

**ANALISIS SPASIAL-TEMPORAL DISTRIBUSI *TOTAL SUSPENDED SOLID* (TSS) MENGGUNAKAN CITRA SENTINEL-2A
MULTITEMPORAL TAHUN 2017 – 2025 DI WADUK MRICA,
KABUPATEN BANJARNEGARA, JAWA TENGAH**

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INTISARI

Waduk Mrica di Kabupaten Banjarnegara memiliki peran strategis sebagai penyedia energi listrik di Jawa Tengah, namun keberlanjutannya terancam oleh laju sedimentasi yang tinggi akibat degradasi lingkungan di Daerah Aliran Sungai (DAS) Serayu Hulu. Penelitian ini bertujuan untuk memetakan distribusi spasial dan temporal *Total Suspended Solid* (TSS) di Waduk Mrica periode 2017 – 2025, menguji efektivitas citra Sentinel-2A dalam estimasi TSS, serta menganalisis pengaruh dinamika penutup lahan dan variabilitas curah hujan terhadap fluktuasi sedimen.

Metode yang digunakan meliputi pemrosesan citra digital multitemporal satelit Sentinel-2A, pengambilan sampel *in situ* melalui uji laboratorium gravimetri, interpolasi curah hujan *Inverse Distance Weighted* (IDW), dan analisis penutup lahan berbasis *Deep Learning*. Pemilihan algoritma estimasi TSS terbaik dilakukan melalui uji korelasi regresi linier sederhana dan validasi menggunakan *Normalized Mean Absolute Error* (NMAE) serta *Root Mean Square Error* (RMSE).

Hasil uji akurasi menunjukkan algoritma Syarif Budhiman merupakan model estimasi terbaik dengan koefisien determinasi (R^2) sebesar 0,504 dan RMSE sebesar 31,83 mg/L. Secara spasial, konsentrasi TSS tertinggi konsisten ditemukan pada area inlet Sungai Serayu dan menurun ke arah *outlet* bendungan. Secara temporal, nilai TSS berfluktuasi dinamis; relatif rendah pada tahun kering (2018 – 2022) pada kisaran 8 – 25 mg/L, namun melonjak drastis pada 2025 dengan rata-rata 72 mg/L dan nilai ekstrem >518 mg/L. Lonjakan sedimen ini merupakan respons hidrologis dari interaksi degradasi penutup lahan (ekspansi lahan terbangun) dan intensitas curah hujan anteseden (akumulasi 7 hari) yang bertindak sebagai pemicu utama turunnya beban erosi ke waduk.

Kata kunci: Waduk Mrica, *Total Suspended Solid* (TSS), Sentinel-2A, Curah Hujan Anteseden, Penutup Lahan.

***SPATIO-TEMPORAL ANALYSIS OF TOTAL SUSPENDED SOLIDS (TSS)
DISTRIBUTION USING MULTITEMPORAL SENTINEL-2A IMAGERY
FROM 2017 TO 2025 IN MRICA RESERVOIR, BANJARNEGARA
REGENCY, CENTRAL JAVA***

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ABSTRACT

The Mrica Reservoir in Banjarnegara Regency holds a strategic role in supplying electrical energy for Central Java, yet its sustainability is threatened by high sedimentation rates due to environmental degradation in the Upper Serayu Watershed. This study aims to map the spatial and temporal distribution of Total Suspended Solid (TSS) in the Mrica Reservoir for the 2017 – 2025 period, assess the effectiveness of Sentinel-2A imagery in estimating TSS, and analyze the influence of land cover dynamics and rainfall variability on sediment fluctuation.

The methods employed include multitemporal digital image processing of Sentinel-2A satellite imagery, in situ sampling through gravimetric laboratory tests, Inverse Distance Weighted (IDW) rainfall interpolation, and Deep Learning-based land cover analysis. The selection of the best TSS estimation algorithm was conducted through a simple linear regression correlation test and validation using Normalized Mean Absolute Error (NMAE) and Root Mean Square Error (RMSE).

Accuracy test results indicate that the Syarif Budhiman algorithm is the best estimation model with a coefficient of determination (R^2) of 0.504 and an RMSE of 31.83 mg/L. Spatially, the highest TSS concentrations were consistently found at the Serayu River inlet, decreasing towards the dam outlet. Temporally, TSS values fluctuated dynamically; relatively low during dry years (2018–2022) ranging from 8–25 mg/L, but spiked drastically in 2025 with an average of 72 mg/L and extreme values >518 mg/L. This sediment surge is a hydrological response to the interaction between land cover degradation (expansion of built-up areas) and antecedent rainfall intensity (7-day accumulation), which acts as the main trigger for the delivery of erosion loads into the reservoir.

Keywords: *Mrica Reservoir, Total Suspended Solid (TSS), Sentinel-2A, Antecedent Rainfall, Land Cover.*