Field observation of GHGs emission from pome palm oil mill effluent (POME) treatment ponds in an oil palm plantation in tropical peatland.

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1. Introduction

Intense land-use change in tropical Asia has a significant influence on greenhouse gases (GHGs) budget in the region. Conversion of tropical peat swamp forest to both acacia and oil palm plantation is a typical land-use change in the region. To evaluate impact of the conversion on GHGs budget, we have to quantify many related processes, for example, enhanced decomposition of peat soil, N_2O emission from fertilization, biogas emission from palm oil mill effluent (POME) treatment ponds, etc. Oil mill facility is built adjacent to oil palm field because fresh oil palm fruit needs to be processed immediately after harvest. Oil palm plantation forms a stationary material cycle system as an integration of palm oil field and mill facility. POME treatment ponds is typical waste water treatment system in an oil palm plantation. Biogas contains high concentration of methane, because methane fermentation is an essential process in waste water purification in the ponds. Measured values of GHGs emission from POME treatment ponds is limited. We conducted field observation of GHGs emission from a POME treatment ponds in an oil palm plantation in tropical peatland as a joint research of National Institute for Environmental Studies and Sarawak Tropical Peat Research Institute.

2. Methods

We conducted field measurement of GHGs emissions from POME treatment ponds in an oil palm plantation on tropical peatland near Sibu Town, Sarawak, Malaysia. The life of the sampling equipment was assumed considerably short in POME treatment ponds due to the exposure to high concentration of corrosive hydrogen sulfide and pollution by oily scum. To quantify GHGs emission from the ponds, we had developed floating chamber system specialized to the POME ponds. The low cost and program controlled system made it possible to perform multi-point simultaneous sampling automatically in a short period of time. We collected biogas from the ponds into balloons of gas-barrier film using the chambers. We measured total amount of biogas in the balloons with modified water replacement method firstly, consequently measured concentration of gases (CH_4, CO_2, O_2, H_2, and H_2S) with portable gas monitor (BIOGAS 5000, Gastech, U.K.). We calculated gas fluxes from covered area, sampling duration, gas volume and gas concentrations. The gas fluxes measurements were conducted in eight ponds in upstream side of whole ten ponds during dry season (June 2018).

3. Results and discussions

Biogas from POME treatment ponds were mainly CO_2 and CH_4. Markedly large biogas flux was found in fourth pond from upper stream. About 65% of the biogas from the fourth pond was CH_4. This might be due to neutral pH and moderate temperature were suitable for methane fermentation in the pond. In the three upper-stream ponds, the pond water was acidic in which CO_2 dominated about 60% of biogas. Biogas flux was small in the ponds in lower-stream of the forth pond.

4. Summary

In the POME treatment ponds, decomposition process of organic matter in POME would be different in each stage because of differences in the various environmental factors such as pH, temperature, organic matter content, etc. It was successful in the integration of data in severe environmental condition in the POME treatment ponds despite various technical challenge. Oil palm plantation is a continuous and stationary material flow system as a whole including plant field, mill facility and POME treatment ponds. To fully understand the impact of land-use change on GHGs budget, it is very important to quantify the relationship between GHGs budget and material cycle in the whole plantation system. Besides field measurements, we also do interviews on material flow in the plantation with the cooperation of business entity of the plantation.
We will introduce the result of wet season (January 2019) during this presentation.

Keywords: Climate change, Land-use change, Tropical Asia, Tropical peat, Greenhouse gases

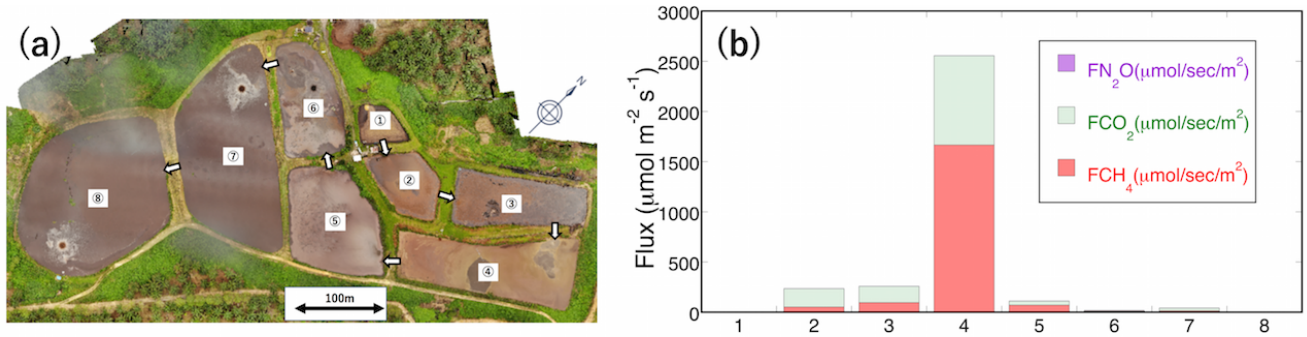

Figure. (a) Location of ponds and (b)GHGs flux from the ponds.

