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Exploring under-utilised low carbon land resources from multiple perspectives: Case studies on regencies in Kalimantan

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ABSTRACT

Mobilising under-utilised low carbon (ULC) land resources for future agricultural production can help reducing pressure on high carbon stock land from agricultural expansion, particularly for deforestation hotspots like Kalimantan. However, the potential of ULC land is not yet well understood, especially at regency level which is the key authority for land-use planning in Indonesia. Therefore, this study explored ULC land resources for all regencies in Kalimantan. By analysing information from six monitoring domains, a range of indicators were derived to provide insights into the physical area of ULC land from various perspectives. It was found that these indicators show largely different values at regency level. For example, regency Pulang Pisau has a substantial area of 'temporarily unused agricultural land' but a very limited area of 'low carbon land' – this implies that not all 'temporarily unused agricultural land' is ready for future exploitation when assessing from different aspects. As a result of such diverging indicators, using a single indicator to quantify available ULC land resources is risky as it can either be an over- or under-estimation. Thus, ULC land resources were further explored in the present paper by taking four regencies as case studies and comparing all the indicators, supported with relevant literature and evidence collected from narrative interviews. This information was used to estimate ULC land area by possible land-use strategies. For example, Gunung Mas was found to have a large area of low carbon land which is not occupied and might be suitable for oil palm deployment. However, the major limitation is that physical estimates cannot provide a complete picture of 'real' land availability without considering a broader range of socio-economic factors (e.g. labour availability). Therefore, physical land area indicators from different domains must be combined with other qualitative and quantitative information especially the socio-economic factors underlying land under-utilisation to obtain better estimates.

1. Introduction

The rate of terrestrial carbon stock loss in Kalimantan (the Indonesian part of Borneo) has grown substantially over the last two decades, largely driven by increasing global demand for timber and agricultural products. The annual emission from land-use change (LUC) has reached to about 52 Tg CO_2/year in 2006–2010 (Agus et al., 2013). Export-oriented agricultural activities, particularly oil palm expansion, are also often associated with carbon stock loss due to deforestation and peat loss (Agus et al., 2013). In 2005–2010, about half of the oil palm expansion (1.8 Mha) has occurred in Kalimantan (Gunarso et al., 2013). Mobilising less-productive lands with low carbon stock and insignificant ecological services may be a solution for increasing agricultural production and preventing further carbon stock loss. To achieve these aims, two general criteria can be employed to assess potential land resources: (i) its current agricultural productivity is insignificant or low compared to its optimal potential; and (ii) it has a low level of carbon stock so that utilisation of the land is unlikely to incur additional carbon stock loss and negative ecological impacts. Land that fulfils the two criteria may be broadly regarded as under-utilised low carbon (ULC) land. In case oil palm is to be cultivated on these lands, the threshold value of above-ground carbon stock can be set, for example, at 40 tC/ha, i.e. the average value of carbon sequestered in an oil palm plantation with a rotation period of 25 years (Khasanah et al., 2012). In terms of soil carbon, areas with potentially high carbon stock in the soil such as wetland should be directly excluded.

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Various names, e.g. 'abandoned', 'degraded', and 'marginal' land, have been proposed to quantify land available for future expansion but they do not necessarily fulfil both the ULC criteria. Furthermore, their definitions or criteria may be different and some are not entirely clear, e.g. abandoned land is not necessarily degraded, and vice versa (Smit et al., 2013; Suhariningsih, 2009). Ambiguous definitions may create unrealistic expectations and unintended consequences in policymaking. For example, in some cases the classification of degraded land was used as an excuse for forest clearing under the guise of reforestation programmes, although the 'degraded' land may still be rich in carbon stock and biodiversity (Barr et al., 2010; Obidzinski and Dermawan, 2010).

For Kalimantan, a number of top-down efforts have been initiated to identify ULC land based on remote sensing coupled with biophysical models, by both international (e.g. Gingold et al., 2012; Hadian et al., 2014) and national institutions (e.g. Mulyani and Sarwani, 2013; MoF, 2013). Most of these analyses focus largely on environmental constraints (e.g. avoiding biodiversity loss) and technical potential, but lack local socio-economic considerations, e.g. land occupancy by indigenous communities. Also, they were often performed between large time-intervals (up to several years) due to resource constraints. Thus, land-use dynamics may not be well captured and technical errors could be significant, e.g. it is difficult to differentiate abandoned land from land which may still be cultivated sporadically by local communities (Treitz and Rogan, 2004).

In addition to top-down efforts, also bottom-up approaches have been developed to identify ULC land resources. In contrast to the top-down approaches, the bottom-up approach integrates relatively more locally focused socio-economic information based on expert opinions and household surveys (e.g. BPS, 2013b; Lambin et al., 2013). For example, Lambin et al. (2013) have estimated the 'potentially available cropland' in several countries based on expert judgement. Such approaches may include more precise local information on a case-by-case basis. However, 'under-utilisation' is a normative notion that can be interpreted differently, e.g. based on socio-cultural values, economic values or legal perspective. For example, land claimed by local communities for certain purposes e.g. shifting cultivation, is not deemed 'under-utilised' by the occupants. Estimates of available land thus often lack consistency from one case to another (Lambin et al., 2013).

Since ULC land can be defined differently based on the different perspectives of land-use actors across scale, the immediate question is at what level relevant policy can be made to achieve the aim of preventing further carbon stock loss while increasing agricultural production. Among the authorities in the Indonesian hierarchy, regencies (*kabupaten*) and municipalities (*kota*) are the most influential decision makers in terms of land-use policies.[1] Since 2001, they are empowered to implement their own spatial planning policies (Thorburn, 2004). Deforestation in Kalimantan in the 2000's was largely driven by regency-oriented policies, which largely promoted (large-scale) oil palm expansion (e.g. Barr et al., 2006). Between regencies, rules and regulations on land-use can be quite different and are enforced with varying degrees of stringency (Fairhurst et al., 2010). Land-use patterns also interact with the wider socio-economic environment within a regency. Understanding and comparing the issues related to ULC land from a regency perspective is thus essential. But at present, most studies on Kalimantan either focus on island, provincial or village level. Quantitative and comparative studies on individual regencies are still rare and only cover a limited number of regencies (e.g. Tomich et al., 1997).

In addition to spatial and scale variations, the changes in land-use patterns across time, e.g. how long has the land been under-utilised or remained in a low carbon state also need to be accounted for when examining its potential for agricultural expansion. Some studies, e.g. Potter (2015), have specifically explored the history of agricultural land-use at regency level by assessing their underlying socio-economic causes, but not quantifying the area changes. Some other studies, e.g. van der Laan et al. (2015), have investigated the land-use trajectories in individual regencies based on land cover changes using spatially explicit methods. However, the interplay of local factors underlying these changes, e.g. land-use intensity and occupancy (whether it is really 'abandoned' or not), has not yet been explored in conjunction with the land-use patterns of ULC land.

This study aims to explore the availability of ULC land by combining information collected with different types of approaches. Firstly, information collected based on distinct perspectives and relevant aspects (e.g. ecological or socio-economic) for assessing ULC land resources are categorised into six monitoring domains and reviewed. Based on information collected from the six monitoring domains, relevant quantitative indicators are analysed and derived for 55 regencies and municipalities in Kalimantan. Finally, based on these quantitative indicators as well as relevant literature and evidence collected from narrative interviews, the potential of ULC land for possible land-use strategies was estimated for four regencies.

2. Study area

Kalimantan is the Indonesian territory that makes up about 73% of the total land area of Borneo Island. It is divided into five provinces. Throughout this study, the newly formed North Kalimantan province (in 2012) is considered as part of East Kalimantan to incorporate data before 2012, when Kalimantan was divided into 46 regencies and 9 municipalities (both are sub-divisions of provinces) (see the map in Fig. A1). The island has experienced serious (legal and illegal) logging and deforestation since the 1980's. Then, the 'oil palm boom' began from the 1990's, surging since 2006 (Agus et al., 2013). Kalimantan was a major transmigration[2] site alongside several large land-based projects, such as the Mega Rice Project (MRP)[3] in Central Kalimantan which planned to locate a large number of Javanese transmigrants. By 2011, the population had grown to >14 million with a 2.4% growth rate (BPS Kalbar, 2014; BPS Kalsel, 2014; BPS Kalteng, 2014; BPS Kaltim, 2014).

In addition to the analysis for all regencies, case studies were conducted in four regencies in Central Kalimantan with distinctive characteristics in order to assess the potential of ULC land for possible land-use strategies. First, Gunung Mas was chosen due to its vast low carbon lands and unusual average land area claimed by households. Next, Kotawaringin Timur was selected for its rapid industrial oil palm expansion. Palangka Raya, the capital of Central Kalimantan, was included for urbanisation and the formation of ULC land surrounding the city. Finally, Pulang Pisau, the former site of the MRP, was chosen for comparison due to its poor agro-ecological conditions.

[1] For convenience, the term 'regency' was used throughout the paper to represent all regencies and municipalities.

[2] The transmigration programme was a population-relocation programme that moved landless people mainly from the densely populated island of Java to less populous parts of the country, e.g. Kalimantan). It was especially active during the Suharto era and continued in a minor way after regional autonomy (Potter, 2012). President Widodo now plans to reactivate the scheme, especially in undeveloped areas such as North Kalimantan.

[3] The MRP, also called Peat Land Project or 'Proyek Lahan Gambut' (PLG), was a failed programme by the Indonesian Government to develop one million hectares of degraded peatland for rice production from 1996.