PROYEKSI PENUTUPAN LAHAN DAN SIMPANAN KARBON ATAS PERMUKAAN DI TAMAN NASIONAL GUNUNG MERAPI

Oleh

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INTISARI

Taman Nasional Gunung Merapi (TNGM) merupakan salah satu kawasan konservasi di Provinsi Jawa Tengah dan DIY dengan luas 6.607,52 ha. TNGM memiliki potensi jasa lingkungan tinggi terutama dalam penyimpanan dan penyerapan karbon. Namun demikian, hingga saat ini TNGM masih mengalami dinamika perubahan penutupan lahan terutama disebabkan pengaruh erupsi Gunung Merapi dan faktor gangguan oleh aktivitas manusia yang dapat berpengaruh terhadap kuantitas simpanan karbon. Sebagai upaya pemantauan potensi sumber daya hutan yang ada di TNGM, maka informasi tentang dinamika perubahan penutupan lahan dan estimasi simpanan karbon serta proyeksinya di masa datang sangat dibutuhkan untuk mengetahui kontribusi kawasan TNGM dalam mendukung mitigasi perubahan iklim. Penelitian ini bertujuan untuk memproyeksikan penutupan lahan tahun 2030 serta menaksir simpanan karbon atas permukaan dan angka emisi bersih gas rumah kaca (GRK) serta perubahannya pada periode 2000-2030 di kawasan TNGM.

Proyeksi penutupan lahan TNGM tahun 2030 dilakukan dengan menggunakan model kombinasi *Cellular Automata* dan *Markov Chain (CA-Markov)* yang disusun berdasarkan peta penutupan lahan tahun 2012, 2021, dan 2022 yang dihasilkan dari penafsiran citra Landsat multitemporal. Penyusunan model perubahan tutupan lahan tersebut menggunakan variabel pendorong berupa zonasi TNGM, areal sejarah erupsi Gunung Merapi, ketinggian tempat, kelerengan, jarak ke jalan, sungai, dan permukiman serta kemungkinan perubahan penutupan lahan (*evidence likelihood*). Simpanan karbon TNGM pada tahun 2030 dihitung berdasarkan data referensi rerata simpanan karbon pada masing-masing kelas penutupan lahan. Emisi bersih GRK dihitung berdasarkan angka emisi dan serapan dengan pendekatan perubahan simpanan karbon (*stock difference*).

Hasil penelitian menunjukkan bahwa penutupan lahan TNGM pada tahun 2030 diproyeksikan terdiri dari ±80,1% areal bervegetasi yang didominasi oleh hutan lahan kering sekunder (49,6%), semak belukar (22,3%), dan hutan tanaman (7,8%). Dengan kondisi tersebut, prediksi simpanan karbon atas permukaan tahun 2030 di TNGM adalah sebesar 990.374 ton C dan reratanya 154±9,3 ton C/ha. Nilai rerata simpanan karbon tersebut termasuk kategori simpanan karbon tinggi. Dibandingkan kondisi tahun 2022, diprediksi ±73,2% areal TNGM cenderung tidak berubah sementara areal berpotensi mengalami perubahan meliputi 15,3% mengarah pada peningkatan tutupan vegetasi dan 11,0 % mengarah pada penurunan tutupan vegetasi. Potensi peningkatan simpanan karbon untuk periode 2021-2030 sebesar 27.944 ton C atau setara dengan emisi bersih GRK sebesar -102.461 tCO$_2$e. Angka serapan karbon tersebut lebih rendah dibandingkan *baseline* periode 2012-2021. Namun demikian, areal TNGM masih dapat berperan dalam mendukung penyerapan emisi gas rumah kaca hingga tahun 2030.

Kata Kunci : TNGM, proyeksi penutupan lahan, estimasi simpanan karbon, emisi bersih gas rumah kaca, *CA-Markov*, *evidence likelihood,* kawasan konservasi, zonasi

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PROJECTION OF LAND COVER AND ABOVE-GROUND CARBON STOCK IN GUNUNG MERAPI NATIONAL PARK
by

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ABSTRACT

Gunung Merapi National Park (GMNP) is one of the conservation areas located in Central Java and the Special Region of Yogyakarta Province, covering an area of 6.607,52 hectares. GMNP plays an important role in providing environmental services particularly on carbon storage and sequestration. However, GMNP is still experiencing land cover dynamic changes mainly due to the effect of Mount Merapi volcanic eruptions and disturbances by human activities that affect the quantity of carbon stock. Information on the dynamic transformation of land cover changes, carbon stock estimation, and future projections in GMNP are essential to monitor forest resources and to determine the contribution of GMNP area in supporting climate change mitigation. This study aims to estimate the following information in GMNP namely land cover projection in 2030, the above-ground carbon stocks, net greenhouse gas (GHG) emissions and its changes from 2000 to 2030 within the GMNP area.

The projection of land cover in GMNP for 2030 was obtained using a combination of Cellular Automata and Markov Chain (CA-Markov) models, which was developed based on land cover maps from 2012, 2021, and 2022 derived from the interpretation of multi-temporal Landsat imagery. The model utilized various driving variables, such as GMNP zoning, historical eruption areas of the Mount Merapi, elevation, slope, distance to road, rivers, and settlement, as well as evidence likelihood of land cover change. Furthermore, the estimated carbon stock in 2030 was calculated based on the reference data of average carbon stock in each land cover class. The net GHG emissions were calculated based on the emission and removal using the carbon stocks difference approach.

The results showed that the land cover in GMNP in 2030 is projected to consist of ±80,1% vegetation areas, dominated by secondary dryland forests (49,6%), shrubs (22,3%), and plantation forests (7,8%). In these conditions, the projected above-ground carbon stock in 2030 is estimated at 990.374 tons C or 154±9,3 tons C/ha in average. This value is categorized as high carbon storage. Compared to the conditions in 2022, it is predicted that ±73,2% of GMNP area is likely to remain unchanged, while the vegetation cover increase by 15,3% and decrease by 11,0%. The potential increase in carbon stocks for 2021-2030 period is estimated around 27.944 tons C or equivalent to a net GHG emissions reduction of -102,461 tons CO_2e. The addition of carbon stocks and sequestration until 2030 indicates that despite a projected lower value in sequestration compared to the period 2012-2021, the GMNP area could still play a role in supporting the removal of GHG emission up to 2030.

Keywords: GMNP, land cover projection, carbon stock estimation, net greenhouse gas (GHG) emissions, CA-Markov, evidence likelihood, conservation area, zoning

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