

Evaluasi Status Keberlanjutan Pengelolaan Kawasan Ekosistem Esensial Mangrove dan Prediksi Tutupan Lahan di Desa Tireman, Kabupaten Rembang

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INTISARI

Pengelolaan Kawasan Ekosistem Esensial (KEE) Mangrove Tireman menjadi penting karena kawasan ini memiliki peran strategis secara ekologis, ekonomi, dan sosial. Nilai ekosistem yang tinggi menjadikan kawasan ini rentan terhadap tekanan yang dapat menyebabkan degradasi mangrove. Oleh karena itu, analisis keberlanjutan dibutuhkan untuk memastikan pengelolaan KEE menjadi efektif dan berkelanjutan. Selain itu, prediksi tutupan lahan tahun 2030 diperlukan sebagai dasar perencanaan dan antisipasi perubahan di masa depan. Penelitian ini bertujuan untuk menganalisis keberlanjutan pengelolaan KEE Mangrove Tireman serta memprediksi tutupan lahannya pada tahun 2030.

Penelitian menggunakan metode *Multi-Dimensional Scaling* untuk menilai keberlanjutan berdasarkan enam dimensi, yaitu ekologi, ekonomi, etika lingkungan, sosial, kelembagaan, dan teknologi. Selain itu, prediksi tutupan lahan tahun 2030 dilakukan menggunakan metode *Cellular Automata–Artificial Neural Network* dengan memanfaatkan citra Sentinel-2A melalui *Google Earth Engine*. Klasifikasi tutupan lahan didasarkan pada *Combine Mangrove Recognition Index* tahun 2018 dan 2021, serta variabel pendorong berupa jarak terhadap jalan, sungai, permukiman, dan kelerengan pantai.

Hasil penelitian indeks keberlanjutan yaitu Kurang Berkelanjutan; dengan indeks Cukup Berkelanjutan pada dimensi ekologi, sosial, dan teknologi; serta indeks Kurang Berkelanjutan pada dimensi ekonomi, etika lingkungan, dan kelembagaan. Atribut sensitif yang memengaruhi indeks keberlanjutan mencakup keanekaragaman mangrove, tutupan tajuk, pH air, kerapatan vegetasi, ketebalan lumpur, rehabilitasi mangrove, jasa wisata, pendanaan, pendapatan, akses, pemanfaatan mangrove, tingkat pemetaan, peran serta, pemahaman masyarakat, konflik pengelolaan, sarana prasarana, penataan wilayah, promosi, fasilitasi, dan pendampingan. Tutupan lahan KEE menunjukkan penurunan luas mangrove dari 6,65 ha pada 2018 menjadi 3,31 ha pada 2021. Diperkirakan pada 2030 akan menyusut menjadi 1,82 ha. Temuan ini menunjukkan bahwa tanpa intervensi yang tepat, fungsi ekosistem mangrove akan semakin terancam. Oleh karena itu, hasil penelitian ini menjadi dasar penting dalam merumuskan strategi pengelolaan yang lebih terarah, yaitu peningkatan kapasitas kelembagaan, rehabilitasi mangrove, dan penguatan partisipasi masyarakat guna mencegah penurunan kualitas ekosistem di masa depan.

Kata Kunci: *Cellular Automata - Artificial Neural Network*, Kawasan Ekosistem Esensial, Mangrove, Multidimensional Scalling, Prediksi Tutupan Lahan.

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Evaluation of the Sustainability Status of Essential Mangrove Ecosystem Management and Land Cover Prediction in Tireman Village, Rembang Regency

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ABSTRACT

The management of the Essential Ecosystem Area (EEA) of Tireman Mangrove is crucial due to its strategic ecological, economic, and social roles. Its high ecosystem value makes the area vulnerable to pressures that can lead to mangrove degradation. Therefore, a sustainability analysis is necessary to ensure that EEA management is both effective and sustainable. Additionally, predicting land cover for the year 2030 is essential as a basis for planning and anticipating future changes. This study aims to analyze the sustainability of the Tireman Mangrove EEA management and to predict its land cover in 2030.

The research employs the Multi-Dimensional Scaling (MDS) method to assess sustainability based on six dimensions: ecology, economy, environmental ethics, social, institutional, and technology. Moreover, land cover prediction for 2030 is conducted using the Cellular Automata–Artificial Neural Network method, utilizing Sentinel-2A imagery via Google Earth Engine. Land cover classification is based on the Combined Mangrove Recognition Index for 2018 and 2021, along with driving variables such as distance to roads, rivers, settlements, and coastal slope.

The sustainability index results indicate a "Less Sustainable" status; with "Fairly Sustainable" ratings in the ecological, social, and technological dimensions, and "Less Sustainable" ratings in the economic, environmental ethics, and institutional dimensions. Sensitive attributes influencing the sustainability index include mangrove biodiversity, canopy cover, water pH, vegetation density, mud thickness, mangrove rehabilitation, tourism services, funding, income, access, mangrove utilization, mapping level, community participation, public understanding, management conflicts, infrastructure, spatial planning, promotion, facilitation, and mentoring. The EEA land cover shows a decrease in mangrove area from 6.65 hectares in 2018 to 3.31 hectares in 2021, and it is projected to further shrink to 1.82 hectares by 2030. These findings indicate that without proper intervention, the ecological functions of the mangrove ecosystem will be increasingly threatened. Therefore, this study serves as an essential foundation for formulating more targeted management strategies, including strengthening institutional capacity, mangrove rehabilitation, and enhancing community participation to prevent future ecosystem degradation.

Keywords: Cellular Automata - Artificial Neural Network, Essential Ecosystem Area, Mangrove, Multidimensional Scaling, Land Cover Prediction.

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