

# Soil C stocks decrease after conversion from degraded forest to rubber

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## Introduction

Land use conversion from degraded forest patches into terraced rubber plantations is taking place in a large area of Xishuangbanna (southern Yunnan, China), northern Laos and northern Thailand (Li & Fox, 2012). These degraded forests consist of woodlots, village forests, and mature fallow fields. The impact of this land use conversion on soil C stocks has not been well-studied.

**Aim: To quantify changes in soil C stocks after conversion from degraded secondary forest to terraced rubber plantations.**

Research questions:

1. Are changes in soil C stock related to rubber plantation age?
2. Can changes in soil C stock be explained by changes in: (i) tree basal area (ii) litter layer quality or quantity?
3. What is the impact of terracing in rubber plantations on soil C stocks?

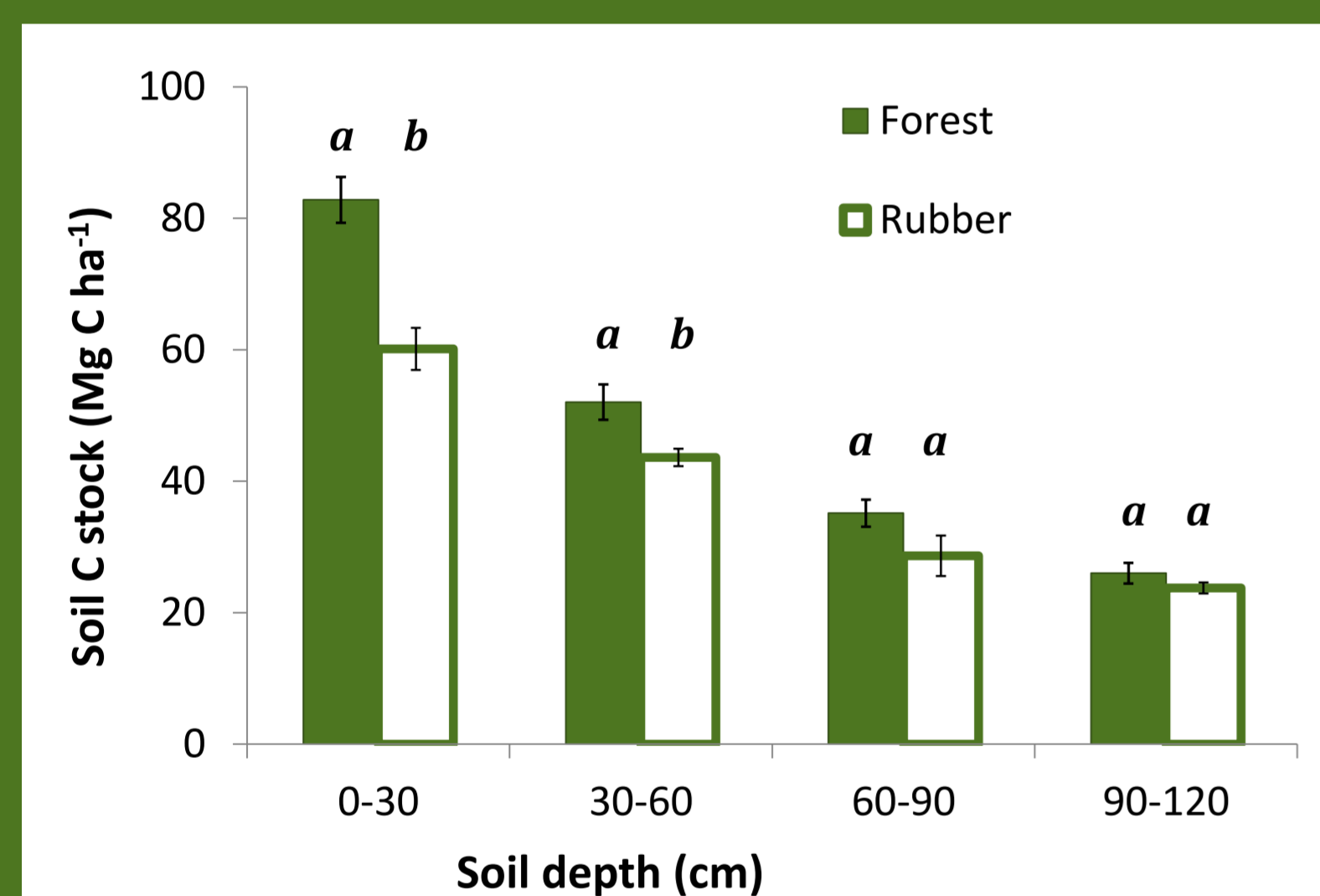
## Conclusions & Discussion

1. Conversion from degraded forest to rubber plantation results in a significant decrease of soil C stock by 37.4 Mg C ha<sup>-1</sup> (19%) in the top 120 cm of the soil.
2. Changes in soil C stock can not be explained by changes in either leaf litter layer or tree basal area.
3. Terracing results in (i) redistribution of soil C stocks along the terrace, and (ii) slight increase of soil C stocks at the terrace in older plantations.

The observed decrease in soil C stock is hypothesized to be driven by:

1. Higher erosion rates in rubber plantations compared to forest
2. Accelerated soil C decomposition rates, due to changes in microclimate.

## Results - Land use change



**Fig. 1:** Soil C stocks in forest (n=7) and rubber plots (n=11) in relation to soil depth (means ± SE). Different letters show significant differences between rubber and forest within soil depth interval (LME at P < 0.05).



**Fig. 2:** Differences in soil C stock in 0-120 cm depth between paired rubber and forest plots in relation to rubber plantation age.

**Table 1:** Means ± SE, forest (n=7) and rubber plots (n=11).

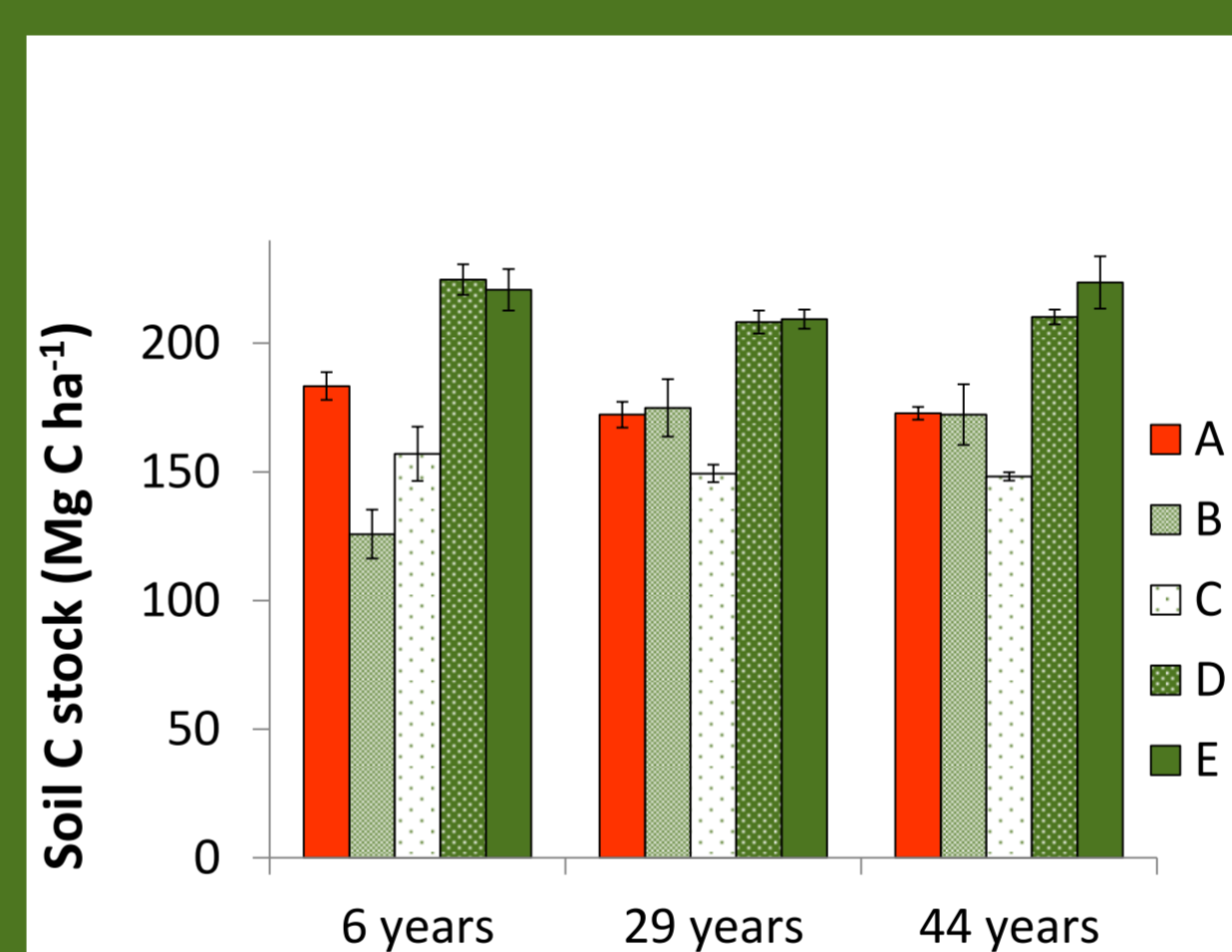
	Forest	Rubber
<b>Total soil C (Mg C ha<sup>-1</sup>)</b>	<b>196 (6.15)</b>	<b>155 (3.55)</b>
Tree basal area (m <sup>2</sup> ha <sup>-1</sup> )	15 (1.67)	19 (3.75)
Litter CN ratio	45 (3.58)	46 (3.80)
Litter layer C (Mg C ha <sup>-1</sup> )	2.68 (0.44)	2.11(0.18)

### Soil C stock to 120 cm depth

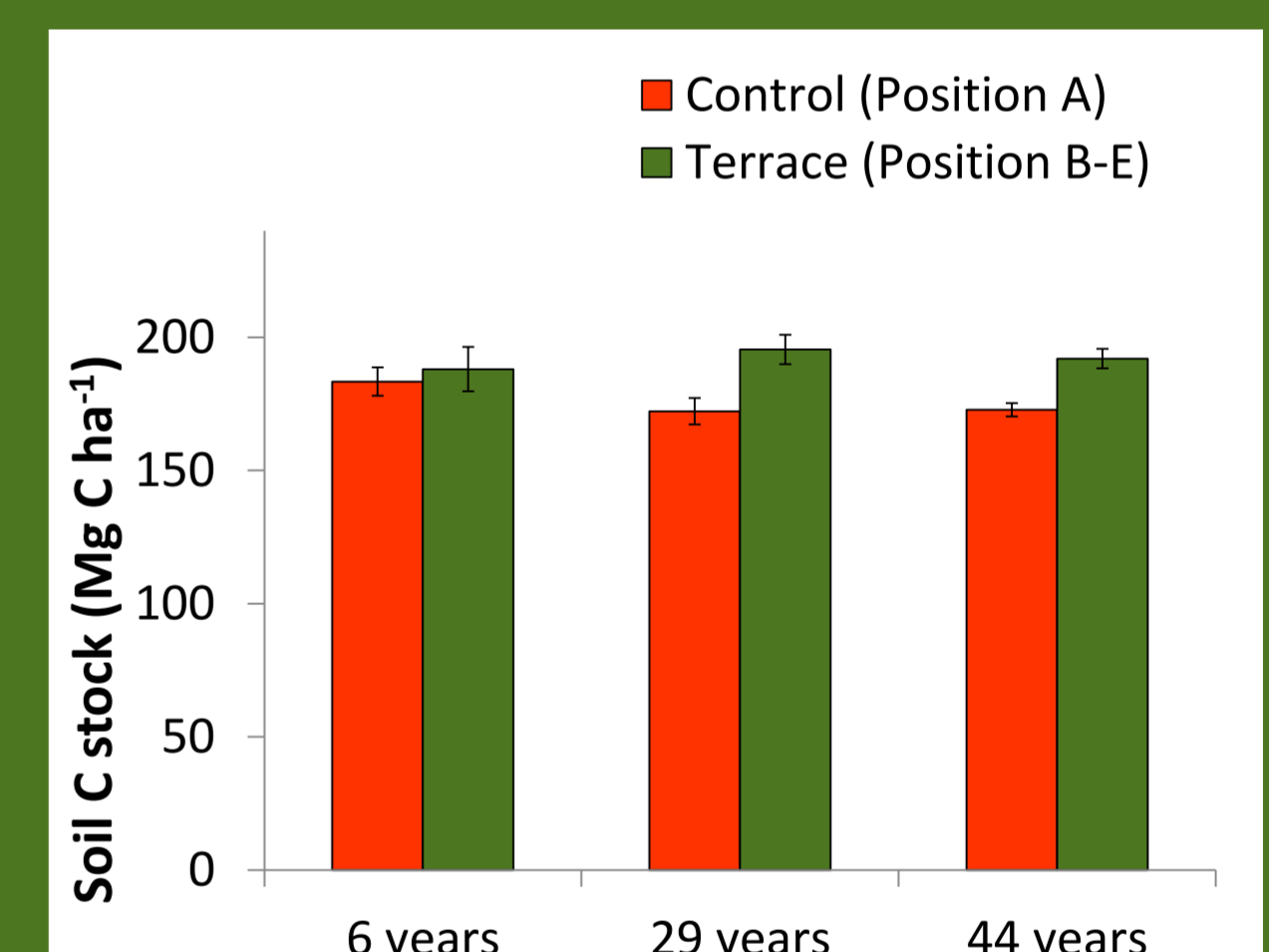
Rubber has a significantly lower soil C stock than forest: - 37.4 Mg C ha<sup>-1</sup> (SE = 4.9) (LME at P < 0.05)

**Litter layer C stock, litter CN ratio, and tree basal area:** No significant differences between paired rubber and forest plots.

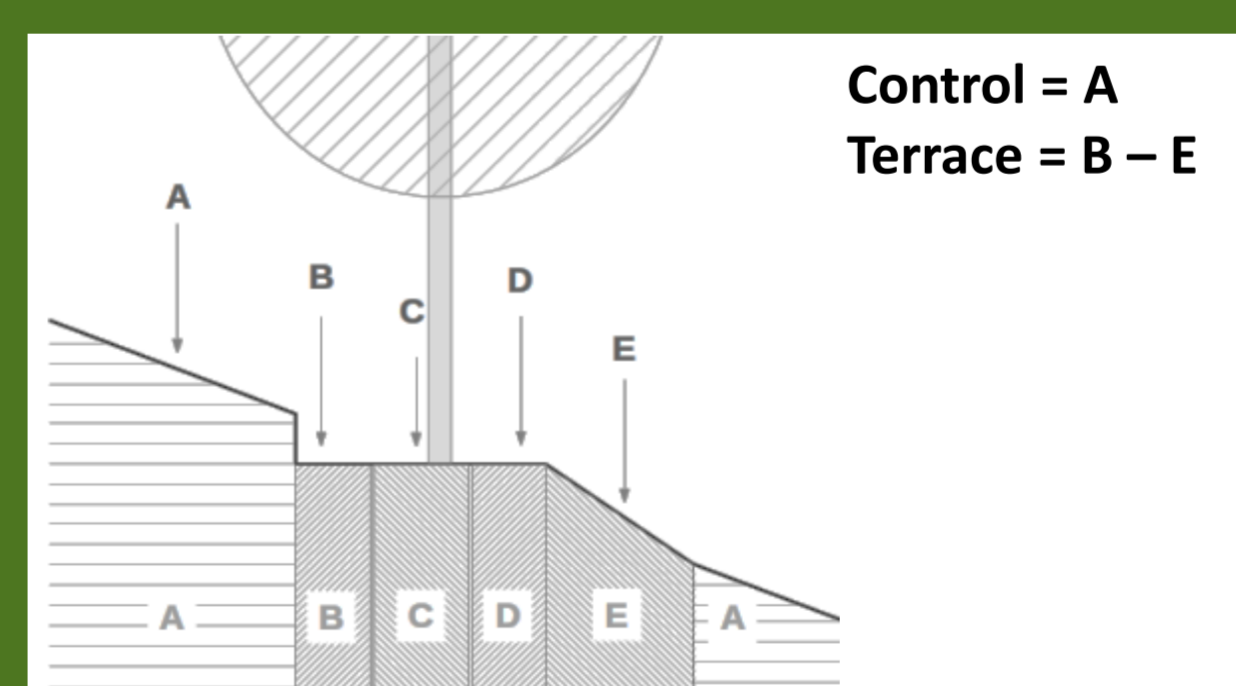
## Results - Terracing



**Fig. 3:** Soil C stocks in 0-120 cm depth per terrace position (n=6) in plantations of different ages (means ± SE).



**Fig. 4:** Soil C stocks in 0-120 cm depth at control (position A) (n=6) and at the terrace (weighted average of position B-E) (n=6) in plantations of different ages (means ± SE).



## Approach

### Land use change

- 11 pairs consisting of a plot in a rubber plantation and a plot in a forest.
- Paired rubber and forest plots have similar biophysical conditions.
- The selected rubber plantations were established on former secondary forest.
- Age of rubber plantations: 5 – 46 years.
- Assumption: Paired plots had comparable initial conditions at the time of land use conversion.

### Terracing:

- 3 rubber plantations: 5, 29 and 44 years
- Plot design: 6 transects per plot. A transect consisted of 5 sampling points along a terrace.



STUDY AREA