

CASE BASED REASONING UNTUK PENDUGAAN STRUKTUR TEGAKAN HUTAN RAKYAT DI WILAYAH KERJA CABANG DINAS KEHUTANAN JEMBER DAN MALANG

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INTISARI

Hutan rakyat berperan penting sebagai sumber kayu bagi industri, sehingga perlu dijamin kelestariannya. Struktur tegakan yang dapat dilihat dari sebaran jumlah pohon pada masing-masing kelas diameter merupakan indikator kelestarian yang penting. Struktur tegakan dapat digunakan untuk pengaturan pemanenan dan penanaman guna menjaga keseimbangan jumlah antara pohon dewasa dan muda di dalam tegakan. Data struktur tegakan seringkali terbatas karena pengukuran lapangan memerlukan biaya dan waktu besar. Data penginderaan jauh menjadi solusi efisien dengan menyediakan data spektral lengkap, terutama di area sulit dijangkau. Metode *Case Based Reasoning* (CBR) berpotensi menggabungkan data lapangan yang terbatas dan citra yang luas sebagai data referensi. Penelitian ini bertujuan merancang dan menilai kelayakan model CBR dalam pendugaan struktur tegakan hutan rakyat di wilayah kerja CDK Jember dan Malang.

Penelitian dilakukan dengan memanfaatkan data 149 petak ukur hasil inventarisasi hutan rakyat di Jawa Timur dan data rasio citra satelit Sentinel 2-A tahun 2024. Pada penelitian ini CBR mencari solusi menggunakan 2, 5, 10 kasus referensi terdekat. CBR dikembangkan menggunakan metode *Waterfall Life Cycle Workflow* Validasi model dilakukan dengan pengujian *Normalized Root Mean Square Error* (NRMSE), Simpangan Agregat (SA), dan Simpangan Rata-Rata (SR) untuk menilai akurasi estimasi.

Hasil penelitian menunjukkan keberhasilan metode CBR dalam menduga struktur tegakan di hutan rakyat CDK Jember dan Malang. Referensi 10 kasus terdekat dengan bobot setara memberikan performa terbaik dalam prediksi struktur tegakan, dibuktikan dengan nilai validasi pengujian NRMSE yang rendah (0,52% sampai 10,45%) yang menunjukkan kesalahan prediksi yang kecil dan model mampu menyesuaikan data dengan baik. Nilai SR yang relatif kecil (1,95% sampai 11,05%) menandakan bahwa residual prediksi tidak menyimpang jauh dari nilai sebenarnya. Nilai SA yang mendekati nol (-0,63 sampai 0,63) mengindikasikan model tidak bias dan menunjukkan keseimbangan antara overestimasi dan underestimasi. Melalui model ini, kelestarian hutan dapat diperkirakan berdasarkan struktur tegakan yang diduga. Namun demikian, untuk melihat kelestarian secara menyeluruh diperlukan tahapan lanjutan seperti analisis hasil pendugaan dan integrasinya terhadap indikator kelestarian.

Kata Kunci: Struktur Tegakan, Hutan Rakyat, *Case Based Reasoning*

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***CASE-BASED REASONING FOR ESTIMATING THE STRUCTURE OF
COMMUNITY FORESTS IN THE WORKING AREAS OF CDK JEMBER
AND MALANG***

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ABSTRACT

Community forests play an important role as a source of timber for industry, so their sustainability must be ensured. The stand structure, which can be seen from the distribution of the number of trees in each diameter class, is an important indicator of sustainability. Stand structure can be used to regulate harvesting and planting in order to maintain a balance between mature and young trees in the stand. Stand structure data is often limited because field measurements require significant costs and time. Remote sensing data provides an efficient solution by providing complete spectral data, especially in areas that are difficult to reach. The Case Based Reasoning (CBR) method has the potential to combine limited field data and extensive imagery as reference data. This study aims to design and assess the feasibility of a CBR model in estimating the stand structure of community forests in the working areas of CDK Jember and Malang.

The research was conducted using data from 149 measurement plots resulting from community forest inventories in East Java and Sentinel 2-A satellite image ratio data from 2024. In this study, CBR sought solutions using 2, 5, and 10 closest reference cases. CBR was developed using the Waterfall Life Cycle Workflow Model validation was performed by testing the Normalized Root Mean Square Error (NRMSE), Aggregate Deviation (SA), and Average Deviation (SR) to assess the accuracy of the estimation.

The results of the study show the success of the CBR method in estimating the stand structure in the CDK Jember and Malang community forests. The 10 nearest reference cases with equal weights provided the best performance in stand structure prediction, as evidenced by low NRMSE validation test values (0.52% to 10.45%), indicating small prediction errors and the model's ability to fit the data well. The relatively small SR values (1.95% to 11.05%) indicate that the prediction residuals do not deviate far from the actual values. The SA values, which are close to zero (-0.63 to 0.63), indicate that the model is unbiased and shows a balance between overestimation and underestimation. Through this model, forest sustainability can be estimated based on the suspected stand structure. However, to assess sustainability comprehensively, further steps are required, such as analyzing the estimation results and integrating them with sustainability indicators.

Keywords: Stand Structure, Community Forest, Case Based Reasoning

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