Estimasi Simpanan Karbon Hutan Tanaman Jati Klon Berdasarkan Indeks Vegetasi Citra PlanetScope di
KPH Ngawi Regional Jawa Timur
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

ESTIMASI SIMPANAN KARBON HUTAN TANAMAN JATI KLON BERDASARKAN INDEKS VEGETASI CITRA PLANETSCOPE DI KPH NGAWI REGIONAL JAWA TIMUR

Riko Nagma Aulia Putra[1], Ris Hadi Purwanto[2], Senawi[3]

INTISARI

Perubahan iklim akibat peningkatan emisi CO_2 memperkuat peran strategis hutan sebagai penyerap karbon terestrial. Hutan tanaman jati klon di KPH Ngawi berpotensi berkontribusi signifikan terhadap sekuestrasi karbon, namun data spasial simpanan karbonnya belum tersedia. Penelitian ini bertujuan menentukan indeks vegetasi terbaik untuk memprediksi simpanan karbon, menganalisis hubungannya dengan simpanan karbon, memetakan distribusi spasialnya, serta mengestimasi besaran simpanan karbon tegakan jati klon di KPH Ngawi.

Penelitian menggunakan citra PlanetScope resolusi 3 meter yang direkam pada Agustus 2025. Lima indeks vegetasi diturunkan dari citra, yaitu NDVI, EVI, ARVI, SAVI, dan RVI, serta dua variabel topografi berupa kelerengan dan arah lereng. Data lapangan dikumpulkan dari 99 plot ukur (30×30 m) menggunakan *stratified purposive sampling*, serta 15 pohon sampel dari tiga kelas umur melalui metode destructive sampling. Biomassa dihitung menggunakan persamaan alometrik spesifik jati klon, kadar karbon diuji di laboratorium, dan analisis regresi univariat maupun multivariat diterapkan untuk membangun model estimasi simpanan karbon.

Klasifikasi tutupan lahan menghasilkan *overall accuracy* 93% dan *kappa coefficient* 0,76. Simpanan karbon hasil inventarisasi lapangan mencapai 84,3 ton C/ha. Model univariat terbaik adalah NDVI dengan persamaan sigmoid (R^2=0,420). Model multivariat polinomial yang mengombinasikan lima indeks vegetasi dan dua variabel topografi menghasilkan R^2=0,82, R=0,90, dan RMSE=9,0. Estimasi spasial menunjukkan simpanan karbon sebesar 84,9 ton C/ha dengan total 442.766 ton C pada luas 5.214,8 ha, setara dengan serapan CO_2 sebesar 311,6 ton CO_2/ha, yang menegaskan peran signifikan tegakan jati klon dalam mitigasi perubahan iklim.

Kata Kunci: Simpanan karbon, Jati Klon, PlanetScope, Penginderaan jauh, Regresi

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ESTIMATION OF CARBON STOCK IN CLONAL TEAK PLANTATION FOREST BASED ON VEGETATION INDICES FROM PLANETSCOPE IMAGERY IN KPH NGAWI EAST JAVA REGIONAL DIVISION

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ABSTRACT

Climate change driven by rising CO_2 emissions reinforces the strategic role of forests as terrestrial carbon sinks. Clonal teak (Jati Plus Perhutani) plantations in KPH Ngawi have significant potential to contribute to carbon sequestration, yet spatial data on their carbon stock remain unavailable. This study aims to determine the best vegetation index for predicting carbon stock, analyze its relationship with carbon stock, map its spatial distribution, and estimate the magnitude of carbon stock in clonal teak stands in KPH Ngawi.

The study used 3-meter resolution PlanetScope imagery acquired in August 2025. Five vegetation indices were derived from the imagery NDVI, EVI, ARVI, SAVI, and RVI along with two topographic variables, namely slope and aspect. Field data were collected from 99 sample plots (30×30 m) using stratified purposive sampling, along with 15 sample trees from three age classes through destructive sampling. Biomass was calculated using allometric equations specific to clonal teak, carbon content was determined through laboratory analysis, and both univariate and multivariate regression analyses were applied to develop the carbon stock estimation model.

Land cover classification achieved an overall accuracy of 93% and a kappa coefficient of 0.76. Field-based carbon stock inventory reached 84.3 ton C/ha. The best univariate model was NDVI using a sigmoid equation (R^2=0.420). The multivariate polynomial model combining five vegetation indices and two topographic variables produced R^2=0.82, R=0.90, and RMSE=9.0. Spatial estimation showed a carbon stock of 84.9 ton C/ha, totaling 442,766 ton C across 5,214.8 ha, equivalent to a CO_2 uptake of 311.6 ton CO_2/ha, underscoring the significant role of clonal teak stands in climate change mitigation.

Keywords: *Carbon stock*, *Clonal teak*, *PlanetScope*, *Remote sensing*, *Regression*

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