

ABSTRAK

Laguna Segara Anakan di pesisir selatan Jawa menghadapi tekanan antropogenik akibat konversi lahan, sedimentasi, degradasi habitat, dan eksploitasi perikanan. Penelitian ini mengevaluasi dampak tekanan tersebut terhadap struktur trofik dan keseimbangan energi ekosistem menggunakan model *Ecopath with Ecosim* (EwE) berbasis data multi-periode (1980-an, 2000-an, 2020-an). Analisis meliputi perubahan tata guna lahan di DAS Citanduy, struktur jaring makanan, aliran energi antar trofik, *Mixed Trophic Impact* (MTI), spesies kunci (*keystone species*), dan indikator kesehatan ekosistem. Perubahan tata guna lahan di DAS Citanduy—ditandai dengan konversi hutan primer, hutan sekunder, dan sawah menjadi perkebunan, pemukiman, serta lahan kering—telah memperbesar erosi dan *run-off* yang meningkatkan sedimentasi ke hilir. Dampak ini mempercepat penyusutan luasan Laguna Segara Anakan dari 4.070 ha pada 1978 menjadi 907 ha pada 2020, menjadikannya salah satu tekanan ekologis utama yang mengancam keberlanjutan fungsi laguna. Hal tersebut berkontribusi langsung pada penurunan total aliran energi ekosistem (*total system throughput*), dari 8.810,82 t/km²/tahun pada 1980-an menjadi 7.224,93 t/km²/tahun pada 2020-an. Penurunan ini diikuti oleh turunnya *relative overhead* (63,5% → 57,9%), yang menandakan melemahnya kapasitas ekosistem untuk menyerap gangguan serta kecenderungan menuju struktur ekosistem yang lebih sederhana. Hasil menunjukkan dua jalur utama aliran energi, yaitu *grazing food web* (48%) dan *detritus-based food web* (52%), dengan dominasi jalur detrital pada 2020-an. *Transfer efficiency* rata-rata 32,3% mengindikasikan efisiensi tinggi pada trofik rendah–menengah, namun biomassa predator puncak rendah akibat degradasi habitat dan indikasi *overfishing*. MTI mengidentifikasi pusat pengaruh pada produsen primer, detritus, dan predator puncak. Rendahnya *connectance index* (0,28) dan *system omnivory index* (0,11) menandakan struktur trofik sederhana dan rentan. Hasil ini menegaskan pentingnya pengelolaan berbasis ekosistem yang mengintegrasikan perlindungan habitat, pengendalian beban sedimen, dan pengaturan perikanan berkelanjutan.

Kata kunci: Laguna Segara Anakan; tekanan antropogenik; Ecopath with Ecosim; struktur trofik; keseimbangan energi ekosistem.

ABSTRACT

The Segara Anakan Lagoon, located on the southern coast of Java, faces significant anthropogenic pressures from land conversion, sedimentation, habitat degradation, and fisheries exploitation. This study evaluates the impacts of these stressors on trophic structure and ecosystem energy balance using the Ecopath with Ecosim (EwE) model with multi-period data (1980s, 2000s, 2020s). The analysis covers land-use changes in the Citanduy watershed, food web structure, trophic energy flows, Mixed Trophic Impact (MTI), keystone species, and ecosystem health indicators. Land-use change in the Citanduy watershed—characterized by the conversion of primary forest, secondary forest, and rice fields into plantations, settlements, and dryland agriculture—has intensified erosion and run-off, increasing sediment delivery downstream. This process accelerated the shrinkage of the Segara Anakan Lagoon from 4,070 ha in 1978 to 907 ha in 2020, making it a major ecological stressor threatening lagoon sustainability. These changes contributed to a decline in total system throughput, from 8,810.82 t/km²/year in the 1980s to 7,224.93 t/km²/year in the 2020s. This was accompanied by a decrease in relative overhead (63.5% → 57.9%), indicating reduced ecosystem resilience to disturbances and a shift toward a simplified ecological structure. Results highlight two dominant energy pathways: the grazing food web (48%) and the detritus-based food web (52%), with the latter dominating in the 2020s. The average transfer efficiency of 32.3% suggests high efficiency at lower–middle trophic levels, but the biomass of top predators remains low due to habitat degradation and overfishing pressure. MTI analysis identified primary producers, detritus, and top predators as key influence nodes. Low connectance index (0.28) and system omnivory index (0.11) further indicate a simplified and vulnerable trophic structure. These findings emphasize the urgent need for ecosystem-based management that integrates habitat protection, sediment load control, and sustainable fisheries regulation.

Keywords: Segara Anakan Lagoon; anthropogenic pressure; Ecopath with Ecosim; trophic structure; Ecosystem energy balance.