Assessing mining disturbance on vegetation in Ouagadougou, Burkina Faso using Landsat data

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Abstract

Quarries are a type of open pit mines, where construction materials, such as granite and clay, are extracted from the earth's surface, leading to a major disturbance of vegetation and degradation of ecosystem services. In Ouagadougou, the capital city of Burkina Faso, quarries are an employment generator, however, their expansion and uncontrolled extraction practices are reasons of serious concern. Detecting, quantifying, and monitoring the extent of quarries and their impact over time is challenging due to their often-small size and irregular shape. Using traditional processing methods of remote sensing data to track the dynamics of quarries is often very time-consuming and requires high computing resources. In this study, we apply a Google Earth Engine (GEE)-based technique for binary classification of quarry and non-quarry using Landsat 9 images of Ouagadougou. Due to varying scales and patterns of quarries, LandTrendr, a trajectory-based algorithm, was employed in the time series analysis of Landsat images (1990-2022) to map annual disturbance effects on vegetation and rehabilitation patterns. We hereby aimed to generate maps of quarries with an overall accuracy of 95 % in our analysis of 257 quarries covering an area of 38 km^2. The LandTrendr outputs allow us to identify the years and magnitude of vegetation disturbance by quarries and assess vegetation recovery in abandoned quarries. The present study employed a rigorous ground truthing approach, involving both fieldwork and analysis of historical aerial photographs, to validate the accuracy of remote sensing results. The results of this validation process indicate that 87 % of the remote sensing data was confirmed as accurate. The study shows the capability of integrating GEE, Landsat data, and the LandTrendr algorithm for the effective monitoring of the impacts of quarrying on land cover, biodiversity, and water resources in Ouagadougou. It indicates implementations for regions with similar characteristics.

Keywords: Binary image analysis, land use change, time series analysis, vegetation degradation

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