A STUDY OF FOREST CANOPY DENSITY (FCD) MODEL USING MULTITEMPORAL LANDSAT IMAGES FOR MONITORING FOREST DEGRADATION

(A Case on a Part of the Forest Areas in South Bengkulu Regency)

Abstract

Forest monitoring systems using middle-resolution satellite images by an appropriate method can produce information with reasonably accurate estimates. Change in forest canopy density should be considered for better forest management. The forest canopy density monitoring can be made as an essential parameter to assess change in forest conditions over times. Forest Canopy Density (FCD) model is a sufficiently good method for monitoring forest degradation.

The objective of this study is to analyze the information produced by FCD model about forest canopy density and forest canopy vegetation structure types for making a classification of forest degradation in a part of the forest areas in South Bengkulu Regency during 2009-2015. It is assumed that FCD model can produce accurate estimates on forest canopy density and forest canopy vegetation structure types. Characteristics of vegetation index (VI), bare soil index (BI), shadow index (SI) and thermal index (TI) are different for each forest canopy structure type. The classification of the forest canopy vegetation structure types was carried out by a decision tree analysis based on VI, BI, SI, and TI. Statistical analyses were carried out to find out difference in VI, BI, SI, and TI, including Pearson product-moment correlation, Analysis of Variance (Anova), and Post-Hoc test.

Based on results of the study, *root means square deviation* (RMSD) of estimates produced by FCD model in 2015 was 87.98, while the accuracy of estimates on the classification of forest canopy vegetation structure types in 2015 was 51.92% and in 2015 was 53.85%. Such accuracy can be included into a 'low' category but it may still be reasonable. The relatively heterogeneous vegetation conditions in tropical rainforests lead to some difficulty in distinguishing forest canopy vegetation where forest and non-forest vegetations were generally mixed. This was confirmed by the results of statistical analysis in the study that there was a significant and negative correlation between VI and BI with a coefficient of -0.864 and a significant and negative correlation between SI and TI with a coefficient of -0.244. The results of the Anova showed that there was a significant difference in forest canopy vegetation structure types of BI, SI, and TI, while VI did not have a significant difference in canopy vegetation type. From the results of change detection, it can be concluded that a part of the forest areas in South Bengkulu Regency from 2009 to 2015 significantly had low, middle, and heavy forest degradation.

Keywords: Forest Canopy Density, Monitoring, Forest Degradation, Change Detection, Tropical Rainforests, Vegetation Structure

KAJIAN MODEL FOREST CANOPY DENSITY (FCD) BERBASIS CITRA LANDSAT MULTITEMPORAL UNTUK MONITORING DEGRADASI HUTAN

(Kasus Sebagian Kawasan Hutan di Kabupaten Bengkulu Selatan)

Intisari

Pemantauan (*monitoring*) hutan menggunakan citra resolusi menengah dengan metode yang tepat dapat menghasilkan informasi dengan akurasi yang dapat diterima. Perubahan kerapatan kanopi hutan harus dipertimbangkan, untuk tujuan pengelolaan hutan yang lebih baik. Memantau kerapatan kanopi hutan dapat dijadikan parameter esensial untuk menilai perubahan kondisi hutan dari waktu ke waktu. Model *Forest Canopy Density* (FCD) merupakan salah satu metode yang cukup baik untuk memantau degradasi hutan.

Penelitian ini menganalisis informasi yang dihasilkan model FCD berupa kerapatan kanopi hutan dan struktur tipe vegetasi penutup hutan, untuk menyusun klasifikasi degradasi hutan sebagian kawasan hutan Kabupaten Bengkulu Selatan Tahun 2009-2015. Model FCD diduga mampu menghasilkan estimasi akurat tentang kerapatan dan struktur vegetasi penutup hutan. Karakteristik *vegetation index* (VI), *bare soil index* (BI), *shadow index* (SI) dan *thermal index* (TI) berbeda untuk setiap struktur tipe vegetasi penutup hutan. Klasifikasi tipe vegetasi penutup hutan menggunakan analisis *decision tree* berdasarkan nilai VI, BI, SI dan TI. Untuk membuktikan terdapat perbedaan tersebut dilakukan analisis statistik parametris, terlebih dahulu hubungan negatif antara VI dan BI, SI dan TI diuji menggunakan analisis statistik *Pearson* (*Product Moment*), kemudian dilakukan Uji Anova (*Analysis of Varian*) dan Uji Post Hoc.

Berdasarkan hasil penelitian estimasi FCD Tahun 2015 menghasilkan *root means square deviation* (RMSD sebesar 87,98. Klasifikasi tipe vegetasi penutup hutan Tahun 2009 menghasilkan akurasi keseluruhan sebesar 51,92 dan Tahun 2015 sebesar 53,85%. Akurasi yang dihasilkan masuk dalam kategori rendah, namun hal ini masih dapat diterima. Pada hutan hujan tropis dengan kondisi vegetasi yang relatif heterogen, menyebabkan sulitnya membedakan vegetasi penutup hutan dimana vegetasi hutan tercampur dengan vegetasi non hutan. Hal ini dipertegas dengan hasil analisis statistik, uji korelasi membuktikan terdapat hubungan negatif yang kuat antara VI dan BI dengan koefisien korelasi -0,864, sedangkan SI dan TI terdapat hubungan negatif yang lemah dengan koefisien korelasi -0,244. Uji Anova menegaskan terdapat perbedaan nyata BI, SI, dan TI terhadap tipe vegetasi penutup, sedangkan VI tidak ada beda nyata terhadap tipe vegetasi penutup. Berdasarkan hasil deteksi perubahan sebagian kawasan hutan Kabupaten Bengkulu Selatan Tahun 2009-2015 secara signifikan mengalami degradasi hutan ringan, sedang dan berat.

Kata Kunci : *Forest Canopy Density* (FCD), *Monitoring*, Degradasi Hutan, Deteksi Perubahan, Hutan Hujan Tropis, Struktur Vegetasi