

ABSTRAK

Klasifikasi penggunaan lahan dan tutupan lahan (LULC) di wilayah tropis menggunakan citra Sentinel-2 menghadapi tantangan berupa tumpang tindih nilai spektral antar kelas objek yang serupa, sehingga pemanfaatan fitur spektral saja belum sepenuhnya mampu merepresentasikan kompleksitas karakteristik permukaan bumi pada area dengan heterogenitas tinggi. Penelitian ini bertujuan untuk mengevaluasi pengaruh integrasi fitur tekstural Gray Level Co-occurrence Matrix (GLCM) terhadap kinerja algoritma Light Gradient Boosting Machine (LightGBM) melalui perbandingan model dengan dan tanpa fitur tekstural. Penelitian dilakukan di wilayah Provinsi Jawa Tengah menggunakan citra Sentinel-2 tahun 2021 yang diproses melalui platform Google Earth Engine, dengan fitur yang diekstraksi meliputi band spektral sentinel-2, indeks spektral, serta enam metrik tekstur GLCM dengan variasi jendela 3×3 dan 5×5 . Klasifikasi difokuskan pada lima kelas utama, yaitu Tree Cover, Cropland, Built-up, Permanent Water Bodies, dan Herbaceous Wetland. Hasil penelitian menunjukkan bahwa integrasi fitur tekstural secara signifikan meningkatkan performa model dalam memitigasi kendala spectral overlap, di mana model dengan kombinasi fitur spektral dan tekstural GLCM menggunakan jendela 3×3 mencapai kinerja optimal dengan akurasi sebesar 0,8653 (87%), meningkat sekitar 3% dibandingkan model yang hanya menggunakan fitur spektral (0,8323). Selain itu, penggunaan jendela tekstur yang lebih kecil (3×3) terbukti lebih akurat dibandingkan jendela 5×5 dengan selisih 1,2%, yang mencerminkan karakteristik objek tropis yang bersifat lokal dan fragmentaris. Penambahan fitur tekstur juga berhasil meningkatkan F1-score kelas built-up dari 0,86 menjadi 0,92. Analisis feature importance mengonfirmasi bahwa kanal SWIR (B12) dan NIR (B8) tetap menjadi fondasi utama, namun fitur tekstural seperti dissimilarity dan homogeneity memberikan kontribusi krusial dalam meningkatkan separabilitas antar kelas, sehingga dapat disimpulkan bahwa pendekatan multi-fitur merupakan strategi efektif untuk menghasilkan pemetaan tutupan lahan yang lebih akurat dan stabil di wilayah tropis.

Kata Kunci: Sentinel-2, LightGBM, GLCM, Tutupan Lahan, Wilayah Tropis.

ABSTRACT

Land Use and Land Cover (LULC) classification in tropical regions using Sentinel-2 imagery faces challenges due to spectral overlap among classes with similar characteristics, indicating that spectral features alone are insufficient to fully represent the complexity of land surface characteristics in highly heterogeneous areas. This study aims to evaluate the effect of integrating Gray Level Co-occurrence Matrix (GLCM) texture features on the performance of the Light Gradient Boosting Machine (LightGBM) algorithm by comparing models with and without texture features. The study was conducted in Central Java Province using Sentinel-2 imagery from 2021, processed through the Google Earth Engine platform, with extracted features including spectral bands sentinel-2, spectral indices, and six GLCM texture metrics using window sizes of 3×3 and 5×5 . The classification focuses on five main classes: Tree Cover, Cropland, Built-up, Permanent Water Bodies, and Herbaceous Wetland. The results show that the integration of texture features significantly improves model performance in mitigating spectral overlap, where the model combining spectral and GLCM texture features with a 3×3 window achieves optimal performance with an accuracy of 0.8653 (87%), an improvement of approximately 3% compared to the model using only spectral features (0.8323). Furthermore, the smaller texture window (3×3) proves to be more accurate than the 5×5 window by a margin of 1.2%, reflecting the localized and fragmented characteristics of tropical objects. The inclusion of texture features also increases the F1-score of the built-up class from 0.86 to 0.92. Feature importance analysis confirms that SWIR (B12) and NIR (B8) bands remain the primary contributors, while texture features such as dissimilarity and homogeneity play a crucial role in enhancing class separability, leading to the conclusion that a multi-feature approach is an effective strategy for producing more accurate and robust LULC mapping in tropical regions.

Keywords: *Sentinel-2, LightGBM, GLCM, Land Use and Land Cover, Tropical Regions.*