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Rapid urban development increase building density at the expense of vegetation. When urban areas become less green and more concrete, environmental problems such as floods and landslides are likely to occur. This study aimed to investigate the changes in vegetation and building density in Wenang and Wanea Districts over 8 years based on Landsat imagery using ArcGIS tools. Methods such as the Normalized Difference Vegetation Index (NDVI) and Normalized Difference Built-Up Index (NDBI) were used to analyze the impact of these effects on floods and landslides. From the results, vegetation density declined while building density increased over 8 years. These changes influenced floods and landslides based on the magnitude of vegetation and building indices. For instance, areas with higher building indices became more prone to flooding while those with higher vegetation indices were susceptible to landslides.

Keywords: Landsat, Normalized Difference Vegetation Index, Normalized Difference Built-Up Index, Flood, Landslides Introduction

The high rate of urbanization in modern times increases the need for urban development to avoid issues such as overcrowding. According to Kaur et al (2022), this can lead to a reduction in the natural land cover and a corresponding increase in built-up land which disrupt the natural patterns and processes of the urban landscape. Zheng et al (2021) established that urbanization lifted hundreds of millions of people out of poverty. However, it had serious environmental consequences and presents enormous social challenges, including increased greenhouse gas emissions, loss of arable land, ecological risks, air and water pollution, and environmental degradation. hydrological and ecological, urban heat island effect, and increased energy use.

Manado is the second largest city in Sulawesi and it is the center of all national activities, specifically North Sulawesi. It is a service center for activities serving the surrounding areas, necessitating land for expansion. This is specifically true when Wenang and Wanea Districts were designated as urban service centers to support growth and the economy in Manado City or become service orientations to other centers in the vicinity. This led to increased rapidity of development in these two areas, both towards the coast and the hills. However, this development has not been beneficial for both people and the environment because of poor planning. According to Li et al (2022), proper planning is necessary for building a comprehensive urban.

Shi et al (2018) established that human activities such as urbanization raised the issue of land use and land cover change (LULCC). The increased rapidity of development resulted in significant changes in urban land use patterns. Moreover, Science (2020) established that more forests turned into built-up areas and natural resources over-exploited for human needs recently.

Remote sensing is the acquisition of information about some feature on the earth surface without coming into direct contact with it. According to Ou et al (2018), the data are collected by sensors installed on air and space platforms and then converted into images that provide details of particular feature. Din et al (2021) established that remote sensing was a better way to extract LULCC attributes because it provided a high frequency of data collection, a wider field of view, and multispectral characteristics. Land cover attributes in urban areas change more quickly in a short time than in other areas. According to Surya et al (2020), this is because of the high rate of urbanization that has occurred as a result of population explosion and economic growth. Remote sensing plays a key role in generating LULCC status and monitoring changes at regional and global scales. According to Jin et al. (2016), remote sensing provided timely and critical information on LULCC for climate change and environmental studies, appropriate land management and land use decision making, as well as regional and global sustainable development. There are various types of satellites used in remote sensing. According to Sanches et al (2020), one of those satellites is the Landsat 8. This satellite provides and global coverage, making it useful in remote sensing applications such as LULC.

Wiatkowska and Słodczyk (2021) explained that the combination of Remote Sensing technology and Geographic Information Systems allowed for accurate monitoring of the types of land cover in urban areas. According to Wang et al. (2020), this provides scientifically credible results and policy recommendations which are valuable for decision-making processes such as land use planning in an urban area. Xie et al. (2018) established that data collected by satellites and airborne sensors provided information on vegetation biophysical variables over large spatial and temporal scales.

According to Olivaries et al. (2021), the data are often calculated using the Normalized Difference Vegetation Index (NDVI) formula to provide information about the level of the greenness of a region’s vegetation. Huang et al. (2020) stated that NDVI was the popular choice for measuring the level of greenness of vegetation cover on the earth's surface. It was preferred to other metrics for various reasons, including simplicity and historical data availability. Liu et al. (2021) established that data provided by the spectral (RED) and near-infrared (NIR) was used to calculate DVI. According to Miller et al. (2020), Red spectral (RED) provides information on moisture, plant type, and soil quality and shows a sharp contrast between plants and soil. On the other hand, Naguib and Daliman (2022) explained that the near-infrared (NIR) spectral behind the red channel spectral region collected information on plant chlorophyll. These two spectra often work side by side to measure plant health and growth. To obtain different types of information about the environment, professionals in different fields can observe the vegetation and perform, extraction on built-up land. Zha et al. (2003) stated that the focus was on a technique for extracting build-up areas called Normalized Difference Built-Up Index (NDBI). Firozjaei et al. (2022) explained that they used NDBI and NDVI to extract and refine build-up areas from the Landsat TM images. According to Yasia et al. (2022), NDBI is used to measure the amount of built-up land using data from spectral shortwave infrared (SWIR) and Near Infrared (NIR).

Vegetation and buildings are an important part of the ecological system and urban landscape. According to Mu et al. (2020), green spaces play an important role in ecosystem services, the environment, and improving the public health of urban and rural residents

This study has a novelty compared to previous ones, where there are variations in the variables measured and analytical techniques used. Those studies include:

a. The Effect of Vegetation and Building Density on UHI (Urban Heat Island) in Magelang City (Riyadi and Rahayu 2019). In the study, GSI analysis and remote sensing were employed to explain the correlation of Quantitative Research Methods that used several variables such as NDVI, NDBI, or LST and the OLS formula

b. The Impact of Vegetation and Building Density Changes on the Banda Aceh City Post-Tsunami Disaster (Trinufi and Rahayu 2020). The study used quantitative descriptive with the processing of NDVI and NDBI algorithms to explain the impacts of land changes after the tsunami disaster in Banda Aceh City.

c. Analysis of the Impact of Land Use on the Green Space in Water Catchment Area In Padang City Using Normalized Difference Vegetation Index (NDVI) (Driptufany, Guvil, and S 2019). In the quantitative descriptive study, GSI analysis was used to explain the relationship e between the green open space area extracted from NDVI and the water catchment area

Although all the studies listed above focused on NDVI and NDBI, they examined different variables. This study also focused on remote sensing applications but examined different variables such as NDVI, NDBI, floods, and landslides to explain their effect on disasters. In contrast to previous studies, the location selection used in this study is more detailed, using a 1:5000 scale map.

By using a map with a higher scale, it is easy to analyze the vegetation and building density and explain their effects on floods and landslides in Wanea and Wenang Districts. Geographic landscape planning can become an effective approach in disaster-based spatial landscape planning and this study shows its potential in this field.

Methodology

Study Area

The study location was Wenang and Wanea Districts, Manado City, North Sulawesi. This study utilizes Landsat 8 images taken in the years 2013, 2017 and 2021 obtained through the website of the United States Geological Survey (USGS). It also uses secondary data such as location points for floods and landslides and DEM data from related agencies.

Data Analysis

After collecting data, Geographic Information Systems were applied to examine the decision-making process and conduct quantitative analysis. Spatial analysis was also used to examine the decision-making process, which involved processing the Landsat 8 image using NDVI and NDBI algorithms. The steps used in data analysis are as shown below.

1. Cropping Area of Interest (AOI), which involves extracting a portion of the image that represents the study area, in this case, Wenang and Wanea Districts.

2. Radiometric Corrections

Umarhadi and Danoedoro (2019) explained that the reflected images obtained through satellite sensors were usually distorted by the effects of the sensor, sun, atmosphere, and topography. To eliminate the distortion, a radiometric correction can be performed. According to Zhal et al. (2018), radiometric correction can be performed by conversion lands at the image (Landsat-8 Collection 1 L1TP) values that are still stored in digital number (DN) format to Top of Atmospheric (TOA) reflectance using radiometric rescaling in landsat metadata files with sun zenith angle correction. The formula is:

$\rho\lambda' = M\rho . Qcal + A\rho / \sin(\theta se)$

Description:

$\rho\lambda'$: Top of Atmosphere (TOA) Reflectance without correction for the zenith angle of the sun

$M\rho$: Band-specific multiplicative rescaling factor from metadata (REFLECTANCE_MULT_BAND_x, where x is the specified band number)

Qcal : Satellite image pixel value (DN)

$A\rho$: Band-specific additive rescaling factor from metadata (REFLECTANCE_ADD_BAND_x, where x is the specified band number)

θse : Sun elevation angle (SUN_ELEVATION)

3. Calculation of Normalized Difference Vegetation Index (NDVI)

According to Onyango and Opiyo (2022), a high NDVI value indicates dense vegetation because it is obtained from a combination of high reflectance on NIR and low reflectance on RED. The formula for calculating NDVI is as follows:

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

Description:

NDVI : Normalized Difference Vegetation Index

NIR : Spectral value Near Infrared (band 5)

RED : Spectral value RED (band 4)

The range of NDVI values ranges from -1 to 1. Das et al. (2019) explained that when NDVI value was higher or close to 1, the area had a higher vegetation density

4. Calculation of Normalized Difference Built-Up Index (NDBI)

On Ameer et al. (2021) established that built-up land and vacant land reflected more SWIR than NIR while vegetation land reflected more NIR than SWIR. The formula for calculating NDBI is as follows:

NDBI = SWIR – NIR

SWIR + NIR

Description:

NDBI : Normalized Difference Built-Up Index

NIR : Spectral value NIR (band 5)

SWIR : Spectral value SWIR (band 6)

NDBI values range from -1 to 1, where a negative NDB value indicates water while a positive value indicates a built-up area. According to Espinoza-Molina et al. (2022), NDBI value for vegetation cover is low.

5. Overlay Analysis

Overlay analysis is a crucial part of spatial analysis performed by combining two maps to produce a new map to analyze the information contained in the two original maps. An overlay analysis using an intersect function is used to detect the influence of vegetation and building density on floods and landslides According to Hamoor et al. (2019), an overlay analysis (intersect function) using GIS is mainly performed between interpolation (map) and other spatial data layers. Concerning this study, data from NDVI and NDBI as well as flood and landslide locations in Manado City specifically Wenang and Wanea Districts were used to produce a new map.

Result and Discussion

Normalized Difference Vegetation Index in Wenang and Wanea Districts in 2013, 2017, and 2021

To understand vegetation density in Wenang and Wanea Districts, Landsat 8 image taken on 2 July 2013, 27 June 2017, and 24 July 2021 was processed and utilized. NDVI value obtained in Wenang District ranged from -0.47 to -0.84 in 2013. In 2017, the value ranged from -0.51 to -0.86, while in 2021, it ranged from -0.24. to -0.83. Meanwhile, NDVI value in Wanea District ranged from 0.021 to - 0.86 in 2013, -0.016 to -0.87 in 2017 and 0.003 to -0.86 in 2021. NDVI classification categorizes the density of vegetation into 4 classes, including a non-vegetation, sparse, medium, and dense vegetation class. A non-vegetation class consists of water bodies, a sparse vegetation class (lowest dense) has a built-up land with minimal vegetation, while a medium vegetation class (dense) represents built-up land that already has vegetation around it. Meanwhile, a dense vegetation class (highest dense) consists of areas with high vegetation density such as bushes, shrubs and gardens. The information from the processed Landsat image concluded that the sparse vegetation class (lowest dense) in Wenang District covered largest area than other density classes, and had more built-up land, settlements, offices, and trade and service areas. There have been significant changes in the sparse vegetation class (lowest dense) in 8 years, where almost every sub-district has always experienced an increase in vegetation. The medium vegetation class (dense) has always experienced decrease in vegetation area, while the dense vegetation class (highest dense) experienced an increase of vegetation by 3% from 2013 to 2017. This information was extracted from the Landsat Image of Wenang Utara Village which was vacant land in 2013 and then turned into vegetation land in 2017 but could not maintain its vegetation growth because it experienced a decrease in vegetation density by 1%.

In Wanea District, the dense vegetation class (highest dense) has the largest area compared to other density classes because there are still many scattered vegetation areas. There have been significant changes in sparse vegetation classes (lowest dense) over the 8 years, leading to an increase in vegetation in almost every sub-district. However, there has always been a decrease in vegetation in the medium vegetation class (dense) and an increase of vegetation by 1% in the dense vegetation class. This information was extracted from the Landsat image of Bumi Nyiur Sub-district, which was a vacant land in 2013, and started experiencing vegetation growth in 2017. However, it could not maintain its vegetation growth and experienced a decrease in vegetation density by 3% in 2021.

Normalized Built-Up Index Wenang and Wanea Districts in 2013, 2017, dan 2021

To understand the building density in Wenang and Wanea Districts, Landsat 8 image taken on 2 July 2013, 27 June 2017, and 24 July 2021 was processed and used. The NDBI algorithm applied using ArcGis software mapping showed that the building density index value in Wenang District ranged from - 0.62 to 0.29 in 2013. In 2017, the value ranged from -0.089 to -0.38, and in 2021, it ranged from -0.052 to 0.33. In Wanea District, NDBI value ranged from -0.021 to -0.34 in 2013, -0.019 to -0.48 in 2017, and -0.17 to -0.42 in 2021. NDBI classification is categorized into 2 class levels, including non-built and built. Below is a visualization in the form of a map and its area in tabular form. The information provided by the processed Landsat image concluded that the built-up area in Wenang District is larger than non-build land. Wenang is a central business district, increasing the need for build-up land in the last 8 years to make the area a center for trade and services, offices and tourism on a regional scale.

In Wanea District, the built and non-built-up land areas are of equal size. The processed Landsat image of Bumi Nyiur and Pakowa Sub-districts which were vegetation lands in 2013 and turned into build-up lands in 2017 and 2021. According to the information provided by the image, shows the built-up area increased in Wanea District, build-up land increased in 2013, reduced in 2017 and increased again in 2021 by 1%. Wanea District influences these changes in the land because it is a provincial-level government service and sub-services center harboring trade and service areas and settlements. Although changes in land cover have benefits, they can cause several environmental problems if not implemented properly. Some of these environmental problems include floods and landslides, which can be influenced by several factors, but this study only focuses on 2 variables, including the density of vegetation and buildings. To understand the effect of vegetation and building density on floods and landslides, an overlay analysis between the data from NDVI and NDBI as well as data from the locations affected by floods and landslides was performed.

Conclusion

The analysis showed that the total distribution of vegetation density class in Wenang District has changed over 8 years. For instance, the vegetation density increased by 3% between 2013 and 2017 and decreased by 1% between 2017 and 2021. However, the same cannot be said for Wanea District, which experienced a decrease in vegetation density by 2%.

The building density in Wenang and Wanea Districts increased by 1% over 8 years because the districts are city service centers and service orientations to other centers in the vicinity. This has promoted many land changes in these areas in the form of trade and services that help support growth and the economy in Manado City. The land changes also create settlements to meet the needs of the community.

The density of vegetation and buildings also influences the occurrence of floods and landslides. A higher vegetation index is associated with the high risk of landslides while a lower vegetation index increases the chances of flooding. However, a higher building index heightens the risk of floods in the area while a lower building index promotes landslides.

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INTERNET SOURCES:

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si_Riau_periode_1990-2019/links/5ff29dbb92851c13fee76ea3/Perubahan-Penggunaan-d
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