ABSTRACT

Aboveground biomass (AGB) estimation is an important step in understanding carbon dynamics and the impact of land use change on ecosystems. This study uses a remote sensing and machine learning approach to estimate AGB in the southern region of Malang Regency, which is experiencing land conversion pressure due to infrastructure and tourism development. The data used include Sentinel-2, Sentinel-1, Copernicus GLO-30 DEM, and GEDI L4A as ground truth, with Random Forest and XGBoost models as the main prediction methods. The results showed that the XGBoost model had the best performance with an RMSE value of 52.75 Mg/ha and an R^2 of 0.71 after hyperparameter tuning. Validation using LOOCV and K-Fold CV indicated the possibility of overfitting due to limited data. Spatial autocorrelation analysis showed that the AGB distribution had a certain spatial pattern, although with a relatively low Moran's I value. The 95% confidence interval (CI) indicates that the average AGB prediction is in the range of 89.45 - 90.96 Mg/ha.

The results of this AGB estimation have direct implications for land use planning and environmental policy. Local governments can use the results of this study to identify areas with high carbon stocks that need to be maintained, as well as areas with low AGB that can be a priority for restoration. In addition, this model can be used to monitor vegetation changes due to land conversion, especially along the Southern Cross Route (JLS).

The contribution of this study compared to previous studies is the application of a remote sensing-based approach without relying on direct field data, which makes it more efficient and can be applied on a wider scale. These findings are expected to be the basis for developing similar methods in other regions and support spatial data-based climate change mitigation policies.

*Keywords—**remote sensing, aboveground biomass, random forest, xgboot.***