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COMPARISON OF LAND COVER CLASSIFICATION ACCURACY TEST USING PIXEL BASED AND OBJECT BASED IMAGE ANALYSIST (OBIA) METHODS ON SENTINEL-2A IMAGE IN 2023 IN PADANG CITY

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ABSTRACT: Land cover is the physical and biological cover of the earth's surface, whether formed naturally such as swamps, rivers, hills or man-made such as rice fields, gardens, forests and buildings. One alternative to obtain information about land cover is by utilizing remote sensing technology. These include pixel-based classification and object-based classification. The fundamental difference between object-based classification and pixel-based classification lies in the object separation process, object-based classification divides based on segmentation results, not just based on single pixel values in pixel-based classification. This research aims to compare the level of classification accuracy of pixel-based methods with object-based methods in identifying land cover in 2023 Sentinel-2A image data in Padang City. The sampling method used was random sampling with a total of 7 classes. To get accuracy results, the same ground truth data is given to both methods.The results of the comparison of object-based classification and pixel-based classification on the two images were tested for accuracy using a confusion matrix which resulted in land cover classification accuracy on the 2023 Sentinel-2A image. The overall kappa accuracy for the pixel-based classification method was 89.80%, while for the pixel-based classification method the object obtained a value of 94.88%. The overall accuracy results show that object-based classification is better than pixel-based classification in classifying land cover.

*Keywords:*Accuracy, Land Cover, pixel-based and object-based (OBIA)

1. INTRODUCTION

Land cover is various types of objects found on the land surface (Lubis et al., 2021). An accurate and effective method is needed to obtain land cover information. One effective technology for mapping land cover is remote sensing technology. The term land cover relates to the type of land appearance on the earth's surface, while land use relates to human activities on certain areas of land and cultivating land for subsistence needs (Awaliyan and Sulistyoadi, 2018).

Non-terrestrial surveys are based on information obtained from space and outer space vehicles using remote sensing technology (Resita et al. 2021). There are several digital classification techniques regarding land cover, namely pixel-based techniques, sub-pixel-based techniques and object-based techniques (Maksum et al. 2017).

Pixel-based classification is an algorithm designed to derive thematic information by grouping phenomena based on spectral values (brightness values) on several channels at once. This grouping is done based on differences in spectral values, where pixels with the same spectral value will be grouped into one class. Meanwhile, object-based classification can be done by looking at two characteristics at once, namely spectral and spatial. The pixel-based classification method, namely maximum likelihood, is a classification system that is currently considered well established and is included in the parametric method which uses the assumption and requirement that each class must be normally distributed. Pixel-based classification technique is a classification technique that has long been used in remote sensing where classification is carried out by determining training areas in the image which then automatically categorizes all pixels in the image into land cover classes (Pratiwi et al., nd, 2020). In reality, finding normally distributed classes is difficult, so the opportunity for errors in taking training areas to separate pixels from different classes is very possible (Arrahman & Kamal, 2021).

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Object-based classification technique or another name, Object-based Image Analysis (OBIA), which is a technique used to classify object segments in the form of polygons from the results of a segmentation process where the object is a group of pixels that are similar to each other based on spectral characteristics, namely color. , size, shape, and texture and their relationship from neighboring pixels. Object-based classification such as Object Based Image Analysis (OBIA) has advantages in data processing that pays attention to the unity of objects based on pixel hue and texture (Widayani, 2018). Meanwhile, object-based digital classification has shown great potential in classifying land cover in urban areas and is widely used in medium resolution imagery (Dimyati et al., 2022).

The city of Padang has a rapid level of development, such as in terms of physical-spatial development, space utilization and activities such as the economic sector, trade and the provision of tourism facilities. Padang City is the capital of West Sumatra Province which has an area of 694.96 km2 with a population based on Central Statistics Agency (BPS) data of 909,040 people. Astronomically, Padang City is located at 0°44'00"-1°08'35" South Latitude and 100°05'05"- 100°34'09" East Longitude.

In previous studies, many of these methods were discussed separately and most of them used high resolution images. Therefore, the author wants to prove that different locations and types of images can produce the same values as previous research. So it is known whether determining different locations, methods and types of images has an effect on the results of this research.

This research aims to determine the level of accuracy of each method, namely the Pixel Based and Object Based-Image analysis (OBIA) methods in identifying land cover in Padang City. It is hoped that this research will later become an option or alternative for land cover classification methods.

2. RESEARCH METHODS

2.1 Research site

This research is located in Padang City, West Sumatra Province with an area of 0°44'00"-1°08'35" South Latitude and 100°05'05"- 100°34'09" East Longitude.

2.2 Tools and materials

The type used in this research is quantitative research. The data used is secondary data, namely the 2023 Sentinel-2A image downloaded at Copernicus and the Padang City administrative boundary map downloaded at Inageoportal.

2.3 Data Processing Stage

2.3.1 Initial processing

At this stage, radiometric correction is carried out to improve the visual quality of the image and at the same time correct pixel values that do not correspond to the reflectance or spectral emission values of the actual object. As well as carrying out atmospheric corrections to reduce the influence of atmospheric disturbances on satellite image data, so that the reflectance values obtained are close to the actual reflectance values of objects on the earth's surface.

Next, cropping was carried out on the image using a polygon shapefile from the Padang City regional government.

2.3.2 Processing

2.3.2.1 Pixel-Based Land Cover Classification

Making training samples (sample areas) in the image is used to obtain the characteristics of each class. A set of training samples can represent each specified land cover class, for example water bodies, rice fields, forests and open land classes.

The pixel-based classification method used is a supervised classification method. The supervised classification algorithm uses the Maximum likelihood algorithm. Maximum likelihood classification is a classification algorithm that produces statistically good results, assuming that similar objects and pixels always show evenly distributed classifications.

The maximum likelihood pixel-based classification algorithm has stages that are carried

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out, in short, as follows: inputting image file data, creating land cover classes, training samples in each land cover class, and running the maximum likelihood algorithm which will automatically classify land cover based on the sample. created land cover classes.

2.3.2.2 Object-Based Land Cover Classification

In multiresolution segmentation there are three parameters that must be determined, namely scale, shape and compactness. These parameters are determined experimentally until segmentation results are obtained that represent land cover objects. After completing the image correction, then carry out the multi-resolution segmentation process using eCognition Developer software, where in the segmentation process there are three parameters used, namely the scale parameter value: 50, shape: 0.3 and compactness: 0.6.

Object-based classification using the nearest neighbor classification method requires selecting samples in each land cover class that represent that class. In this classification, you have to create a sample and then classify it. The segmentation results are grouped (classified) using the assign class algorithm with the first threshold condition layer mean 1 >25, the second threshold condition brightness value >32, the first second condition layer mean 3 value >25 and the second second condition rectangular fit value >0.6 to get the object land cover. The built-up land segment is then divided into residential and trade/services using manual classification.

2.3.3 Sample Point Creation

Purposive random sampling is a technique for determining and taking samples determined by researchers with certain considerations:

$$N = + \frac{Z^2 p q}{E^2}$$

Where: N : Number of Samples
Z: The standard deviation value is 2
p : Expected accuracy is 85%
q : 100 – p
E : Error received

2.3.4 Ground Truth

Conduct surveys in the field/ground truth. This stage is carried out to ensure that the image interpretation is appropriate or not appropriate in the research study area. The field survey stage was carried out by taking samples based on sample points that had been distributed to each class. Next, make observations to adjust to the results of the image interpretation. This ground truth is carried out according to the sample points that have been determined through the sample point creation stage, where these sample points are for accuracy testing purposes. Finally, documentation of land cover as evidence from the field in the form of photos in the field.

2.3.5 Accuracy Test

Accuracy tests were carried out to assess the accuracy of land cover classification data from processing using Sentinel-2A imagery. Accuracy testing is a process that shows the truth of the research carried out. Accuracy testing classification uses the Kappa Accuracy calculation method which considers kappa accuracy, namely user value calculations, manufacturer accuracy calculations, overall accuracy calculations and kappa accuracy calculations.

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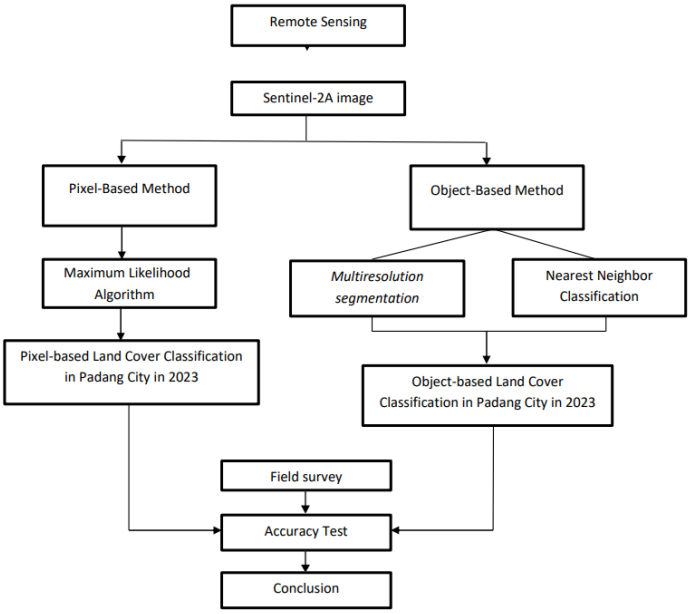
2.3.6 Flow chart



3. RESEARCH RESULTS AND DISCUSSION

3.1 Land Cover Classification

The classification of land cover in Padang City has many variations. In carrying out this land cover classification, digital methods are used, namely pixel-based and object-based methods based on remote sensing data with 2023 Sentinel-2A satellite image data which has a spatial resolution of 10 meters. There are 7 land cover class classifications from the results of pixel-based and object-based land cover classification in Padang City, namely, water bodies, forests, built-up areas, open land, mixed gardens, wetlands and shrubs.

3.2 Pixel-Based Land Cover Map in 2023

Land cover classification for making pixel-based land cover maps in Padang City uses the supervised or maximum likelihood method with processing using Argcis software with the process of taking training samples and carrying out a classification process that describes class information for determining land cover area in the form of hectares (Ha).

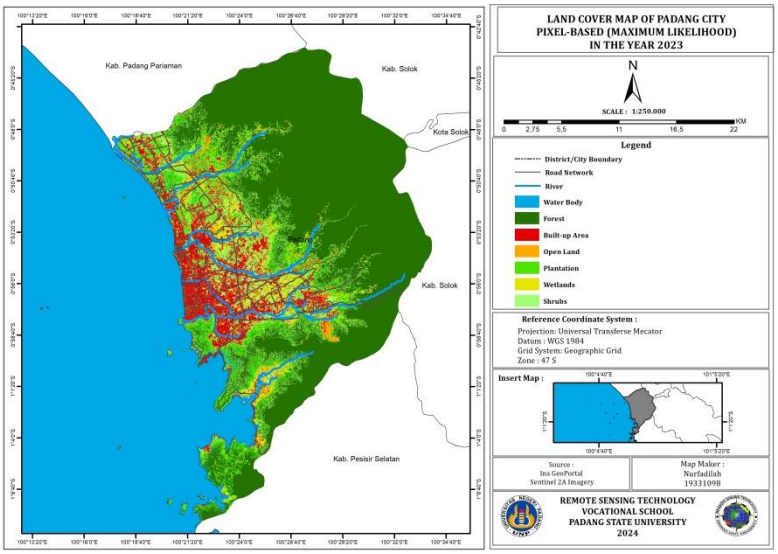


Figure 1. Pixel-Based Land Cover in 2023

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The following is a pixel-based table of land cover area in 2023:

Table 1. Land Cover Area Based on Pixels in 2023

Land cover	Area (Ha)
	2023
Water body	1,175
Forest	40,678
Built-up Area	8,094
Open Land	644
Plantation	9,200
Wetlands	3,831
Shrubs	4,957

3.3 Object-Based Land Cover Map 2023

Land cover classification for making object-based land cover maps in Padang City using the Object Based Image Analysis (OBIA) method with processing using eCognition Developer and Arcgis software with multi-resolution segmentation processes and nearest neighbor classification, to determine the area of land cover in hectares (Ha) .

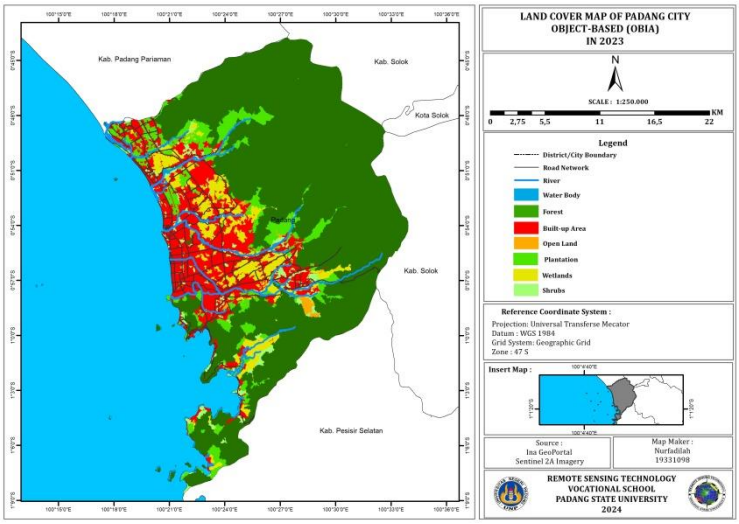

Figure 2. Object-Based Land Cover in 2023

The following is a table of land cover area based on objects in 2023:

Table 2. Land Cover Area Based on Pixels in 2023

Land cover	Area (Ha)
	2023
Water body	590
Forest	43,027
Built-up Area	11,792
Open Land	6.126
Plantation	4,771
Wetlands	1,936
Shrubs	330

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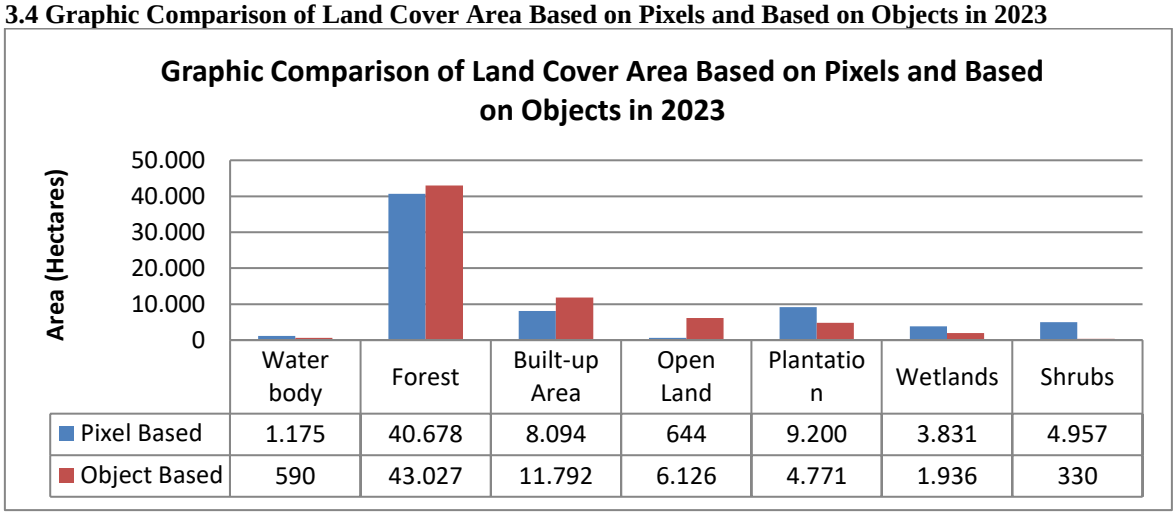
3.4 Graphic Comparison of Land Cover Area Based on Pixels and Based on Objects in 2023



Graph 1. Comparison graph of land cover area based on pixels and based on objects in 2023

3.4 Accuracy Test

The classification for the accuracy test uses the Kappa Accuracy calculation method. Kappa accuracy can be used for the land cover mapping process by looking at the accepted accuracy value of 85% or 0.85 (Fitriawan Dedy, 2022). The aspects considered in kappa accuracy are the calculation of user value (user accuracy), the calculation of producer accuracy, the overall calculation (overall accuracy) and the calculation of kappa accuracy, so the results of the accuracy are as follows:

$$N = \frac{2^2 \; x \; 85 \; x \; 15}{15^2} \quad \frac{4 \; x \; 1275}{225} = 23$$

Table 3. Distribution of sample points based on land use class

Land cover	Sample Point
Water body	2
Primary Forest	4
Built-up Area	4
Open Land	3
Mixed Gardens	3
Wetlands	4
Shrubs	3
Amount	23

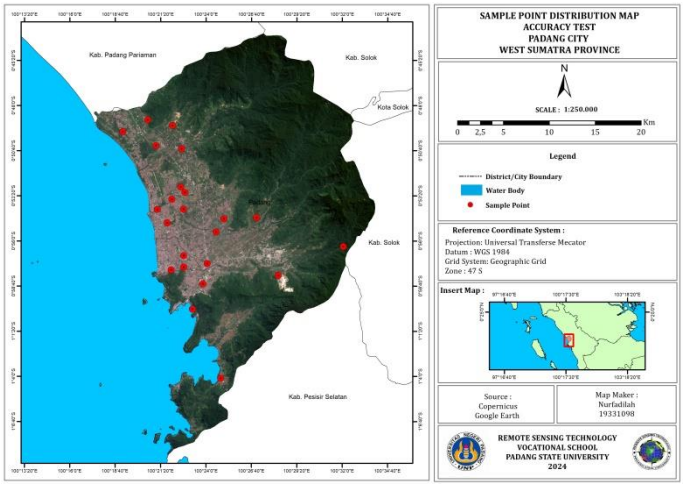


Figure 3. Map of distribution of precision test sample points

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3.4.1 Pixel-Based Land Cover Accuracy Test in 2023

Determining the confusion matrix value for land cover in 2023 is carried out in several stages, namely user's accuracy, producer accuracy, overall accuracy and Kappa index. The following is a land cover accuracy test for 2023 which is presented in the following table based on the results of ground checks in the field.

Table 4. Pixel-Based Kappa Confusion Matrix Table for Land Cover

Class	Water body	Primary Forest	Built-up Area	Open Land	Mixed Gardens	Wetlands	Shrubs	Number (users)	Commission	MA (%)
Water body	2	0	0	0	0	0	0	2	0	100
Primary Forest	0	4	0	0	0	0	0	4	0	100
Region Awakened	0	0	4	0	0	0	0	4	0	100
Land Open	0	0	0	3	0	0	0	3	0	100
Mixed Gardens	0	0	0	0	2	0	1	3	1	66
Wetlands	0	0	0	0	1	3	0	4	1	75
Shrubs	0	0	0	0	0	0	3	3	0	100
Amount	2	4	4	3	3	3	4	23		
Commission	0	0	0	0	1	0	1			
MA (%)	100	100	100	100	66	100	75			
Overall Accuracy					91.30%					
Kappa					89.80%					

3.4.2 Object-Based Land Cover Accuracy Test in 2023

Determining the confusion matrix value for land cover in 2023 is carried out in several stages, namely user's accuracy, producer accuracy, overall accuracy and Kappa index. The following is a land cover accuracy test for 2023 which is presented in the following table based on the results of ground checks in the field.

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Primary Forest	0	4	0	0	0	0	0	4	0	100
Region Awakened	0	0	4	0	0	0	0	4	0	100
Land Open	0	0	0	3	0	0	0	3	0	100
Mixed Gardens	0	0	0	0	2	0	1	3	1	66
Wetlands	0	0	0	0	0	4	0	4	0	100
Shrubs	0	0	0	0	0	0	3	3	0	100
Amount	2	4	4	3	2	4	4	23		
Commission	0	0	0	0	0	0	1			
MA (%)	100	100	100	100	100	100	75			
Overall Accuracy					95.30%					
Kappa					94.88%					

4. CONCLUSION

Based on the accuracy test results in the table above, pixel-based land cover classification using the maximum likelihood algorithm has an accuracy value of 89.80%. Based on the accuracy test results of object-based classification using the OBIA method, it shows an accuracy of 94.88%, indicating that object-based classification is better to use. in land cover classification.

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