Are tree plantations forests?

A comparison of soil erosion under rubber tree plantations and annual crops in mountainous areas of Northern Thailand

Context: soil erosion and RT expansion in Thailand

- High rainfall erosivity and rapid land-use change have caused a quick increase of soil erosion in SE Asia.

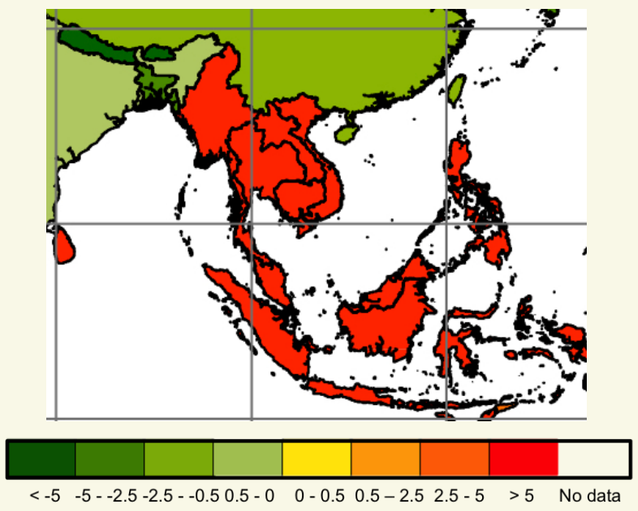


Figure: Annual changes of the average soil erosion (%) (Borrelli et al. 2017)

- "Afforestation" by rubber tree (RT) plantations in Northern Thailand was expected to promote soil conservation and increase farmers' income.
- What is the effect of RT plantation on runoff and soil detachment?

Methods

- Mountainous area of Northern Thailand
- Erosion microplots installed in 2015 and 2016 in maize, young RT with intercrop and mature RT, within or between tree rows.

- Measures of runoff and detachment after each rainfall event.

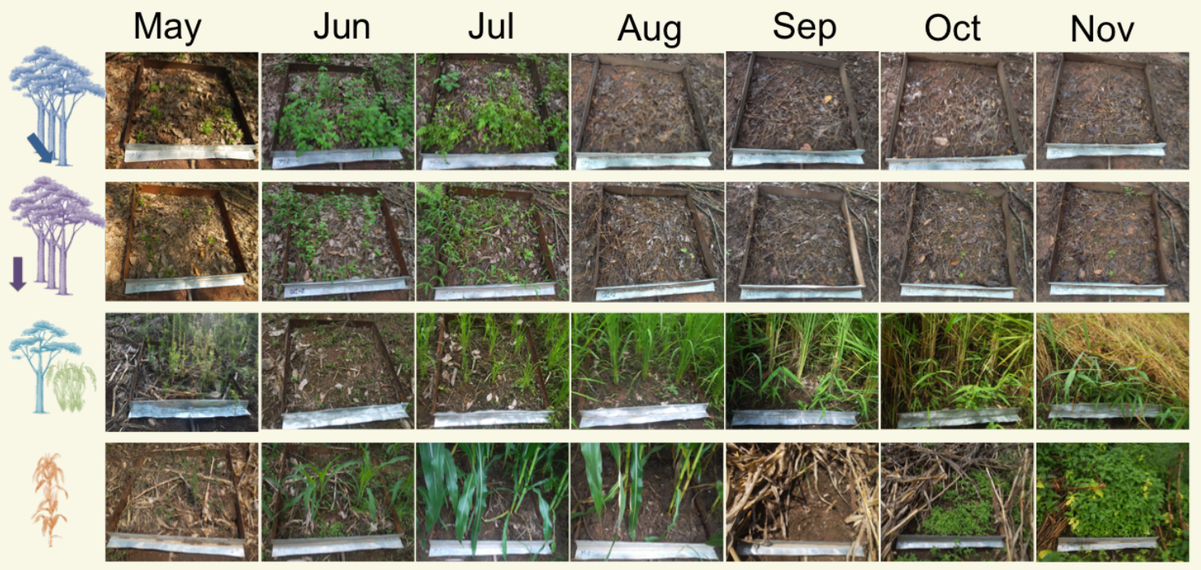
Results

1. Soil runoff and detachment are 10x to 30x higher under mature RT than maize or young RT.

Land use	Runoff (100 L/ y/m^2)	Soil detachment (kg/ y/m^2)
Maize	0.4 to 1.0	0.12 to 0.63
Young RT + rice	0.4 to 0.9	0.08 to 0.24
Mature RT	1.6 to 6.0	1.90 to 12.8

Table: Annual runoff coefficient and soil detachment in 2016. Total rainfall height was 1540 mm and cumulated rainfal erosivity (EI_{30}) was 33 700 kJ mm m^{-2} ha^{-1}.

2. Soil surface under RT is degraded in the course of the rainy season due to herbicide spraying.



3. The very low soil cover under mature RT in the middle of the rainy season leads to increased runoff compared to maize and young RT.

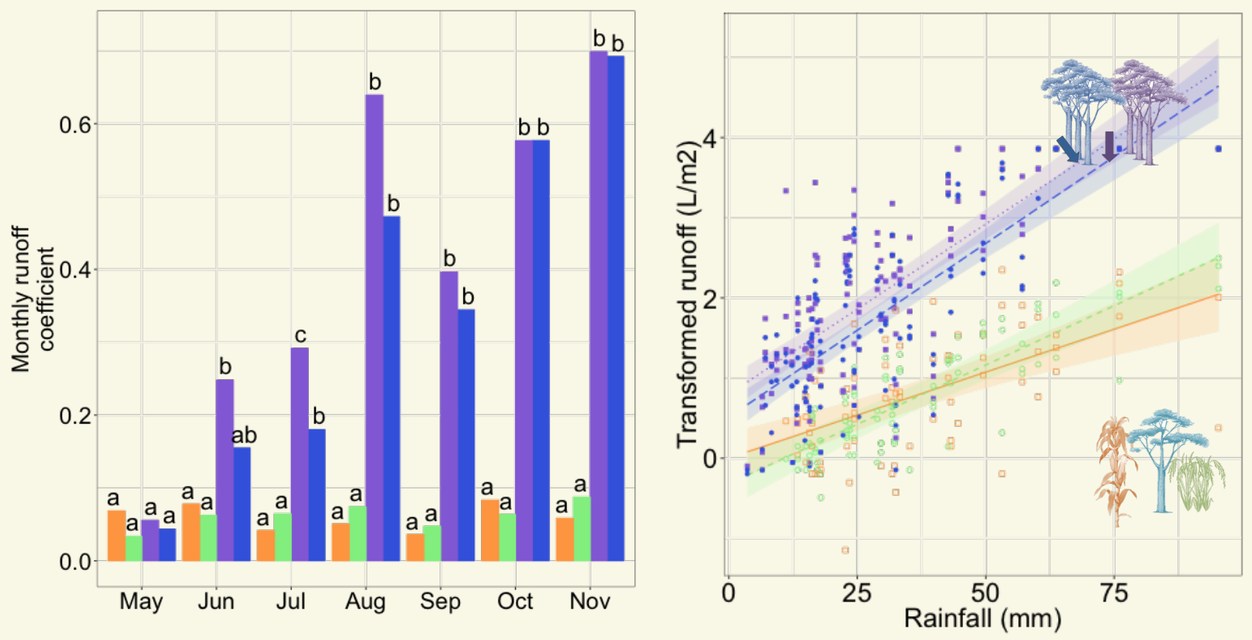


Figure: Left. Dynamics of monthly runoff coefficient depending on the land use. Right. Increase of runoff volume (box-cox transformed, $\lambda = 0.1$) with rainfall ($P < 10^{-6}$) depending on land use (interaction: $P < 10^{-4}$).

Conclusion

- RT plantations, far from supporting soil conservation, increase runoff and soil detachment
- This is mainly due to scarce understory and a high canopy, which leads to higher raindrops kinetic energy
- Cultivated steep slopes, including tree plantations, should always have ground cover, especially during the rainy season.

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References

Based on Neyret, Robain, de Rouw, Janeau, Kaewthip, Trisophon & Valentin. **Rubber tree plantations increase runoff and soil detachment compared to annual cultivation in steep mountainous Thailand**. Submitted to *Catena*.

Borrelli, Robinson, *et. al.* 2017. **An assessment of the global impact of 21st century land use change on soil erosion**. *Nature Communications*

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