Rainfall - Soil moisture response in relation to land use in steep tropical environments: field-based research in NW-Rwanda

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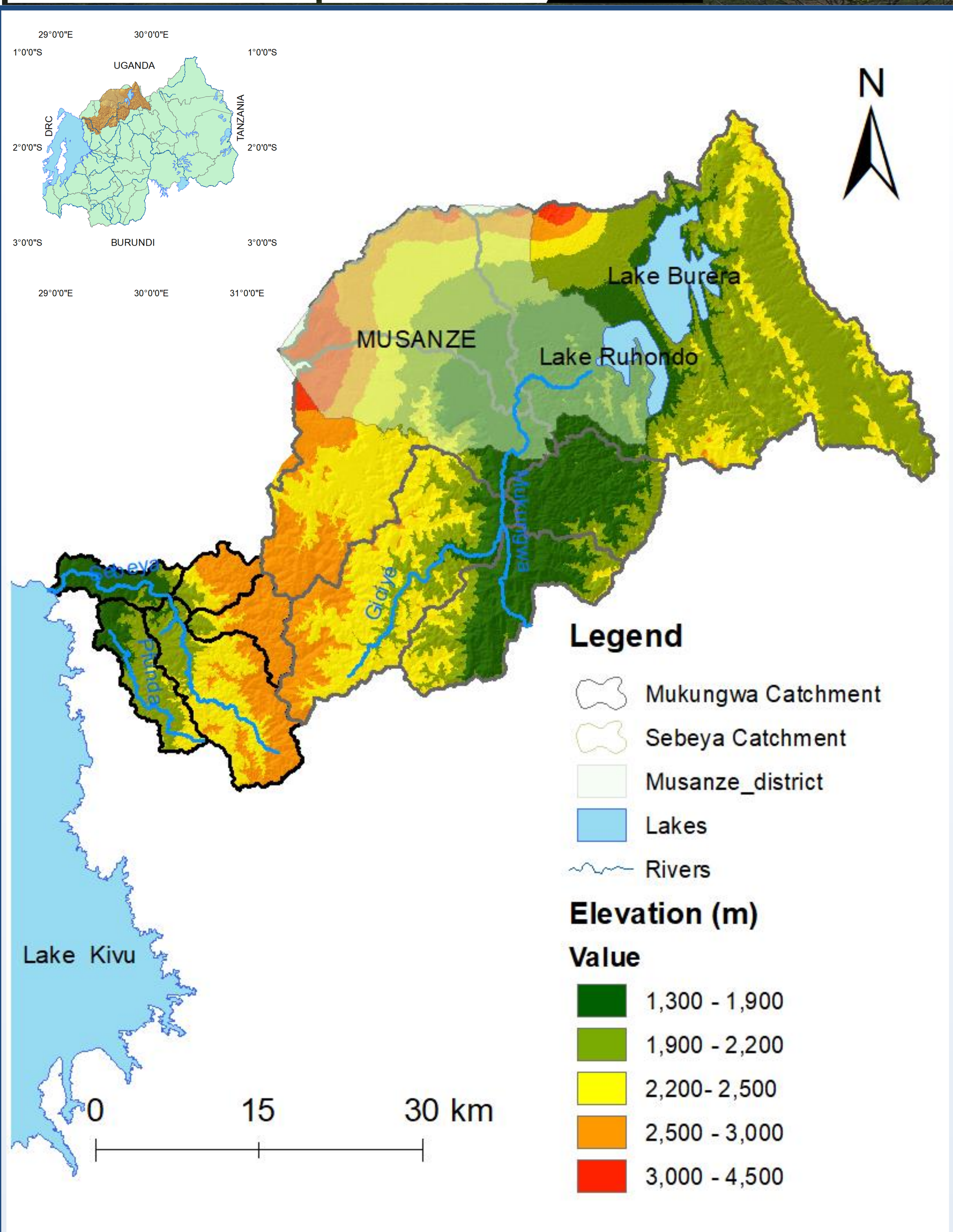
Young Soil Scientists Day 'Future challenges for soil scientist'



Study area: Mukungwa and Sebeya catchments (NW provinces of Rwanda); **2,070 km^2**

Context

- ❖ Many tropical regions are strongly affected by landslides due to their intense rainfall and weathering rates, specifically in zones with steep topography and/or tectonic activity (Nsengiyumva et al., 2018).
- ❖ For example, the steep sloped environments of the Northern-western provinces of Rwanda are often affected by severe cases of rainfall-triggered shallow landslides. These landslides often lead to severe direct (and indirect) impacts.
- ❖ The high demographic pressure of this area and its associated impacts on land use/cover (e.g. deforestation) strongly aggravates this problem. This because the actually triggering of rainfall-induced landslides largely depends on local soil moisture conditions.
- ❖ There is therefore a large need to better understand and predict the conditions that trigger landslides and, specifically, the relation between rainfall, soil type, land cover/use and soil moisture.

The objective of my PhD will be:

To better quantify and understand the relation between rainfall and soil moisture and how this is influenced by weather patterns, soil characteristics, land use/management and topography.

Methodology

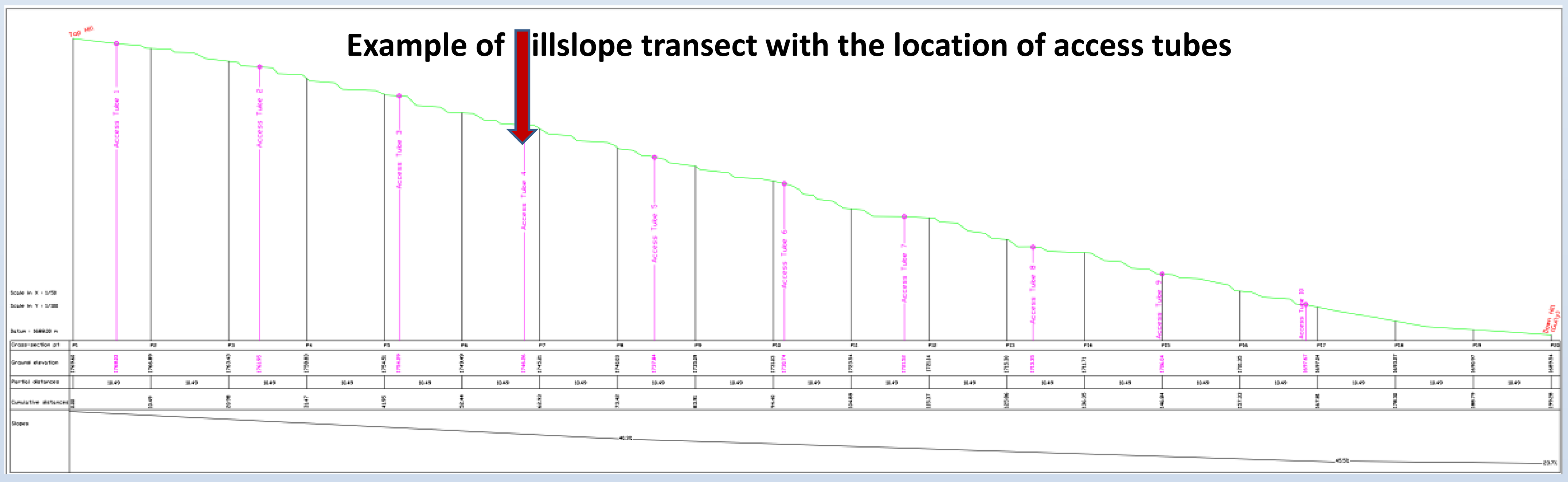
We recently installed equipment along six hillslope transects, reflecting different soil types and land use/cover that are representative for the study area. More specifically, we selected forested, cultivated and terraced hillslopes on both a sandy and a clayey soil.

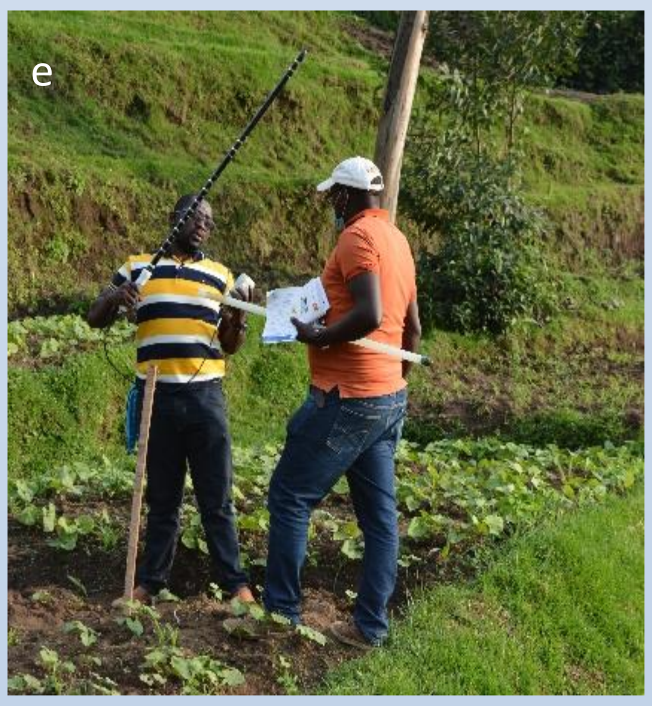
The following activities are conducted at each site:

- **Monitoring of spatial variation of soil moisture:** Around 10 access tubes of 100 cm depth were installed at each transect;
- **Monitoring of temporal soil moisture:** 3 soil moisture sensors (Ech20 10HS) were installed at each site at the depth of 30 cm, 60 cm, and 100 cm.
- **Measuring groundwater fluctuations:** 1 piezometer, equipped with TD-Diver was installed on each site.
- **Measurement of rainfall**: 5 automatic rain gages were installed near the experimental hillslopes.

Experiment setup

Example of hillslope transect with the location of access tubes





a) Landscape of cultivated hillslope in sandy soil, b) Installation of soil moisture sensors, c) Installed piezometer, d) Automatic rain gage, e) PRD-SDI12 its HH2 moisture.

Frequency of monitoring :

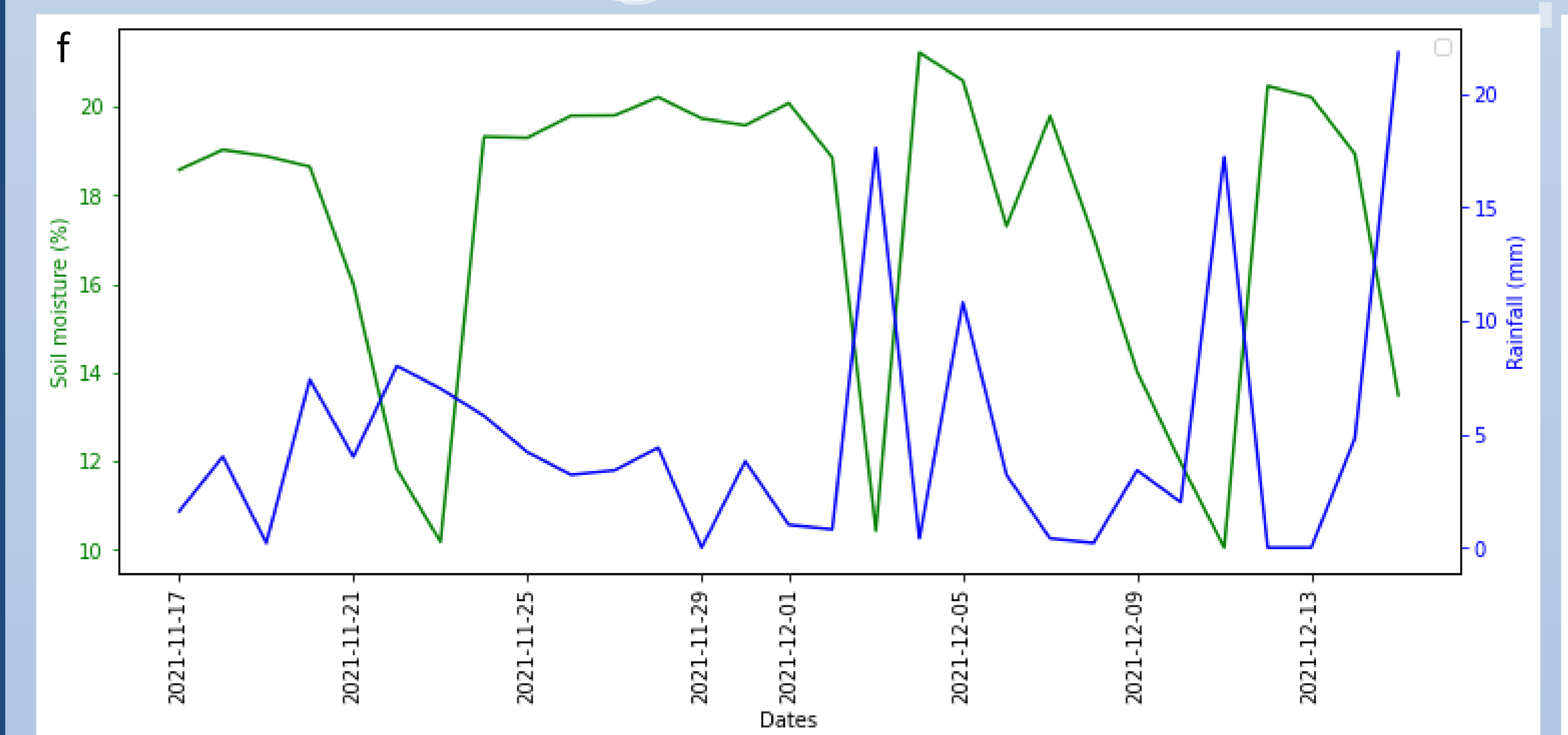
-Spatial variation of soil moisture content : everyday and at each access tube 18 measurements are taken

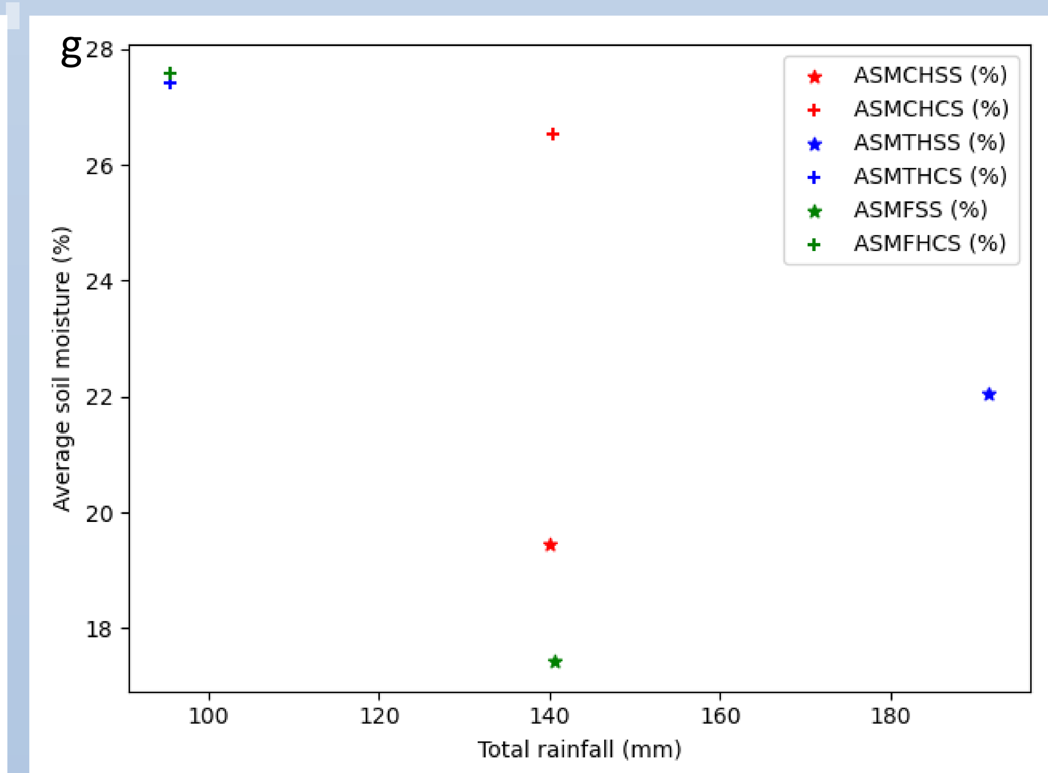
-Temporal variation of soil moisture content: on each hillslope 3 measurements are recorded for each 15 minutes

-Groundwater fluctuation: on each hillslope the water level is recorded at each hour

-Rainfall: Rain gages record the data each 15 minutes

Preliminary results





-From the figure f, it was observed that the soil moisture increases after a few days of rainfall;

-The scatter plot of average soil moisture vs rainfall on a period from 17th November to 15th December 2021, showed that clayey hillslopes have relative high soil moisture content than to the sandy hillslopes.

In addition, despite the intense rainfall occurred on forested hillslope, its transect showed a lowest average soil moisture content.

REFERENCES

Nsengiyumva, J. B., Luo, G., Nahayo, L., Huang, X., & Cai, P. (2018). Landslide susceptibility assessment using spatial multi-criteria evaluation model in Rwanda. *International Journal of Environmental Research and Public Health*, *15*(2). https://doi.org/10.3390/ijerph15020243