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Assessing land use and land cover (LULC) dynamics and future change in a cocoa landscape (Côte d'Ivoire)

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Abstract

A better understanding of the land use and land cover (LULC) dynamics of the cocoa landscape in Côte d'Ivoire is essential for meeting sustainability initiatives, such as European regulations aimed at zero deforestation. This study assesses the land-use dynamics of the cocoa landscape in Aboisso, Abengourou, and Divo (Côte d'Ivoire) for the years 2002, 2015, 2024, 2035, and 2050. Satellite Landsat images are used to classify 9 LULC dynamics for the years 2002, 2015, and 2024 using the Random Forest classifier. The LULC predictions of 2035 and 2050 were simulated using the Markov chain and Multi-Layer-Perceptron neural network in Land Change Modeler. Classification accuracy for 2002, 2015, and 2024 was 89.6 %, 90 %, and 93.6 % for Abengourou, 90 %, 87 %, and 86.8 % for Aboisso, and 89.6 %, 90 %, and 75.15 % for Divo, respectively. The results show spatial agreement between the classified maps and those produced by the model, demonstrating the model's ability to accurately replicate dynamic land use processes with 74.38 % in Abengourou, 75.25 % in Aboisso, and 87.51 % in Divo. In Abengourou and Divo, 19 % of the cocoa full sun area has been converted to agroforestry, and 10 % in Aboisso from the transition matrix of 2002 to 2024. According to predictions, an increase in agroforestry cocoa will be observed in Abengourou, Aboisso, and Divo, as well as an increase in the area of full-sun in Divo. In Abengourou, an increased area of rubber trees will be observed, while the palm area will increase in Aboisso and Divo. Nevertheless, factors such as the expansion of the more economically advantageous industrial crops, agronomic factors linked to the ageing of cocoa orchards, poor soils, and social limitations are influencing the decline in cocoa acreage.

Keywords: Cocoa, Côte d'Ivoire, deforestation, land change modeler, Markov chain, TerrSet

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