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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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Abstract

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 slope direction and predominant maize plots are ploughed downhill. Soil erosion is determined non-linearly by slope length, hence spatial arrangement and positioning of crops should be of great concern. We posited that placement of soil erosion conservation measures at different slope locations affects the total amount of soil and nutrient loss on that slope and in the landscape. This was tested by a) field measurements of run-off and erosion on 12×4 m RCBD plots under different legume ground cover (*Mucuna pruriens*, *Lablab purpureus*, *Arachis hypogaea*) planted in pure stand and *Zea mays*/*Phaseolus vulgaris* intercrop (farmers' practice) with and without mulch; b) *Zea mays*/*Phaseolus vulgaris* intercrop on bounded plots of 20, 60, and 84 m length at different locations in the landscape; c) a modelling approach using the landscape model LUCIA (Land Use Change Impact Assessment). Field experiments showed that *Mucuna pruriens* decreased runoff and soil loss most effectively after the mulch treatment, followed by *Lablab purpureus* and *Arachis hypogaea*. Highest runoff and soil loss was observed under *Zea mays*/*Phaseolus vulgaris* intercrop. Slope length influenced runoff, and larger soil loss was observed on the longer slope lengths. LUCIA was calibrated and validated with the 1-year field datasets on runoff and soil loss. Model scenarios are led by maximising food crop and fodder use whilst reducing nutrient loss on cropped fields and avoiding siltation of fish ponds and streams in the lower watershed parts. Regarding sediment loads at the watershed outlet, uphill soil conservation measures during first simulations proved more effective than filter strips along streams, but growth of some legumes may be restricted by soil moisture on the upper slopes. Modelled best practices of legume-based soil conservation

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will be extended to the landscape scale. We will discuss aspects of implementation of soil conservation measures by farmers at the landscape scale.

Keywords: Landscape, legume, LUCIA, modelling, scenario, slope length, soil erosion