MASWAR. Carbon stock study on drained tropical peat land for perennial crops. Under direction of OTENG HARIDJAJA, SUPIANDI SABIHAM, and MEINE VAN NOORDWIJK

Peat lands are important sinks for atmospheric carbon (C), and current decline of their C stocks represent several percent of global C emissions, contributing to global climate change. It is therefore important to understand the effects of peat land drainage and conversion on the distribution of soil carbon and dynamics of emissions. Tropical peatland occurs in multiple forms and data are limited so far. The study reported here was conducted in West Aceh from May 2008 until October 2009. Peat land characteristics after drainage and conversion were investigated by field observation and laboratory analysis of peat soil samples. Calculations of C stock and C loss were carried out by interpretation data of bulk density (BD), ash content, carbon content and subsidence (changes in peat depth). A pre-study evaluated methods and tools for determining BD and carbon content and found that: a) the commonly used peat auger needs division by a correction factor of 1.136 to convert to the bulk density measured in large soil blocks; b) carbon content (%C) can be derived from the percentage organic matter derived from loss on ignition (LOI) by division by 1.922. A ‘triangulation’ of methods was set up to compare direct CO₂ flux measurements in chambers, calculations based on subsidence rate and change in bulk density and calculations based on differences in ash content (LOI method). Key results of field observation combined with laboratory peat soil analyses were: 1) Location and drainage influences the rates of subsidence, with rates of less than 4 cm/year for some oil palm plantation, rubber agroforests, and drained forest soils, and rates up to 10 cm/year in young oil palm newly drained. 2) the surface structure of the landscape varies over short ranges, making peat depth unattractive as measure of changes in peat C stock, 3) ash content and bulk density of the peat are related, indicating the partial loss of soil C during decomposition and compaction, 4) an “internal tracer” estimate of peat C loss yielded estimates of CO₂ flux up to 48 t CO₂-eq per ha per year for young oil palm, highly correlated with the measured rates of subsidence of the surface, 5) an experiment with surface fertilizer application suggest considerable increase in peat C loss (based on increase in ash content and the “internal tracer” method), 6) the spatial pattern of peat subsidence with increasing distance from the drain differed between oil palm and forest + rubber agroforest, consistent with a direct effect of fertilizer application on CO₂ emissions (as microbial activity is N limited at the prevailing high C/N ratios) beyond the drainage effect alone, 7) the pattern of weight loss of surface litter, measured in litter bags, responded to the inherent quality (C/N) rather than land use, 8) estimate of peat C loss from a documented forest fire were up to 133 t C ha⁻¹ equivalent with 490 t CO₂ ha⁻¹. 9) The difference between C accumulation and C loss for rubber agroforests (>15 year age) on peat, and oil palm agroforests (> 15 year age) on shallow peat indicated have a positive value (C accumulation > C loss). These results support through the triangulation of methods that drainage and fertilization of peat soils increases CO₂ emissions at rates of 30-40 t CO₂-eq per ha per year, with higher values in early stages of conversion.

Key words: Annual crops, conservation, C-stock, C-loss, drained, peat.