

INTISARI

Pertambangan batu bara berkontribusi besar pada ekonomi, namun menimbulkan kerusakan ekosistem serius dengan pemulihan alami terbatas, sehingga diperlukan proses reklamasi untuk pengelolaan pasca tambang berkelanjutan. Penelitian ini bertujuan untuk mengetahui dinamika tutupan, mengevaluasi keanekaragaman hayati serta kesehatan tanah secara kronosekuen pada lahan reklamasi umur 1, 5, 10 tahun setelah revegetasi. Penelitian dilakukan di blok Air Laya, Kecamatan Tanjung Enim, Kabupaten Muara Enim, Sumatera Selatan.

Dinamika tutupan dianalisis dengan indeks vegetasi NDVI, EVI, SAVI menggunakan citra Sentinel 2 MSI resolusi 10 m per blok. Keanekaragaman hayati dievaluasi menggunakan indeks Shannon, Evenness, dan Richness berdasarkan tingkat perkembangan vegetasi (semai, sapihan, tiang, pohon) secara plot bersarang dengan 10 petak ulangan ukuran 20m x 20m per blok. Kesehatan tanah dievaluasi melalui sifat fisik (tekstur tanah, berat volume dan jenis tanah, porositas, kapasitas lengas tersedia, jeluk mempan bor), sifat biologi (bahan organik tanah, karbon aktif tanah, respirasi tanah), dan sifat kimia (pH H₂O, unsur NH₄, P, K, Mg, Fe, Mn, Cr dapat diekstrak Morgan) pada jeluk tanah 0-5 cm secara komposit dengan 3 ulangan.

Hasil analisis indeks vegetasi menunjukkan peningkatan seiring bertambahnya umur reklamasi, dengan NDVI 0,42–0,80; EVI 0,42–0,47; SAVI 0,40–0,43. Kepadatan spesies, indeks Shannon, dan Richness menunjukkan peningkatan pada tingkat tiang dan pohon. Spesies seperti *Pterocarpus indicus* (Angsana) dan *Senna siamea* (Johar) dapat beradaptasi dan beregenerasi dengan baik sebagai tanaman pionir. Sedangkan spesies lokal seperti *Mallotus paniculatus* (Balig angin), *Commersonia bartramia* (Ndilau), *Bridelia tomentosa* (Keliat), *Vitex pinnata* (Laban) mampu tumbuh alami di petak pengamatan. Kesehatan tanah mengalami tren perbaikan pada struktur tanah dengan berat jenis menurun dari 2,99-2,11 g/cm³, berat volume dari 1,20-0,96 g/cm³, kapasitas lengas tersedia (0,13-0,19 g/g) dengan seluruh tekstur tanah dominan lempung (clay). Aspek biologi tanah memperlihatkan kandungan karbon aktif meningkat (378,01-591,48 mg/kg), namun bahan organik secara total menurun (4,44-3,43%) dengan respirasi tanah sangat rendah (0,13–0,18 mg CO₂/g) pengaruh terhambatnya aktivitas mikroba dari pH tanah sangat masam (3,71–4,27) atau sebagai faktor pembatas. Hara makro NH₄ (7,07-50,68 mg/kg), P (23,89-82,06 mg/kg), K (44,41-49,01 mg/kg), Mg (145,84-194,35 mg/kg), mikro Fe (44,42-108,13 mg/kg) Mn (33,58-71,39 mg/kg), dan logam berat Cr (680-1160 µg/kg) mengalami dinamika yang beragam. Melalui pendekatan kronosekuen, penelitian ini menunjukkan dinamika tutupan, keanekaragaman hayati, dan kesehatan tanah dapat berfungsi sebagai bioindikator untuk menilai keberhasilan reklamasi serta mengidentifikasi faktor pembatas demi keberlanjutan ekosistem.

Kata kunci: reklamasi pasca tambang, kronosekuen, indeks vegetasi NDVI, keanekaragaman hayati shannon, kesehatan tanah.

ABSTRACT

Coal mining contributes significantly to the economy but causes severe ecosystem degradation with limited natural recovery, thereby necessitating reclamation processes for sustainable post-mining management. This study aims to assess vegetation cover dynamics, biodiversity, and soil health through a chronosequence approach on reclaimed lands aged 1, 5, and 10 years after revegetation. The research was conducted in the Air Laya block, Tanjung Enim District, Muara Enim Regency, South Sumatra.

Vegetation dynamics were analyzed using NDVI, EVI, and SAVI indices derived from Sentinel-2 MSI imagery with a 10 m resolution per reclamation block. Biodiversity was evaluated using Shannon, Evenness, and Richness indices based on vegetation developmental stages (seedlings, saplings, poles, and trees) through nested plots with 10 replicates of 20 × 20 m per block. Soil health was assessed through physical properties (soil texture, bulk density, specific gravity, porosity, available water capacity, effective depth), biological properties (soil organic matter, active carbon, soil respiration), and chemical properties (pH H₂O, extractable NH₄, P, K, Mg, Fe, Mn, Cr using Morgan extraction) at a depth of 0–5 cm, composited with three replicates.

Vegetation indices showed improvement with reclamation age, with NDVI ranging from 0.42–0.80, EVI from 0.42–0.47, and SAVI from 0.40–0.43. Species density, Shannon index, and Richness increased at the pole and tree stages. Pioneer species such as *Pterocarpus indicus* (Angsana) and *Senna siamea* (Johar) adapted and regenerated well, while native species including *Mallotus paniculatus* (Balig angin), *Commersonia bartramia* (Ndilau), *Bridelia tomentosa* (Keliat), and *Vitex pinnata* (Laban) established naturally in observation plots. Soil health exhibited structural improvement, with specific gravity decreasing from 2.99–2.11 g/cm³, bulk density from 1.20–0.96 g/cm³, and available water capacity increasing from 0.13–0.19 g/g, with clay-dominated textures. Biological aspects showed rising active carbon (378.01–591.48 mg/kg), declining total organic matter (4.44–3.43%), and very low respiration (0.13–0.18 mg CO₂/g) due to strongly acidic soil pH (3.71–4.27) acting as a limiting factor. Macronutrients NH₄ (7.07–50.68 mg/kg), P (23.89–82.06 mg/kg), K (44.41–49.01 mg/kg), Mg (145.84–194.35 mg/kg), micronutrients Fe (44.42–108.13 mg/kg), Mn (33.58–71.39 mg/kg), and heavy metal Cr (680–1160 µg/kg) exhibited diverse dynamics. Through a chronosequence approach, this study demonstrates that vegetation cover, biodiversity, and soil health can serve as bioindicators for evaluating reclamation success and identifying limiting factors to ensure ecosystem sustainability.

Keywords: post-mining reclamation, chronosequence, NDVI vegetation index, Shannon biodiversity, soil health