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Carbon emissions from oil palm development on deep peat soil in central kalimantan indonesia

Alue Dohong[a,b,c], Ammar Abdul Aziz[d,*], Paul Dargusch[a]

[a] School of Earth and Environmental Sciences, University of Queensland, Brisbane QLD 4072, Australia
[b] Faculty of Economics and Business, Palangka Raya University, Indonesia
[c] Peatland Restoration Agency, Indonesia
[d] School of Agriculture and Food Sciences, University of Queensland, Gatton QLD 4343, Australia

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ABSTRACT

Of the 44 million hectares of peatland in the tropics, Indonesia has proportionately the largest area (45%) and carbon content (64%). These carbon-rich peat ecosystems play an important role in regional climate stabilization and biodiversity conservation. The Indonesian Government has enacted numerous regulatory measures since the 1990s aimed at boosting protection of the remaining intact peatland, with a threshold that peat deeper than 3 m must be conserved and cannot be cultivated. Despite these regulatory measures, extensive conversion of peatland to other land uses has occurred, especially large-scale palm oil plantation. This study shows that over 40% of palm oil plantations located in the former Ex-Mega Rice Project area (of some 1.04 million hectares) in Central Kalimantan in Indonesia are situated in deep peat areas. We estimate that continuing the present palm oil development practices on deep peat in the Ex-Mega Rice Project area will result in the release of between 93 and 217 megaton carbon dioxide equivalent (MtCO2e) over the next 25 years.

1. Introduction

Indonesia's peatland accounts for the largest proportion of carbon in terrestrial peat in the tropics (Page et al., 2011). This carbon-rich ecosystem has important socio-economic values and provides valuable ecological services, including controlling and mitigating global climate change (Jaenicke et al., 2008). Due to this, over the past two decades the Government of Indonesia has enacted various regulatory and policy measures concerning peatland, aimed at conserving and protecting the remaining intact peat forest and carbon-rich peat. These regulatory and policy measures are at the national, sectoral and local levels, and require deep peat to be protected and conserved; therefore, no cultivation is allowed within areas containing deep and very deep peat (Anon., 1990, 2007,2009a,2009b). The regulatory measures were further strengthened through the enactment of recent Presidential instructions (number 10 of 2011 and number 6 of 2013): policies that place a moratorium on developing primary natural forest and peatland (Anon., 2013).

However, despite these regulatory measures, peatland in Indonesia is under severe threat of conversion to other land uses, notably to large-scale palm oil plantations (Dohong et al., 2017). The rapid expansion of the palm oil plantation industry in Indonesia and Malaysia in the past two decades has come partly at the expense of peat swamp forest (Koh et al., 2011; Miettinen et al., 2012a,b,c). The area of large-scale palm oil plantations on former peat swamp forests in the Malaysian Peninsula and in Borneo increased from around 0.880 million hectares in the early 2000s (Koh et al., 2011) to 2.14 million hectares in 2010 (Miettinen et al., 2012a,b,c), with an average annual growth of over 14%. If the current rate of peat swamp forest conversion continues, and no appropriate land-use policy is adopted, it is predicted that the primary peat swamp forests of South-East Asia will completely disappear by 2030 (Miettinen et al., 2012a,b,c). Despite the lucrative short-term financial benefits that Indonesia has gained from its palm oil industry, the development has led to widespread deforestation (Miettinen et al., 2012a,b,c; Carlson et al., 2013; Lee et al., 2014), resulting in biodiversity decline (Koh et al., 2011; Fitzherbert et al., 2008; Koh and Wilcove, 2008; Savilaakso et al., 2014), and immense carbon dioxide (CO_2) emissions via the removal of above-ground biomass and peat oxidation resulting from peat drainage (Murdiyarso et al., 2010; Hergoualc'h and Verchot, 2011; Hooijer et al., 2010; Hooijer et al., 2012). A recent estimate suggests that over a quarter of Indonesia's palm oil plantations are located on peatlands (Varkkey, 2012).

* Corresponding author.
E-mail address: a.abdulaziz@uq.edu.au (A.A. Aziz).

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Between 1995 and 1998, the Indonesian Government allowed almost one-third of Central Kalimantan's 3 million hectares of peatland to be cleared for rice fields (Anon., 1995). The project, now renown as the Ex Mega Rice Project (EMRP), was eventually terminated in 1999 as a failure through the enactment of a presidential decree (Anon., 1999). The EMRP was abandoned for more than a decade, with no clear policy guidance or attempts at physical rehabilitation or restoration. This area has been the source of massive annual CO_2 emissions resulting from recurrent fires and peat oxidation and subsidence caused by peat drainage.

Since 2004, the vagueness in governance for the area was exploited by district leaders who granted licenses to the private sector to develop palm oil estates, with scant regard for the existing peatland regulatory measures or the planning guidance that had been provided for the revitalization and restoration of the peatlands (Anon., 2008a,b,c). Despite their non-compliance with existing ordinances, the granting of new permits for palm oil plantations in the EMRP has somewhat complicated the current land-use plan, and may impede the implementation of rehabilitation and restoration plans that have been designated for the area.

This study aims to: (i) summarize the regulatory measures that apply to peatland conservation and protection in Indonesia and cross-reference those regulations with a reliable estimate of palm oil development in the EMRP, thus allowing a reasonable estimate of the extent of palm oil development in the region over the past 10 years; (ii) estimate the potential CO_2 emissions resulting from peat oxidation caused by drainage, with and without palm oil plantations on deep peat; and (iii) calculate the potential CO_2 emission reductions contribution from three different scenarios towards the country's greenhouse gases (GHGs) emissions reduction target by 2020.

2. Method

2.1. Study location

The **s**tudy is focused on the Ex-Mega Rice Project (EMRP) of Central Kalimantan, Indonesia. The study site encompasses 1.04 million hectares and comprises blocks A, B, C and D (Fig. 1). Of this area, around 0.427 million hectares (41.09%) comprises mineral soil, about 0.173 million hectares (16.66%) comprises peat with a thickness of less than 200 cm, and about 0.439 million hectares (42.24%) comprises peat with thickness greater than 200 cm (Table 1).

2.2. Indonesia's regulatory measures on peatland conservation, protection and restoration

The information about Indonesian laws and policies on peatland conservation, protection and restoration was collected and compiled from secondary sources through a desktop study.

2.3. Calculating the total area of palm oil plantations on deep and non-deep peats and mineral soil

The total area of palm oil cultivation on mineral soil, non-deep and deep peats was determined by overlaying the palm oil

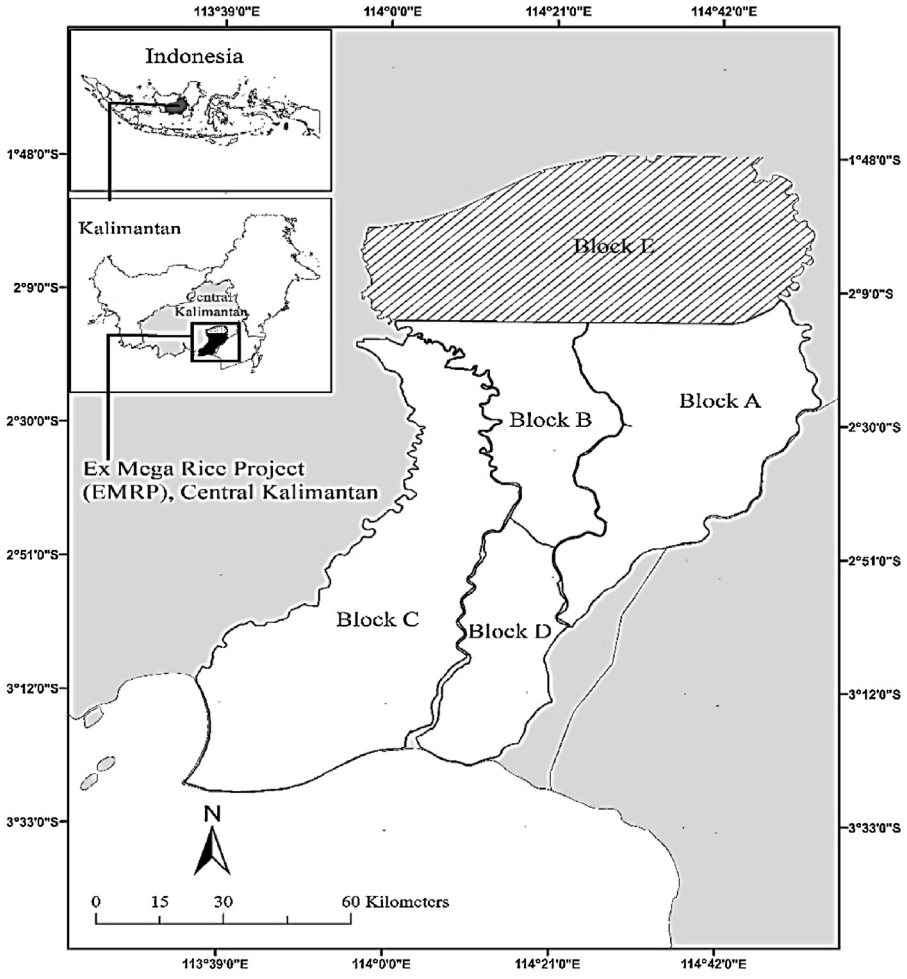

Fig. 1. Map of research location: Ex-Mega Rice Project, Central Kalimantan, Indonesia.