

ABSTRAK

Intrusi air laut merupakan proses masuknya air asin ke dalam akuifer, terutama pada wilayah pesisir. Salah satu kawasan yang terdampak adalah pesisir Kecamatan Tugu, Kota Semarang, Jawa Tengah. Permasalahan utama di kawasan ini berkaitan dengan meningkatnya ancaman intrusi air laut terhadap air tanah, yang dipicu oleh intensitas pemompaan air tanah serta perubahan penggunaan lahan pesisir. Penelitian ini bertujuan memetakan zonasi kerentanan akuifer terhadap intrusi air laut sekaligus menelusuri karakteristik serta asal-usul air tanah melalui pendekatan terpadu meliputi geologi, hidrogeologi, geofisika, analisis geokimia, dan isotop stabil. Metode penelitian bersifat deskriptif kuantitatif, menggunakan 59 titik pengamatan geologi/hidrogeologi, empat lintasan geolistrik, dan 14 sampel air tanah dari sumur maupun mata air, serta penerapan metode GALDIT dan AHP untuk menilai tingkat kerentanan intrusi. Parameter yang dianalisis mencakup sifat fisik (EC, TDS, pH), komposisi kimia (Cl^- , rasio Na^+/Cl^- , rasio $\text{Cl}^-/\text{SO}_4^{2-}$, indeks Simpson, dan BEX), tipe fasies berdasarkan diagram Piper, dan isotop stabil ($\delta^{18}\text{O}$ dan $\delta^2\text{H}$). Hasil penelitian menunjukkan bahwa beberapa titik, khususnya di pesisir Mojorejo Kecamatan Kaliwungu dan Mangkang Wetan Kecamatan Tugu, mengalami peningkatan EC hingga $>10.000 \mu\text{S}/\text{cm}$ serta konsentrasi $\text{Cl}^- >4.000 \text{ mg}/\text{L}$. Rasio kimia juga mengindikasikan proses salinisasi aktif. Fasies air tanah pada wilayah pesisir didominasi tipe Alkali-Klorida, sedangkan analisis isotop menegaskan adanya pencampuran air tanah dengan air laut, menandakan intrusi telah menjangkau akuifer dangkal pada zona aluvial. Zonasi kerentanan berdasarkan metode GALDIT dan AHP terbagi menjadi dua kategori: kerentanan rendah yang luas pada daerah jauh dari pantai, serta kerentanan sedang pada kawasan pesisir dekat garis pantai. Peta kerentanan berbasis AHP menunjukkan keselarasan tinggi dengan kondisi lapangan, dengan parameter L (ketinggian muka air tanah terhadap muka laut) sebagai faktor paling dominan. Temuan ini penting untuk pengelolaan air tanah pesisir melalui rekomendasi pembatasan ekstraksi, pembentukan zona konservasi, dan pemantauan berkala berbasis geoindikator.

Kata Kunci : Semarang, Intrusi air laut, Geoindikator, GALDIT, AHP

ABSTRACT

Seawater intrusion is the process of salt water entering aquifers, especially in coastal areas. One of the affected areas is the coast of Tugu District, Semarang City, Central Java. The main problem in this area is related to the increasing threat of seawater intrusion to groundwater, which is triggered by the intensity of groundwater pumping and changes in coastal land use. This study aims to map the aquifer's vulnerability to seawater intrusion and trace the characteristics and origins of groundwater through an integrated approach that includes geology, hydrogeology, geophysics, geochemical analysis, and stable isotopes. The research method is descriptive and quantitative, using 59 geological/hydrogeological observation points, four geophysical profiles, and 14 groundwater samples from wells and springs, as well as applying the GALDIT and AHP methods to assess the level of vulnerability to intrusion. The parameters analyzed included physical properties (EC, TDS, pH), chemical composition (Cl^- , Na^+/Cl^- ratio, $\text{Cl}^-/\text{SO}_4^{2-}$ ratio, Simpson index, and BEX), facies type based on the Piper diagram, and stable isotopes ($\delta^{18}\text{O}$ and $\delta^2\text{H}$). The results showed that several points, particularly on the coast of Mojorejo in Kaliwungu District and Mangkang Wetan in Tugu District, experienced an increase in EC to $>10,000 \mu\text{S/cm}$ and Cl^- concentrations $>4,000 \text{ mg/L}$. The chemical ratio also indicated active salinization. Groundwater facies in coastal areas are dominated by the Alkali-Chloride type, while isotope analysis confirms the mixing of groundwater with seawater, indicating that intrusion has reached shallow aquifers in the alluvial zone. Vulnerability zoning based on the GALDIT and AHP methods is divided into two categories: low vulnerability in areas far from the coast, and moderate vulnerability in coastal areas near the coastline. The AHP-based vulnerability map shows high consistency with field conditions, with parameter L (groundwater level relative to sea level) as the most dominant factor. These findings are important for coastal groundwater management through recommendations for extraction restrictions, the establishment of conservation zones, and periodic monitoring based on geoindicators.

Keywords: Semarang, Seawater intrusion, Geoindicators, GALDIT, AHP