



Tropentag, September 20-22, 2017, Bonn

“Future Agriculture:  
Socio-ecological transitions and bio-cultural shifts”

## Rubber Cultivation Weakened the Soil Methane Sink Function Compared to Natural Forest

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### Abstract

The impact of transforming natural forest into rubber plantations on soil function as CH<sub>4</sub> sink has not been well understood, especially on the seasonal dynamic and changes in underlying soil processes. Aimed to understand how this land use conversion changes the soil CH<sub>4</sub> sink, we conducted measurements in both natural forests and rubber plantations in Xishuangbanna, SW China. Temporal dynamic of soil surface CH<sub>4</sub> flux, CH<sub>4</sub> concentration and isotope signature of <sup>13</sup>CH<sub>4</sub> in the soil profile at 5, 10, 30 and 70 cm depth were measured at representative time in dry and rainy season.

CH<sub>4</sub> uptake by soils in rubber plantations was only 41.8% of uptake by forest soils, with annual CH<sub>4</sub> cumulative flux of  $-2.41 \pm 0.28$  and  $-1.01 \pm 0.23$  kgC ha<sup>-1</sup>yr<sup>-1</sup> for forests and rubber plantations respectively. The CH<sub>4</sub> oxidation was stronger in dry season than in rainy season, mainly explained by changes in soil moisture. From dry season to rainy season, CH<sub>4</sub> flux shifted to weak consumption in forest and young rubber plantation, or even towards emission in older rubber plantations; CH<sub>4</sub> concentration increased in all four depths with higher increment in older rubber plantations. The enrichment of soil CH<sub>4</sub> by <sup>13</sup>CH<sub>4</sub> was higher in forest than in rubber plantations. The decrement of delta <sup>13</sup>CH<sub>4</sub> from dry to rainy season in both land uses indicated the increased CH<sub>4</sub> production in rainy season, while the flux showed the net consumption. The CH<sub>4</sub> turnover rate suggested that the surface 0–5 cm soil was the most active layer responsible for CH<sub>4</sub> oxidation.

Conversion the forest into rubber plantation weakened soil CH<sub>4</sub> sink function. Seasonal change of CH<sub>4</sub> flux and <sup>13</sup>CH<sub>4</sub> enrichment was larger under rainforest than rubber plantations, indicating modified soil water regime under rubber. Converting forest into rubber plantations and rubber cultivation may have profound impact on greenhouse gas emission from soil.

**Keywords:** Land use change, methane sink, rubber plantation, tropical soil