MONITORING THE IMPACT OF LOCAL MANAGEMENT OF NATURAL RESOURCES ON FOREST CONSERVATION IN NORTH-EASTERN MADAGASCAR

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ABSTRACT

This study describes the use of PCA (Principal Components Analysis) and fuzzy logic methods to solve change detection problems and map land cover changes by using AdaBoost Neural Network-based algorithm. The aim is to study the impact on forest conservation of transferring the management of natural resources from national to local level, with a case-study in Didy area in North-Eastern Madagascar (**Plates 1 and 2**). The test site is located at the transition between humid forest and savanna and lower areas are occupied by rice fields.

In this approach, the study makes the difference pixel by pixel of each pair of spectral bands acquired at two dates. After that, all images have been introduced as variables into the PCA process in order to reduce them to the first axes. Then, the fuzzy approach is applied over the first PCA components to highlight the pixels that show the changes. Finally, changes on image were classified so as to find all types of land cover changes.

The application of this method was performed on Landsat 5 images (path = 158, row = 073) acquired in 1994, 2001 and 2009, to verify the impact of the management of natural resources by the local community and its impacts on forest conservation.

Images of 1994 and 2001 are used to study the changes before management of natural resources transfer projects. And images taken in 2001 and 2009 are processed for studying changes since this project launches. In this study, we considered only the first three components of PCA because they contain all change information (**table 1**). The first three PCA component histograms show that all pixels values are close to the normal distribution (**Plate 3**). So, the use of fuzzy membership function proposed by Gong (1993) is well justified. **Plate 4** shows the map of changes by PCA and fuzzy set theory (a): between 1994 and 2001; (b): between 1994 and 2001. Then, the changes in **Plate 4** were classified using an Adaboost Neural Network-based algorithm.

To verify the effectiveness of management transfer at local level on forest conservation, three vegetation classes were analyzed: crops on slash and burn areas, natural forest and forest regrowth. Results from changes map are displayed at **Plates 5 and 6**. Statistics of changes have been computed (**Table 2**), excluding changes to clouds and shadows. Analysis of map and statistical results shows that after local communities manage natural resources, there was a decrease of the practice of slash and burn ('tavy') and a progressive dynamic from any other land cover classes to forest regrowth ('savoka'). Consequently, this study demonstrates that the transfer of natural resources management to the local community has a significant positive impact on forest conservation.

KEYWORDS

Change detection, PCA, fuzzy logic, Adaboost, natural resources, forest, Madagascar

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Plate 3: First three principal components with their histograms (a): between 1994 and 2001; (b): between 1994 and 2001

Plate 4: Map of change by PCA and fuzzy set theory (a): between 1994 and 2001; (b): between 1994 and 2001

Plate 5: Map of land cover changes between 1994 and 2001

Plate 6: Map of land cover changes between 2001 and 2009