ANALISIS SPASIAL SEBARAN DAN DAMPAK REMBESAN AIR LAUT PADA SEA WALL MUARA BARU JAKARTA UTARA

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ABSTRAK

Penelitian ini bertujuan untuk: (1) menganalisis karakteristik dan pola sebaran spasial rembesan air laut pada struktur *sea wall* di kawasan Muara Baru; (2) mengidentifikasi faktor-faktor fisik yang memengaruhi terjadinya rembesan air laut; serta (3) menilai dampak lingkungan secara berimbang (positif dan negatif) yang ditimbulkan oleh fenomena rembesan air laut tersebut. Penelitian ini dilaksanakan di koridor pesisir Muara Baru, Kelurahan Penjaringan, Kecamatan Penjaringan, Kota Jakarta Utara, dengan pendekatan kualitatif dan analisis spasial deskriptif berbasis Sistem Informasi Geografis (SIG). Data dikumpulkan melalui observasi lapangan pada bentangan tanggul sepanjang 270 meter, pengukuran parameter fisik-kimia salinitas dan berat jenis (*specific gravity*) menggunakan refraktometer tangan ATC pada 4 titik sampling, dokumentasi fisik kerusakan beton, serta wawancara terstruktur dengan warga lokal. Data kemudian dianalisis menggunakan teknik analisis *buffering* radius 100 meter, tumpang susun (*overlay*), serta pengujian klasifikasi salinitas standar UNESCO. Hasil penelitian menunjukkan: (1) sebaran rembesan air laut secara eksplisit membentuk pola sebaran linier menempel ketat mengikuti bentangan *seawall*, dengan genangan lateral setinggi 10–45 cm merendam daratan pada zona kritis *buffer* 100 meter; (2) rembesan air laut dibuktikan secara empiris oleh tingginya gradien tekanan hidrostatis pasang puncak harian Teluk Jakarta sesuai Hukum Darcy, permeabilitas tinggi tanah aluvial Kuarter (*subsurface piping underflow*), serta amblasnya tiang pancang akibat *land subsidence* yang memicu retakan internal dan pelapukan klorida beton (*moisture ingress*); dan (3) pembangunan tanggul memberikan dampak positif berupa perisai mekanis penahan hantaman pasang rob ekstrem (*wave overtopping*) dan penahan abrasi, namun rembesannya menimbulkan dampak negatif berupa salinisasi tanah jenuh garam (40–44 ppt) yang memicu dehidrasi *plasmolisis* tanaman, pelapukan fisik bangunan (*rising damp*), bio-korosi beton oleh kerang hijau (*Perna viridis*), serta terendamnya Masjid Wal Adhuna. Saran untuk penelitian selanjutnya adalah mengkuantifikasi debit rembesan (*seepage flow rate*) menggunakan pemodelan numerik hidrodinamika dua dimensi serta memetakan batas intrusi air asin bawah tanah dengan metode Geolistrik Tahanan Jenis 2D (*2D ERT*).

Kata kunci: *sea wall*, rembesan air laut, analisis spasial, salinitas, Muara Baru.

SPATIAL ANALYSIS OF SEA WATER SEEPAGE DISTRIBUTION AND IMPACT ON THE MUARA BARU SEA WALL NORTH JAKARTA

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ABSTRACT

This study aims to: (1) analyze the characteristics and spatial distribution patterns of seawater seepage on the sea wall structure in the Muara Baru area; (2) identify the physical factors influencing the occurrence of seawater seepage; and (3) assess the balanced environmental impacts (positive and negative) resulting from the seawater seepage phenomenon. This research was conducted in the coastal corridor of Muara Baru, Penjaringan Village, Penjaringan District, North Jakarta City, using a qualitative approach and descriptive spatial analysis based on Geographic Information Systems (GIS). Data were collected through field observations along a 270-meter dyke section, physical-chemical measurements of salinity and specific gravity using an ATC hand-held refractometer at 4 sampling points, documentation of physical concrete degradation, and structured interviews with residents. The data were analyzed using a 100-meter buffer spatial analysis, overlay techniques, and standard UNESCO salinity classification testing. The results show: (1) the distribution of seawater seepage explicitly forms a linear distribution pattern closely following the sea wall structure, with lateral inundation heights of 10–45 cm submerging the land within the 100-meter critical buffer zone; (2) seawater seepage is empirically proven by the high hydrostatic pressure gradient during daily peak Jakarta Bay high tides according to Darcy's Law, high permeability of Quaternary alluvial soil (subsurface piping underflow), and pile settlement due to land subsidence triggering internal cracking and concrete chloride degradation (moisture ingress); and (3) the sea wall construction provides positive impacts as a mechanical shield against extreme tidal waves (wave overtopping) and coastal erosion prevention, but its seepage causes negative impacts in the form of hypersaline soil salinization (40–44 ppt) triggering plant plasmolysis dehydration, physical building deterioration (rising damp), concrete bio-corrosion by green mussels (Perna viridis), and the permanent submergence of the Wal Adhuna Mosque. Suggestions for future research include quantifying the seepage flow rate using two-dimensional hydrodynamic numerical modeling and mapping subsurface saltwater intrusion boundaries using the 2D Electrical Resistivity Tomography (2D ERT) method.

Keywords: *sea wall, seawater seepage, spatial analysis, salinity,* Muara Baru.