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USE OF MEDIUM RESOLUTION IMAGERY FOR PREDICTION MAPPING OF LAND COVER CHANGES IN SOLOK DISTRICT

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ABSTRACT: This research aims to determine changes in land cover from 2017-2022 in Solok Regency, to find out predictions of changes in land cover until 2032 in Solok Regency, to find out the results of land cover accuracy tests in Solok Regency. This research uses the Supervised (Maximum Likelihood) method to identify changes in land cover in Solok Regency in 2017 and 2022. This research was carried out in several stages, namely the preprocessing stage including radiometric and atmospheric correction, image cropping according to the research area. The processing stage uses the Supervised (Maximum Likelihood) method to determine the classification, then creating a land cover change identification matrix, creating sample points in the field, accuracy testing, and finally making predictions using the Cellular Automata model to predict land cover in 2032. Identification results in areas there was a change in land cover from 2012 to 2017 to 2022, land cover that changed, namely primary forest in 2012 to 2017 experienced a change in 2022 to 206,362.04ha, built-up land also experienced an area change of 3,162.37ha, followed by open land experiencing changes 283.98ha, mixed plantation land experienced a change of 78,176.71ha, wetland farming experienced a change of 12,751.07ha and dry land farming experienced a change of 20,707.08ha in 2022. Then the results of land cover predictions in 2032 are forest land area primary area in Solok Regency changed to 207,382.99ha, while the area of water bodies changed to 6,889.05ha, then built-up land experienced a change of 3,288.13ha, then open land cover changed to 77,912.95ha, then mixed plantation cover changed to 13,248.51 , in wetland agriculture it changed to 13,248.51ha and dryland agriculture to 19,164.11ha.

Keywords: Medium Resolution Imagery,Prediction,Land Cover Change

1. INTRODUCTION

Very rapid population growth and increasing people's need for land, often results in a mismatch between land cover and its use. Rapid population growth has also resulted in an increase in demand for built-up land for settlement. The rate of population growth will trigger the pace of development along with the increase in population which causes quite significant changes in land cover from forests to agricultural land or plantations and from agricultural land to residential and industrial areas (Fahmudin, 2010).

Land cover is the physical surface of land (Pauleit et al., 2005). Land cover is related to human activities on land, while land cover is more of a physical manifestation of objects that cover land without considering human activities on these objects (Lillesand and Kiefer, 1993). While Gaveau et al. (2009) stated that in general changes in cover are not only caused by one cause but a combination of various causes under certain conditions.

The appearance of land cover is greatly influenced by land factors that will change in the composition of land cover. Land cover change is a global phenomenon that is often studied by researchers in various countries. Land cover change is defined as a process of change from previous land cover to another land cover which can be permanent or temporary and is a logical consequence of the growth and transformation of changes in the socio-economic structure of a developing society for both commercial and industrial purposes. In terms of land change, this is also related to the rate of population growth which is increasing greatly from time to time, so that the level of need for land to increase income to meet living needs and raise the standard of living is also increasing (Muiz, 2009).

As time goes by the need for land for residence is getting higher, this is influenced by population growth which continues to increase every year, including in the Solok Regency area. Solok Regency, West Sumatra is one of the areas that has quite extensive land, especially at the plantation level. This district is located at coordinates 00.32'14- 01.46'45 South Latitude and 100.25'00-101.41'41 East Longitude. The topography of

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the area varies greatly between land areas, and is hilly with a height of between 329 meters – 1,458 meters above sea level. Judging from the perspective of the location of Solok Regency, its position is very strategic because it passes through the Sumatra route, as for the territorial boundaries of Solok Regency, namely in the west it borders Padang City and Pesisir Selatan Regency, in the north it borders with Tanah Datar Regency, in the east it borders with Sawahlunto/Sijunjung Regency and to the south with South Solok Regency. The area reaches 3,738.00 km² and the population is around 375,801 people (2017) with a distribution of 101 people/km². In 2019 the population of Solok Regency was 387,868 people, experiencing growth of 0.98 percent. This district consists of 14 sub-districts with 74 nagari and 402 jorong. The Solok district area has a high level of land use, some of which is cultivated by the community or plantation companies. In this area, land is needed to provide residential development which tends towards tourist development because this area is an area with a lot of tourist development.

This research was carried out to see the development of Solok Regency which was marked by the development of several residential areas. Apart from that, there are also many areas that were originally residential and then changed because the settlements were abandoned. To see changes in land use/cover in Solok Regency before and after, a spatial analysis of land cover changes needs to be carried out. The map of changes in land cover/coverage is to be able to see previous, current and future conditions as well as predict the potential availability of plantation land in Solok Regency until 2032. Predictions will be made using the Cellular Automata (CA) Markov method, in order to solve problems that are solved with transition probability, which is a calculation of changes from one condition to another over a period of time.

2. RESEARCH METHODS

2.1 Research site

This research is located in the Solok Regency area, which is one of the areas in West Sumatra. This district is located at coordinates 00.32'14- 01.46'45 South Latitude and 100.25'00-101.41'41 East Longitude. The research was conducted based on changes in land cover that occur from year to year.

2.2 Tools and materials

The type used in this research is quantitative research. The data used is secondary data, namely sentinel 2A images for 2017 and 2022 downloaded on EarthExplorer and administrative boundary maps downloaded on Inageoportal.

2.3 Data Processing Stage

2.3.1 Initial processing

At this stage, radiometric correction is carried out to correct the pixel values so that they are appropriate. The factors considered are atmospheric disturbances, the main source of error, atmospheric effects causing the reflected value of objects on the earth's surface to be recorded by the sensor and not the original value. 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, the sentinel image was cut based on the Solok Regency administrative shapefile data obtained from INA Geospatial.

2.3.2 Processing

Image classification is carried out using the Supervised method, which is a classification that uses trace areas, so we determine objects in the image to create polygons for certain areas (signature files). Then use the Maximum Likelihood (MCL) Tools to process data from the objects we have created. Maximum Likelihood also requires representative spectral training sample data for each class accurately. If the training sample is limited or not representative, inaccurate element estimates often result in poor classification (Dongsheng Lu et al, 2003).

2.3.2.1 Land cover classes consist of Water Bodies, Primary Forest, Mixed Plantation, Built-up Land, Wetland Agriculture, Dry Land Agriculture, Open Land.

2.3.2.2 Determining samples for each land cover class uses training samples.

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2.3.2.3 The results of making samples are processed using the Maximum Likelihood method

2.3.2.4 The results of the classification can be continued if the coordinates are the same, the size of the columns and rows are the same, and the number of land cover classes will be used for land cover predictions.

2.3.3 Changes in land cover in this study can be determined using statistical analysis in the form of a matrix from the results of land cover classification in 2017 and 2022.

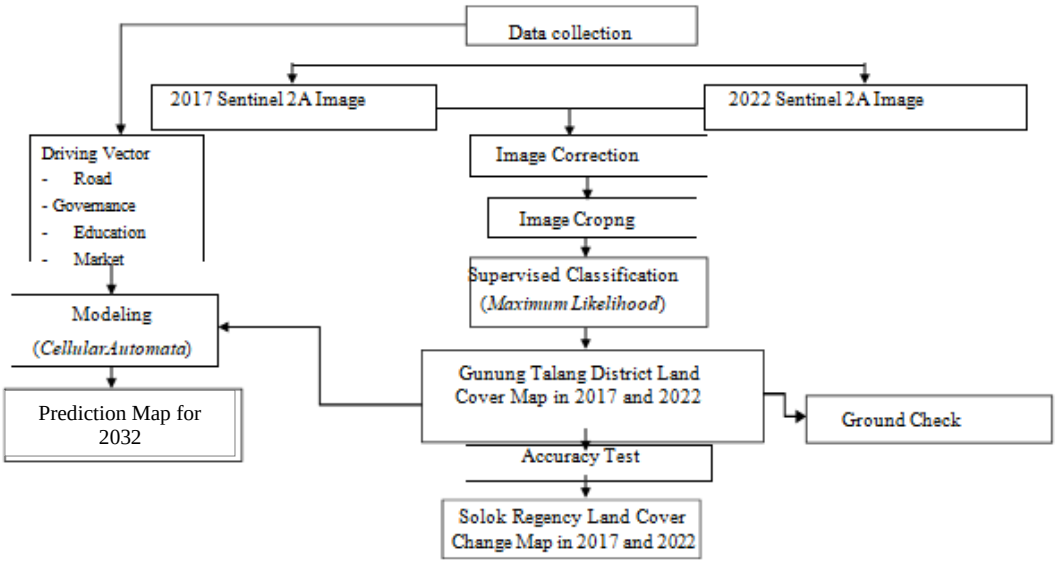
2.3.4 Field survey / ground check. This stage is carried out to ensure changes to the land cover that has been processed. This stage will determine the magnitude or error of the results of the image interpretation of the research area. This stage is carried out by taking sample points using Google Earth Pro software by spreading the samples. The distribution of sample points will be ground checked directly on land cover objects.

This field survey is carried out according to the sample points that have been determined when creating the sample points. When conducting a field survey, it is necessary to mark samples for each land cover classification, so that it is easier to know whether the survey carried out is correct or not. Finally, document the land cover for evidence from the field in the form of photos of the land cover in the surveyed field.

2.3.5 Accuracy Test

Accuracy tests are carried out to assess the accuracy of land use classification data from processing using Landsat 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.

2.3.6 Flow chart



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3. RESEARCH RESULTS AND DISCUSSION

3.1 Land Cover Map

The three-year land cover classification series used is sentinel 2a imagery for 2012, 2017 and 2022.

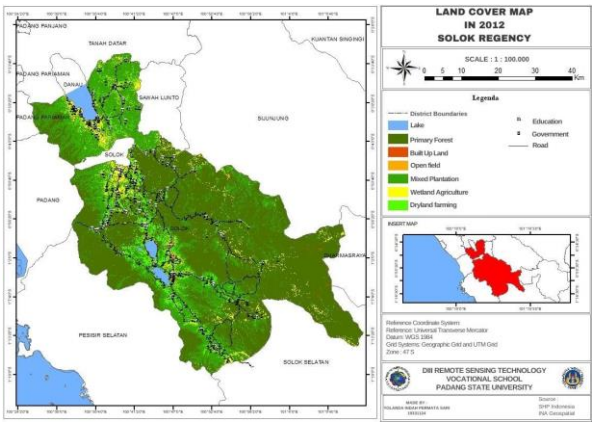

Figure 1. Land Cover Map in 2012

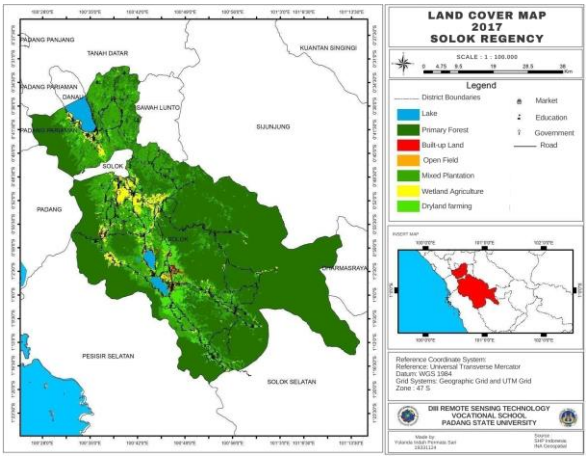

Figure 2. Land Cover Map in 2017

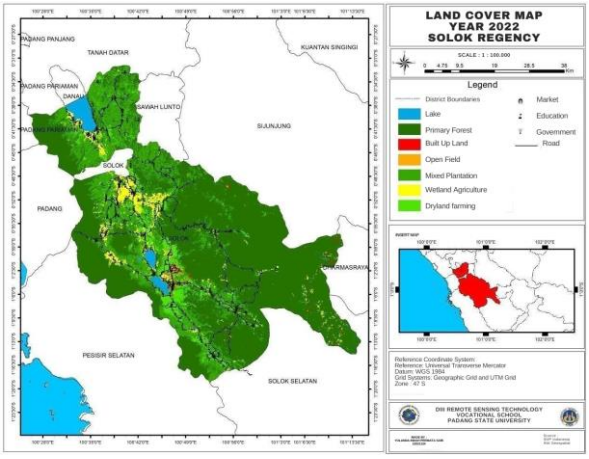

Figure 3. Land Cover Map in 2022

Land cover map for 2012, 2017 and 2022 in Solok Regency, using the Maximum Likelihood method. Processing was carried out using Arcgis software with a sample selection process and maximum likelihood classification with a number of classifications such as water bodies, primary forest, developed land, open

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land, mixed plantations, wetland agriculture and dry land agriculture. The following is a table of land use areas and years 2012, 2017 and 2022:

Table 1. Land Cover Area

Land cover	Area (Ha)		
	2012	2017	2022
Water body	6,889.05	6,889.05	6,889.05
Primary Forest	194.494.91	214,782.63	206,362.04
Built Up Land	3,540.34	2,411.08	3,162.37
Open field	1,465.26	225.49	283.98
Mixed Plantation	88.590.84	72,351.75	78,176.71
Wetland Agriculture	14,832.49	11,947.48	12,751.07
Dryland farming	19368.65	19,724.82	20,707.08

3.2 Land Cover Changes

3.2.1 Land cover changes from 2017 to 2022

The results of identification of land cover processing from 2017 to 2022 in Solok Regency show that primary forest in 2017 had an area of 214,782.63ha, then changed in 2022 to 206,362.04ha, built-up land also experienced a change in area from 2,411.08ha to 3,162.37ha, followed by with open land from 225.49ha changing to 283.98ha, mixed plantation land changing from 72,351.75ha to 78,176.71ha, wetland farming changing from 11,947.48ha to 12,751.07ha, and dry land farming changing area from 19,724.82ha to 20,707.08ha in 2022.

Table 2. Changes in land use from 2012 to 2017

Row Labels		2017							The final result
		Water body	Primary Forest	Built Up Land	Open field	Mixed Plantation	Wetland Agriculture	Dryland farming	
2012	Water body	6,889.05							6,889.05
	Primary Forest		1074248.39			214849.68		214849.68	1503947.75
	Built Up Land			7549.23	2516.41	2516.41	2516.41	2516.41	17614.88
	Open field			230.01	690.03		230.01	230.01	1380.06
	Mixed Plantation			72382.63	72382.63	289530.53		72382.63	506678.43
	Wetland Agriculture				11986.74		5933.72	1186.74	83907.20
	Dryland farming			20075,40	20075,40		20075,40	80301.59	140527.79
The final result		6,889.05	1074248.39	100237.28	107651.22	506896.62	82755.53	32.76	2302455.12

Table 3. Changes in land use from 2017 to 2022

Row Labels		2022							The final result
		Water body	Primary Forest	Built Up Land	Open field	Mixed Plantation	Wetland Agriculture	Dryland farming	
2017	Water body	6,889.05							6,889.05
	Primary Forest		200,362.04			6,287.23	1,329.87	803.48	214,782.63
	Built Up Land			2411.08					2,411.08
	Open field			1.43	188.84		8.14	27.07	225.49
	Mixed Plantation			244.43	31.87	71,356.93	188.61	529.90	72,351.75
	Wetland Agriculture			90.03	1.98	532.54	11,224.44	98.48	11,947.48
	Dryland farming			415.39	61.29			19,248.15	19,724.82

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The final result	6,889.05	200,362.04	3,162.37	283.98	78,176.71	12,751.07	20,707.08	328,332.29

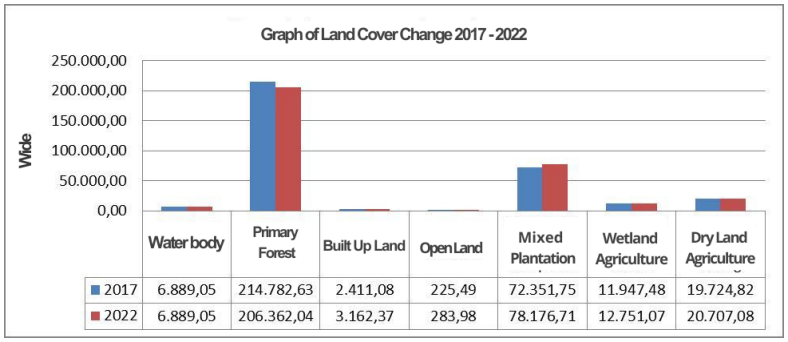

Figure 4. Graph of land cover changes from 2017 to 2022

3.3 Accuracy Test

The results of the Sentinel 2-A image data classification were validated using a contingency matrix or what is usually called an error matrix. This calculation is carried out to see the accuracy / accuracy test, by comparing the results of image data classification against land cover classes at the actual location. Before carrying out an accuracy test, sampling will be carried out, namely by spreading sample points over each land cover. The sample points created will determine whether the land cover identification is true or false which will be included in the confusion matrix table. The method used in sample selection is random selection.

Based on the results of identification in the field, sentinel image land cover classification is carried out by creating sample points and collecting data in the field. The number of sample points used was 23 points taken randomly from several land cover classes as follows:

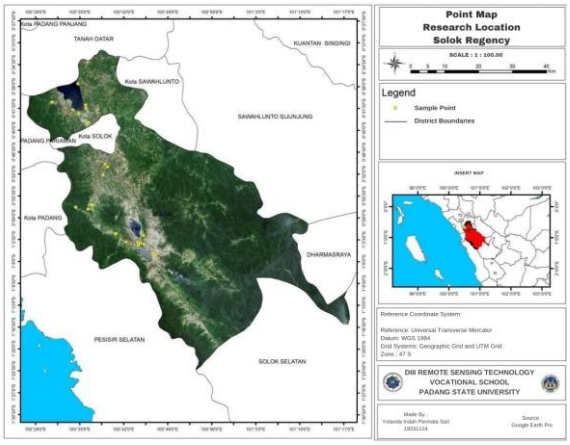

Figure 5. Accuracy test sample points

Table 4. Level of truth of land cover interpretation

Class	Water body	Primary Forest	Built Up Land	Open field	Mixed Plantation	Wetland Agriculture	Land farmingDry	Total (user)
Water body	2	0	0	0	0	0	0	2
Primary Forest	0	3	0	0	1	0	0	4
Built Up Land	0	0	4	0	0	0	0	4
Open field	0	0	0	1	0	1	0	1
Mixed Plantation	0	0	1	0	3	0	0	4
Wetland Agriculture						3	0	3
Land farmingDry	0	0	0	0	0	2	5	5
Total (Users)	2	3	5	1	4	3	5	23

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In terms of accuracy using the kappa precision method, accuracy of water body users is 66%, primary forest 75%, built up land 100%, open land 100%, mixed plantations 75%, wetland farming 100%, dry land farming 100%. In terms of calculation accuracy, water bodies are 100%, primary forest is 100%, built up land is 80%, open land is 100%, mixed plantations are 100%, wetland farming is 100%, dryland farming is 100% and in the calculation of kappa accuracy a value of 89 is obtained. .80%.

3.4 Land Cover Change Map Results

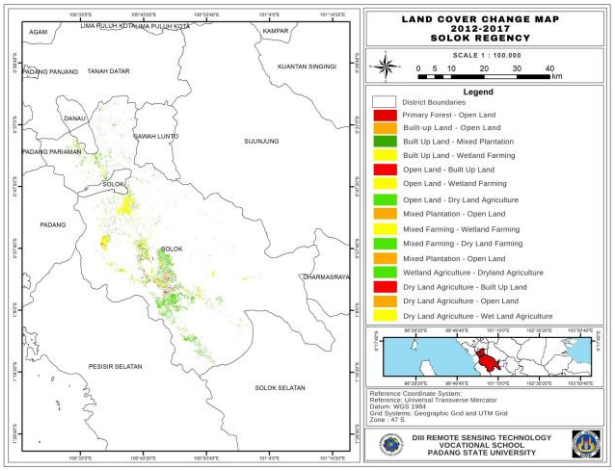

Figure 6. Changes in land cover from 2012 to 2017

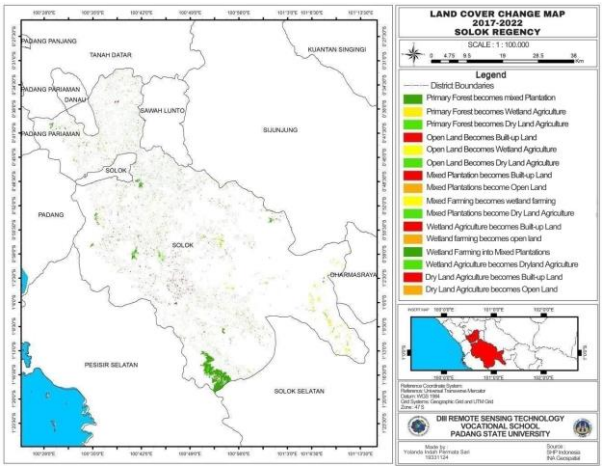

Figure 7. Changes in land cover from 2017 to 2022

3.5 Solok Regency Land Cover Prediction for 2022

The prediction of land cover in 2022 in Solok Regency was obtained from the results of processing land cover data in 2012 and 2017 with supporting factors using road and government data. From the prediction results when producing 2012 and 2017 land cover by comparing the maps resulting from 2012 and 2017 sentinel image processing. If the prediction results are valid, land cover predictions can be continued for 2017.

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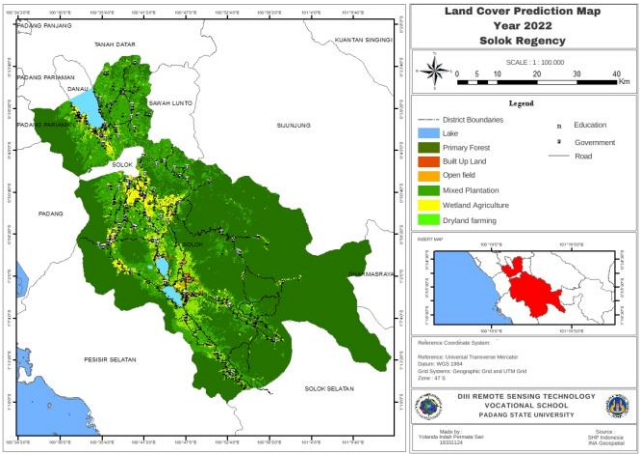

Figure 8. Map of predicted land cover in 2022

Table 5. Land Cover Area

Land Cover Class	Area (Ha)
	2022
Water body	6,889.05
Primary Forest	214.612.29
Built Up Land	2,244.79
Open field	203.02
Mixed Plantation	75.908.07
Wetland Agriculture	11.174.4
Dryland farming	17,969.68

3.6 Solok Regency Land Cover Prediction in 2032

The prediction of land cover in 2032 in Solok Regency was obtained from the results of processing land cover data in 2017 and 2022 with supporting factors using road and government data. From the prediction results when producing land cover predictions for 2022 by comparing the maps resulting from 2022 sentinel image processing. If the prediction results are valid, land cover predictions can be continued for 2032.

Based on prediction results using Cellular Automata for land cover in Solok Regency in 2032, the area of primary forest land in Solok Regency changed to 207,382.99ha, while the area of water bodies changed to 6,889.05ha, then built-up land experienced a change of 3,288.13ha, then land cover open area changed to 77,912.95ha, then in mixed plantation cover it changed to 13,248.51, in wetland farming it changed to 13,248.51ha and in dry land farming it changed to 19,164.11ha.

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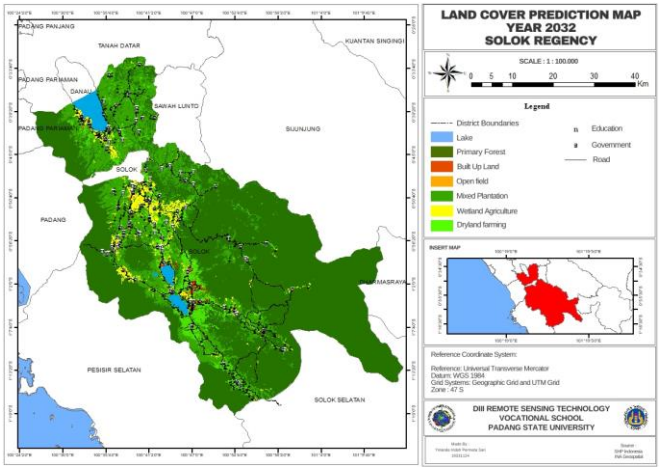

Figure 9. Map of predicted land cover in 2032

Table 6. Land Cover Area

Land Cover Class	Area (Ha)
	2032
Water body	6,889.05
Primary Forest	214,644.99
Built Up Land	2,244.13
Open field	203.02
Mixed Plantation	75,933.75
Wetland Agriculture	11.174.6
Dryland farming	17,962.63

4 CONCLUSION

From the results of research conducted on land cover in 2017 and 2022 using sentinel 2A imagery, 7 classes were obtained and showed that the largest area was primary forest at 214,782.63ha and open land had the smallest area at 225.49ha. Likewise, in 2022 primary forest will still be the classification with the largest area of 206,362.04ha.

The prediction results for land cover using the cellular automata model can be applied in the Solok Regency area using supporting factors such as roads and government centers. In terms of changes in land cover from 2017 to 2022, the land cover that changed was primary forest in 2017 which had an area of 214,782.63ha then experienced a change in 2022 to 206,362.04ha, built-up land also experienced a change in area from 2,411.08ha to 3,162.37ha , followed by open land from 225.49ha changing to 283.98ha, mixed plantation land changing from 72,351.75ha to 78,176.71ha, wetland farming changing from 11,947.48ha to 12,751.07ha, and dry land farming change in area from 19,724.82ha to 20,707.08ha in 2022.

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