Measuring and modelling soil loss and runoff mitigation potential of legume–led crop rotations under varying slope lengths in a small SW Kenyan catchment

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Introduction

Soil erosion is a major constraint to crop productivity in South Western (SW) Kenya where agricultural activities are mostly spread on hilly terrains. In smallholder-dominated Rongo sub-county soil erosion has reportedly changed the soil properties in the entire landscape. Land tenure is conventionally structured in strips in slope direction and predominant maize plots are ploughed downhill. It is hypothesized that soil erosion is determined non-linearly by slope length (SL), hence spatial arrangement and positioning of crops should be of great concern.

Aim

To improve knowledge of the impact of slope length on farmer selected legume-based cropping systems on sustainability of the production base (soil fertility) and environment (runoff, erosion).

Objectives

- To assess the impact of different slope lengths on soil loss and its impact on agronomic yield.
- To test different positioning of certain crops/ cropping systems in the landscape as conservation measures for best effect against erosion.

Materials and methods

Field experiments

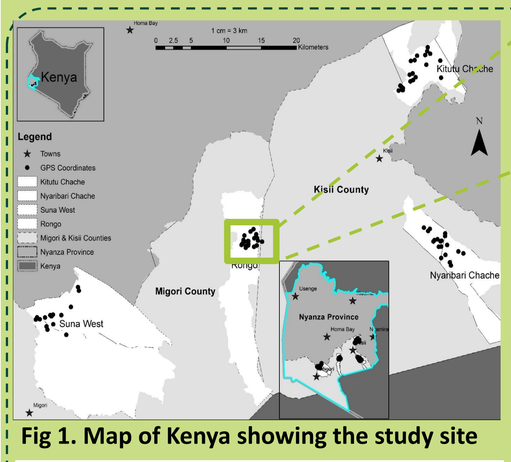

Fig 1. Map of Kenya showing the study site

- **Hilly region under intensive cropping**
- **Long slope lengths cultivated to maize-common beans intercropping**

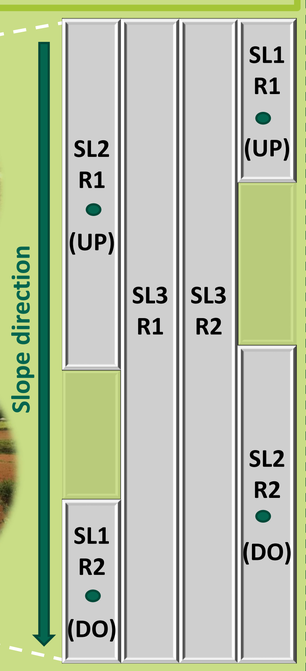

Fig 2. Experimental block (farm); 2017 long rains

Design: RCBD, 3 blocks (farms) with two replicates each of SL's

- **SL: SL1=20, SL2=60, SL3=84 m**
- **Parameters evaluated: runoff, soil loss, crop yield.**
- **Measured soil properties: texture, aggregate stability, BD, stone content, organic C, total N.**

Modelling

Land Use Change Impact Assessment (LUCIA) model

- Process-based dynamic model
- Simulates landscape-scale effect of changes in environmental conditions

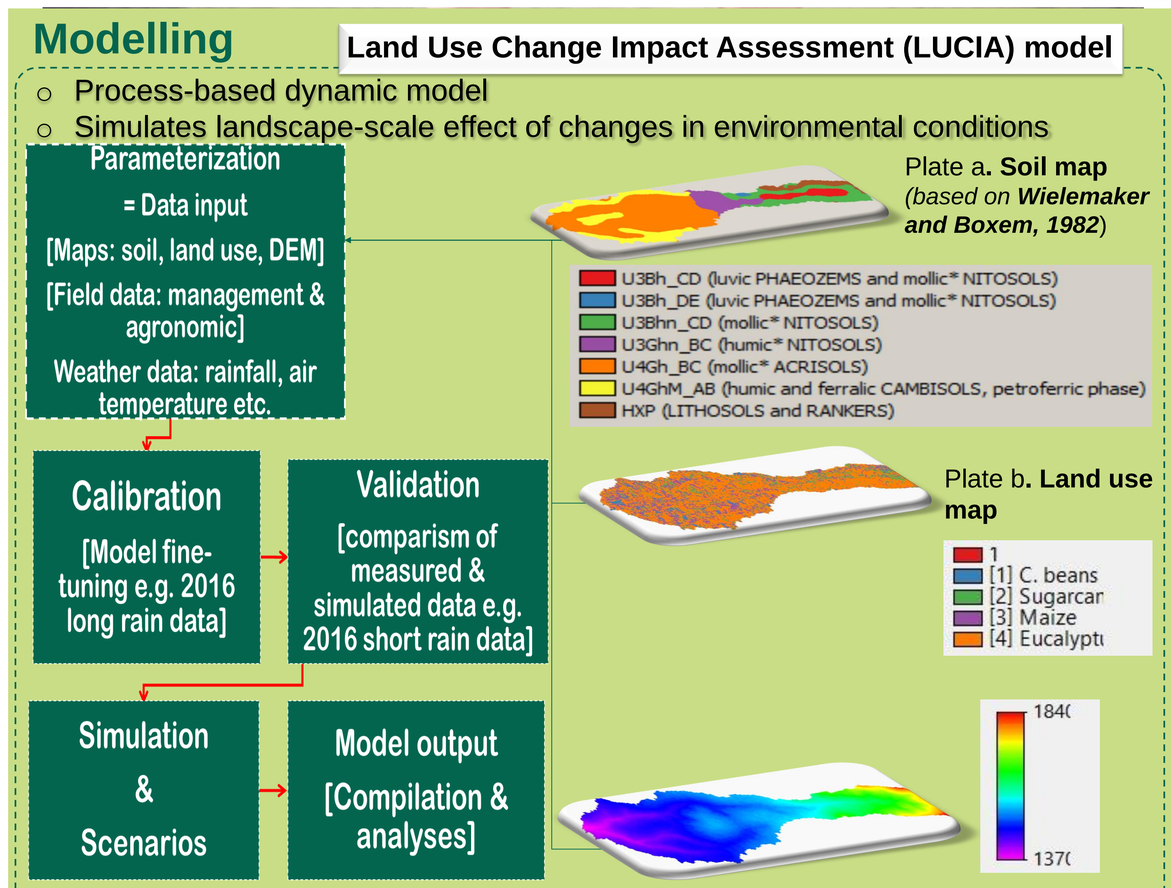

Fig 3. Structure of the modelling process

Plate a. **Soil map** *(based on **Wielemaker and Boxem, 1982**)*

Plate b. **Land use map**

Plate c. **Digital Elevation Model (DEM)**

Results of field experiments

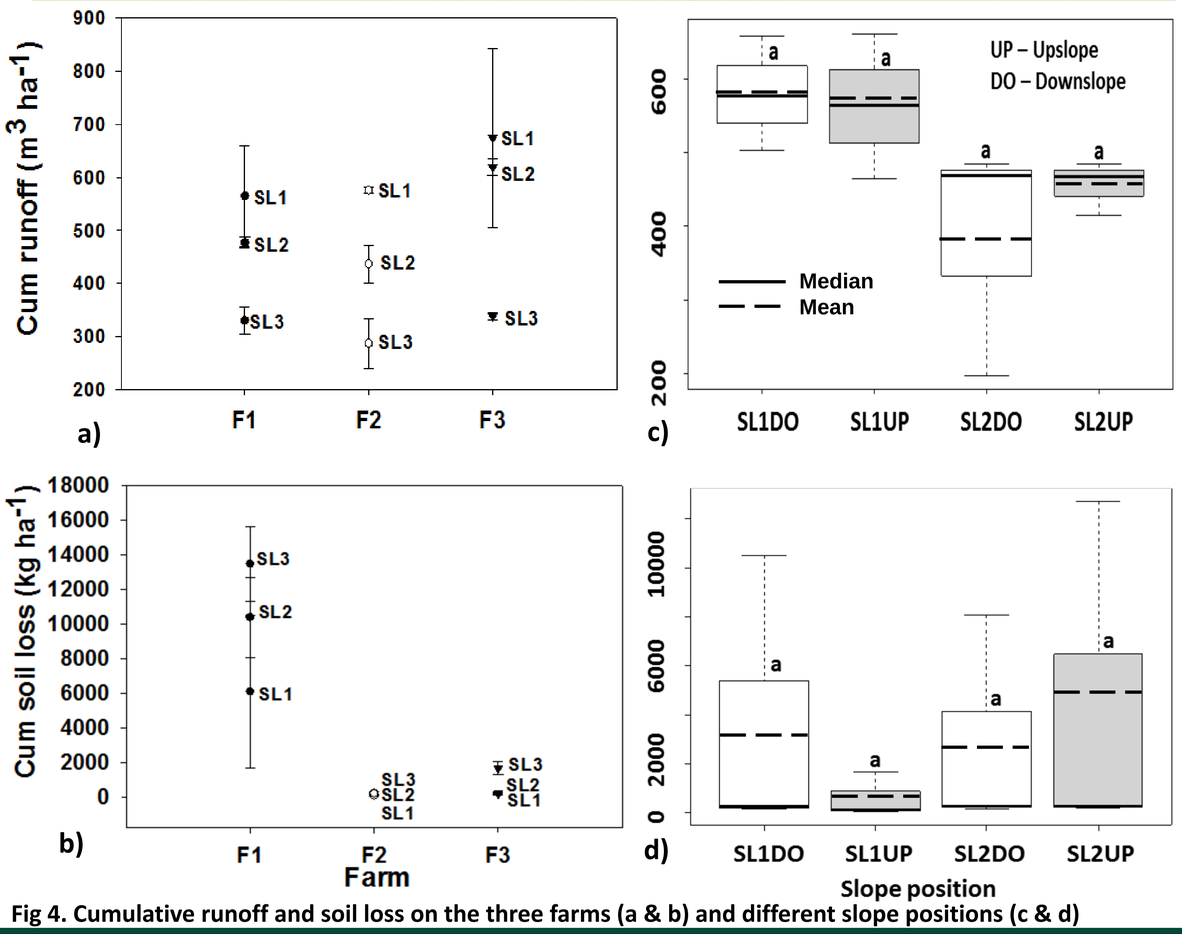

Fig 4. Cumulative runoff and soil loss on the three farms (a & b) and different slope positions (c & d)

Fig. 5 Cumulative soil loss on farm 1

Discussion and conclusion

- Runoff decreased with increasing slope length (SL1> SL2 > SL3). The reverse was observed for soil loss (SL1< SL2 < SL3) but the differences were not significant ($p < 0.05$).
- Upper and footslope positions of SL1 and SL2 were analysed separately to account for varying slope inclination.
- Longer slope length (SL2) positioned at the upper part of the slope generated larger soil loss than those at the bottom although the differences were not significant ($p < 0.05$).
- Preliminary model runs at the watershed scale suggest that soil conservation should focus on the upper parts of long slopes.
- Eventwise run-off and soil loss will be analysed in detail to improve the model algorithms at the slope to catchment scale.

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