FORMAS

Swedish Research Council

SLU

World Agroforestry

EXTENSION DOCUMENT
TECHNICAL GUIDELINES

HOW TO MEASURE THE SLOPE OF A LAND?

Hanoi | March 2024

ABOUT THE PROJECT

The Project ***"Agroforestry: potential for sustainable development in the uplands"*** aims to contribute to sustainable development in sloping upland areas, with focus on evaluating agroforestry practices and systems addressing production and productivity, soil conservation, management practices such as nutrient application and weeding, and competitive effects between trees, crops and forage grass in young and mature agroforestry systems, study fruit value chains and market links, and assess opportunities and bottle-necks for wider agroforestry adoption and increasing of scale.

The Project (formally two projects) is funded by Formas, a Swedish Research Council for Sustainable Development and Vetenskapsrådet / Swedish Research Council, respectively. It is carried out between January 2020 and December 2023 (Formas), and December 2024 (VR), by SLU - Swedish University of Agricultural Sciences and the International Centre for Research in Agroforestry (ICRAF - also known as World Agroforestry) in Viet Nam, the Soil and Fertilizers Research Institute (SFRI) and the Departments of Agriculture and Rural Development from provinces of Dien Bien, Son La and Yen Bai.

SLOPE AND AGRICULTURE ON SLOPING LAND

Upland agricultural systems play a crucial role in global food production (Wang et al., 2022a). Agricultural landscapes developed in hilly and mountainous regions constitute a historical heritage that provides cultural and ecosystem services (Wang et al., 2022b).

Sloping land, defined as any land with a steepness exceeding 5%, serves as a vital resource for upland agriculture. The slope's steepness directly influences soil depth, susceptibility to erosion, soil tillage, the utilization of agricultural machinery, irrigation, and plant adaptation. The steepness and length of the slope affect soil and water loss (Everest et al., 2021). Understanding slope is crucial for implementing proper management procedures in agricultural production on sloping land. Examples include managing surface runoff and preventing soil erosion by suitably designing the production system, adapting soil tillage, selecting tree and crop species, applying fertilizer and manure at correct rates and with suitable methods, pruning trees, choosing the time and methods of weed control, and managing soil vegetation cover, residues from trees and crops, and irrigation. A fundamental step toward this is to understand the steepness of the slope.


Photo: AFLI Project

METHODS OF MEASUREMENT

1. USING A WATER TUBE

Material:

A water tube (5 m long), measurement ruler and a bamboo stick (2.5 m long).

Instructions:

Fill the tube with water (Fig. 1). Place one end of the tube, A, along a vertically positioned stick (point 1 in Fig. 2 and 3). The other end, B, is positioned slightly up the slope over point 2, with the water tube placed on the ground between the two points.

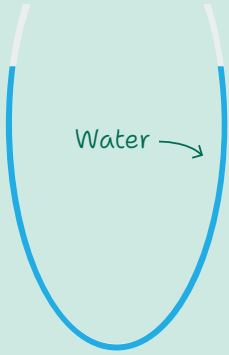

Figure 1*.Water tube*

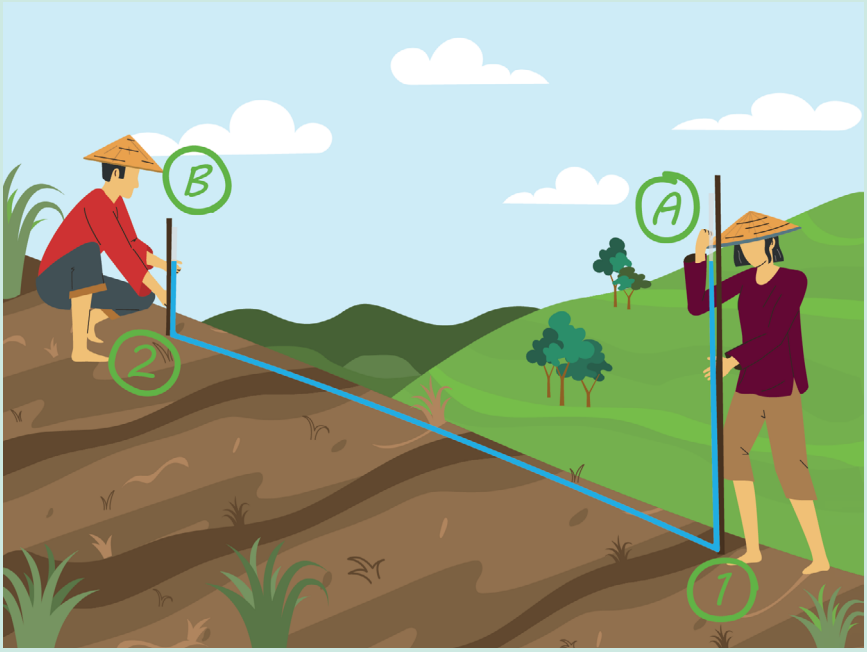

Figure 2*. Measuring the slope with a water tube in the field*

Open both ends of the tube to equalize water levels against atmospheric pressure. Adjust the water level so that it is at or above the soil surface level at B (y1) by lifting or lowering the tube at A. Measure the water level height at A (y2) and B (y1) using a yardstick. Measure the distance between points 1 and 2 (L) and calculate the slope (S) by dividing the water level difference (Δy) by the horizontal distance (x) between y1 and y2 using Equations 1 and 2:

$$S(\%) = \frac{\Delta_Y}{x} * 100 \qquad \text{(Eq.1)}$$

$$x = \sqrt{(L^2 - \Delta_Y^2)} \qquad \text{(Eq.2)}$$

Where x is the horizontal distance between A and B

L is the distance between points 1 and 2

And Δy=y2-y1

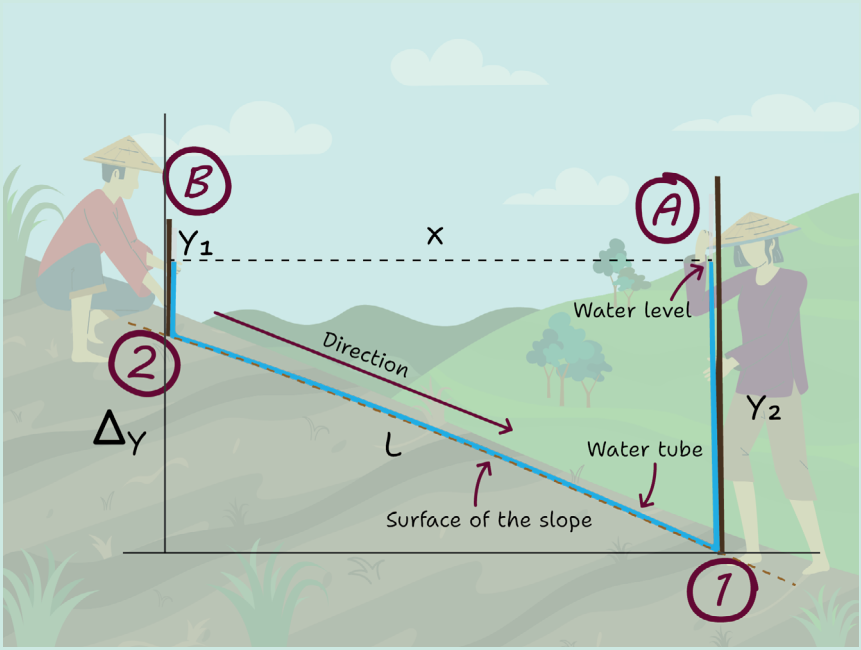

Figure 3. *Measuring a slope with a water tube (Source: Sjödell and Thelberg, 2020)*

2. USING A MOBILE PHONE

Material:

Prepare two short sticks of identical length (e.g. 0.5 m length), one long straight stick (3-4m length) and install an inclinometer app in smartphone.

Instructions:

Place the two short sticks vertically well apart, making sure they remain on top of the soil surface.

Place the long stick on top of them. Open the inclinometer app on your smartphone, then lay the phone along the long stick.

Read the slope value displayed on your phone (Fig. 5 and 6).

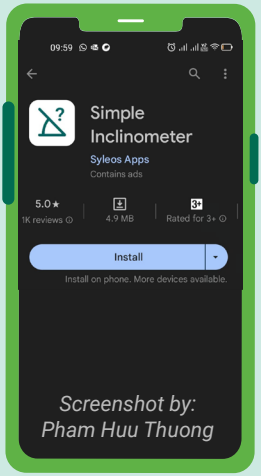

Figure 4. *Example of inclinometer app on mobile phone*

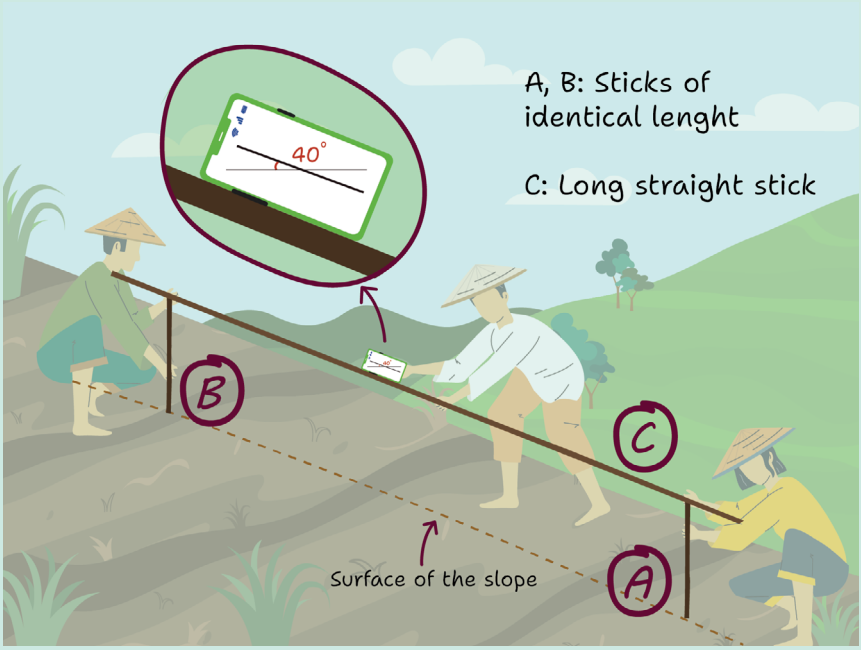

Figure 5. *Measuring a slope with a mobile phone*

Figure 6. *Participants practicing how to measure a slope of land using a mobile phone, during a TOT training in Kim Boi, Hoa Binh*

REFERENCES

Sjödell, B., Thelberg, H., 2020. Impact of Agroforestry on Soil Loss Mitigation in the Sloping Land of Northwest Vietnam. Diss (Master's Thesis). Swedish University of Agricultural Sciences & Uppsala University. Uppsala, Sweden. urn:nbn:se:uu:diva411180

Everest, T., Sungur, A., Özcan, H., 2021. Determination of agricultural land suitability with a multiple-criteria decision-making method in Northwestern Turkey. Int. J. Environ. Sci. Technol. 18, 1073–1088. https://doi.org/10.1007/s13762-020-02869-9

Wang, W., Pijl, A., Tarolli, P., 2022a. Future climate-zone shifts are threatening steep-slope agriculture. Nat. Food 3, 193–196. https://doi.org/10.1038/s43016-021-00454-y

Wang, W., Straffelini, E., Pijl, A., Tarolli, P., 2022b. Sustainable water resource management in steep-slope agriculture. Geogr. Sustain. 3, 214–219. https://doi.org/10.1016/j.geosus.2022.07.001

NOTES

WE HOPE THAT THIS DOCUMENT IS USEFUL

FORMAS

Swedish Research Council

SLU

World Agroforestry

CONTACT

Viet Nam Coordinator: PhD. La Nguyen, ICRAF Viet Nam,
E-mail: l.nguyen@cifor-icraf.org | *Phone:* +84 (0)962021472

PhD. Do Van Hung, ICRAF Viet Nam, Swedish University of Agricultural Sciences,
E-mail: d.hung@cifor-icraf.org | *Phone:* +84 (0)977843201

MSc. Pham Huu Thuong, ICRAF Viet Nam, Swedish University of Agricultural Sciences,
E-mail: p.thuong@cifor-icraf.org | *Phone:* +84 (0)912755998