APPLICATION METHOD OF DIGITAL CLASSIFICATION TO MAKE LAND RESOURCES MAP

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Abstract. The Lumajang Urban Area (BWP) is the center of government and the economy in Lumajang Regency. The growth and development of cities in BWP Lumajang every year results in significant land changes. Thus, a map of land resources in Lumajang BWP is needed to determine the level of land use in the area. This research was conducted to make the Lumajang BWP Land Resource Map of Lumajang Regency using Geographic Information Systems (GIS). This study uses data processing methods with Object-Based Classification (OBIA). The data used for this study are the results of the Pleiades 1-A High-Resolution Satellite Image (CSRT) segmentation in 2016. The data used as an initial reserve (asset) is the 2009 RBI map. The data used for resource utilization (liability) is the result segmentation of Pleiades 1-A High-Resolution Satellite Imagery (CSRT) in 2016. In processing OBIA using scale, shape, and compactness parameters. In this study, it can be seen that the scale parameters have the greatest role in the formation of OBIA segmentation. The smaller the scale value is given results in more accurate segmentation. The results of this study are that at a higher level of accuracy is the method of image segmentation method of 89.041% and the land cover that has the largest decrease in area is irrigated rice fields and the largest increase is a plantation.

Keywords— BWP Lumajang, Land Resources, GIS, Digital Classification, OBIA

1. Introduction

Utilization of Natural Resources (SDA) is one of the bases used in the implementation of development in Indonesia. One of the concrete principles of implementing Sustainable Development Goals (SDG) for input in the post-2015 agenda is that SDG will be focused on achieving the three dimensions of sustainable development, namely the dimensions of human development, economic dimension, and environment dimension (environment development) in a balanced and integrated manner [1]. With one of the related policies, natural resources, and the environment which constitutes a green economy, namely improving the management and utilization of sustainable natural resources by balancing between utilization and sustainability [1]. So, we need a tool to achieve this goal, one of which is the preparation of the Natural Resource Balance (NSDA). NSDA is a scale that is compiled to calculate the availability of resources and the potential that can be generated and provide information about the number of resources that have been used, as well as reserves that are still filled with resources. NSDA consists of 4 balance sheet components, one of which is the Land Resource Balance (NSDL). The preparation of NSDL is used to determine the number of initial reserves of land resources stated in assets, and the amount of utilization stated in liabilities so that changes in reserves can be known the number of remaining reserves stated in balances in an area and within a period[2].
Lumajang BWP consists of Lumajang District and Sukodono District. As the center of government and economy, Lumajang District has the highest population, reaching 2,706 inhabitants / km². The second highest position is in Sukodono District with 1,719 inhabitants / km² [1]. An annual population growth, at BWP Lumajang, results in significant land changes.

This research was conducted using a remote sensing system. Remote sensing is the science and art of obtaining information about objects, areas, or symptoms through analysis of data obtained by devices that are not in contact with the object, area, or phenomenon being investigated [3]. The data processing method used is digital classification. In digital classification, especially OBIA has the advantage of separating between highly accurate and precise objects so that it can be an alternative to replace pixel-based digital classification and visual classification or delineation [4]. OBIA classification is done by adding parameters such as scale, shape, and compactness.

A researcher [5] to compare Object-Based Classification and Pixel-Based Classification. This study states that pixel classification has difficulty in handling information content rich with Very High Resolution (VHR) or medium resolution such as Landsat TM data. The ability of this approach is limited when objects have similar spectral information. In the case of pixels in the overlapping area of feature space, with binary theory, these pixels will be labeled into only one class but they show affinity with more than one class. Whereas, the rules of separation while object-based classification considers spectral values, shape, and texture information together with fuzzy logic for classification. The object formation is done in a way that the overall homogeneous resolution is stored. The negative impact of lower segmentation errors on the potential for object-based classification accuracy can be illustrated by developing a new measure of segmentation accuracy [6]. One of the main issues in OBIA is the selection of the right spatial scale for image segmentation to ensure that object classes are mapped consistently at one scale, that is, the right space for image segmentation to ensure that object classes are mapped consistently at one scale and do not overlap, but according to the hierarchy with the class applicable to other scales [7]. So, in this study modifications to the scale parameters are used because they have a significant effect on the results of image segmentation. The smaller the scale value assigned to the segmentation process, the more accurate and meticulous the segmentation will be. Therefore, in this study applying digital classification to compile Land Resource Balance in Lumajang BWP and analyzing the results of a digital classification in the preparation of the Lumajang Land Resource Balance Sheet.

2. Methodology
This study was conducted at Lumajang BWP Lumajang Regency. Geographically, the location of the study is located at 8°4’38.87” South Latitude to 8°9’22.53” South Latitude and 113°12’4,458” East Longitude to 113°16’30,124” East Longitude. Data of this research are Pleiades 1-A Image Imagery, Lumajang Regency Administrative Boundary Validation Data in 2016 from BAPPEDA Lumajang, Map of Rupa Bumi Indonesia (RBI) 1: 25,000 in 2009 and Raw Map of Lumajang Regency RBI Scale 1: 25,000 in 2009.

The main process in Object-Based Classification (OBIA) consists of two parts, namely segmentation, and classification. Segmentation is a very important part of automatic image analysis because in this procedure the desired object will be tapped for further processing, for example in pattern recognition [8]. This segmentation process depends on assigning weighting values to several parameters used such as scale, shape, and compactness of the object. The scale criteria are used to determine the separation between objects according to the gray level in the object. The greater the weighting value is given, the more heterogeneous the object so that the object size will be even greater. This shape criterion is related to the color parameters of the object. The greater the weighting value is given to the shape criteria will affect spatial homogeneity compared to spectral homogeneity. The compactness criteria are used to separate objects according to the compactness of the object. The greater the weighting value is given, the more compact the object in the image. In this research, the main parameter modification is on the scale parameter. Because this scale parameter has a large and dominant influence in data processing in this study.
There are several image segmentation algorithms, one of which is the Multiresolution Segmentation (MRS) algorithm developed is one of the most widely used algorithms in the process of image segmentation. The following is the formula for calculating the MRS algorithm:

\[ S_f = w_{\text{colour}} \times h_{\text{colour}} + (1 - w_{\text{shape}}) \times h_{\text{shape}} \]  

(1)

In the algorithm above, \( S_f \) is the resulting Segmentation Function, \( w_{\text{colour}} \) is Color Parameter Weight, \( h_{\text{colour}} \) is Color Parameter, \( w_{\text{shape}} \) is Shape Parameter Weights and \( h_{\text{shape}} \) is Shape Parameter [9].

The results of the segmentation that has been done, the image can be classified into suitable land cover. Classification on OBIA is the process of giving land cover type classes to segments or objects that were formed during segmentation. Classification is done based on the sample and the rules used.

To determine the accuracy of the results of data processing using the OBIA method, an accuracy test was performed. In this study using the accuracy-test with the confusion matrix method. For each class calculated together with overall accuracy and Kappa coefficients (Congalton and Green. 1999; Whiteside Timothy G et al. 2011)[10]. The Kappa coefficient is used to determine the strength of agreement between the results of the classification and the actual land cover class. The following is the Kappa Coefficient algorithm [4] :

\[ \text{Kappa (K)} = \frac{N \sum_{i=1}^{n} X_{ii} - \sum_{i=1}^{n} \sum_{j=1}^{n} X_{ij} X_{ji}}{N^2 - \sum_{i=1}^{n} \sum_{j=1}^{n} X_{ij} X_{ji}} \times 100\% \]  

(2)

In the algorithm above, \( N \) is the number of pixels in the example, \( X \) is the diagonal value of the I-line contingency matrix and the i-th column, \( X_{ii} \) is the number of pixels in the i-th row and \( X_{ij} \) is the number of pixels in the i-th column.

3. Result and discussion

3.1 Segmentation Image of BWP Lumajang

The process of segmentation using the multiresolution segmentation method. In this research, segmentation uses three parameters, namely scale, shape, and compactness. In the segmentation process of this study, scale parameters can divide the heterogeneity of the resulting segments. The greater the scale value is given, the greater the level of heterogeneity of the segment, and the greater the size of the segment. The segmentation process is done by trial and error on a scale value. The form and compactness parameter is using the default value in the processing software are form 0.1 and compactness 0.5.

This is one of the results of segmentation in BWP Lumajang. This is segmentation results in rogotrutan villages that have parameter score are scale 600, form 0.1, and compactness 0.5.

![Figure 1. Results of Rogotrutan Village Segmentation Around The Asem River](image)

Rogotrutan Village has a complex and diverse land cover. Thus, the scale used in this region is of little value to be able to distinguish segments and be able to present objects contained in this region correctly.
3.2 Classification Image of BWP Lumajang

The next step after segmentation is classification. Classification is the process of giving classes to each segment according to the land cover class. On the results of data processing that has been done, there are 5 (five) classes detected, namely settlements, plantations, fields or fields, irrigated fields, and rivers. This is one of the results of a classification in BWP Lumajang. This is a classification of Rogotrutu Villages.

![Classification Image of BWP Lumajang](image)

Figure 2. Classification Results of Rogotrutu Villages Around The Asem River

In the Rogotrutu Villages have four land cover classes are settlements, fields or fields, rivers, and irrigated fields. However, in the village of Rogotrutan is dominated by irrigated paddy land cover class.

3.3 Accuracy Test Calculation

Data from sampling points in each land cover class in the field, it is used to determine the accuracy of the data processing results. For the accuracy value used in the processing of this test, the data accuracy is 85%. Based on the results of the calculation of the accuracy-test using the confusion matrix method that has been carried out in processing the OBIA classification data, it is known that the OBIA classification data processing method has an overall accuracy value of 89.041% and a kappa accuracy of 0.851. The results of OBIA classification data processing have an accuracy value of more than 85%. Thus, data that has been processed can be stated accurately and accurately. Thus, the results of data processing can be used for further data processing.

3.4 Land Resources Balance Results

After it is produced from OBIA data processing and has an accuracy that meets the parameters. Furthermore, land cover classification data for 2016 was overlaid with land cover in 2009. It was found that the type of land cover that occurred in the largest area was plantation land cover that was 119,097 Ha and land cover which had the largest area decreased was irrigated rice fields. of 98,608 Ha. This is because changes in paddy fields change their use to other land covers, especially plantation land cover.

4. Conclusion

This study shows accurate results on the OBIA method in the preparation of NSDL BWP Lumajang because the data processing that has been done produces an overall accuracy of 89.041% and Kappa accuracy of 0.851. This value indicates that the strength of the agreement that is owned is very strong. This is influenced by the satellite image data that is used greatly affects data processing because the higher the spatial resolution that is owned will result in higher land suitability. Next is the influence on the process of segmentation and classification of satellite images. In the segmentation process, the values entered on scale parameters, shape and compactness greatly affect the results of segregation. The greater the scale value entered will result in increasingly heterogeneous segmentation and the object will have a larger size. Thus, the segmentation process is done using a trial and error process on the scale parameters until the results obtained are correct and correct. Furthermore, the classification process must
be following the actual land cover class by giving the right class to each land cover in the segmentation results. Thus, the right and appropriate land cover classes are obtained.

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