

**PEMODELAN PERUBAHAN EKOSISTEM BENTANG LAHAN
WILAYAH PESISIR DAERAH ISTIMEWA YOGYAKARTA
DALAM KERANGKA PERUBAHAN IKLIM GLOBAL**

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INTISARI

Dinamika penutup dan penggunaan lahan (LULC) di wilayah pesisir Daerah Istimewa Yogyakarta (DIY) serta sensitivitasnya terhadap paparan kenaikan muka laut global (SLR) dapat mempercepat degradasi lingkungan dan meningkatkan kerentanan wilayah terhadap risiko perubahan iklim. Kondisi ini memicu fragmentasi bentang lahan yang berdampak langsung pada penurunan kualitas habitat ekosistem penting. Penelitian ini mengintegrasikan data citra satelit dan observasi lapangan untuk menyediakan analisis yang komprehensif dalam mencapai tujuan berikut : (1) membangun model perubahan struktur bentang lahan berbasis penutup/penggunaan lahan dalam kerangka perubahan iklim global; (2) menilai pengaruh perubahan struktur bentang lahan terhadap kualitas habitat pada ekosistem esensial; dan (3) menganalisis hubungan antara perubahan struktur bentang lahan dan struktur sosial.

Pemodelan LULC masa depan (2030, 2040, dan 2050) dikembangkan menggunakan metode CA-Markov (TerrSet) berdasarkan tren historis 2019–2024 melalui skenario dasar dan *policy-driven* berbasis RTRW. Dampak SLR global 2050 dimodelkan melalui skenario SSP1, SSP2, dan SSP5. Kualitas habitat spesies *Calidris tenuirostris* yang terancam punah berdasarkan IUCN *Red List* di Kawasan Ekosistem Esensial (KEE) Burung Migran Trisik dinilai menggunakan model InVEST. Pengaruh fragmentasi bentang lahan terhadap kualitas habitat ditentukan melalui analisis statistik, sedangkan hubungannya dengan struktur sosial dievaluasi menggunakan analisis deskriptif pada data demografi, pendidikan, dan ekonomi wilayah.

Akurasi rata-rata model pada seluruh wilayah mencapai 79,77% (*RMSE* 0,3469 dan *skill* 0,6255) sehingga dapat cukup diandalkan dalam aplikasi praktis. Hasil menunjukkan persentase fragmentasi terbesar terjadi di pesisir Bantul dengan pola *ribbon development* sebagai manifestasi fenomena *urban sprawl* dan kepadatan jaringan jalan, fragmentasi dengan pola intensif dan terpusat terbentuk di Kulon Progo akibat dampak Aerotropolis, sedangkan fragmentasi secara masif muncul pada bentuk lahan perbukitan karst di Gunungkidul sebagai implikasi terbukanya aksesibilitas wilayah efek pembangunan JJLS. Skenario SSP5 memicu risiko kehilangan lahan tertinggi di Kapanewon Galur Kabupaten Kulon Progo (1,13%) dan degradasi 0,95 Hektar pada zona inti habitat di KEE Burung Migran Trisik. Analisis statistik mengonfirmasi pengaruh negatif signifikan fragmentasi terhadap kualitas habitat (*p-value* < 0,05; *rho* -0,1974 hingga -0,3661; Prob > F < 0,05; *r*² 0,0665 hingga 0,1032). Pendorong utama terjadinya fragmentasi bentanglahan bergeser dari kepadatan penduduk (>800 jiwa/km²) dan kegiatan ekonomi pada periode historis menuju kebijakan pembangunan infrastruktur strategis di masa depan. Temuan ini menegaskan perlunya integrasi prinsip keadilan spasial dalam perencanaan infrastruktur untuk memastikan distribusi manfaat dan risiko lingkungan yang lebih adil, sekaligus mendukung kebijakan pengembangan pesisir yang tangguh terhadap perubahan iklim, inklusif, dan berkelanjutan guna menjaga integritas ekosistem penting di wilayah tersebut.

Kata Kunci : LULC, Kenaikan Muka Air Laut Global, Fragmentasi, Kualitas Habitat, Pesisir DIY.

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**MODELING LANDSCAPE ECOSYSTEM DYNAMICS IN
YOGYAKARTA COASTAL REGION UNDER GLOBAL CLIMATE CHANGE**

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ABSTRACT

Land cover and land use (LULC) dynamics in the coastal areas of the Special Region of Yogyakarta (DIY) and their sensitivity to global sea level rise (SLR) can accelerate environmental degradation and increase the region's vulnerability to climate change risks. These conditions trigger landscape fragmentation, which directly impacts the decline in the quality of important ecosystem habitats. This study integrates satellite imagery data and field observations to provide a comprehensive analysis in achieving the following objectives : (1) to develop a model of landscape structure change based on land cover/land use within the framework of global climate change; (2) assess the impact of landscape structure change on habitat quality in essential ecosystems; and (3) analyze the relationship between landscape structure change and social structure.

*Future LULC modeling (2030, 2040, and 2050) was developed using the CA-Markov (TerrSet) method based on historical trends from 2019 to 2024 through baseline and policy-driven scenarios based on RTRW. The impact of global SLR in 2050 was modeled using the SSP1, SSP2, and SSP5 scenarios. The habitat quality of the endangered *Calidris tenuirostris* species based on the IUCN Red List in the Essential Ecosystem Area (KEE) of Trisik Migratory Birds was assessed using the InVEST model. The effect of landscape fragmentation on habitat quality was determined through statistical analysis, while its relationship with social structure was evaluated using descriptive analysis of demographic, educational, and economic data for the region.*

The average accuracy of the model across the entire region reached 79,77% (RMSE 0,3469 and skill 0,6255), making it reliable enough for practical applications. The results show that the highest percentage of fragmentation occurs on the coastal region of Bantul with a ribbon development pattern as a manifestation of urban sprawl and road network density. Fragmentation with an intensive and centralized pattern is formed in Kulon Progo due to the impact of Aerotropolis, while massive fragmentation appears in the form of karst hills in Gunungkidul as an implication of the opening of regional accessibility due to JJLS development. The SSP5 scenario triggered the highest risk of land loss in Kapanewon Galur, Kulon Progo Regency (1.13%) and a degradation of 0.95 hectares in the core habitat zone of the Trisik Migratory Bird KEE. Statistical analysis confirms the significant negative impact of fragmentation on habitat quality (p -value < 0,05; ρ -0.1974 to -0.3661; $\text{Prob} > F < 0,05$; r^2 0,0665 to 0,1032). The main drivers of landscape fragmentation have shifted from population density (>800 people/km²) and economic activities in the historical period to future strategic infrastructure development policies. These findings emphasize the need to integrate the principle of spatial justice into infrastructure planning to ensure a more equitable distribution of environmental benefits and risks, while supporting coastal development policies that are resilient to climate change, inclusive, and sustainable in order to maintain the integrity of important ecosystems in the region.

Keywords : LULC, SLR Global, Fragmentation, Habitat Quality, Yogyakarta Coastal.

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