

Nitrous oxide emission from the drainage and the production processes in oil palm plantation on peatland

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In South-East Asia, oil palm plantation has rapidly expanded in the past few decades even in peatland areas. In the light of nitrogen cycling, this land-use change would result in enrichment on the ecosystem N cycling due to the N fertilization for the maintaining oil palm growth and the wastewater emission from the palm mills in the plantation. Oil palm plantations converted from peat swamp forests require the drainage to keep cultivation and thus has unique hydrological characteristics. In such plantation, drainage water surface dominates up to 5% of plantation area and therefore it is important to evaluate the gas exchange between the drainage water and atmosphere.

In this study, we have conducted spatial sampling for dissolved N_2O concentration (dN_2O) in the oil palm plantation on drained peat soil in July 2018, in Sarawak, Malaysia in order to evaluate the indirect N_2O emission from palm oil plantation. We have intensively sampled the water samples from the drainage in the plantation (ca. 120 km²) and the water samples from Raja river, which is adjacent to the plantation. 90% of samples (N = 84) in the drainage water showed over-saturation in dissolved N_2O concentration (up to 570%), suggesting that the drainage water in the oil palm plantation acts the source of N_2O to the atmosphere. The emission factor for indirect emission (E_{Fr}: i.e., dN_2O /nitrate concentration) showed relatively higher than the default E_{Fr} in IPCC. However, there were no clear linear relationships between the water qualities (including nitrate) and dN_2O . We have also analyzed the isotopic composition of dN_2O in both drainage and river samples. This analysis suggested the denitrification contributed dN_2O in the drainage water.

Keywords: Nitrous oxide, Oil palm plantation, Nitrogen stable isotope