SPATIAL ANALYSIS OF LAND USE CHANGE DUE TO MINING ACTIVITIES IN KALUMATA VILLAGE, SOUTH TERNATE DISTRICT (2014–2024)

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Abstract
The mining area in Ternate City is generally a mining business for rock excavation materials, which is found in almost all areas of Ternate city, one of which is in Kalumata Village, South Ternate District. This study investigates land use change in the mining area of Kalumata Village, South Ternate District, from 2014 to 2024, using Geographic Information System (GIS) and Landsat 8 imagery. Mining activities in this area are predominantly carried out by the local community without official permits, leading to uncontrolled land conversion. The study classifies land use into six categories in 2014 and seven in 2024, with the addition of a mining land class. The results show a significant increase in residential areas (28.01 ha) and mixed gardens (3.22 ha), along with the emergence of 5.95 ha of mining land. Conversely, plantation land decreased by 23.24 ha, while forest areas declined by 1.1 ha. These changes are primarily driven by rapid urban development and expanding mining operations. The findings highlight the urgent need for spatial planning and land management strategies to mitigate environmental degradation in Ternate City.

Keywords: k*alumata, land-use change, mining, spatial analysis*

Introduction

Ternate City is an autonomous region part of the province of North Maluku. One of the natural resources that is owned to be managed is mining resources. The mining area in Ternate City is generally a mining business for rock excavation materials, which is found in almost all areas of Ternate city, one of which is in Kalumata Village. South Ternate District. The type of mining in this village is sand mining. Sand mining activities in Kalumata Village have been going on for a long time. Mining activities are carried out by the community manually or mechanically and do not have permits (Fardan, 2018).

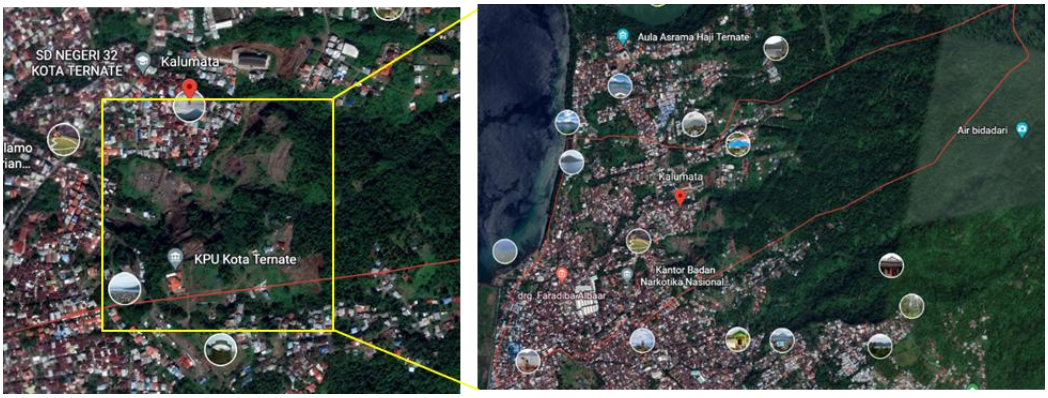
Spatial monitoring plays a crucial role in identifying patterns of land use change in mining areas, which then becomes the basis for developing a more prudent land management strategy. Spatial monitoring allows for early identification of land-use changes in mine areas, which is critical for drafting land use planning that prevents widespread environmental impactsIn order to monitor land use changes. Land use information from time to time is needed which is analyzed spatially to see the distribution of land use changes and changes to time that are analyzed temporally (Wardani, 2016).

Mining activities that use an open-pit mining system provide significant changes to land clearance and have the potential to have an important impact on the environment. The main activities are in the form of excavation and stockpiling activities of excavated materials and overburden (Firman, 2017)

This research aims to analyze spatially the changes in land use in the mining area of Kalumata Village, South Ternate District using the Geographic Information System (GIS) from 2014 to 2024.

Method

The research area is in Kalumata Village, South Ternate District which is shown on the map of the location of the research area to be conducted. The time used to identify land use changes is 2014 and 2024. The time for the research was carried out in March 2024 – December 2024.



Picture 1. Research Area

The data used in this study is remote sensing data or image data. The image data used is landsat image data in 2014 and 2024. The type of landsat imagery is landsat 8 sourced from the USGS. The Landsat 8 imagery for the Operational Land Imager (OLI) sensor is the latest satellite image that has the ability to identify land cover classes. The OLI sensor has a spatial resolution of 30 meters x 30 meters and a spectral resolution of 8 bands. This image data will be used later to become land use data for the research area. Other data is the administrative data of Kalumata Village which is included in the research area obtained from the Indonesian Terrain Map (RBI) sourced from BIG/Geospatial Information Agency

The results of land cover and land use maps obtained from the results of landsat 8 image processing were cut using an administrative map of the research area with features in GIS software. The land use map of the research area in 2014 and 2024 overlapped with the features in the GIS software. The result of overlapping the two maps is generalized to eliminate polygons with small sizes. So that a map of land use changes in the mining area of Kalumata Village was produced. In the database (data attributes) of land use maps, area recalculation is carried out using features in GIS software so that the area for each polygon is obtained.

Result and Discussion

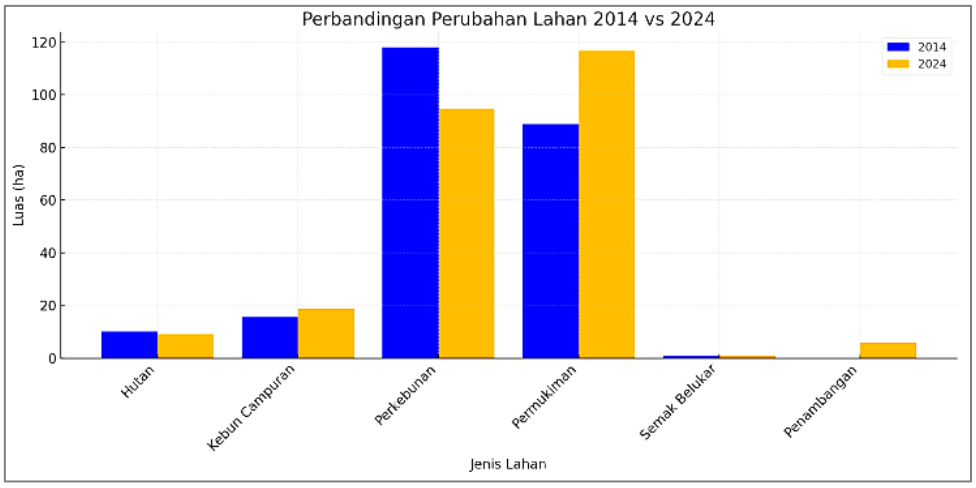
The land use map was obtained from the Landsat 8 satellite image processing process. Next, classification is carried out to obtain the class of each land cover

Land Use Change

Land use in Kalumata Village is divided into 6 land cover classifications in 2014 namely, forest land, plantations, mixed gardens, settlements, bushes and open areas and 7 land cover classification in 2024 namely, forest land, plantations, mixed gardens, settlements, bushes, open areas, and mining areas. Shown in table 1 below.

Table 1. Land use in 2014 and 2024

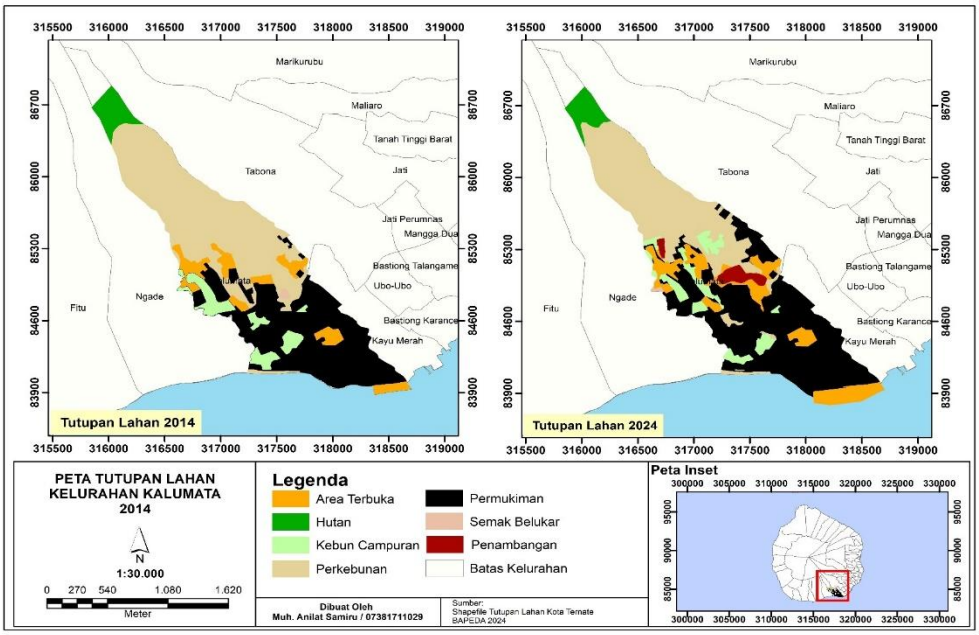
Land use (2014)	Area (Ha)	Land use (2024)	Area (Ha)
Open Area	16,95	Open Area	19,59
Forest	10,11	Forest	9,10
Mixed Garden	15,51	Mixed Garden	18,72
Plantation	117,94	Plantation	94,70
Settlement	88,79	Setlement	116,80
Shrubs	0,75	Shrubs	0,99
		Mining Area	5,95



Picture 2. Land Use Change Comparison Chart

Based on the land change graph, it can be seen that there are several changes, both increases and decreases in land from 2014-2024. The increase in the mixed garden area is 3.22 ha (5.5%), the shrub area is 0.24 ha (0.41%) and the residential area is 28.1 ha (48%) of the total area. In the open area there was also a change, namely a decrease in the area of 2.62 ha (5.52%) and also in the plantation area there was a significant decrease of 23.24 ha (39.8%) and the forest area was 1.1 ha (1.7%).

In 2024, there will be an additional mining area of 5.9 ha (10.1%) where this change consists of open areas and mixed garden areas that have been converted into mining areas. Many plantation lands are converted into residential areas. This can happen as the population increases, the need for housing and infrastructure, and public facilities also increase. Also, deforestation for new land is also a result of the increasing need for land for various economic and social activities. This change can occur in the Kalumata area because in general the city of Ternate itself has high population growth, where pressure on land is increasing.



Picture 3. Map of Land Use Changes in 2014-2024

Land use changes from 2014 to 2024 show a distinctive trend in the development of the Kalumata region, mainly due to urbanization, economic changes, and exploitation of natural resources. One of the most significant changes is the increase in the area of settlements by 28,01 ha, which is most likely due to population growth and the expansion of the urban area of Ternate City. Rapid urbanization often causes land conversion from plantations or forests to residential areas. In addition, government spatial planning policies that support the development of infrastructure and housing can also be a major factor in this change.

On the other hand, the plantation area experienced a significant decline, namely 23.24 ha, which may have occurred due to land conversion into settlements or industry. Changes in agrarian policies and land degradation could also contribute to the reduction in plantation area. Meanwhile, the emergence of new mining areas with an area of 5.95 ha indicates an increase in exploitation of natural resources, both due to investment in the mining sector and changes in policies that grant exploitation permits.

In addition, the forest area decreased by 1.1 ha, which is most likely caused by deforestation to open new land, both for plantations and settlements. Illegal logging activities and the impact of climate change can also accelerate the loss of forest cover. If not managed properly, these changes can have an impact on the ecological balance, including decreasing environmental quality and increasing the risk of natural disasters such as floods and landslides. Deforestation for Land and settlements as a result of the increasing need for land for various economic and social activities. This change often occurs in areas with high population growth, where pressure on land is increasing. In addition, the expansion of infrastructure such as highways and industrial areas also contributes to the loss of forest cover.

Conclusion

Based on the research results, it can be concluded that changes in land use in Kalumata Village experienced quite significant changes in the period 2014–2024. This change was mainly influenced by increasing mining activities and residential developments. Increasingly widespread mining has reduced plantation and forest areas.

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