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Coastal Landcover Dynamics In Cimanuk, West Java

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Abstract. The coastal region of Cimanuk is characterized by its complex interactions between freshwater and marine environments, resulting in distinctive ecological dynamics. These interactions can significantly influence the dynamics of land cover changes. This study aims to assess the coastal dynamics in Cimanuk, focusing on landcover changes due to both natural processes and anthropogenic influences. The research employs remote sensing techniques, utilizing imagery from Landsat 8 OLI to effectively analyze landcover variations. A multispectral classification method was applied to interpret landcover types, which include built-up lands, open lands, mangroves, vegetations and aquaculture areas. This methodology allowed for an accurate temporal analysis of landcover dynamics. The analysis revealed that agricultural lands predominate the coastal landscape, underscoring the region's heavy reliance on farming activities, which are characterized by different times of harvest and growth phases throughout the year. These findings underscore the necessity for effective management strategies to balance economic development and environmental conservation in the Cimanuk coastal region. Overall, this research emphasizes the importance of understanding landcover dynamics in coastal areas, providing valuable insights for sustainable land management and policy-making in the face of environmental changes.

Keywords : Landcover; Coastal Dynamics; Cimanuk

INTRODUCTION

The coastal region of Cimanuk located in the northern of West Java, Indonesia. This region is a dynamic area characterixed by the Cimanuk delta, one of the most rapidly developing river deltas in West Java (Aidi, 2019). The dynamism of the Cimanuk coastal area is evidenced by changes in landcover. Understanding landcover dynamics in this region is crucial for effective resource management, environmental conservation, and sustainable development (Shang & Wu, 2022). This study employs geospatial data, particularly from satellite imagery, to analyze the changes in land cover over time. Geospatial data allows for the monitoring and assessment of landcover patterns and changes (Polat & Kaya, 2021), providing a spatial resolution that is important for understanding the interactions between various landcover types. This research investigates the dynamics of landcover in Cimanuk across different time periods. The utilization of new generation of Landsat 8, which bringing sensor Operational Land Imager (OLI), offers multi-temporal imageries to analyze landcover changes over several years (Jia et al., 2014), providing insights into trends and dynamic in the coastal of Cimanuk. By applying advanced classification techniques, such as unsupervised classification methods, this study aims to interpret landcover types accurately. This classification facilitates an understanding of the factors driving land cover changes, which may include natural processes such as seasonal variations, climatic changes, and anthropogenic influences such as urbanization and agricultural expansion (Assede et al., 2023).

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The findings from this analysis are essential for developing integrated coastal management strategies. By understanding the dynamics of landcover in Cimanuk, stakeholders can make informed decisions that promote sustainable landuse practices, conserve critical habitats, and enhance the resilience of the coastal ecosystem. Moreover, this research contributes to the broader field of coastal studies, providing valuable data that can assist in addressing global challenges such as climate and environmental changes.

METHOD

This research focuses on the coastal of the Cimanuk, Indramayu, West Java. This area features a flat topography, with land use predominantly dominated by agriculture. The research location is depicted in **Figure 1** below.

Figure 1. The Study Area

Land use interpretation was conducted using Landsat 8 OLI imagery with spatial resolution in 30 meters. **Table 1** presents the Landsat 8 OLI images utilized in this study. The method employed is the multispectral classification method, which has been widely used and has demonstrated good accuracy in land use mapping (Polat & Kaya, 2021). The samples used were derived from ground truth data collected in 2017.

Table 1. Landsat 8 OLI imageries

ID	Date
LC81210642014265LGN00	22 September 2014
LC81210642015140LGN00	20 May 2015
LC81210642016303LGN00	29 October 2016
LC08_L1TP_121064_20170525_20170525_01_RT	25 May 2017

RESULTS AND DISCUSSION

Land cover classification was conducted using guided multispectral classification. In this study, the classification employed the mahalanobis distance method, as it is particularly

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effective for detecting bare earth areas (Polat & Kaya, 2021). The imageries used underwent sharpening, improving the spatial resolution from the original 30 meters to 15 meters. Cloud cover at the study area ranged from 0-5%, resulting in unclasiffied class for cloud cover. The classification of the imagery was based on identifiable features, including built-up areas, open lands (both wetland and dry land), low-density vegetation, medium-density vegetation, mangroves, and aquaculture areas. A comparison of the landcover interpretation results along the coastal of Cimanuk is illustrated in **Figure 2** below.

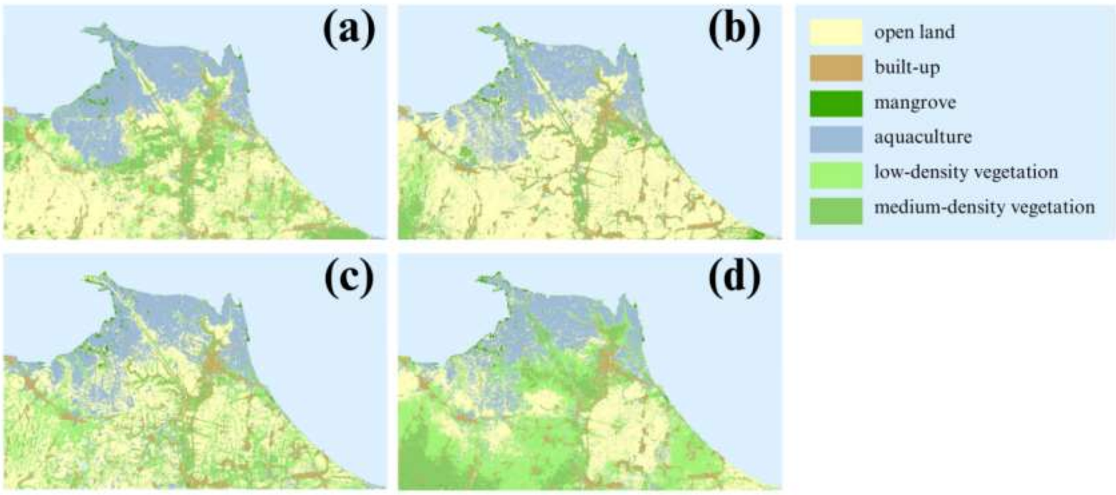

Figure 2. Multispectral classification results in (a) 2014; (b) 2015; (c) 2016; (d) 2017

The landcover classification in Cimanuk shows the dynamics of increasing and decreasing areas every year as presented in **Figure 3**. However, several classes remain relatively consistent across the years, including built-up areas, mangroves, and aquaculture ponds. In contrast, the classes for open land, low-density vegetation, and medium-density vegetation exhibit significant changes annually.

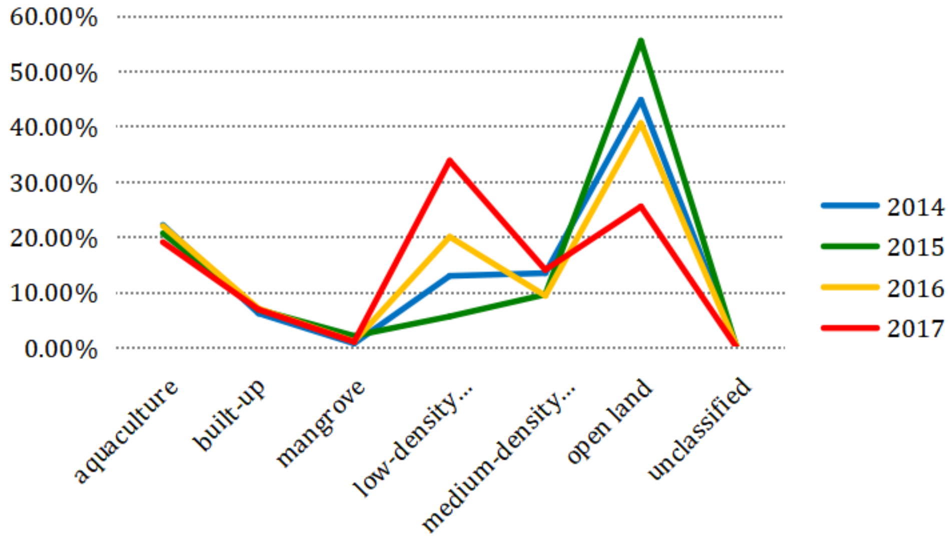

Figure 3. Landuse change in coastal regions of Cimanuk

Built-up areas, mangroves, and aquaculture areas are characteristics that do not change significantly from year to year. Built-up areas include structures such as residential

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housing, public facilities, offices, and other buildings, did not experience rapid changes between 2014 and 2017. This is due to the population growth or urban development in Indramayu is not concentrated in coastal areas, resulting in the presence of only rural communities (Suryanto et al., 2023). Similarly, both aquaculture areas and mangroves did not undergo significant alterations during the years 2014 to 2017. These two landcovers are interrelated, particularly regarding the productivity of aquaculture, which is positively associated with mangrove density (Maulidar & Samosir, 2016).

Indramayu, in general, is predominantly characterized by agriculture, primarily rice paddy fields (Ridwansyah et al., 2020). Each year, the agricultural land experiences varying seasonal patterns due to the unpredictable climate in Indonesia (Nugroho & Nuraini, 2016). This climate variability influences the harvest seasons of farmers in the surrounding Cimanuk area. Imagery captured in the same month—May—of 2015 and 2017 reveals differences in planting seasons as illustrated in **Figure 4**. In 2015, the peak harvest period in Indramayu occurred in April and May, resulting in several areas already having completed their harvest. This peak harvest period coincided with the planting season, which commenced during the wet months in February 2015, while drought conditions were observed from May to October 2015 (Tamamadi et al., 2015). Rice paddy fields that have undergone harvesting appear as open lands in imagery as depicted in box **a** in **Figure 4 (a)** below.

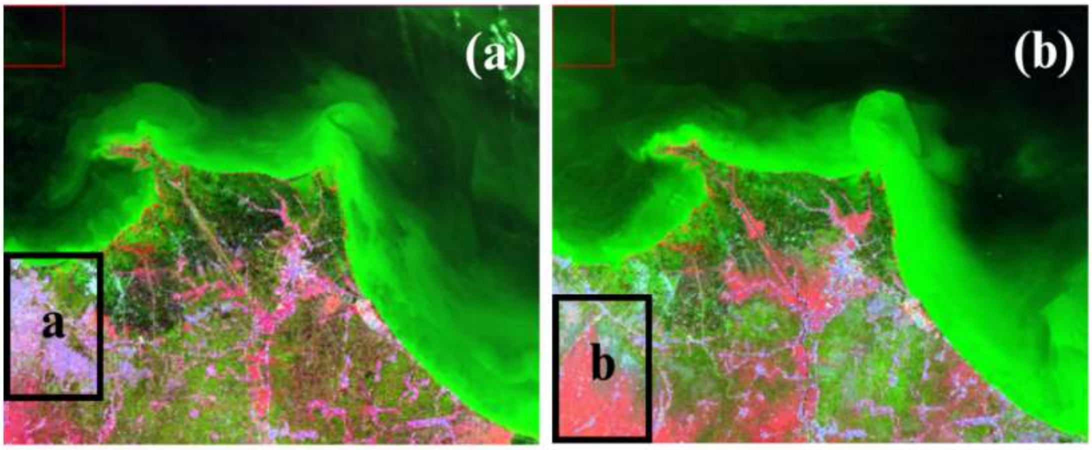

Figure 4. Imageries in **(a)** May 2015 and **(b)** May 2017

In 2017, a drought issue prompted some farmers to accelerate their planting schedules, even during the harvest period. As a result, dryland agriculture increased in 2017 (Ridwansyah et al., 2021). Certain regions initiated their planting activities earlier, in March 2017, as reported by Republika (2017). This conditioan led to the imagery captured in May 2017 showing rice paddies dominated by medium-density vegetation as illustrated in box **b** in **Figure 4 (b)**. This shift highlights the adaptive responses of local farmers to climatic changes and underscores the influence of external factors on agricultural practices in the region.

The area of open lands in 2014 and 2016 was notably high, approaching the extent of open lands observed in 2015. As previously mentioned, the open land detected in 2015 was influenced by a significant harvest that occurred prior to the image capture date, resulting in agricultural lands being classified as open lands post-harvest. Similarly, the extent of open

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lands in 2014 was attributed to a harvest that took place before the image acquisition in September 2014. However, it is important to note that the harvest in 2014 was predominantly characterized by soybean crops (Juswadi et al., 2021). A similar situation was observed in the imagery captured in 2016, where harvesting occurred prior to the image acquisition in October, causing agricultural lands to be classified as open lands. The harvest took place one month before the image acquisition, specifically in September 2016 as reported by Tempo (2016). Field surveys conducted in May 2017 aligned with the imagery used for interpretation in that year. This survey facilitated the verification of the imagery classifications with the actual conditions observed in the field. The groundtruth and existing landcover as illustrated in **Figure 5** below.

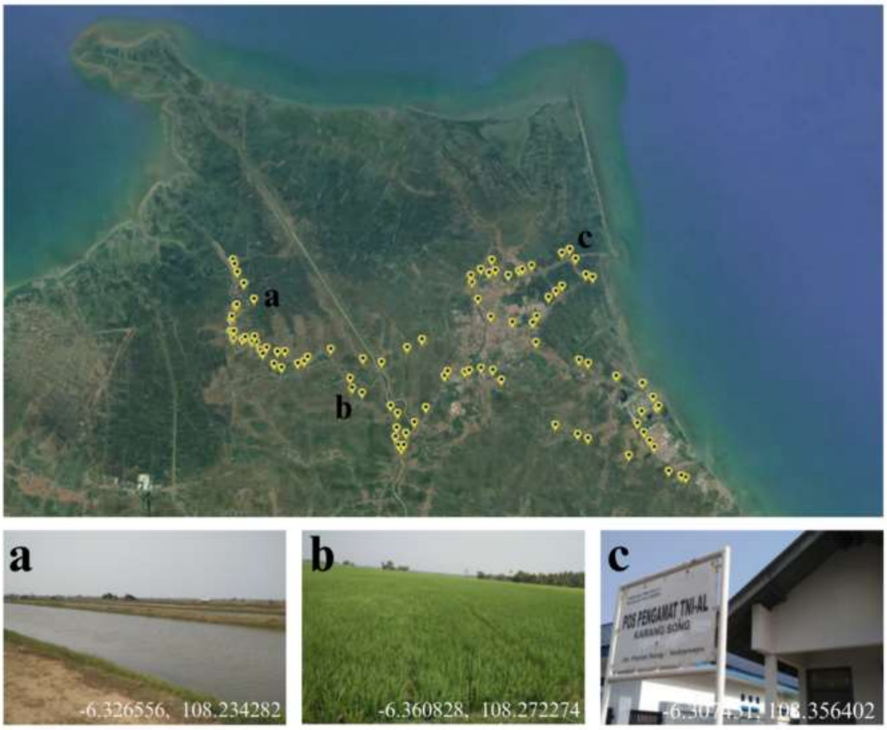

Figure 5. The groundtruth data and existing landcover by field survey

The findings of this study indicate that the dynamics of landcover change in the Cimanuk coastal area were predominantly influenced by both natural and anthropogenic activities, particularly in agricultural areas. Natural factors, represented by weather and climate, significantly impact planting and harvesting seasons in Cimanuk. Anthropogenic activities play a crucial role in accelerating planting seasons to mitigate the risk of crop failure due to dry or wet season changes. This condition exemplifies the adaptations of coastal communities in Cimanuk, particularly in response to climate change. The results of this study are expected to provide an understanding of land cover dynamics for the community and government in developing strategies to address environmental changes.

CONCLUSION

The landcover identified in the Cimanuk coastal area includes built-up areas, open lands, mangroves, low-density vegetation, medium-density vegetation, and aquaculture areas. A small portion of the data could not be classified due to cloud coverage ranging from

0-5%. The built-up areas, mangroves, and aquaculture areas did not experience significant changes. However, there were notable dynamics in open lands and low-density vegetation, which were identified as agricultural lands. The level of dynamism in agricultural land is attributed to the fact that planting and harvesting seasons do not remain consistent each year. Nevertheless, the community, particularly farmers, has adapted to these conditions by taking into account the dry and wet seasons to mitigate the risk of crop failure. This study has limitations due to the ground truth data from the year 2017, which has led to less optimal information for subsequent years. Future research should aim to update this information with more recent data by incorporating additional parameters for coastal dynamics that are more detailed such as coastline change and sediment accumulations.

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