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A STUDY OF THE DENSITY OF BUILT-UP LAND BASED ON AERIAL PHOTOGRAPHS IN PASARAN ISLAND, BANDAR LAMPUNG

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Abstract

Pasaran Island is a small island connected to the mainland island of Sumatra and located in Bandar Lampung. Pasaran Island is one of the supports for the economy in Bandar Lampung. This is in line with the 2011-2030 RTRW of Bandar Lampung as a strategic minapolitan area (Pasaran and Lempasing) in driving the regional economy and utilizing appropriate technology. Pasaran Island is dominated by fishing villages and seafood processing centers in Lampung. With a population of ± 1,233 people in an area of ± 12 Ha, Pasaran Island has the potential for continued development. A study of the density of Built-up Land on Pasaran Island needs to be carried out so that it can become important information and data in managing the development of Pasaran Island in the future. Remote sensing technology using UAV was carried out to retrieve accurate and precise large-scale mapping information that allows the level of detail of Built-up Land to be mapped according to the original conditions in the field. In this study, the data used to extract Built-up Land was orthophoto which was produced through visual interpretation methods, and to determine the level of density and efficiency of Built-up Land conditions the digitization method and spatial analysis was by calculating the area of Built-up Land and calculating the percentage of Built-up Land density in Pasaran Island. The results of this study consisted of two maps, namely a map of the classification of Built-up and Non-Built-up Land and a map of Built-up Land types. The percentage of Built-up Land density was obtained from the calculation of the area of Built-up Land classes divided by the area of Pasaran Island, which resulted in a built-up density of 87.15% consisting of building classes, open land, public facilities and road networks. As for the results of the non-built density was 12.84%, which consisted of a vegetation class where the vegetation is in the tree-shaped form, the population density and building density of Pasaran Island are low density.

Keywords: Pasaran Island; Built-up Land; UAV; Orthophoto.

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Introduction

The addition of urban infrastructure is one indicator of the progress of an area. The phenomenon of growth and development of an area that is not planned is experienced by several cities. There are several factors that underlie the development of an area, namely the rapid growth of the population and the soaring economic growth, of course, both of these have an impact on the need for a space, land and infrastructure for various community activities and the need to have a place to live. A study conducted by Webster (2002) states that the factor that causes rapid growth in a city is the addition of residential areas as a place for various human activities such as the demand for housing development, industry and other activities.

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Along with the development of cities in Indonesia occurs on the basis of the desire for the availability of land use that serves as a community facility. The increase in population from time to time affects business activities that make demands on the survival of the population. So that, a good and structured land management effort is needed to avoid land conversion (Yunus, 1994).

Bandar Lampung is a city with several tourism destinations, both culinary tourism, cultural tourism, marine tourism and others. This certainly makes the development of various human activity traffic more advanced and better. Pasaran Island is one of the destinations in Bandar Lampung where Pasaran Island is the closest island to Bandar Lampung located in Teluk Betung with a panoramic view of its natural beauty. One of the marine tourism destinations because it is an island with a salted anchovy center in Lampung (Detik Travel, 2020). Pasaran Island is an artificial island, currently Pasaran Island is inhabited by many residents making Pasaran Islandlook like a slum island due to the increase in population growth living on the island.

Given that the need for space and land is needed to overcome the rate of population growth so that space and land can be properly distributed as a place for community activities, the study of the density of Built-up Land on Pasaran Island needs to be carried out so that it can become important information and data in managing the future development of the market island, for this reason it is necessary to carry out mapping quickly in assessing the density of Built-up Land. Currently the existence of Unmanned Aerial Vehicle Technology is one of the efforts in the process of accelerating mapping, because using this technology produces spatial data quickly, safely, cheaply and with good accuracy, especially in monitoring the increase in the number of buildings. This study was conducted to determine and map the density of Built-up Land on Pasaran Island based on Aerial Photoshoot with UAVs.

Materials and Methods

This study was conducted on Pasaran Island, Bandar Lampung. The time of this study began in May 2022 to October 2022. The material used in this study is Aerial Photoshoot data that has become orthophoto data. The equipment used includes Drone brand DJI Phantom 4 (Unmanned Aircraft), Geodetic GPS, Premark, Hardware, namely: Laptop Asus Core i7, Software namely: DJI Go Android application, Agisoft PhotoScan Professional Edition software.

Furthermore, the study implementation procedure consisted of preparation, data collection, measurement of control points and Aerial Photoshoot, processing of Aerial Photoshoot data, interpretation, classification and analysis. It is described as follows.

1. Preparation Stage

Conducting surveys to ensure field conditions, Flyway Plans, control point distribution plans, and tool preparation. Meanwhile, the preparation of literature studies is a series of activities related to library data collection methods including scientific journals, articles, books and others that are aligned with this study.

2. Data Collection

The data source used in this study was Aerial Photoshoot data obtained from Aerial Photoshoot using a Rotary Wing (Copter) type UAV (Unmanned Aerial Vehicle).

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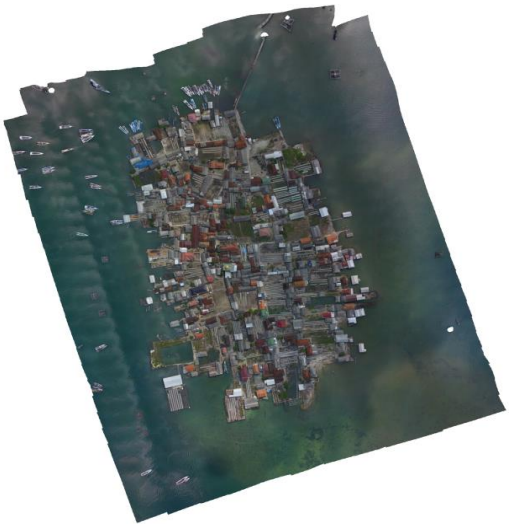

Figure 1. Pasaran Island

3. Control Point Measurement and Aerial Photoshoot

The control point measurement stage was to conduct a survey in advance to ensure that the site to be studied is safe for the distribution of the installed control points. The distribution for measuring control points on Pasaran Island is as follows:

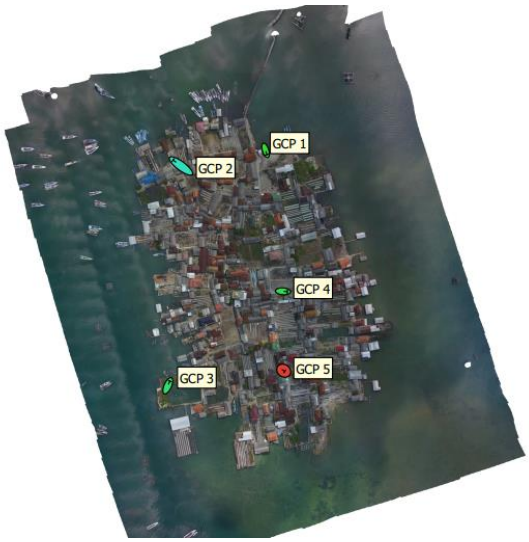

Figure 2. Ground Control Point Distribution

The measurement of ground control points used Geodetic GPS and performs GPS data processing of ground control points by calculating the results obtained from measurements and comparing with base maps that already have a coordinate system reference.

Figure 3. Ground Control Point Measurement

After determining the distribution of ground control points or GCPs, the Premark was installed, which was used as an identity for the existence of GCPs in the field. So that, when taking aerial photographs, it was seen from above and then measuring ground control points using Geodetic GPS.

Figure 4. Installation of Premark

The stages of Aerial Photoshoot were to carry out the tool calibration process first to eliminate existing distortions. Next, shooting with the UAV was carried out in accordance with the Flyway Plan that has been designed. The following is an overview of the Flyway Plan as follows:

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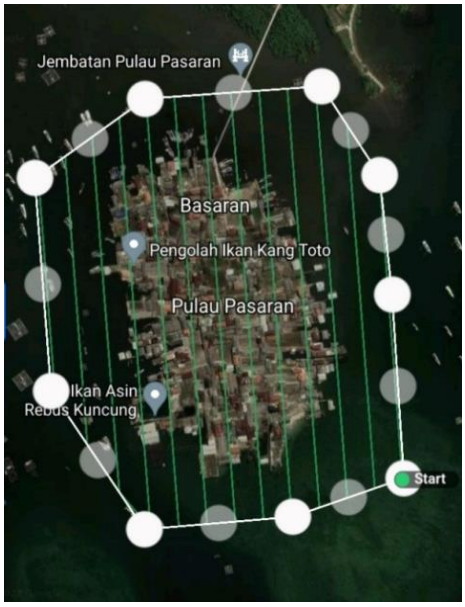

Figure 5. Flyway Plan

Picture 6. Aerial Photoshoot using UAV

4. Data Analysis

a. Point matching process, inserting GCPs so that the coordinates in the photo match the coordinates on the ground, point cloud forming, orthophoto data forming and creating a DEM in this case an Aerial Photo DSM.

b. The process of visual interpretation and delineation of Built-up Land on orthophoto using 9 elements of image interpretation, namely hue, size, shape, texture, pattern, height, shadow, position and association while Built-up Land Delineation by manually digitizing on screening of aerial photo data (orthophoto). This stage will produce Built-up Land parcels according to the situation in the field. Besides that, other land information can also be identified.

c. Built-up Land Classification Process. Classification is formed from the process of digitization or delineation, which can distinguish several land cover classes on screen. Ensuring the extent of Built-up Land class and other classes. The criteria for built-up land are level II, namely: places of worship, settlements, and others. In addition to Built-up Land, other classes also need to be delineated as a complement in the depiction of the Built-up Land map. The classification of Built-up Land in this study is the class of buildings, open land, roads, and public facilities, while for Non-Built-up Land, it is the class of vegetation.

Figure 7. Public Facility Class

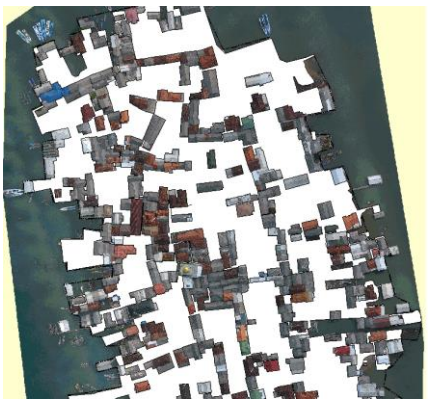

Figure 8. Open Land Class

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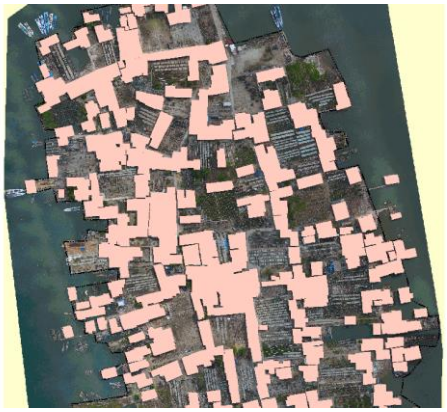

Figure 9. Building Class

Figure 10. Vegetation Class

Figure 11. Road Class

5. Density Analysis of Built-up Land

The analysis of the results was by calculating the area of Built-up and Non-Built-up land areas and then determining the class for the level of Built-up land density, in addition, the analysis was carried out to calculate the percentage of Built-up and Non-Built-up land in Pasaran Islandarea compared to the area so that the current state of Built-up Land and land cover of Pasaran Island was able to be known.

Results and Discussion

The results of the Aerial Photoshoot that has been carried out are as follows:

Number of images: 206
Flying altitude: 106 m
Ground resolution: 4.25 cm/pix
Coverage area: 0.387 km²
Camera stations: 206
Tie points: 117,043

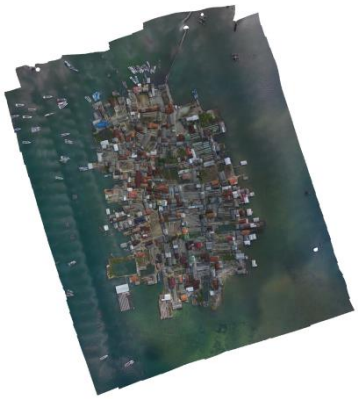

Figure 12. Aerial Photoshoot Result

From the photoshoot, the orthorectification process was carried out using five GCP points. The overall RMSe result is 0.067 with RMSe details as follows.

Table 1. RMSe Orthorectification

NO	Point Name	RMS
1	**GCP1**	**0.215093**
2	GCP2	0.92053
3	GCP3	0.078985
4	GCP4	0.068125
5	GCP5	0.021074
	RMSe	**0.067997**

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DEM (Digital Elevation Model) results on Pasaran Island show that elevations range from -60 m to 90 m.

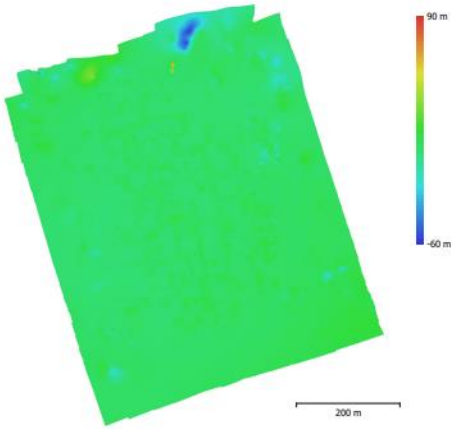

Figure 13. Digital Elevation Model Result

The map of Built-up and Non-Built-up land was obtained from the process of digitizing on screening by means of aerial photo interpretation using image interpretation keys including hue or color where to distinguish land classes, using patterns. The patterns were seen that tend to be regular, shape and size adjust to the identified object. The analysis of Built-up Land Density is obtained by calculating the area of Built-up and Non-Built-up Land, determining the class for the level of built-up land density based on the classification of medium level Built-up Land such as road classes, public facilities, buildings, and open land. Calculating the percentage of Built-up and Non-Built up Land in the area of Pasaran Island divided by the market island area, the results of the calculation of the area of each type of Built and Non-Built-up Land as follows:

Table 2. Built-up and Non-Built-up Land Class Area

No	Classification	Area (Ha)
1	Total area of Pasaran Island	11,52
2	Built-up Land Area	
	Public Facility Area	0,19
	Road Network Area	0,38
	Open Land Area	5,05
	Building Area	4,42
	Total	10,04
3	Non-Built-up Land Area (Vegetation)	1,48

Based on the table above, the total area of Pasaran Island is 11.52 Ha, then the classification of Built-up and Non-Built-up Land. The Built-up Land class is divided into 4 classes, including 9 types of public facilities consisting of places of worship such as mosques, village halls, village health centers, to elementary schools with an area of 0.19 Ha, the road network class consists of 1 type of path of 0.38 Ha, the open land class consists of 1 type of salted fish drying place because Pasaran Island is the location of the largest salted fish center in Lampung of 5.05 Ha. Furthermore, the building class consists of 40 types consisting of settlements where the majority of physical buildings are permanent with an area of 4.42 Ha with a total Built-up Land area of 10.04 Ha. The percentage of built-up land density was calculated based on the number of each class divided by the total area as follows:

Table 3. Percentage of Built-up Land Density

No	Density Type	Total (%)
1	Density of Built-up Land	87,15
2	Non-Built-up Density	12,84

Based on table 3 above, the results of Built-up Land Density of 87.15% consist of building classes, open land, public facilities and road networks. While for the results of Non-Built-up density of 12.84% consist of a vegetation class where vegetation is in the form of shady trees. The area of Pasaran Island from the results of Aerial Photography is 11.52 Ha, with a total population of 1,233 people, the population density of Pasaran Island is 107 people / Ha, namely Low Density. As for calculating building density using building data. The formula is as follows:

$$\frac{\text{Number of buildings}}{\text{Total Area}} = \text{Building Density}$$

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Table 4. Classification of density building

No	Density Building	Total (%)
1	>100 unit/Ha	High
2	80-100 unit/Ha	Medium
3	<80 unit/Ha	Low

Source: (Concept Guidelines for Identification of Slum Areas Buffering Metropolitan Municipality, 2006).

Based on the calculation formula above, the density of the building is obtained indicating a low building density in Pasaran Island. This study produced three maps, namely Built-up and Non-Built-up Land Map, Land cover map and Built-up Land Type Map in Pasaran Island. The results of this study are as follows:

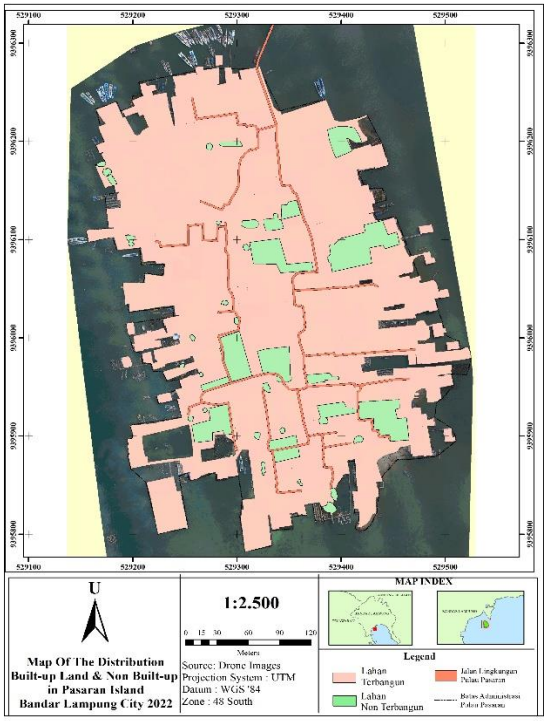

Figure 14. Map of Built-up and Non-Built-up Land of Pasaran Island

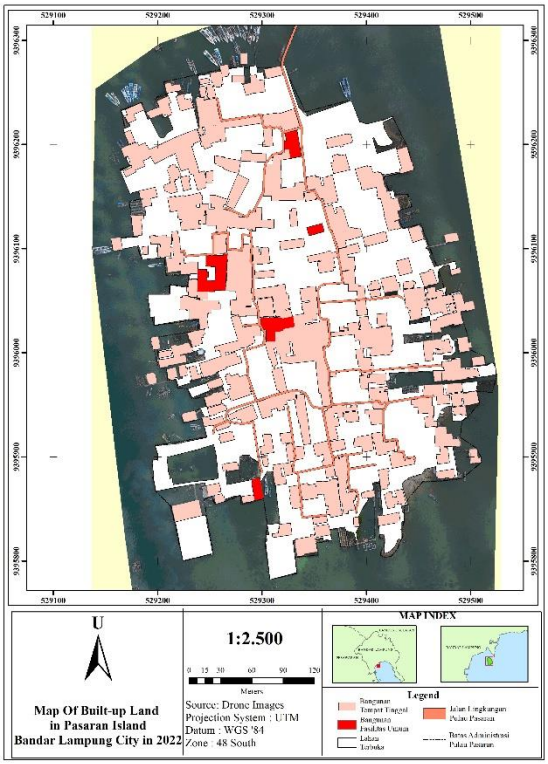

Figure 15. Built-up Land Map of Pasaran Island

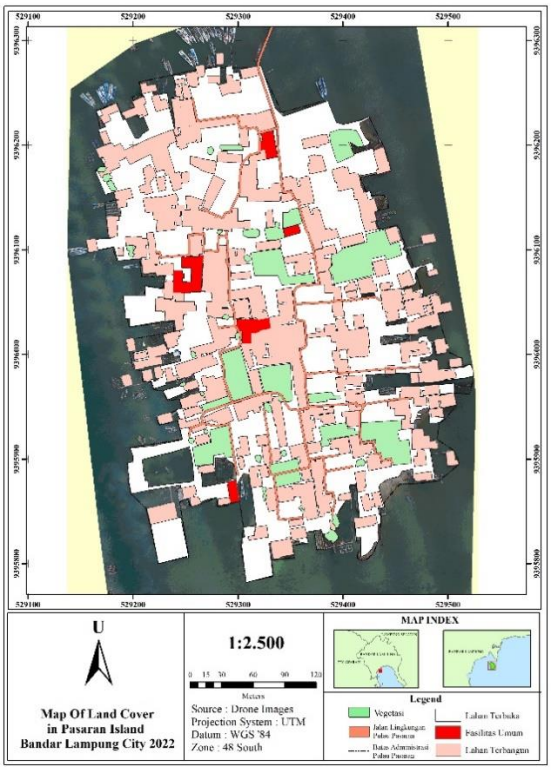

Figure 16. Land Cover Map of Pasaran Island

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Conclusion

The study of Built-up Land was obtained from visual interpretation using the satellite image interpretation keys of hue, shape, size, and pattern. Build-up Land Density Mapping using UAVs (drones) is a solution to get the results of Build-up Land Density Mapping quickly and easily. The percentage of Built-up Land Density of Pasaran Island obtains the results of Built-up Land Density of 87.15% consisting of building classes, open land, public facilities and road networks. As for the results of non-built density of 12.84% consisting of vegetation classes where vegetation in the form of shady trees, the population density of Pasaran Island is low density and the building density of Pasaran Island is also low.

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Author Contribution

Division of tasks authors, the first author the processing of Aerial Photograph Data to Become Orthophoto (Results Analysis), the second author did Built-up Land Classification (Introduction), The third author planned Flyway and ground control points distribution (materials and method), the last fourth author did ground control points measurement and aerial photography (conclusion and reference).

Conflict of Interest

In terms of financing there isi already a financing agreement through research grants so it is not burdensome for researchers and fellow writers not to claim each other regarding research and article writing because there is already an agreement.

References

Andaru, R., & Santosa, P. B. (2017). Analisis Spasial Bencana Longsor Bukit Telogolele Kabupaten Banjarnegara Menggunakan Data Foto Udara UAV. *Jurnal Nasional Teknologi Terapan (JNTT)*, *1*(1), 77.https://doi.org/10.22146/jntt.34089

Anonim. (2006). *Konsep Pedoman Identifikasi Kawasan Permukiman Kumuh Penyangga Kota Metropolitan Tahun 2006.*

BPN Kanwil Lampung. (2020). *Laporan Pilot Project Pulau Pasaran Sebagai Kampung Agrarian.* Badan Pertanahan Nasional. Lampung.

Estes, J. E., & Simonett, D. S. (1975). Fundamentals of Image Interpretation. *Manual of Remote Sensing*, *1*, 869-1076.Falls Chruch, Virginia : The American Society of Photogrammetry.

Gularso, H., Subiyanto, S., & Sabri, L. M. (2013). Tinjauan Pemotretan Udara Format Kecil Menggunakan Pesawat Model Skywalker 1680 (Studi Kasus: Area Sekitar Kampus UNDIP). *Jurnal Geodesi Undip*, *2*(2).

Hidayati, I. N., Suharyadi, R., & Danoedoro, P. (2018). Kombinasi Indeks Citra untuk Analisis Lahan terbangun dan Vegetasi Perkotaan. *Majalah Geografi Indonesia*, *32*(1), 24.

Julzarika, A. (2010). Perbandingan Teknik Orthorektifikasi Citra Satelit SPOT 5 Wilayah Semarang dengan Metode Digital Mono Plotting (DMP) dan Metode Rational Polynomial Coefficients

ISSN: 2579-5821 (Print)
ISSN: 2579-5546 (Online)
URL address: http://journal.unhas.ac.id/index.php/geocelebes
DOI: 10.20956/geocelebes.vxix.xxxx

(RPCs). *Jurnal Penginderaan Jauh dan Pengolahan Data Citra Digital, 6*.

Kaspi, S.R. Sunaryo, D.K dan Sai, S.S. (2019). *Analisis Tingkat Perkembangan Wilayah Dengan Pemanfaatan Citra Satelit Resolusi Tinggi (Studi Kasus: Kota Purwokerto, Kabupaten Banyumas).* ITN Malang

Kementrian Pekerjaan Umum, (2008). *Peraturan Menteri Pekerjaan Umum No 5/PRT/M/2008 tentang Pedoman Penyediaan dan Pemanfaatan Ruang Terbuka Hijau di Kawasan Perkotaan.*

Lillesand and Keifer., (1997). *Pengindraan Jauh dan Interpretasi Citra.*, Penerjemah: Dulbahri., et.al., Gajah Mada University Press. Yogyakarta. Vol.6.

Lillesand and Kiefer. (1986). *Remote Sensing and Image Interpretation. New York (US) :* John Wiley & Son.

Lillesand, T.M and Kiefer, R.W. 1979. *Penginderaan Jauh Dan Interpretasi Citra(terj. Sutanto, dkk).* Yogyakarta : Gadjah Mada Unversity Press.

Lillesand, T.M., Kiefer, R.W. and Chipman, J.W. (2004). *Remote Sensing and Image Interpretation.* 5th Edition, John Wiley & Sons Inc., New York.

Nurrohmat, A. (2021). *Pemetaan Sebaran lahan Terbangun Dalam Koridor 250 Meter Sesar Lembang.* Jurnal Elipsoida Volume 4 No 1 2021, ISSN 2621-9883.

Nurwahida, & Hernawaty. (2020). Pendugaan Lapisan Akuifer Air Tanah dengan Metode Geolistrik Resistivity Konfigurasi Schlumberger di Berbagai Wlayah Indonesia. Jurnal Teknosains, 14(1), 1–10.

Nurwahida, & Hernawaty. (2020). Pendugaan Lapisan Akuifer Air Tanah dengan Metode Geolistrik Resistivity Konfigurasi Schlumberger di Berbagai Wlayah Indonesia. *Jurnal Teknosains*, 14(1), 1–10. https://doi.org/10.24252/teknosains.v14i1.10589

Putri, L. K. R. (2014). *Deliniasi Citra Dengan Software ArcGis.* Semarang (ID): Universitas Diponegoro.

Ramdhan, M. (2012). *Analisis Kegempaan Sesar Sumatera Menggunakan Relokasi Gempabumi Metoda Double-Difference*. ITB.

Rokhmana, C.A. (2007). *The Joint Convention Low-Cost Monitoring System For Landslide And Volcano With Digital Photogrammetry.* Proceeding. HAGI, IAGI, IATMI.

Salihin, I., Akbar, L.O.N dan Jaya. G. (2018). Analisis Perubahan Tingkat Kepadatan Lahan Terbangun Kota Kendari Berdasarkan Indeks Lahan Terbangun. *Jurnal Geografi Aplikasi dan Teknologi*, 2(2), ISSN 2549-9181.

Sutanto, (1994). *Penginderaan Jauh Jilid I*. Yogyakarta: Gadjah Mada University Press.

Tjahjadi, M.E., (2017). *Single Frame Resection Of Compact Digital Cameras For UAV Imagery.* National Institute of Technology (ITN) Malang.

Wijaya, Sufwandika Muhammad. (2013). *Integrasi Model Spasial Cellular Automata dan Regresi Logistic Biner untuk Pemodelan Dinamika Perkembangan lahan terbangun (Studi Kasus Kota Salatiga).* Fakultas Geografi Universitas Gadjah Mada. Yogyakarta

Wikantika. K. (2009). *Unmanned Mapping Technology: Development and*

ISSN: 2579-5821 (Print)
ISSN: 2579-5546 (Online)
URL address: http://journal.unhas.ac.id/index.php/geocelebes
DOI: 10.20956/geocelebes.vxix.xxxx

Applications. Workshop Sehari "Unmanned Mapping Technology: Development and Applications" (UnMapTech2008). Bandung, Indonesia. 9 Juni 2008.

Wolf, P, R. (1993). *Element of Photogrammetry dengan Interpretasi Foto Udara dan Penginderaan Jauh.* Yogyakarta. Gadjah Mada University Pres.