

Analysis and representation of vegetation cover evolution in natural resource restoration areas in northern Burkina-Faso

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Abstract:

Rural Sahelian and Sudano-Sahelian environments are strongly impacted by climate change (heterogeneity of rainfall patterns, rising average temperatures...) and environmental changes (desertification, deforestation, land degradation...). These changes, combined with an increase in rural farming populations, are amplifying pressure on existing natural resources (UNCCD, 2021). Faced with the alarming prospects suggested by these dynamics, alternatives for innovative agricultural management need to be implemented, to enable sustainable resilience of production systems (Sultan et al., 2015). To address these issues, soil and vegetation regeneration programs have been proposed by various NGOs (Roose, 2017). These programs contribute locally to major emblematic projects in Sahelian countries, such as the Great Green Wall project (Dia and Duponnois, 2012). In Burkina Faso, the Tiipaalga association has been working since the early 2000s to restore natural resources, mainly in northern and central Burkina Faso. These actions are characterized by the establishment of protected areas or MEDs ("Mis En Défens" in french), assisted natural regeneration (RNA), or the dissemination of improved fireplaces that are more economical with firewood (FC3P). In Burkina Faso, for example, almost 400 MEDs have been set up over the past 20 years.



Figure 1. Example of a two MEDs around Pobe-Mangao, using Pléiades imagery (22/03/2013)

In order to study qualitatively and quantitatively the changes implied by these soil and vegetation cover regeneration programs in Burkina-Faso, the INFLUENCES project (funded by the ANR) started in March 2023. Among the various tasks associated with the INFLUENCES project, the analysis of landscape dynamics on a local and regional scale is established. More specifically, an analysis of the evolution of vegetation cover in protected areas is carried out around the 6 pilot villages selected for the project (Djibo, Pobe-Mengao, Laye, Toeghin, Dapelogo, Zitenga).

This article details the methodology and initial results for quantifying changes in vegetation cover in 64 MEDs in northern Burkina Faso, near the villages of Djibo and Pobe Mengao. To carry out this analysis, it was first necessary to digitize the MED contours using GPS points supplied by the Tiipalga association, and based on satellite images available online. At the same time, Pleiades satellite images (50 cm spatial resolution) for the years 2013-14 and 2021 were acquired through the DINAMIS program, in order to analyze changes in vegetation cover over an 8-year period. To enable Pleiades images to be compared over time, radiometric and atmospheric corrections were first performed on the raw images. An automated image processing procedure was then developed. It allows to clip the corrected satellite images around each MED (within a buffer of 10 m, to take into account trees located at the border of the MED), then calculates radiometric indices suitable for studying vegetation (NDVI and SAVI). Finally, for each MED, an object-oriented supervised classification is performed using the random forest algorithm, in order to map land cover into 3 categories: tree cover, grass cover and bare soil.

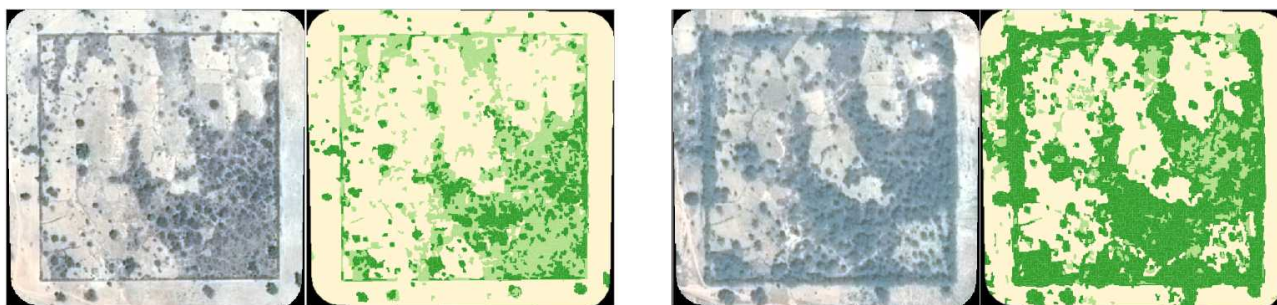


Figure 2. Vegetation cover evolution of a MED using classified Pléiades imagery (22/03/2013 on left and 29/09/2021 on right).

Over the 64 MEDs studied, corresponding to a surface area of 233 ha, the area of trees (crown area) has increased from 19 ha in 2013 to 77 ha in 2021. This means that for an average area of 3.6 ha, the area occupied by trees in each MED increased from 0.3 ha in 2013 (8 % of the MED's area) to 1.2 ha in 2021 (33 % of the MED's area). These results demonstrate the effectiveness of the tree restoration methods in the MEDs implemented by the Tiipalga association over the past 20 years. Nevertheless, these results must be used with caution, due in particular to the variable acquisition conditions of satellite images between the 2013-14 and 2021 (especially in terms of seasonality), or due to potential segmentation or classification errors (over-detection and under-detection, especially on the 2021 images). Despite these uncertainties, the trend towards restoration of vegetation cover observed in the MEDs remains unquestionable.

The INFLUENCES project will continue with a similar analysis in the protected areas of the southern zone (villages of Laye, Toeghin, Dapelogo, Zitenga). It is also planned to extend the analysis of changes in vegetation cover in the North and South zones back to the early 2000s, when the first MEDs were created. An analysis of the evolution of vegetation cover in village terroirs around the MEDs is also planned. Finally, the spatio-temporal representation of the evolution of vegetation cover in and around the MEDs should be considered, in order to integrate different temporalities, notably between the dates of MED creation (which range from 2003 to 2017) and the dates of satellite image acquisition (to characterize the evolution of vegetation cover).

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