

【Grant-in-Aid for Scientific Research (S)】

Broad Section K



Title of Project : Effects of land conversion from tropical peat swamp forest to oil palm plantations on ecosystem functions and the atmospheric environment

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【Purpose and Background of the Research】

Tropical peatlands coexisting peat swamp forest were distributed widely in lowlands in insular Southeast Asia, especially in Indonesia and Malaysia, and have accumulated a huge amount of soil organic carbon (peat).

Recently, however, the peat ecosystems have been disturbed severely through deforestation and drainage to develop oil palm plantations. The land conversion makes peat carbon vulnerable and potentially changes the peatlands from a carbon sink to a large carbon source. Figure 1 shows pictures of recent land conversion from a peat swamp forest to an oil palm plantation in Sarawak, Malaysia. A large amount of carbon dioxide (CO₂) was emitted through the land conversion, including deforestation, drainage and biomass and peat burning.

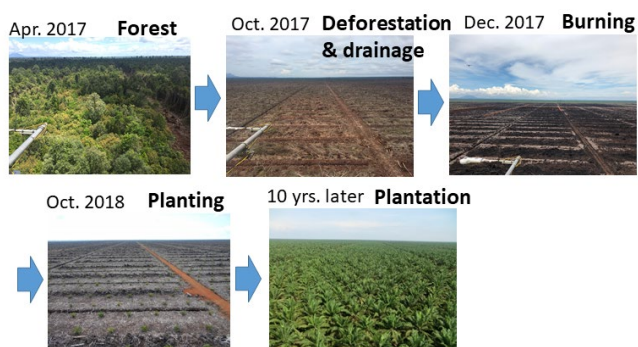


Fig.1 Land conversion in Sarawak, Malaysia.

The objectives of this study are 1) to elucidate the effects of the land conversion and the resultant expansion of oil palm plantations on the carbon pool and the fluxes of greenhouse gases (GHGs), reactive trace gas (BVOC: isoprene) and energy, and 2) to quantify and model the effects of the plantation expansion on the balance of GHGs between the ecosystems and atmosphere and regional climate system.

【Research Methods】

We will establish a tower flux network in tropical peat ecosystems in insular Southeast Asia, including natural and disturbed swamp forests, and oil palm plantations with different ages in collaboration with research institutes in Malaysia, Singapore and Indonesia (Fig. 2). Moreover, we will establish a database, including the fluxes of GHGs (CO₂ and methane (CH₄)), isoprene and energy (sensible and latent heat), meteorological and soil factors, and so on. Using the database, synthesis research will be conducted on the effects of the land conversion on ecosystem

functions, such as GHGs balance and energy balance. In addition, we will quantify and model the effects of oil palm expansion on the GHGs balance and climate system in peat areas in Sumatra, Borneo and the Malay Peninsula using satellite remote-sensing, a terrestrial biosphere model (VISIT) and local / regional climate simulation.

【Expected Research Achievements and Scientific Significance】

There were no comprehensive synthesis studies so far on the effects of land conversion to oil palm plantations in tropical peatlands. Therefore, scientifically valuable outcomes on the change of GHGs balance and regional climate is highly expected, including 1) robust emission factors for CO₂ and CH₄, 2) age-averaged GHGs emissions from oil palm plantations by life cycle assessment, and 3) high-resolution land cover mapping using PALSAR data.



Fig.2 Flux tower

【Publications Relevant to the Project】

Hirano T et al., Effects of disturbances on the carbon balance of tropical peat swamp forests. *Global Change Biology*, **18**, 3410-3422, 2012.

Ishikura K, Hirano T, Hirata R et al., Soil carbon dioxide emissions due to oxidative peat decomposition in an oil palm plantation on tropical peat. *Agriculture, Ecosystem and Environment*, **254**, 202-212, 2018.

【Term of Project】 FY2019-2023

【Budget Allocation】 119,200 Thousand Yen

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