              | 6,480               |
| Bush           | 24,957              | 7,002               |
| Total          | 1,045,872           | 1,045,872           |

Based on Table 2, the level of change in land cover in the Tapaktuan region is getting bigger, namely in 2014 the area of land used for residential areas is 33,606 ha to 35,523 ha in 2018, meaning that the increase in development every year, in addition to settlement, other land cover also affects such as forests with an area of 2014 was 701,352 to 892,602 ha in 2018. However, it is different for plantation cover and open land. Based on previous research [3] most of the population...
in Tapaktuan work as farmers by cultivating nutmeg crops, but with the development, the population no longer carries out these activities. This was obtained from the mapping results obtained that the area of forest in the Tapaktuan region had a high area compared to the size of other classes due to the conversion of plantation land, bush, open land into residential land and other land use.

V. Conclusion
The conclusion of this research is the making of land cover classification maps have been carried out using remote sensing technology in the form of OLI Landsat-8 satellite imagery in 2014 - 2018 through the image classification method, and the results of the classification tests of the two images stated the interpretation accuracy is more than 80% and meet the requirements set with the Overall Accuracy value on OLI landsat-8 in 2014 was 96.2250% and Kappa Coefficient was 0.8713. While the results of the OLI Landsat-8 image matrix in 2018, the Overall Accuracy value was 98.6190 and the Kappa Coefficient was 0.8557. The results of image data processing and land cover classification are divided into seven forms of land use, namely plantations, forests, settlements, open land, and clouds. From these classes, the area of land cover change in Tapaktuan is increasing in size from year to year.

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