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The Accuracy of Remote Sensing Image Interprepation On Changes In Land Use Suitability In Merauke Regency Papua

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Abstract *- Land use suitability is the real manifestation of human activities on land, which causes changes in land use. This research is conducted in Merauke Regency by collecting samples in four districts, namely Merauke, Semangga, Tanah Miring, and Kurik. The researcher identifies changes in land use suitability, shape, and distribution of land use changes and evaluates land suitability between land use maps using remote sensing and the actual field data in Merauke Regency.*

The data in this study were image data using remote sensing method and other supporting data. The image data were then interpreted digitally using the classification method as a reference when conducting observation in the field. After adjusting them to the existing field conditions, they were then reclassified using the manual interpretation method (digitizing on screen). Next, an accuracy test was carried out to determine the level of accuracy of the image used.

The results of the accuracy test show that the level of accuracy is 86.04% and obtain eight land use classifications, namely settlement, medium-density forest, high-density forest, shrubs, bare soil, crop field, rice fields, and waters. Five of those eight land classifications have changed in the land use suitability, namely high-density forest, medium-density forest, shrubs, bare soil, and crop field.

Keywords: *Interpretation, Remote Sensing, Land Use Suitability, Merauke, Papua*

I. INTRODUCTION

Land use activity is a form of physical use of socio-economic activities of the community in an area[1]. Land use can be said as the result of multiple interactions in an area, and these interactions are closely related to social, cultural, economic, and geographic aspects[2]. Present land use is a sign of the dynamics of human exploitation (either individually or communally) towards natural resources to meet their needs[3].

The interactions between humans and their environment, especially land, in fulfilling their needs, include making the land as a place of settlement or using the land for agricultural production, and the spot of tourism [4,5] and classification of the mainstay economic region[6] which result in changes in land use. To monitor land use change, information regarding land use change in an area or region is needed. Land use change occurs mostly because of humans, and not by natural processes[7]. Land systems and their changes are the results of human and environmental interactions[8]. Meanwhile[9] states that land use is influenced by economic, cultural, political, historical, and land ownership factors. In addition, land use and environmental conditions can be used as variables in predicting the spread of infectious diseases [10].

Landscape structure, function, and process are related to the type and intensity of land use, which influence land use change[11]. These changes are inseparable from the types of human works and land use, which aim to promote and to overcome environmental degradation[12].

Land use is an important factor in the economic development of a region. Land use describes the form of physical land use in a certain area[13]. Various land use changes have occurred in various regions throughout Indonesia, including Merauke Regency. The land area of Merauke Regency is 46,791.63 km^2 (around 14.67 percent of the total area of Papua Province).

Like other regions, land use in Merauke Regency varies, depending on the conditions of the region. According to data obtained from the Central Statistics Agency (BPS)[14], land use in Merauke Regency consists of rice fields and dry land. Dry land use consists of yards/ land for buildings and the surrounding yard, crop field, rice fields, fields, grasslands, unplanted swamps, ponds, dam, temporary uncultivated land, timber plants/forests, state forests, plantations, and others.

Various forms of land use in Merauke Regency need to be monitored and observed to control the use of the existing natural resources and to prevent environmental degradation. One of the effective methods for monitoring objects and events on the earth's surface, especially regarding land use, is to use remote sensing technology, which describes objects appearing on the earth's surface based on their original conditions.

Land use is dynamic, and its development is relatively fast, so it is necessary to have information about land use change occurred. The use of multi-temporal

satellite imagery is able to provide data of the existing land use change. Satellite records data periodically and continuously, which makes it possible to see the characteristics and land use conditions continuously as well as to monitor land use change, which is useful for land use planning[15]. This satellite image is extracted to obtain information about the types of land use in Merauke Regency. The results are then processed using Web-based Geographical Information System (WebGIS) software. The results can be used to monitor the progress of land use change because land use often does not meet the regulations and match its designation.

II. RESEARCH OBJECT

Merauke Regency is located at the coordinates 137^0-141^0 of East Longitude and 5^0-9^0 of South Latitude. Meanwhile, in terms of administrative position, Merauke Regency has the following territorial boundaries:

- North : Asmat Regency and Mappi Regency
- East : Papua New Guinea
- West : Boven Digul Regency
- South : Arafura Sea

Prior to the expansion, Merauke Regency had an area of 119,749 km^2 or around 29 percent of the total area of Papua Province. After the expansion, Merauke Regency has an area of 46,791.63 Km^2 (around 14.67 percent of the total area of Papua Province). Having this area, Merauke Regency not only becomes the largest area in Papua Province, but also among other regencies in Indonesia. Figure 1 describes the administrative map of districts in Merauke Regency.

Merauke Regency consists of 20 districts, 11 sub-districts, and 179 villages. Waan District is the largest district with an area of 5,416.84 km^2 or about 12 percent of the entire area of Merauke Regency. Meanwhile, Semangga District is the smallest district because it only has an area of 326.95 km^2 or less than 1 percent of the entire area of Merauke Regency.

Figure 1.Administrative Map of Merauke Regency

Merauke Regency consists of 20 districts, 11 sub-districts, and 179 villages. Waan District is the largest district with an area of 5,416.84 km^2 or about 12 percent of the entire area of Merauke Regency. Meanwhile, Semangga District is the smallest district because it only has an area of 326.95 km^2 or less than 1 percent of the entire area of Merauke Regency.

According to the administrative data of Merauke Regency, it is known that only Merauke District has 11 sub-districts. Meanwhile, Jagebob District has the largest number of villages, which is 14 villages. The smallest number of villages, which is 5 villages, belongs to Merauke District, Kaptel District, Animha District, Naukenjerai District, and Sota District.

TABLE 1. RESEARCH SAMPLE AREA

District	Capital City	Amount		Total
		Village	Sub-District	
Merauke	Merauke	5	11	16
Semangga	Semangga	10	0	10
Tanah Miring	Tanah Miring	14	0	14
Kurik	Kurik	13	0	13

Source: Merauke Regency in Figures 2019

The research sample areas consist of Merauke, Semangga, Tanah Miring, and Kurik Districts according to Table 1.

Figure 2 describes the flow diagram of the research carried out.

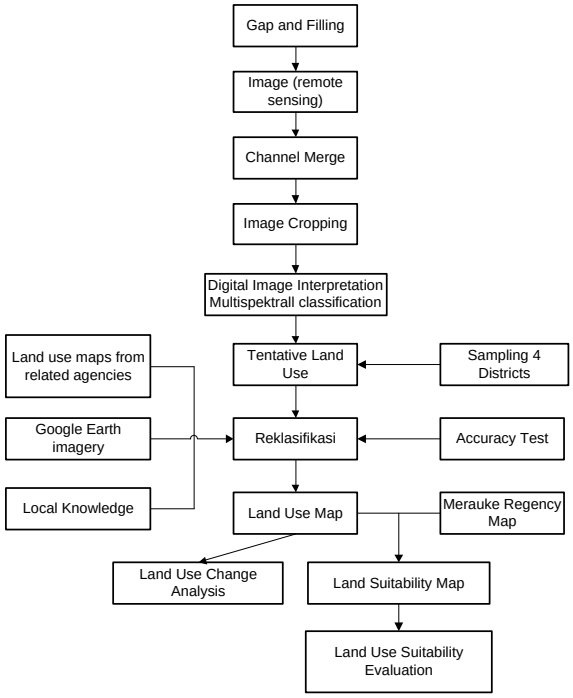

Figure 2. Research Flowchart

III. RESULT OF DISCUSSION

A. Classification of Land Use

To determine the total area of land use change, the researcher first classifies or determines the class of land use in the study area. After that, based on the results of the classification, a map of observed land use is created to obtain land use data. Land use information is extracted directly from digital images. The complexity of the

research area and the unfavorable image conditions require a combination of methods to minimize misinformation, namely by using two methods of classifying land use to obtain land use maps digitally and visually. The digital classification method uses a computer-assisted classification method that produces a temporary classification of land use map. Meanwhile, in the visual method, manual digitization on a direct computer screen (on screen digitization) is carried out after field observations that produce a land use map.

The results of the initial interpretation obtain 11 (eleven) land use classes according to Table 2, namely settlement, mangrove forest, forest, shrubs, plantation, mixed garden, rice field, waters, river, moor, and open water land. After conducting field observations, the land use classes are simplified into 8 classes, namely settlement, medium-density forest, high-density forest, crop field, bare soil, shrubs, rice fields, and waters. They are simplified because there are several land use classes that are less dominant and difficult to distinguish from other land use classes. The classification of land use classes is also based on the similarity of functions and types of the land use.

TABLE 2. COMPARISON OF LAND USE INTERPRETATION RESULTS

Land Use Data from the Initial Interpretation	Land Use data from the Final Interpretation
Settlement	Settlement
Mangrove Forest	Low-Density Forest
Forest	High-density Forest
Shrubs	Field
Mixed garden	Bare soil
Bare soil	Shrubs
Rice field	Rice field
Waters	Waters
River	
Moorland	
Open Land	

Source: Data Processing 2020

Meanwhile, open land around the settlement is used as settlements because the open land is part of schoolyards, offices, and football fields.

The explanation of interpretation results of land use in this research is provided below:

a) Settlement

Settlement is housing/human habitation that has an irregular or regular pattern. Settlement has a bright hue and compact or clustered shape. Clustered settlement is easy to interpret, while scattered settlement is difficult to identify. This is due to the limited size of the image pixel, which is 30 m, while the size of most houses is less than 30 m, so the pixel color will be dominated by the dominant object, namely vegetation and other objects. Urban settlement has a bright hue, a slightly rough texture, and a clustered shape. Meanwhile, rural settlement has an elongated pattern that follows roads, and the land is associated with mixed garden Fisherman settlement is associated with swamps or beach with a smooth texture because it is a dense settlement.

b) Medium-Density Forest

This is a forest with a low to medium density level, where the trees in the forest *look like the rest of the natural forest, but the condition is not dense, and the distance among the trees is not too dense (You can find the community plants/mixed garden).*

c) High-Density Forest

High-density forest is land, which is still in the form of forest, where the trees there are still dense like the rest of natural forest, or secondary forest of which condition is close to primary forest.

d) Crop field

Cultivating system in the study area still uses a shifting cultivation system, so it is difficult to distinguish this type of land use from shrubs and open land. Crop field and moorland that are temporarily cultivated, but have not been planted, have visual similarities to open land's image. On the other hand, when the crop field is abandoned or not cultivated during the periodic phase, it has similarities with shrubs. Since the condition of the land use for crop field varies according to the processing phase, interpretation of the type of land use in the fields needs to use a higher level of interpretation keys. The interpretation keys are wider size than house yards, sites not too far from settlements, associated with forests according to the tendency of the local community's cultivation system.

e) Bare soil

According to the Indonesian National Standard, bare soil is an area of land where there are no trees or plants on it. This type of bare soil in the research area is generally an empty land usually associated with settlements. The appearance of empty land in the image is similar to that of shrubs because both of them have land cover in the form of smooth vegetation compared to the texture of forest land-use.

f) Shrubs

The appearance of shrubs is light gray hue, rough texture, located some distance from the building and away from the main street. Shrubs appear in the image with a slightly fine to slightly coarse texture, a brighter hue when compared to forest and garden. In the study area, shrubs are found in areas with karst topography, which is relatively thin soil solum overgrown with bush and grove in various density levels from sparse to dense. In the dry season, the chlorophyll content of shrubs is lower than that during the rainy season, so the interaction with the red channel gives a bright yellowish hue and color. In the rainy season, the leaf chlorophyll content increases, and shrubs spectral is higher against the infrared channel than during the dry season so that it looks dark red. Grass and shrubs are

difficult to visually separate in the image. However, the appearance in a large group looks a slightly bright and relatively uniform color gradation.

g) Rice Field

Land use of rice field in the research location requires field knowledge because it is very wide. Land use of rice field in this study is land use designated for rice farming activities. Irrigated rice field has various hues, namely dark, dark gray, and bright. Rice field with dark color is watery rice field because water absorbs light, so it appears dark. Rice field with dark gray tones may have low water content or dense vegetation cover that makes water is not visible. Rice field with bright colors is dry or has no water content so that the light that comes to the rice field that is ready to be harvested can be reflected. Therefore, the image will appear bright. Rice field with bright hues is often misidentified as fields.

h) Waters

Waters is a collection of water masses in a certain area, either dynamic (moving or flowing) such as seas and rivers, or static (inundated) such as lakes. These waters can be fresh, brackish, or salty (sea). The waters in the research area jut into the mainland and are limited by the coastal mainland. The area consists of sand and found in coastal areas of the sea. The coastal area is the boundary between land and seawaters. The length of this coastline is measured around the entire coast, which is the territorial area of an area.

B. Results of Interpretation Accuracy Test

This study uses an accuracy test in the form of accuracy matrix of interpretation results. Accuracy test needs to be done considering the level of accuracy of the interpretation results affects the amount of trust given to the data used. The accuracy test is carried out by matching the data between the results of the image interpretation and the actual conditions in the field.

The level of accuracy of the interpretation results of all samples is obtained by summing the correct interpretation results of all samples. The type of accuracy test for the interpretation results of land use is the point accuracy test by comparing the interpreted land use unit to the land use unit resulting from field sample observation at the same point for each sample.

TABLE 3. IMAGE INTERPRETATION TEST RESULTS 2020

2020	Interpretasi										
Survey	**St**	**Ld**	**Hd**	**Sh**	**Bs**	**Fl**	**Rf**	**Wb**	**Amount**	**Omission**	**Accuracy**
St	15	-	-	-	-	-	-	-	15	0	100.00
Ld	-	10	-	2	-	-	4	-	16	37.5	62.50
Hd	-	1	10	-	-	3	-	-	11	9.09	90.91
Sh	-	-	-	12	-	-	3	-	15	20.00	80.00
Bs	-	-	-	1	12	-	-	-	13	7.69	92.31
Fl	-	-	-	4	-	12	-	-	16	25.00	75.00
Rf	-	-	-	-	-	-	15	-	15	0	100.00
Wb	-	-	-	-	-	-	-	3	3	0	100.00
Amount	15	11	10	17	12	15	15	3	104		
Commission	0	1	0	5	0	3	0	0			

Source: Results of Data Processing 2020

Information:
St : Settlement, Ld : Low Density Forest, Hd : High-density Forest, Sh: Shrubs, Bs : Bare soil, Fl : Crop Field, Rf : Rice fields, Wb : Water Bodies

Table 3 shows how to test the accuracy of remote sensing interpretation of land suitability change in Merauke Regency with the following formula:

- The number of land use commission X = the number of non-X land use on line X
- The number of land use commission X = the number of non-X land use on column X

$$Individual\ accuracy = \frac{The\ number\ of\ correct\ sample\ X}{The\ total\ number\ of\ sample\ X}\ x\ 100\%$$

$$Interpretation\ Accuracy = \frac{The\ number\ of\ correct\ sample}{The\ total\ number\ of\ sample}\ x\ 100\%$$

Accuracy of interpretation results of the 2020 land use map =

$$\frac{15 + 10 + 10 + 12 + 12 + 12 + 15 + 3}{104}$$

= 86.04%

Based on the results of field observations, the level of accuracy of each land use is obtained, as seen in Table 3. The level of accuracy of land use interpretation using images is 86.04% according to the data in Table 3. Standard value of feasibility for a test result is equal to 85%, and it is seen that the accuracy test value meets the standard.

According to the results of the accuracy test, each sample category shows a high accuracy value. In the sample category of land use for settlement, medium-density forest, rice fields, and waters shows a perfect accuracy value of 100% for each map interpretation, while high-density forest has an average accuracy value of 90.91% when summed up as a whole. The high value of the accuracy test obtained in settlement, rice field, medium-density forest, and waters is due to the influence of the researcher' local knowledge. Moreover, the settlement never turned into another land use. Land use for rice field is also easy to interpret because the locations are in almost all research sample districts, namely Semangga, Tanah Miring and Kurik Districts. Likewise with the waters, which are only located on the coast and coastal estuaries which, although mixed with medium-density forests, have a different appearance of a bright hue.

The land use for medium density forest has the lowest accuracy, namely 62.50% of all classes; medium-density forest is land use that is rapidly changing. The shifting cultivation system practiced by many people has led to rampant land clearing for forest to become rice fields. Furthermore, the low accuracy of the interpretation results of land use in the form of crop field is also caused by the existence of crop fields that are not cultivated in a certain period, so that the image is identified as shrubs. Former crop field that has been used for several years has two possibilities, namely used as a crop field or is abandoned for a certain period so that the land changes its function to shrubs or turns into forest if the land is not cultivated again.

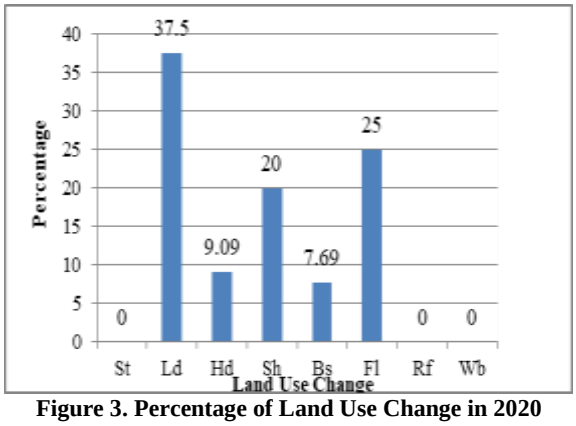

Figure 3. Percentage of Land Use Change in 2020

Figure 3 explains that there are five samples of change in land use suitability, namely land suitability change of high-density forests by 9.09%, land suitability change of medium-density forests by 62.50%, change in shrub land suitability by 20%, change in land suitability of deforested land by 7.69%, and change in land suitability by 25%. Meanwhile, the land use for settlement, rice field, and waters has a rate of 0% indicating that the land use has not changed the land suitability.

IV. CONCLUSIONS

Based on the research that has been carried out, it can be concluded as follows:

1. The results of image interpretation carried out are 8 (eight) classes of land use, namely settlement, medium-density forest, high-density forest, shrubs, bare soil, crop field, rice field, and waters.
2. Changes in land suitability use occur in land use for high-density forest, medium-density forest, shrubs, bare soil, and crop field.
3. The level of accuracy in the interpretation of land suitability using images data is 86.04%.

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REFERENCES

[1] Rustiadi, E., 2001, "*Alih Fungsi Lahan dalam Perspektif Lingkungan Perdesaan dalam Lokakarya Penyusunan Kebijakan dan Strategi Pengelolaan Lingkungan Kawasan Perdesaan"*, Bogor : IPB

[2] Bintarto dan Hadisumarno, S., 1991, "*Metode Analisa Geografi, Jakarta : LP3ES (Lembaga Penelitian, Pendidikan dan Penerangan Ekonomi dan Sosial)*".

[3] Ritohardoyo, S., 2002, "Bahan Kuliah : Penggunaan dan Tata Guna Lahan*"*, Yogyakarta : Fakultas Geografi UGM.

[4] Sugiartawan, P., Hartati, S. and Musdholifah, A., 2020. "*Modeling of a Tourism Group Decision Support System using Risk Analysis based Knowledge BaseNo Title*". International Journal of Advanced Computer Science and Applications (IJACSA), 11(7), pp.354–363.

[5] Sugiartawan, P. and Hartati, S., 2018. "*Group Decision Support System to Selection Tourism Object in Bali Using Analytic Hierarchy Process (AHP) and Copeland Score Model*". In 2018 Third International Conference on Informatics and Computing (ICIC). Palembang, Indonesia: IEEE, pp. 1–6.

[6] Ismanto, H., Azhari, Suharto, Arsyad, L., 2018. "*Classification of the Mainstay Economic Region Using Decision Tree Method".* Indonesian Journal of Electrical Engineering and Computer Science (IJEECS), 12(3), pp.1037–1044.

[7] Weng, Q., 2010, "*Remote Sensing and GIS Integration"*, New York: Mc Graw Hill

[8] Turner II, B. L., 2009, "*Blackwell Companion to Geography: A Companion to Environmental Geography, Chapter 11: Land Change (Systems) Science"*, United Kingdom, West Sussex: A John Willey Sons Ltd Publication.

[9] Brown, D.G., 2003, "*Land Use and Forest Cover on Private Parcels in the Upper Midwest USA, 1970 to 1990"*, Landscape Ecology vol 18, Netherlands: Kluwer Academic Publishers.

[10] Munir, A.Q, Hartati, S. and Musdholifah, A., 2019. "*Early Identification Model for Dengue Haemorrhagic Fever (DHF)*

Outbreak Areas Using Rule-Based Stratification Approach". International Journal of Intelligent Engineering and Systems (IJIES), Vol 12, No. 2, pp. 246-260.

[11] Hietel, E., Waldhardt, R., dan Otte, A., 2004, "*Analysing Land-Cover Changes in Relation to Environmental Variables in Hesse, Germany",* Landscape Ecology vol 19, Netherlands: Kluwer Academic Publishers.

[12] Soundranayagam, J.P., Sivasubramanian, P., Chandrasekar, N., dan Durairaj, K.S.P., 2011, "*An Analysis of Land Use Pattern in the Industrial Development City Using High Resolution Satellite Imagery",* Springer Press.

[13] Darsimon, 2010, "*Fungsi Institusi Hukum Terhadap Penegakan Hukum Lingkungan DalamKasus Kerusakan Hutan di Kabupaten Muna Provinsi Sulawesi Tenggara"*,Yogyakarta : Sekolah Pasca Sarjana UGM.

[14] BPS Kabupaten Merauke (2019). Kabupaten Merauke Dalam Angka 2019. Kabupaten Merauke: Badan Pusat Statistik Kabupaten Merauke

[15] Suriadikusumah, A. dan Pratama, A., 2010, *"Penetapan Kelembaban, Tekstur Tanah, dan Kesesuaian Lahan untuk Tanaman Kina (Chinchona spp.) di Sub Das Cikapundung Hulu Melalui Citra Satelit-TM Image",* Jurnal Agrikultura 2010, 21(1) :85-92