

# The effectiveness of soil and water conservation measures in Tanzania



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## Introduction

The highlands in Tanzania are seriously affected by soil erosion (Fig. 1A). In the West Usambara Mountains considerable efforts have been undertaken to reduce the amount of erosion through soil and water conservation (SWC) measures (Fig. 1B), but it is unknown how effective these measures are for soil erosion control. Therefore the aims of the study were:

- To locate existing SWC measures in the West Usambara Mountains using remote sensing.
- To assess the effectiveness of the SWC measures in controlling soil erosion.

## Methods

The study was conducted for two 10 x 10 km<sup>2</sup> areas around the villages Soni and Sunga. Worldview 2 images (30 January 2010) were acquired and used to locate the existing SWC measures by Object Based Image Analysis (OBIA). Only grass strips (Fig. 2A) and terraces (Fig. 2B) were classified.

The Universal Soil Loss Equation was used to calculate annual soil erosion in the 10 x 10 km<sup>2</sup> areas. The modelling was done twice, first without the SWC measures and then with the measures, to determine the effectiveness of the existing measures.

## Results

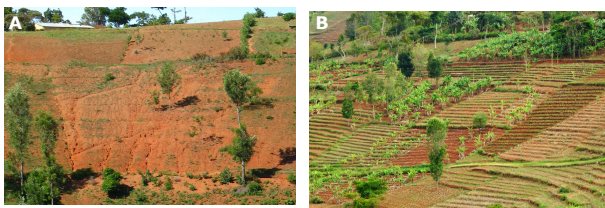


Fig. 1. A severely eroded field (A), and well conserved, terraced fields (B) in the West Usambara Mountains of Tanzania.

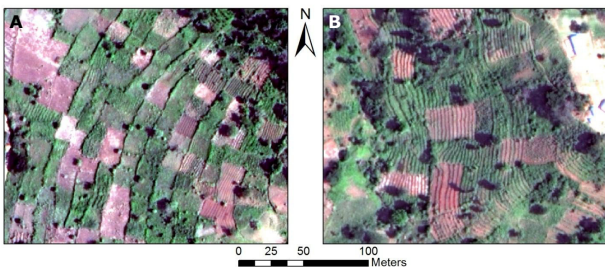


Fig. 2. Selected parts of the Worldview 2 image showing grass strips (A) and terraces (B) in the agricultural fields. These spatial objects were classified with OBIA for the entire 10 x 10 km<sup>2</sup> areas covered by the satellite images.

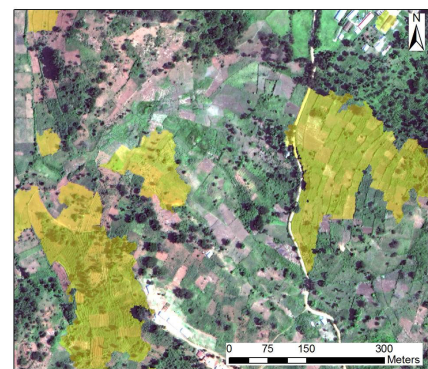


Fig. 3. Selected part of the Soni area where the agricultural fields with SWC measures (yellow parts) have been classified by OBIA.

Table 1. Results of the Worldview 2 image analysis and soil erosion modelling for the two 10 x 10 km<sup>2</sup> areas in the West Usambara Mountains.

Village area	Agricultural area km <sup>2</sup>	Area with SWC km <sup>2</sup>	Mean erosion No SWC	Mean erosion With SWC
			Mg ha <sup>-1</sup> y <sup>-1</sup>	Mg ha <sup>-1</sup> y <sup>-1</sup>
Soni	72	2.1	39.8	23.0
Sunga	47	9.3	52.0	22.5

## Discussion

The OBIA method was able to classify most of the fields with SWC measures in the two 10 x 10 km<sup>2</sup> areas (Fig. 3). The overall accuracy was 75% for the Soni area and 80% for the Sunga area.

The adoption of SWC measures is much higher in the Sunga area than in Soni, but the USLE modelling of annual erosion showed that the current erosion levels are similar (Table 1).

The presence of SWC measures reduces soil erosion by 42.1% in the Soni area and 56.7% in the Sunga area (Table 1).

## Conclusions

- SWC measures can be mapped by using a high resolution satellite image in combination with OBIA.
- There exists a large difference in adoption of SWC measures between Sunga and Soni.
- The SWC measures are effective in reducing soil erosion