The Dark Side of SExI-FS: Tree Roots as Landslide Anchor

World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

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Background

The role of tree planting and agroforestry in reducing landslide risk on slopes is still a question. The Index of Root Anchoring (IRA) and Index of Root Binding of soil (IRB) show differences in the distribution of woody roots between species (Hairiah, 2006). Species selection and plot management can then be assessed for their effects on the cohesiveness of the topsoil and the degree to which the 'root mat' is anchored in the subsoil. Will it break apart?, Slide as a whole? Or stay in place? 3D-visualization of above & belowground architecture can help to evaluate options.

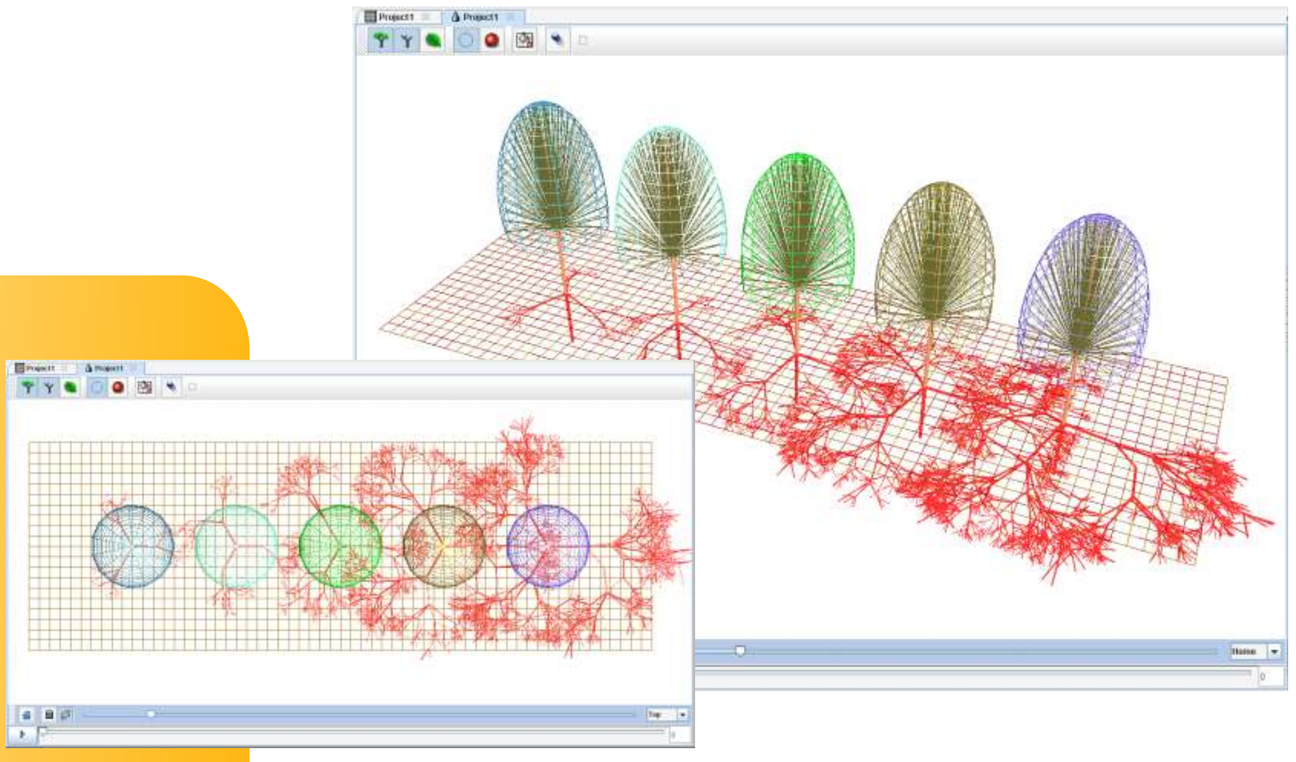

Figure 3. Trees with different Index of Root Binding (IRB) from 1 (the most left) to 2 the most right

Methods

All trees in plots of 50x50m were recorded (Figure 1) at a slope in Sentul (Bogor) that experiences gradual landslides in a village, despite its homegardens. This plot will be used for simulating plot management and explore the tradeoff between 'anchoring' and 'binding' roles of trees.

Root distribution are simulated based on IRA and IRB value, and using fractal branching (FBA) algorithm (van Noordwijk, 2002) to show the root branching pattern in 3D (Figure 3).

Other benefits of the trees such as fruit yields (Harja, 2007), wood production and carbon stocks can already be captured by the SExI-FS model. Fractal root branching rules were added to see the belowground parts. A new plot-level Risk Index can be calculated as (1 – Binding Roots Cover Area)/Plot Area for Horizontal plot stabilization, and (1 – ΣRoot Depth)/Top Soil Layer Depth for vertical plot stabilization.

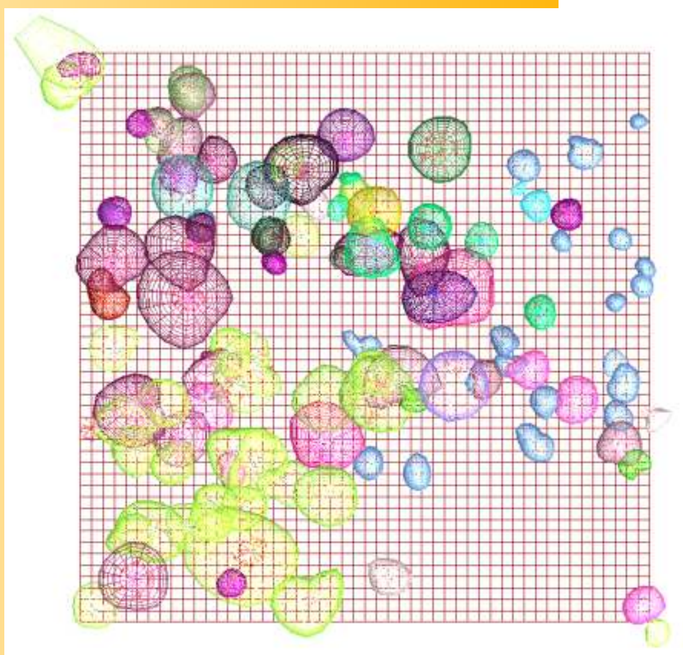

Figure 1. A record of all trees in a 50x50 m plot

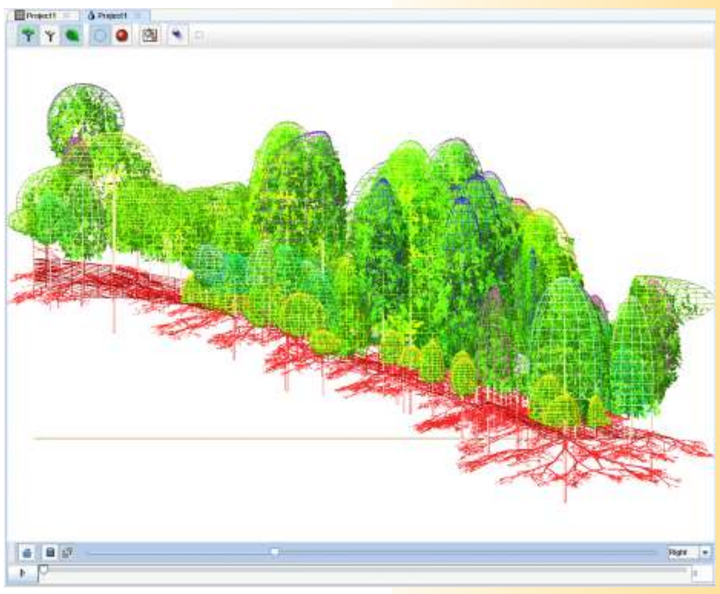

Figure 2. The slope at recorded tree plot in Sentul

IRA was calculated as Dv^2/dbh^2 where dbh is tree diameter at breast height (1.3 m height) and Dv is the diameters of all vertical roots (van Noordwijk, 1996) and IRB was calculated as Dh^2/dbh^2, where Dh is the diameters of all horizontal roots.

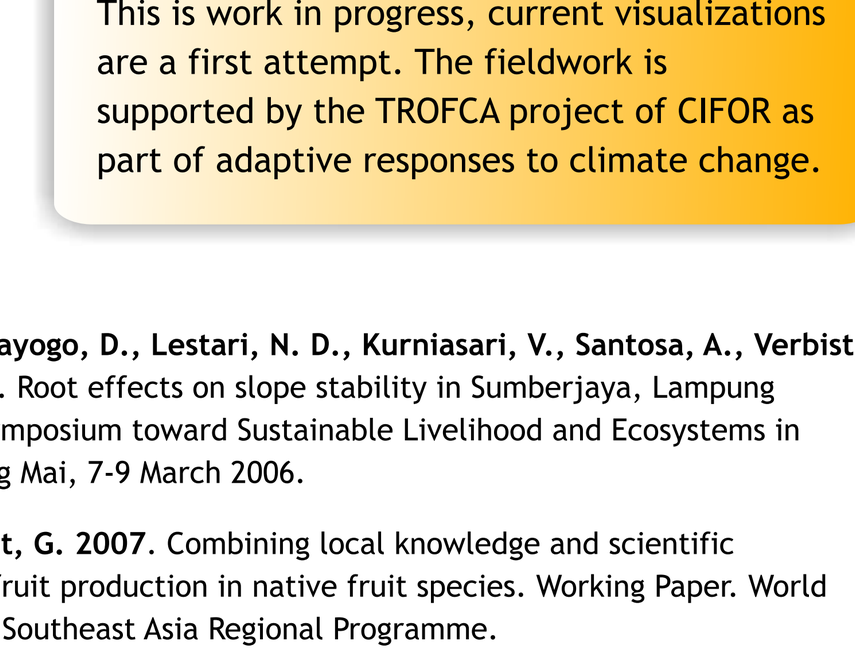

Figure 4. The root coverage of an established plot

This is work in progress, current visualizations are a first attempt. The fieldwork is supported by the TROFCA project of CIFOR as part of adaptive responses to climate change.

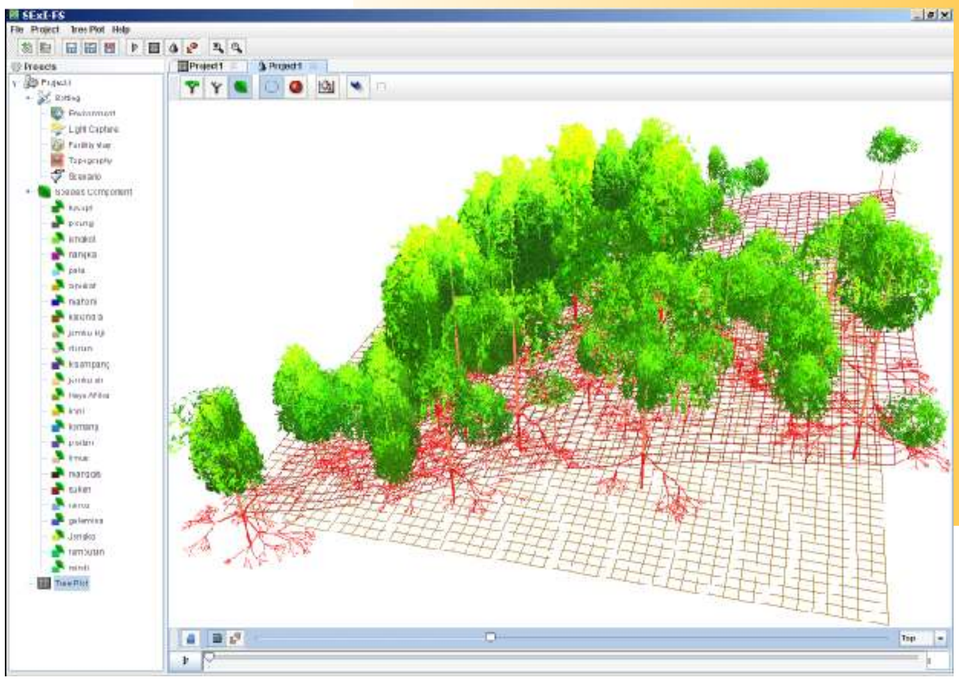

Figure 5. The SExI-FS software user interfaces, used for interacting with the simulated trees and try the preferred management options

References

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