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IDENTIFICATION OF LAND USE CHANGES USING THE OBJECT BASED IMAGE ANALYSIS (OBIA) METHOD IN BUNGUS TELUK KABUNG DISTRICT

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ABSTRAK: Object-based image analysis (OBIA) is an image classification that considers not only the spectral aspects of objects, but also their spatial aspects. This classification is guided by objects that have distribution patterns from object samples which are used as references for their accuracy. However, this object-based classification process must be taken into account when looking at color and calculating it so that there is no error in classification. In this research, the OBIA method was used to identify changes in land use in the Bungus Teluk Kabung District in 2012, 2017 and 2022. By using the OBIA method, identification results were obtained in areas where land use changes occurred between 2012 and 2017, which were identified as having changed from open land to built-up land. with an area of 355.84ha, plantations 22.62ha and rice fields 20.97ha. From 2017 to 2022, it was identified that there was a change in land use from dry land forests to 6.30ha of built-up land. The change in open land to built-up land was 7.47ha. Plantations experienced changes to 6.21ha of built-up land and 9.27ha of rice fields. Meanwhile, bushes/shrubs experienced changes in plantations of 2.47ha.

Keywords: Object Based Image Analysis (OBIA)

1. INTRODUCATION

Land is the entire environment on the surface of the earth that provides opportunities for life. Land is a certain area on the surface of the earth that includes all the materials that make up the biosphere, such as the atmosphere, soil and matrix, topography, water, plants and animals, as well as the results of human activities in the past and present, all of which will have a real impact on land use (Juhadi, 2007).

Changes in land use occur because of population growth and developments in the demands of life, the need for housing, which requires space as a container is increasing. The reverse movement of the population, namely from the city to the suburban areas including rural areas, the suburban area as an area that has relatively wide space has an attraction for residents in obtaining a place to live. Population density can generally be interpreted as the ratio between the number of residents and the area of land occupied in unit area. Population density is influenced by topography, climate, water management, accessibility and availability of living facilities.

Bungus Teluk Kabung District is one of 11 sub-districts in the administrative area of Padang City. Bungus Teluk Kabung District is located at 0.54º– 1.80º South Latitude and 100º.34' East Longitude with a distance from the capital city of Padang of 18.6 km2. Geographically, the area of Bungus Teluk Kabung District is 100.78 km2, the population density is around 279 per km2 and the total population is 28,090 people consisting of 14,428 men and 13,662 women with a family card of 6028 households.(Central Statistics Agency. Padang, 2022).

Bungus Teluk Kabung District is flowed by three large rivers, namely: the Baramas River, the Cindakir River and the Bungus River. The Bungus Teluk Kabung District area has the potential for natural resources and environmental carrying capacity, including land resources for agriculture, settlement, industry, fishing ports, Pertamina ports, ferry ports, steam power plants (PLTU), fisheries cultivation and coastal tourism. In addition to land use changes caused by nature, land-based activities in the area can directly or indirectly change the coastline(Tanto, 2014).

Changes in land use in Bungus Teluk Kabung District that occur without planning and control will cause environmental damage. Such as the use of forest land for agriculture and plantations that do not pay attention to the concept of land conservation. This causes land use that is not environmentally friendly, which will exacerbate the land destruction disaster. Changes in land use are fundamental because human activities and

interests vary. Limited land causes the conversion of land from empty or open land to residential areas to meet the needs of an ever-increasing population.

Changes in land use are rapid and difficult to control due to the increase in population and population activities that occur. Then it is impossible to know how extensive the land use changes are for each land use unit. There is no comprehensive data on the intensity and frequency of land use changes. Mapping terrestrial land use change requires a lot of money, time and effort. In addition, there is no numerical data on land use in terms of intensity, area and type of land use.

Identification of changes in land use is important to monitor changes in the area of land use that can be identified. Geographic information systems (GIS) have a very important role in monitoring land use changes. GIS can be used for optimal input, analysis, processing and display of geographic information data.

The specific objective of this study is to determine land use changes that occurred in 2012, 2017, 2022 in Bungus Teluk Kabung District using the Object Based Image Analysis (OBIA) method.

2. RESEARCH METHODS

2.1 Research sites

This research is located in Bungus Teluk Kabung District, Padang City, West Sumatra Province with an area of 0.54° - 1.80° South Latitude and 100°34' East Longitude.

2.2 Tools and materials

The type used in this research is quantitative research. The data used is secondary data, namely Landsat 7 satellite images for 2012 and Landsat 8 for 2017 and 2022 downloaded on EarthExplorer and administrative boundary maps downloaded on Inageoportal.

2.3 Data Processing Stage

2.3.1 Preprocessing

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 match the reflection or spectral emission values of the actual object.(Nilasari, 2017). And carry 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.

Furthermore, cropping the image using a polygon-shaped shapefile from the regional administration of Bungus Teluk Kabung District.

2.3.2 Processing

OBIA is an image classification method that considers not only the spectral aspects of objects, but also their spatial aspects. OBIA is a classification technique that focuses on distinguishing the uniformity of objects based on the hue and texture of pixels(Alim, 2020).

This method can be used to create training samples for each land cover object. This classification is guided by objects that have a distribution pattern from object samples that are used as a reference for their accuracy. The OBIA method has better separation accuracy between objects and has the advantage of being more efficient because the segmentation process is based on objects and not pixels. In this object-based classification process, attention must be paid to seeing colors and calculating them so that there is no error in classification. After classifying this image, to save it in the form of a shp file, you have to export the data.

2.3.2.1 Multi-resolution segmentation

Multi-resolution segmentation uses eCognition Developer software, where in the segmentation process there are three parameters which use the parameter values scale: 50, shape: 0.3 and compactness: 0.6.

2.3.2.2 Nearest Neighbor Classification

Make samples and then classify them into six classification classes: Dry Land Forest, Built Up Land, Open Land, Rice Fields, Plantations and Shrubs/Shrubs

2.3.3 Making a Land Use Change Matrix

From the land use results for 2012, 2017 and 2022, there are land use results from 2012 to 2017 and 2017 to 2022 which are processed using Microsoft Excel and then displayed in the form of tables and graphs.

2.3.4 Making Sample Points

Making sample points 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: Standard deviation value is 2

p : The expected accuracy is 85%

q : 100 – p

E : Error received

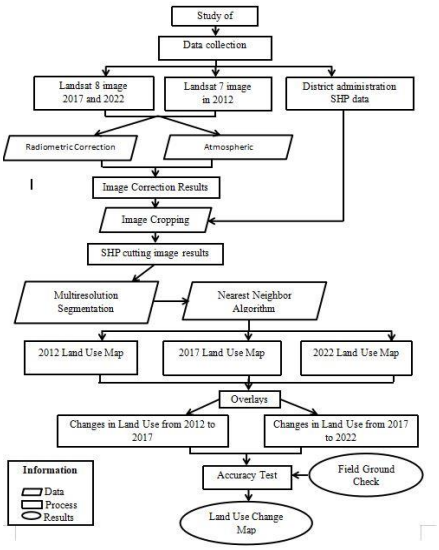
2.3.5 Field Survey / Groundcheck

Sampling using Google Earth Pro software is based on sample points that have been distributed to each land use class.

2.3.6 Accuracy Test

The accuracy test is carried out to assess the accuracy of the data - data resulting from land use classification from the processing using landsat imagery. Accuracy testing is a process that shows the truth of the research carried out. The classification for accuracy testing uses the Kappa Accuracy calculation method which is taken into consideration from kappa accuracy, namely user value calculations, producer accuracy calculations, overall accuracy calculations and kappa accuracy calculations.

2.3.7 Flow Chart



3. RESEARCH RESULTS AND DISCUSSION

3.1 Land Use Classification 2012

The three year series of land use classifications used are Landsat images for 2012, 2017 and 2022.

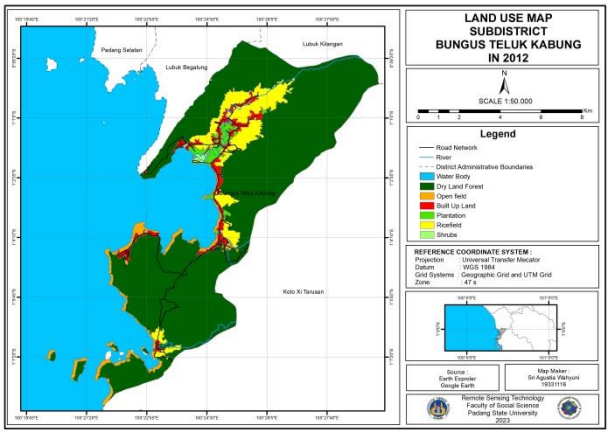


Figure 1. Land Use 2012

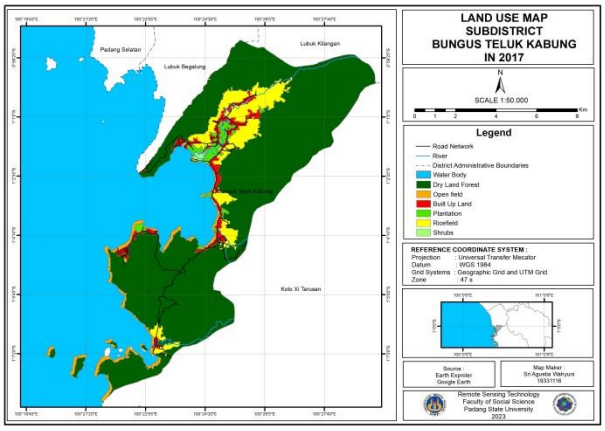


Figure 2. Land Use 2017

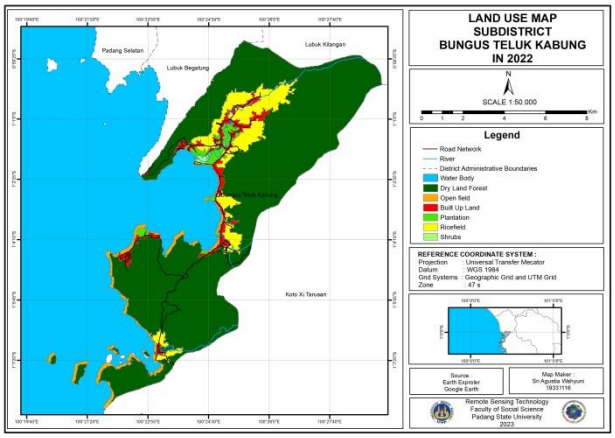


Figure 3. Land Use 2022

Classification of land use in Bungus Teluk Kabung District for 2012, 2017 and 2022 using the Object Base Image Analysis (OBIA) method with processing using eCognition Developer and Arcgis software with a multi-resolution segmentation process of scale 50, shape 0.3 and compactness 0.6 and classification nearest neighbor with classification results in 6 classes such as dry land forest, open land, built-up land, plantations, rice fields, bushes. The following is a table of land use areas and years 2012, 2017 and 2022:

Table 1. Area of Land Use

Land Use	Area (Ha)

	2012	2017	2022
Dry Land Forest	6,839.87	6,839.87	6,833.57
Open field	355.84	309.99	302.53
Built Up Land	341.38	343.63	363.61
Plantation	162.09	184.71	171.71
Ricefield	787.65	808.62	817,89
Shrubs	32.75	32.75	30.28

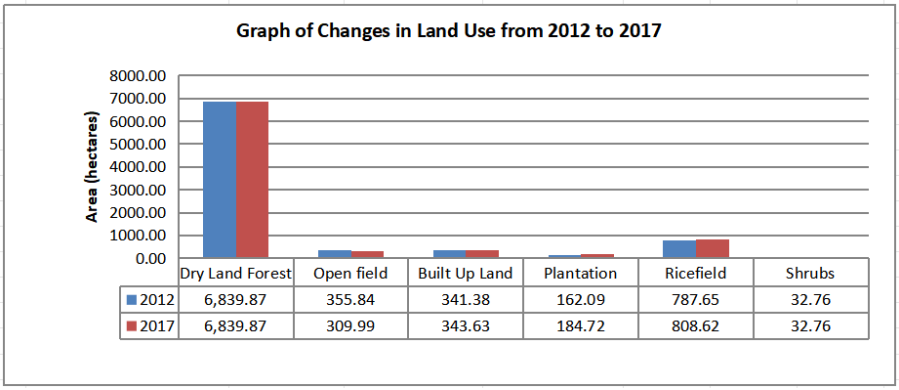
3.2 Land Use Change

3.2.1 Land use change from 2012 to 2017

The results of identifying changes in land use from 2012 to 2017 in the Bungus Teluk Kabung sub-district show that in open land with an area of 355.84ha, but in 2017 open land with an area of 309.99ha underwent a change to built-up land, namely 2.25 ha, plantations 22.62 ha and 20.97 ha of paddy fields.

Table 2. Changes in land use from 2012 to 2017

Row Labels		2017						The final result
		Dry Land Forest	Open field	Built Up Land	Plantation	Ricefield	Shrubs	
2012	Dry Land Forest	6.839,87						6.839,87
	Open field		309,99	2,25	22,62	20,97		355,84
	Built Up Land			341,38				341,38
	Plantation				162,09			162,09
	Ricefield					787,65		787,65
	Shrubs						32,76	32,76
The final result		6.839,87	309,99	343,63	184,72	808,62	32,76	8.519,60



Graph 1. Changes in land use from 2012 to 2017

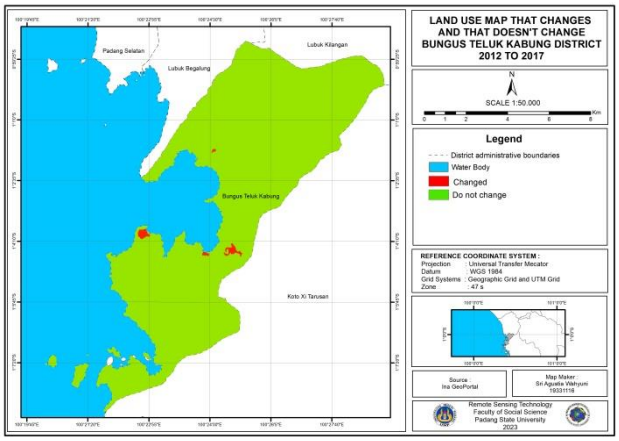


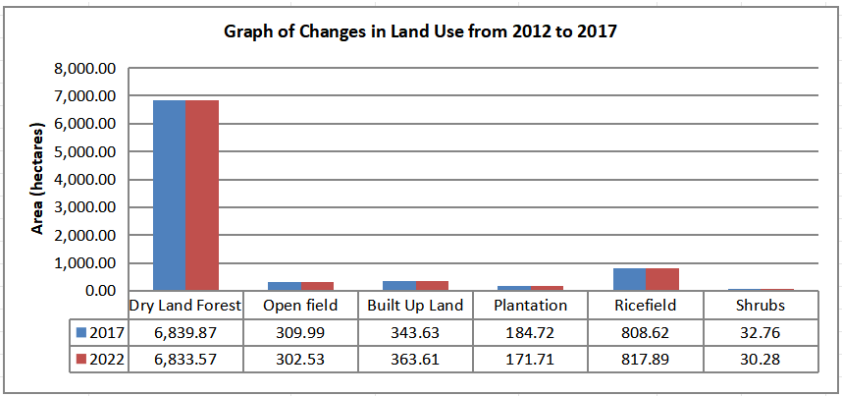
Figure 4. Changes in land use from 2012 to 2017

3.2.2 Changes in land use from 2017 to 2022

The results of identifying changes in land use from 2017 to 2022 in the Bungus Teluk Kabung sub-district show that dry land forests in 2017 were 6,839.87 ha and in 2022 were 6,833.57 ha, which experienced changes in built-up land of 6.30 ha. In 2017, open land was 309.99ha, while in 2022 it was 302.53ha, with a change in built land of 7.47 ha. Furthermore, plantations in 2017 with an area of 184.72 ha, while plantations in 2022 with an area of 171.71 experienced changes in built land of 6.21 ha and in rice fields of 9.27 ha. And in 2017 the bushes/shrubs had an area of 32.76 ha, while in 2022 the area was 30.28 ha but experienced changes in plantations of 2.47ha.

Table 3. Changes in land use from 2017 to 2022

Row Labels		2022						The final result
		Dry Land Forest	Open field	Built Up Land	Plantation	Ricefield	Shrubs	
2017	Dry Land Forest	6.833,57		6,30				6.839,87
	Open field		302,53	7,47				309,99
	Built Up Land			343,63				343,63
	Plantation				169,24			184,72
	Ricefield					808,62		808,62
	Shrubs						30,28	32,76
The final result		6.833,57	302,53	363,61	171,71	817,89	30,28	8.519,60



Graph 2. Changes in land use from 2017 to 2022

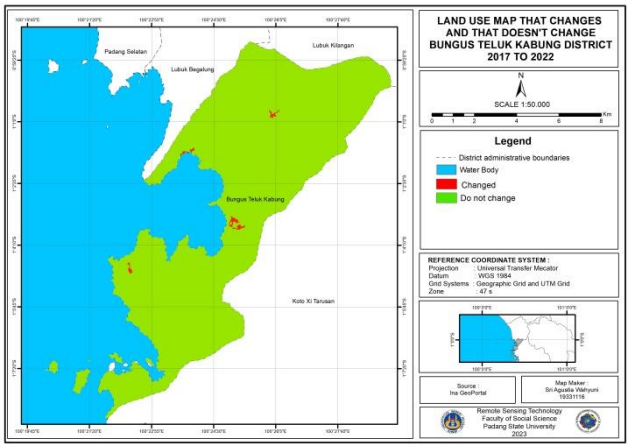


Figure 4. Changes in land use from 2017 to 2022

3.3 Accuracy Test

In the classification for accuracy testing using the Kappa Accuracy calculation method. Kappa accuracy can be performed for the land cover mapping process by looking at the accuracy value received is 85% or 0.85(Fitriawan Dedy, 2022). The following calculations determine the sample points taken in this research. It is hoped that they can represent each classification class. The number of samples calculated can be determined. Determination of the number of samples is determined by the formula (McCoy, 2005) as follows:

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

Table 4. Distribution of sample points to land use classes

Land Use	Sample Point
Dry Land Forest	4
Open field	3
Built Up Land	4
Plantation	5
Ricefield	5
Shrubs	2
Amount	23

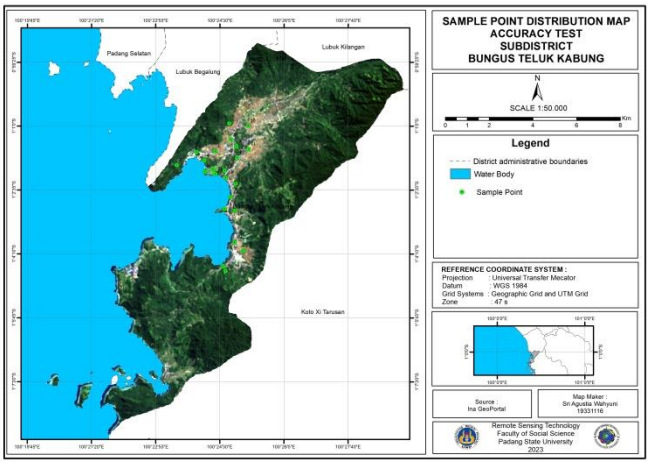


Figure 5. Accuracy test sample points

Table 5. The level of correctness of land use interpretation

Class	Dry Land Forest	Open field	Built Up Land	Plantation	Ricefield	Shrubs	Producer Accuracy
Dry Land Forest	4	0	0	0	0	0	4
Open field	0	3	0	0	0	0	3
Built Up Land	0	0	4	0	0	0	4
Plantation	0	0	0	4	0	1	5
Ricefield	0	0	0	0	5	0	5
Shrubs	0	0	0	0	0	2	2
User Accuracy	4	3	4	4	5	3	23

In terms of accuracy using the kappa accuracy method, the accuracy of dry land forest users is 100%, open land is 100%, built-up land is 100%, rice fields are 80%, bushes are 100% and plantations are 100%. In terms of accuracy calculations, dry land forest is 100%, open land is 100%, built-up land is 100%, plantations are 80%, rice fields are 100% and shrubs are 100%. In overall accuracy, a value of 95.65% is obtained and in the calculation of kappa accuracy, a value of 94.76% is obtained.

3.4 Result of Land Use Change Map

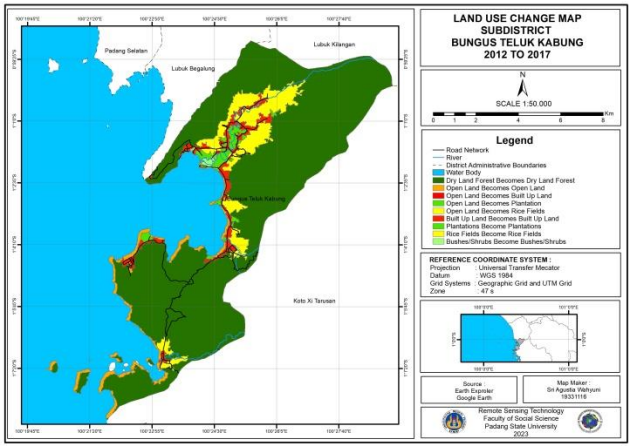


Figure 5. Changes in land use from 2012 to 2017

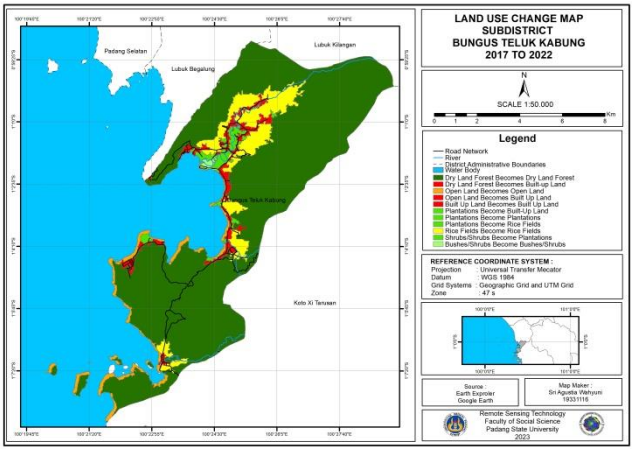


Figure 6. Changes in land use from 2017 to 2022

4 CONCLUSIONS

The results of land use research in 2012 and 2017 using Landsat 7 imagery obtained 6 classes and showed the largest area in dryland forest, namely 6,839.87ha and the smallest was 32.75ha. But the results of the 2022 study using Landsat 8 imagery show that the largest area is in dryland forest of 6,833.57ha and the smallest is in shrubs/shrubs of 30.28ha. Meanwhile, changes in land use from 2012 to 2017 occurred in open land and from 2017 to 2022 changes occurred in dryland forest, open land, plantations and shrubs. The results of the land use accuracy test using the kappa accuracy method in the Bungus Teluk Kabun sub-district were 94.76%.

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