

## Spatial Analysis Of Land Cover Change In Wae Batu Gajah Watershed, Ambon City In 2013, 2018 And 2023 Using Geographic Information System

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### ABSTRACT

This research presents a spatial analysis of land cover change in the Wae Batu Gajah Watershed, Ambon City, over three time periods, namely 2013, 2018, and 2023, using Geographic Information Systems (GIS). The data used for land cover change analysis are Landsat 7 satellite images for 2013 and satellite images for 2018 and 2023. Land cover is classified based on SNI 7465:2010 on Land Cover Classification which consists of built-up land, open land, non-agricultural land and water bodies. The analysis showed significant changes in land use patterns, including rapid urbanization, loss of natural habitats, and transformation of agricultural land. This information provides an important basis for sustainable regional planning and natural resource management. In addition, this study provides insights into the socioeconomic impacts of land cover change on local communities, and makes an important contribution to the understanding of environmental dynamics and better decision-making for the future of the Wae Batu Gajah watershed.

### Research Paper


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**Keywords:** *Ambon, land cover, GIS, Wae Batu Gajah.*

### INTRODUCTION

The Wae Batu Gajah watershed, located in Ambon City, Indonesia, is an area that plays an important role in the availability of natural resources and a sustainable environment in Maluku Province (Rakuasa, Sihasale, et al., 2022). The watershed has experienced significant changes in land use over the past few decades, along with economic growth and urbanization development in Ambon City (Latue et al., 2023). With this growth, increased human activity around the Wae Batu Gajah watershed has resulted in land cover changes that can have major ecological and social consequences (Latue et al., 2023; Latue & Rakuasa, 2023).

According to Septory et al. (2023), land cover change in the Wae Batu Gajah watershed, Ambon City, certainly has significant impacts both ecologically and socially. The loss of natural farmlands and forests can harm the livelihoods of local agricultural communities, threaten the sustainability of river ecosystems, and increase the risk of flooding and soil erosion (Manakane et al., 2023; Muin & Rakuasa, 2023). Meanwhile, urbanization and industrial development can bring economic benefits, but can also lead to water pollution, loss of natural habitats and environmental degradation (Salakory & Rakuasa, 2022). Therefore, land cover change in these watersheds needs to be managed wisely by considering

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environmental and social aspects in order to maintain a balance between economic growth and environmental sustainability and the welfare of local communities (Latue & Rakuasa, 2023).

Land cover change is a complex phenomenon influenced by various factors, such as population growth, land use policies, climate change, and infrastructure expansion (Somae et al., 2023). Therefore, a comprehensive understanding of these changes is essential to plan and manage the region wisely (Latue, 2023 & Rakuasa). In this context, Geographic Information Systems (GIS) have become an important tool in spatial analysis to monitor and understand land cover change (Latue & Rakuasa, 2023).

According to Sugandhi et al. (2022), the use of Geographic Information Systems (GIS) has become a very useful tool in analyzing land cover change, as it allows for the integration of extensive spatial data and temporal analysis more efficiently. Through the use of GIS technology, we can track changes in land cover patterns over time and identify factors that drive such changes (Manakane et al., 2023). According to Rakuasa et al. (2022), land cover change trends in the region are highly relevant to social and economic development, and have implications for environmental sustainability. Thus, this analysis will make an important contribution to understanding the ongoing dynamics of regional change.

Based on research conducted by Rakuasa et al. (2022), in 2013, the Wae Batu Gajah watershed may have undergone considerable changes, mainly related to urbanization, agricultural land use change, and infrastructure development. GIS analysis will help us identify the patterns and locations of the most significant land cover changes. Furthermore, by 2018, these changes may experience further development in line with the growth of Ambon City. By 2023, further estimates of land cover change will help us forecast future trends. This research will also provide insight into the impact of land cover change on the ecosystem of the Wae Batu Gajah watershed, including the sustainability of the river ecosystem and the availability of water resources (Latue & Rakuasa, 2023). In

addition, this analysis can provide an understanding of the socioeconomic impacts of land cover change on local communities living around the watershed.

Thus, this research has enormous relevance in the context of natural resource management, regional planning, and environmental sustainability in the Wae Batu Gajah watershed, as well as providing a useful framework for the development of better and more sustainable policies for the future of Ambon City and the surrounding region (Manakane et al., 2023). Based on the description above, this research aims to determine land cover changes in the Wae Batu Gajah watershed, Ambon City in 2013, 2018 and 2023 using Geographic Information Systems.

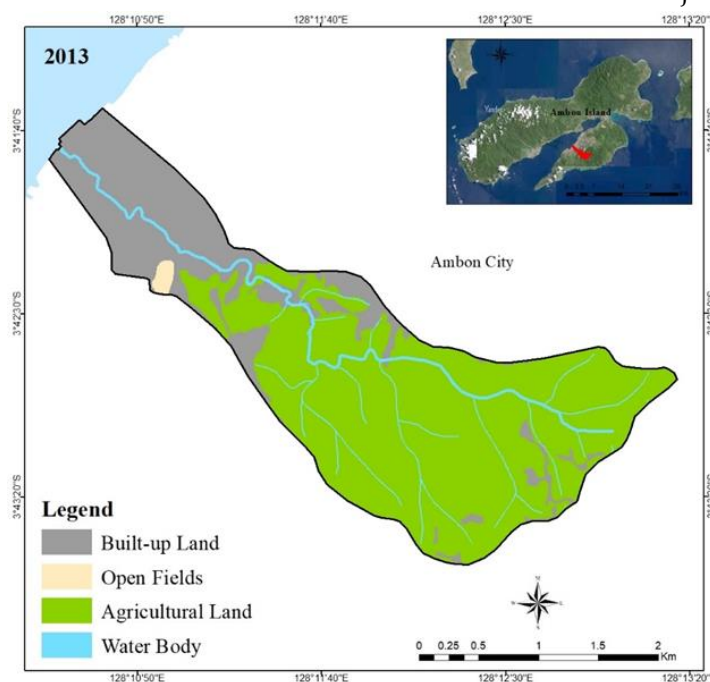
## METHODS

This research was conducted in the Wae Batu Gajah watershed which is geographically located in Ambon City. This research began with a preparatory phase containing literature studies from books, journals, or from the internet. The literature study was conducted to understand the basic theories related to the analysis of land cover change in the Wae Batu Gajah watershed, Ambon City using geographic information systems. After the preparation stage, the next stage is data collection. The data collected consisted of primary data and secondary data, which in this study used a lot of secondary data. The data used to analyze land cover change is Landsat 7 satellite imagery for 2013 and satellite imagery for 2018 and 2023. The satellite image data was downloaded from the United States Geological Survey (USGS) website: <https://earthexplorer.usgs.gov/>. The satellite image data was then subjected to radiometric and geometric correction processes, after which a band composite and pansharpening process was carried out to facilitate the interpretation and classification of land cover. Land cover is classified based on SNI 7465:2010 concerning Land Cover Classification which consists of built-up land, open land, non-agricultural land and water bodies (National Standardization Agency, 2010).

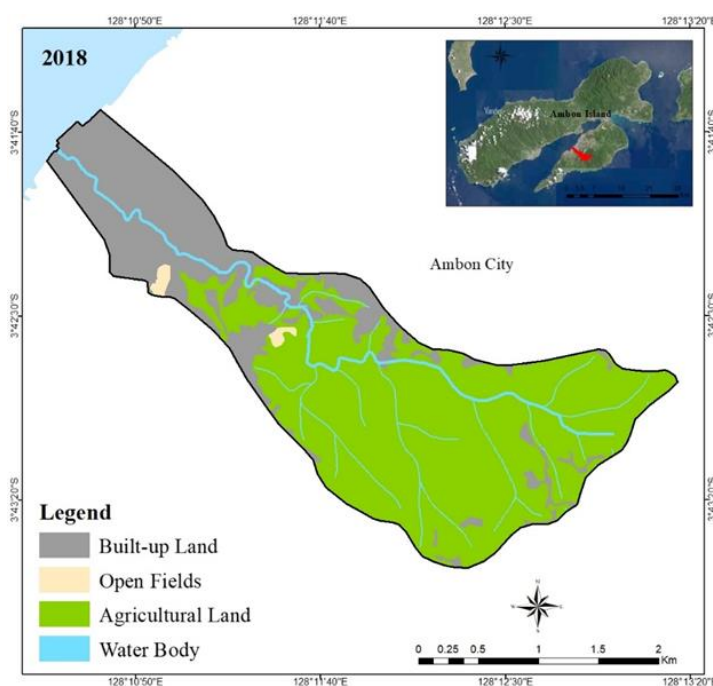
## RESULTS AND DISCUSSION

Land Cover Change in Wae Batu Gajah Watershed, Ambon City was obtained from the processing of Landsat satellite images in 2013, 2018 and 2023 which were validated with field observations. The results of digitization and interpretation are the basis for looking at the development of land cover in

Ambon City over the past 15 years. Based on the results of Landsat 7 image interpretation in 2013, land cover in the Wae Batu Gajah watershed is dominated by built-up land cover covering 176.72 ha or 27.55%, agricultural land covering 457.55 ha or 71.33%, open land covering 3.96 ha or 0.62% and water bodies covering 3.27 ha or 0.51% of the total area of the Wae Batu Gajah watershed.



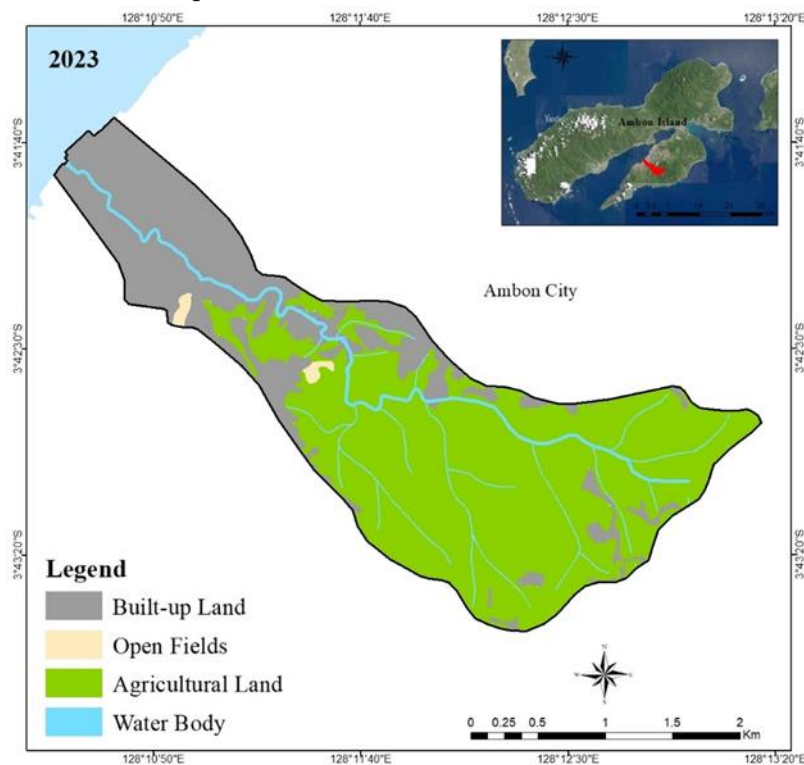
**Figure 1.** Land Cover of Wae Batu Gajah Watershed in 2013



**Figure 2.** Land Cover of Wae Batu Gajah Watershed in 2018

(Rakuasa et al., 2023) area of 193.46 ha or 30.16%, agricultural land had an area of 439.83 ha or 0.77%, open land had an area of 4.95 ha or 0.77% and water bodies had an area of 3.27 ha or 0.51% of the total area of the Batu Gajah watershed. In 2023 built-up land cover

experienced an increase in area of 335.11 ha or 31.96%, open land had an area of 4.2 ha or 0.65%, agricultural land had an area of 429.02 ha or 66.88% and water bodies had an area of 3.27 ha or 0.51% of the total area of the Wae Batu Gajah watershed.



**Figure 3.** Land Cover of Wae Batu Gajah Watershed in 2023

Based on Figures 1, 2 and 3, it can be seen that land cover changes in 2013, 2018 and 2023 in the Batu Gajah watershed, Ambon City have increased in built-up land cover, while land cover that has decreased is agricultural land cover and non-agricultural land cover. Then land cover that does not change is only water land cover. The development of residential land cover is mostly towards the north and west. The rate of population growth in Ambon City each year and also supported by the increasing flow of migration due to the high attractiveness of the city, especially the economic sector for residents in the surrounding area, has resulted in the continuing high demand for urban space, including for settlements, health facilities, educational facilities, trade facilities, services and so on, which is one of the factors that trigger changes in the cover of the watershed located in the center of Ambon City. This is supported by the opinion of Sihasale et al.,

(2023) that the movement of people from rural to urban areas, brings substantial and diverse changes to urban land, both in land use and land cover. Pertuack et al., (2023), added that the increase in population is in line with the increase in human activities in various sectors, especially the economic sector, so that the need for land resources will also continue to increase. Spatial Analysis of Land Cover Change in Wae Batu Gajah Watershed, Ambon City in 2013, 2018, and 2023 using Geographic Information System (GIS) provides a number of important benefits:

- 1) Environmental Change Monitoring: This analysis enables extensive monitoring of changes in land cover over significant periods of time (Rakuasa et al., 2023). This provides a better understanding of how land use patterns have changed over time and how those changes affect the



environment in the Wae Batu Gajah watershed.

- 2) Identification of Trends and Causal Factors: Through GIS, we can identify trends in land cover change and the factors driving such changes. For example, does urbanization, population growth or land use policies have a significant impact? This information is important for better urban planning, land management and policy making (Sugandhi et al., 2023).
- 3) Natural Resource Management: This analysis can help in the management of natural resources, such as forests, water, and land. Through understanding land cover change, we can identify areas that are vulnerable to soil erosion, changes in water quality, or loss of natural habitats. This can help in planning appropriate conservation and restoration measures (Sugandhi et al., 2023)
- 4) Understanding Socioeconomic Impacts: In addition to environmental impacts, this analysis also provides insight into the socioeconomic impacts of land cover change (Sihasale et al., 2023). How do these changes affect the livelihoods of local communities and the economy of the region? This information can help in the development of sustainable development programs.
- 5) Better Regional Planning: The results of GIS analysis can be used in better regional planning (Latue et al., 2023). This involves more effective policy making, land use planning, and sustainable infrastructure development. This information can assist local governments in better managing regional growth (Latue et al., 2023).

Thus, spatial analysis of land cover change using GIS is an invaluable tool for environmental understanding, natural resource management, and sustainable decision-making in the Wae Batu Gajah watershed, Ambon City. Spatial Analysis of Land Cover Change in the Wae Batu Gajah

watershed, Ambon City in 2013, 2018, and 2023 using Geographic Information Systems (GIS) provides a number of important benefits.

## CONCLUSION

In this study, spatial analysis of land cover change using Geographic Information Systems (GIS) in the Wae Batu Gajah watershed, Ambon City, over the periods 2013, 2018, and 2023 has revealed a deep understanding of the dynamics of environmental change in the area. The results show significant changes in land use over the period, which include rapid urbanization, loss of natural habitats, and transformation of agricultural land. This information is important for sustainable regional planning, natural resource management and better decision-making. In addition, this study provides insights into the socioeconomic impacts of land cover change on local communities. As such, this research makes an important contribution to efforts to maintain environmental sustainability and community welfare in the Wae Batu Gajah watershed, and provides a solid foundation for better policy development in the future.

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### Author's declaration

### Authors' contributions and responsibilities

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

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### Availability of data and materials

All data are available from the authors.

### Competing interests

The authors declare no competing interest.

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