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The impact of oil palm plantations on soil nutrient translocation to riparian buffer strips and rivers

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The role of riparian buffer strips between rivers and oil palm plantations is to reduce nutrient and sediment flow into the rivers, and thereby safeguard the high river water quality needed to maintain aquatic biodiversity. Runoff and leaching of fertiliser and herbicides routinely used in oil palm management will accumulate in properly working riparian buffer strips, leading to raised concentrations of N,P,K and micronutrients. In particular increased concentrations of soil nitrogen are of concern, as this will increase emissions of the greenhouse gas nitrous oxide, and may lead to eutrophication of the buffer strips and rivers.

In order to investigate the effectiveness of buffer strips in reducing nutrient leaching to the river, we installed measurement transects from three mature oil palm plantations to adjacent riparian buffer areas, and down to the river within the SAFE project landscape (https://www.safeproject.net), SE Sabah. The riparian areas differed: R1 – a steep sloping mature deciduous forest; R2 - an Octomeles sumatrana plantation with ferns and the legume Pueraria phaseoloides on a flood plain of a small tributary river; R3 – a 20 m Pueraria phaseoloides area between the oil palm plantation and a steep sloping mature deciduous forest draining into the same river as R1. Every two months greenhouse gas fluxes (N2O, CH4, soil respiration) from the oil palm plantations and forests were measured using static chambers, and river concentrations using the headspace method. In addition mineral nitrogen concentrations and physical soil and water parameters were monitored at the same frequency.

Results are currently been analysed. Very preliminary trends suggest larger soil respiration rates from the forests, presumably due to large amounts of decomposing leaf litter. Methane fluxes depended on the slope of the plantation, with the wettest soils producing the largest methane emissions and the driest soils the largest CH4 oxidation rates. Nitrous oxide emissions were of similar order of magnitude in the oil palm plantations and adjacent riparian areas R2 and R3, but larger in riparian area R1. This may be explained by the larger soil nitrate concentrations in the riparian forests and similar KCl extractable ammonium concentrations in forest and oil palm plantations. The nitrous oxide fluxes and soil respiration rates from the riparian forests in this study appear to be larger than to the non-riparian forests studied previously at the same location (Drewer et al., Geophysical Research Abstracts, EGU 2017 - 6495). The overall trends suggest that the buffer strips are enriched in nitrogen, and have altered the greenhouse gas fluxes. This does have implications when estimating the greenhouse gas footprint of oil palm.

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