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THE UTILIZATION OF ORTHOPHOTO MULTITEMPORAL TO DETECT SPATIAL CHANGE OF GREEN OPEN SPACE AT THE GREEN CAMPUS (RESEARCH LOCATION: UNIVERSITY OF LAMPUNG)

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ABSTRACT

Lampung University is one of the Indonesian universities that is committed to achieving sustainable green campus environmental management. The University of Lampung was ranked 15th in the UI Green Metric award in 2021. On the other side, infrastructure building to support the education tri-dharma process is still ongoing. Development impact will decrease green open space (GOS). The UAV has several advantages such as simple operation, high accuracy, and efficiency. The objective of this research is to evaluate the availability and changes of green open space at Lampung University from 2019 to 2022. Multitemporal data of orthophoto 2019 and 2022 were used. The method in this research used visual interpretation, classification, and overlay to get information about green open space areas and changes. Research results showed that the availability of green open space at the University of Lampung in 2019 was 32.45 hectares (39.82%), and in 2022 it was 29.33 hectares (35.99%). The change of green open space at the university campus from 2019 to 2022 decreased by 3.12 Ha.

Keywords: University, GOS, UAV, orthophoto, image interpretation

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INTRODUCTION

The campus is an agent of change that contributes to creating a comfortable, clean, green, beautiful, and healthy environment. The Green open space provides various advantages, including giving beauty and comfort on campus as well as long-term advantages, such as serving as a medical garden, absorbing polluted air, sustaining water availability, and keeping a variety of flora and fauna (Imas, *et al.*, 2020).

One indicator concept of a green campus is green open space. Green Campus is defined as a campus that cares about the environment, has an environmental culture, and has implemented environmental management systems and sustainably. The Green Campus is a reflection of the entire academic community's involvement in the campus environment so that they aware of factors of health and the surrounding environment.

Law of The Republic of Indonesia Number 26 2007, regulates Spatial Planning, Urban Spatial Planning, and the provision and use of Green Open Space, the ideal amount of green open space is 30% of the city area, divided into 20% public green open space and 10% private green open space.

Lampung University is one of the Indonesian universities that is committed to achieving green and sustainable campus environmental management. The University of Lampung (Unila) was ranked 15th in the UI Green Metric award in 2021 as the predicate of an environmentally friendly green campus. This success increased significantly from the previous year, and several agendas were developed and implemented to continue improving achievements, such as reforestation and others.

The UAV has been increasingly used in mapping activities in recent years. This technique has several advantages, including ease of use, high precision, and efficiency (L. Qing, 2020).

The novelty of this research is to determine the availability and change of Green Open Space at the Unila Campus using multi-year orthophoto data for 2019 and 2022.

LITERATURE REVIEW

Green Open Space

Green Open Space (GOS) is a type of land use that is intended for the open greening of plants (Ranasinghe et al., 2018). The aim of green open space to improve the quality of the urban environment (Grey, 1986: 1). Green open space consists of yard, courtyards in the form of offices, shop yards, and places of business, gardens on roofs/buildings, urban village parks, sub-district parks, city parks, urban forests, green belts, road green lanes covering the median path, pedestrian space, the space under the flyover, certain functions include the railroad line border, in the form of an electricity network (SUTET), and the border of rivers, beaches, water sources, and cemeteries. Based on Law No. 26 of 2007, concerning spatial planning explains that the proportion of green open space in urban areas is at least 30% of the urban area. Percentage of green open space (%) = area of city green open space / total area of city area × 100% Source: Nirwono (2011: 205).

Purwanto *et al.* (2018) researched the arrangement of green open spaces as an indicator of the

sustainability of the Diponegoro University campus with a green campus concept. His research yielded a study of green space organization based on functional elements, physical and non-physical features, and environmental/ ecological aspects.

Suripto *et al*., (2019) investigated the total amount of land, the area of green open space, the coefficient value of the green area (CV) , and the value of the CV concerns the stipulations of the applicable regulatory requirements in the PNJ campus environment. The CV number derived by comparing the extent of green open space to the total land area is 39.61%, which is still greater than the stipulated minimum need of 20%. This value must be preserved to achieve a healthy balance between development and the environment.

Koto A.G., *et al.*, (2018) used drone aerial photographs to investigate the availability of green space on the UMGo Campus. The findings revealed that the availability of green open space on the UMGo Campus satisfied the standards outlined in Spatial Planning Law No. 26 of 2007.

Research by F Agus *et al,* (2018), Green Open Space (GOS) provides great benefits as a supplier of oxygen, and a carbon fixing agent. The study applies GIS Cloud Computing (CC) to mapping the green open space of Bontang City using a base map that is available free and open source, the results explain the existence of the Bontang City GOS and the design of the green open space mapping application.

Aris *et al*. (2018) did research on green open spaces on the Sriwijaya campus. The study's goal is to promote the use of green open space for the development of agro-eco-educational zones. Using interview techniques to assess the requirement for green open space. The analysis was carried out using quantitative and qualitative descriptive approaches, including interviews and questionnaires. The outcomes are used as a guide for planning the space needs. This study obtains the structure, layout, and shape of the building to develop green open spaces in the Faculty of Agriculture, Sriwijaya University, Indralaya.

The ratio of the area of green open space and the building area of the University of Lampung is 65:35. It is intended that the Unila campus air is fresher, the availability of water is more than sufficient and the campus is more beautiful (Utomo M., 2007).

Photogrammetry

The art, science, and technology of obtaining information about physical objects and the environment through the process of recording, measuring, and analyzing aerial pictures are known as photogrammetry (Thomson and Gruner, 1980). Photogrammetry is the technique of recording, measuring, and analyzing photographic images and recorded patterns of electromagnetic energy radiation to gather trustworthy information about physical objects and their surroundings (Wolf, 1993).

Unmanned Aircraft

Unmanned Aerial Vehicle which is also known as a drone. UAV controlled on autopilot, semi-autonomously, or remotely by a navigator or pilot on the ground. This model of aircraft is outfitted with a variety of photogrammetric sensors that are commonly found on manned aircraft. Metric cameras, video, and more complex camera systems such as infrared, aerial LIDAR systems, or a mix of both are regularly used sensors. The UAV can fly low, below the clouds. The UAV's flight height can be changed to meet your specific requirements.

Photogrammetric Mapping Stages Using UAV

Photogrammetric mapping stages with UAV are as follows:

Preparation: administrative preparation, planning the distribution of control points, and equipment.

Measurement of Control Points, namely from the numbering process, distribution of control points, pre-marking, and GNSS measurements.

Data acquisition, namely aerial photo data obtained by data acquisition using an Unmanned Aerial Vehicle (UAV) such as a drone.

Data Processing, namely the process of processing aerial photo data into orthophoto data with qualified software.

The results are part of the output of aerial photo data that have been processed with a good result.

Visual Interpretation Based on Orthophoto Data

Image interpretation consists of two ways: manual image interpretation and digital image interpretation.

a) Visual Interpretation (Manual). Visual interpretation can be done directly on the hardcopy image by demarcation or by digitizing the image on the monitor screen (Somantri, 2008). There are nine keys to image perception, according to Este and Simonett (1975): hue and color, texture, shape, size, pattern, site, shadow, association, and evidence convergence.
b) Digital Interpretation. Digital interpretation is the process of studying a picture by manipulating and interpreting with the computer, and it is typically a methodical and complex process. Photo interpretation, also known as image interpretation, is a technique for assessing things in photos based on interpretation components such as color, size, shape, pattern, texture, and shadow, combined with visual context and the surveyor’s experience.

Delineation

The procedure of providing an arc/temporary border feature for the region above the map is known as delineation (Putri, 2014). Digitization is the act of transforming analog data into digital data in which attributes holding information from the item in question may be added.

Classification and Overlay

Danoedoro (2012) defines categorization as "a series of groupings of pixels into specified classes or based on their spectral similarities." The categorization process's goal is to automatically group each pixel into a certain class. While Overlay is a portion of the process of entering two or more georeferenced data (layers) into the same system, so that the data entered is in line with the format, for example, vector data with the spatial properties of each data layer, whereas raster data is carried out by a pair of cells (Escobar, 1998).

IMPLEMENTATION METHOD

This research was conducted at the Green Campus of the University of Lampung. The data used in this study are aerial photos (orthophoto) in 2019 and 2022. The equipment needed in this study is Drone brand DJI Phantom 4, GPS-Geodetic, Premark, Laptop, Android, DJI Go Android application software, PIX 4D Mapper, and Agisoft PhotoScan Professional Edition software.

Stages of Implementation

a) The preparation stages include Preparation for administration and field survey, mobilization, creation of a flight path plan map, creation of a control point distribution plan map, and testing of the readiness of the equipment to be utilized.
b) A literature study is an activity related to library data collection methods including various library information such as books, scientific journals, articles, and supporting documents.

Data Collection

a) Development of Flyway Plans. The flight path plan was made before conducting aerial photography survey activities using flight path planning software. The stages were: Determining the Area of Interest (AOI) and creating a work block, creating a flight path according to the shape of the Area of Interest (AOI) and its topography, and Adding a cross strip that cuts all the main flight paths at least at the edge and the center of the work block, Designing a forward overlap 80%, Designing a side overlap 60%.
b) Planning of Ground Control Points. Ground control points consist of ground control points (GCP) and independent check points (ICP).

Control Point Measurement

a) Preliminary Survey. Reconnaissance was conducted to determine the condition of the location around the planned control point in the study area.
b) Installation of Premarks Control points was realized in the field in the form of remarks.
c) Measurement of Ground Control Points. Measurement of ground control points was performed by using a geodetic type GNSS receiver.
d) GNSS Data Processing at Ground Control Points.

Implementation of Aerial photography

Aerial Photography and Aerial shooting surveys were carried out according to the flight path plan.

Data Processing to Produce Orthophoto

The stages in processing aerial photo data were downloading the raw GNSS and IMU data photo, then performing aerial triangulation and the formation of point clouds to the orthorectification process.

Interpretation, Delineation, Classification of Green Open Space on Orthophoto in 2019 and 2022

Performing the process of interpreting green open space using 9 image interpretation elements: hue, size, shape, texture, pattern, height, shadow, position, and association. Process delineating green open space by digitizing aerial photo data (orthophoto). The aim of the classification stage is to categorize each type of green open space.

Overlay of GOS in 2019 and 2022 and Analysis of Changes in GOS

After carrying out the green open space classification process on multi-temporal orthophoto data, then an overlay process was carried out between orthophoto data in 2019 and orthophoto in 2022. The change in green space was obtained from the results of overlaying the two classified green open space data.

RESULT

The availability of green open space in 2019 (**Figure-1)** at the Lampung University campus obtained based on the 2019 orthophoto data processing was 32.4481 hectares or 39.82% of the total area of the Lampung University campus.

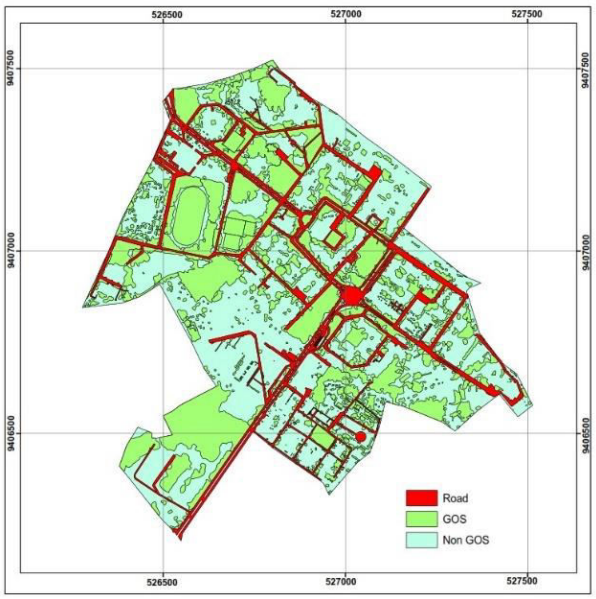

Figure-1. GOS-unila in 2019.

These results were calculated based on the total green area/vegetation area, which was 32.4481 hectares (32.4481m2) compared to the total campus area of 81.4933 hectares (81.4933m2). The 2019 green open space identified consisted of 9 types, namely parks, sports fields, green roads, office yards, shops and business premises, open parking lots, open fields, educational yards, plantations, and yards. **Figure-1**. shows the green open space on the UNILA campus, while **Table-1** below lists the types of green open space in 2022.

Table-1. Types of gos unila in 2019.

Type of GOS	Large (Hectares)
Yard of building	2.5722
Park	5.7223
Sport Court	1.8959
Open Field	0.3794
Green Path Road	0.8112
Yard of Stores and Business Place	1.0745
Yard	0.5849
Plantation	17.1035
Open Parking	2.3040
Total	**32.4481**

The availability of green open space in 2022 (**Figure-2**) at the campus of Lampung University obtained based on data processing orthophoto 2022 is 29.3304 hectares or 35.99% of the total area of the campus of the University of Lampung.

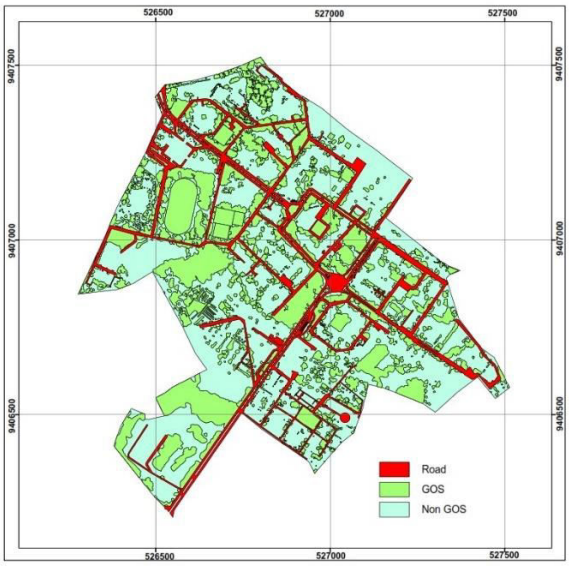

Figure-2. GOS unila in 2022

The results are calculated based on the total green area/vegetation area which is 29.3304 hectares (29.3304m2) compared to the total campus area of 81.4933 hectares (81.4933m2). The type of green open space in 2022 identified consists of 9 types of green open space, namely parks, sports fields, green lanes, office yards, shops and business premises, open parking, open fields, educational yards, plantations, and yards. The 2022 green open space on the Unila campus is shown in **Figure-2** and the 2022 green open space can be seen in **Table-2** below.

Table-2. Type of GOS unila in 2022.

Type of GOS	Large (Hectares)
Yard of building	2.2506
Park	5.3813
Sport Court	1.9301
Open Field	0.3933
Green Path Road	0.7874
Yard of Stores and Business Place	1.4580
Yard	0.5308
Plantation	14.2775
Open Parking	2.3215
Total	**29.3304**

Changes in Green Open Space for the period 2019 to 2022 (**Figure-3**) were obtained based on the difference between the 2019 green open space area of 32,4481 hectares and the 2022 green open space of 29,3304 hectares which resulted in a difference or a decrease of 3.1177 hectares (9.6%). Changes in green open space can be seen in **Figure-3**.

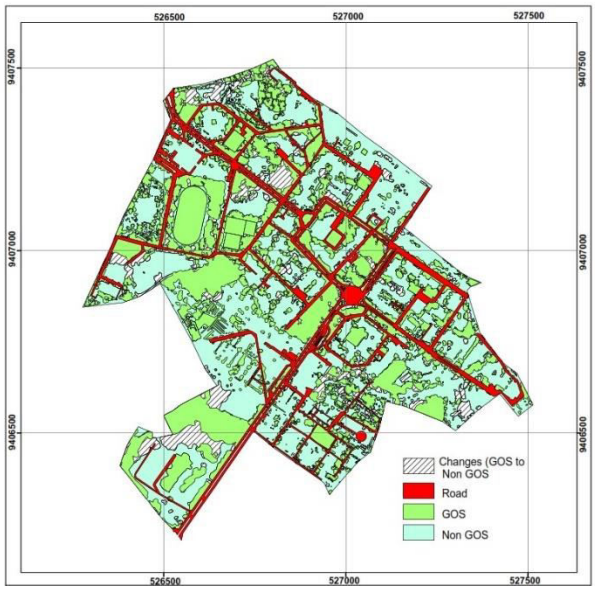

Figure-3. Change of GOS unila in 2019-2022.

The reduction in green open space of 3.1177 hectares has turned into non-green open space such as

buildings, the reservoirs that function as water absorption and flood control, and the path of the reservoir.

According to Law Number 26 of 2007, that green open space makes up at least 30% of the total area, there should be at least 24.4 hectares of green open space on the Unila campus. When compared to the amount of green open space that will be accessible in 2019 and 2022, the Unila campus' green open space is still over the minimal need.

CONCLUSIONS

a) According to Orthophoto data, the amount of green open space available on the Unila campus in 2019 is 32.4481 Ha (39.82%), and in 2022, it will be 29.3304 Ha (35.99%).
b) The University of Lampung campus's availability of green open space still answers the green open space criteria based on Law Number 26 of 2007 even if there has been a decline in the size of green open space, which is 3.1 Ha (9.6%) for the years 2019 to 2022.
c) Based on the results of this research, the multitemporal orthophoto is able, flexible, effective, and efficient in detecting changes in green open space in the small area.

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