ABSTRAK

Perubahan garis pantai yang terjadi secara dinamis akibat proses oseanografi dan aktivitas manusia menjadi isu penting dalam pengelolaan wilayah pesisir. Dinamika tersebut berkaitan erat dengan proses angkutan sedimen yang memengaruhi terjadinya abrasi maupun akresi di sepanjang pantai. Penelitian ini bertujuan untuk menganalisis perubahan garis pantai serta mengestimasi angkutan sedimen menggunakan pendekatan citra satelit dan sistem informasi geografis. Studi ini diharapkan dapat memberikan gambaran kuantitatif mengenai laju perubahan garis pantai dan pola distribusi sedimen sebagai dasar perencanaan pengelolaan wilayah pesisir yang berkelanjutan. Metode penelitian dilakukan melalui pengolahan citra satelit multi temporal menggunakan *Google Earth Engine* (GEE) untuk ekstraksi garis pantai pada beberapa periode pengamatan. Data pasang surut dianalisis menggunakan *XTIDE* untuk mengoreksi pengaruh elevasi muka air laut terhadap posisi garis pantai. Selanjutnya, pengolahan spasial dilakukan di *ArcMap* untuk digitasi dan validasi garis pantai. Analisis perubahan garis pantai secara kuantitatif dilakukan menggunakan *Digital Shoreline Analysis System* (DSAS) untuk memperoleh nilai laju perubahan *(rate of change)* dalam satuan meter per tahun. Estimasi angkutan sedimen dilakukan berdasarkan pendekatan empiris dengan mempertimbangkan parameter gelombang, kemiringan pantai, serta hasil analisis perubahan garis pantai. Hasil analisis menunjukkan bahwa total nilai *Shoreline Change Envelope* (SCE) sebesar 1406,53 meter yang menggambarkan jarak maksimum perubahan garis pantai selama periode penelitian. Nilai *Net Shoreline Movement* (NSM) sebesar -358,13 meter mengindikasikan dominasi pergeseran garis pantai ke arah darat (erosi). Laju perubahan berdasarkan *End Point Rate* (EPR) sebesar -86,05 m/tahun dan *Linear Regression Rate* (LRR) sebesar -28,82 m/tahun menunjukkan kecenderungan erosi dalam jangka pendek maupun tren jangka panjang. Estimasi net volume angkutan sedimen sebesar -9776,95 m^3 memperkuat indikasi terjadinya kehilangan material sedimen secara keseluruhan. Secara spasial, kondisi laju perubahan garis pantai dan angkutan sedimen menunjukkan perbedaan antar segmen, di mana segmen utara mengalami kecenderungan akresi, sedangkan segmen selatan didominasi oleh erosi. Temuan ini menunjukkan adanya distribusi sedimen yang tidak merata yang dipengaruhi oleh dinamika hidrodinamika dan kondisi morfologi pesisir.

Kata kunci: citra satelit, estimasi angkutan sedimen, garis pantai*, GEE, XTIDE, ArcMap, DSAS.*

ABSTRACT

Shoreline change occurring dynamically due to oceanographic processes and anthropogenic activities has become a critical issue in coastal zone management. Such dynamics are closely associated with sediment transport processes that influence the occurrence of erosion and accretion along the coastline. This study aims to analyze shoreline changes and estimate sediment transport using a satellite image–based approach integrated with geographic information systems. The research is expected to provide a quantitative assessment of shoreline change rates and sediment distribution patterns as a basis for sustainable coastal management planning. The research methodology was conducted through multi-temporal satellite image processing using Google Earth Engine (GEE) to extract shoreline positions at several observation periods. Tidal data were analyzed using XTIDE to correct the influence of sea level elevation on shoreline position. Furthermore, spatial processing was carried out in ArcMap for shoreline digitization and validation. Quantitative shoreline change analysis was performed using the Digital Shoreline Analysis System (DSAS) to obtain shoreline change rates expressed in meters per year. Sediment transport estimation was conducted using an empirical approach by considering wave parameters, beach slope, and the results of shoreline change analysis. The results indicate that the total Shoreline Change Envelope (SCE) value reached 1,406.53 meters, representing the maximum distance of shoreline variation during the study period. The Net Shoreline Movement (NSM) value of –358.13 meters indicates a dominant landward shoreline retreat (erosion). The shoreline change rates based on the End Point Rate (EPR) and Linear Regression Rate (LRR) methods were –86.05 m/year and –28.82 m/year, respectively, demonstrating both short-term and long-term erosion trends. The estimated net sediment transport volume of –9,776.95 m³ further confirms the overall sediment loss within the study area. Spatially, variations in shoreline change rates and sediment transport were observed among segments, where the northern segment exhibited a tendency toward accretion, while the southern segment was predominantly characterized by erosion. These findings indicate an uneven sediment distribution influenced by hydrodynamic dynamics and coastal morphological conditions.

Keywords: satellite imagery, sediment transport estimation, shoreline change, GEE, XTIDE, ArcMap, DSAS.