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RECOGNIZING THE COMPLEXITY OF TROPICAL PEATLAND ECOSYSTEMS AND MANAGEMENT FOR SUSTAINABILITY PURPOSES

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SUMMARY

This paper examines the drivers of change to peatland vegetation cover in Central Kalimantan Indonesia, one of the largest sources of human-induced greenhouse gas emissions globally. Systems analysis is used to understand the complexity of the factors involved in land use change, and results are explained using causal loop diagrams and a state and transition model of peatland vegetation cover change. The results indicate that interventions that address poverty and livelihood considerations are likely to be the most effective way of reducing human-induced greenhouse gas emissions from peatlands in Central Kalimantan Indonesia.

KEY WORDS: tropical peatland, system thinking, REDD+, drivers of deforestation, climate policy

INTRODUCTION

Over the last two decades, human activities have caused the degradation of tropical peatland ecosystems around the world, resulting in the release, mostly through peat fires, of massive volumes of greenhouse gasses into the atmosphere (Murdiyarso and Lebel, 2007). Previous studies of tropical peatlands have mostly focused on the physical and chemical components of peat and the biophysical characteristics of vegetation, hydrological and fire systems. There are however still considerable knowledge gaps in the science of tropical peatland management (Hooijer et al., 2009). For instance, Page et al. (2009) suggested that there is still lack of knowledge and understanding on the relationship between human motives and behaviour and the state of peatland ecosystems; these are variable and complex and could be different between and within regions. Each peatland management case is likely to have its own unique socio-ecological characteristics. Moreover, given that the natural vegetation of most tropical peatland areas is forest, peatland management, the management of peatland fires, and the management of deforestation and degradation are critically interrelated. Developing a better understanding of the drivers of deforestation and degradation in forests and related vegetation on peatlands at regional and landscape-level scales is therefore of fundamental importance to the effective design and implementation of climate change mitigation initiatives such as Reducing Emission from Deforestation and forest Degradation (REDD+). In this paper we examine the human activities influencing change in peatland vegetation in Block A-NW (North West) and Block E of the location known as the 'ex-Mega Rice Project' (MRP) in the Kapuas District of Central Kalimantan Indonesia (see Dephut (2007) for further explanation of the MRP history). Using system analysis to understand the complex socio-ecological factors involved, we identify both the direct and underlying causes of change in peatland vegetation cover in this case study landscape and assessing how those causes and actions affect the land uses and peat in complex causal relationships.

MATERIALS AND METHODS

A method known as Group Model Building (GMB) (described in Andersen and Richardson (1997) and Vennix (1996)) was used to collect data on the factors driving change in peatland vegetation cover within the case study landscape between 2000 and 2010, Twenty-three local facilitators (all indigenous *Dayak* people to Central Kalimantan) hired by the Kalimantan Forest Carbon Partnership (KFCP) Project – an on-going REDD+ Demonstration Project between the Indonesian and Australian Government in this area, were involved in the GMB data collection process. The results of the GMB data collection were validated using triangulation with secondary data and data collected directly by the first author. The first author also spent two weeks in the field observing conditions in the case study landscape to compare the result of GMB with the factual condition, meanwhile, the KFCP provided some physical and livelihood data from its earlier survey in 2009 to support our further data analysis. The framework developed by Kaimowitz and Angelsen (1998) of the drivers of deforestation and degradation in tropical forests was used to structure our analysis. This framework required the identification of 'Actors', 'Actions', and 'Direct' and 'Underlying' causes. A causal loop diagram was the used to analyze the feedback relationships among the variables involved. The causal loop diagram was also used to identify the main drivers of vegetation change and the most effective intervention strategies.

RESULTS

The results indicated that there were changes between five main peatland vegetation types in the case study landscape. The dynamics between these five vegetation types is shown in the state and transition model presented in Figure 1. Data suggests that there were three major flows of land use change in the case study landscape. Firstly, conversion flows from larger to less land cover area ($C_{1,2,3,4}$); secondly, conversion flows from less to larger covered area ($C_{5,6}$), and the thirdly, natural rehabilitation flows ($R_{1,2,3}$). From these flows, we can assume that $C_{5,6}$ and $R_{1,2,3}$ potentially provided more advantage for carbon conservation efforts. Results indicate that the communities living in both blocks of the case study landscape were the main actors that caused all changes in vegetation cover. Most changes resulted from the use of fires and small-scale logging activities. Analysis identified four broad categories of factors that influence the communities' decisions regarding these activities as shown in Figure 2: (1) community welfare; (2) livelihood demand; (3) land demand and production; and (4) the communities' livelihood activities. Within these categories, we determined that at least 23 endogenous and seven exogenous factors affected the community actions (fire and small scale logging) that eventually change the vegetation cover. Those parameters were linked in feedback relationships systemically as shown in the causal loop diagram (Figure 2).

Figure 1: State and Transition Model

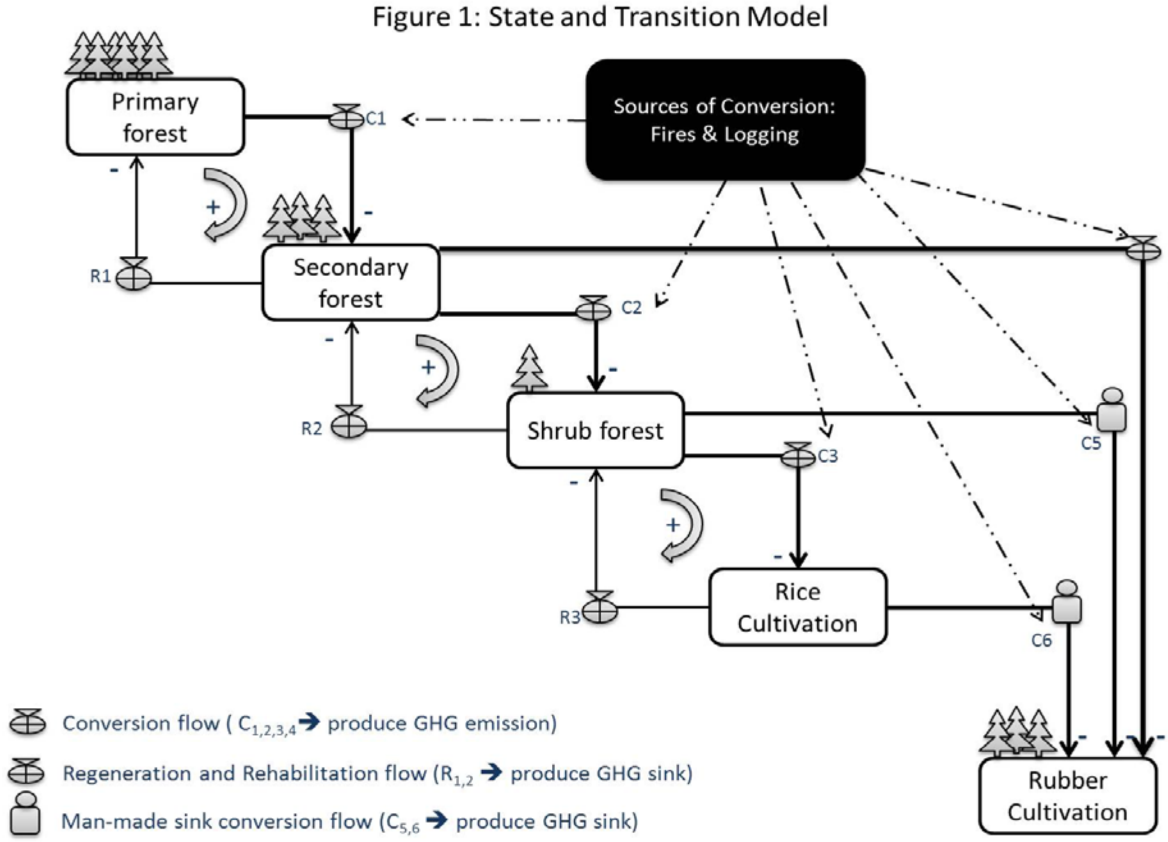
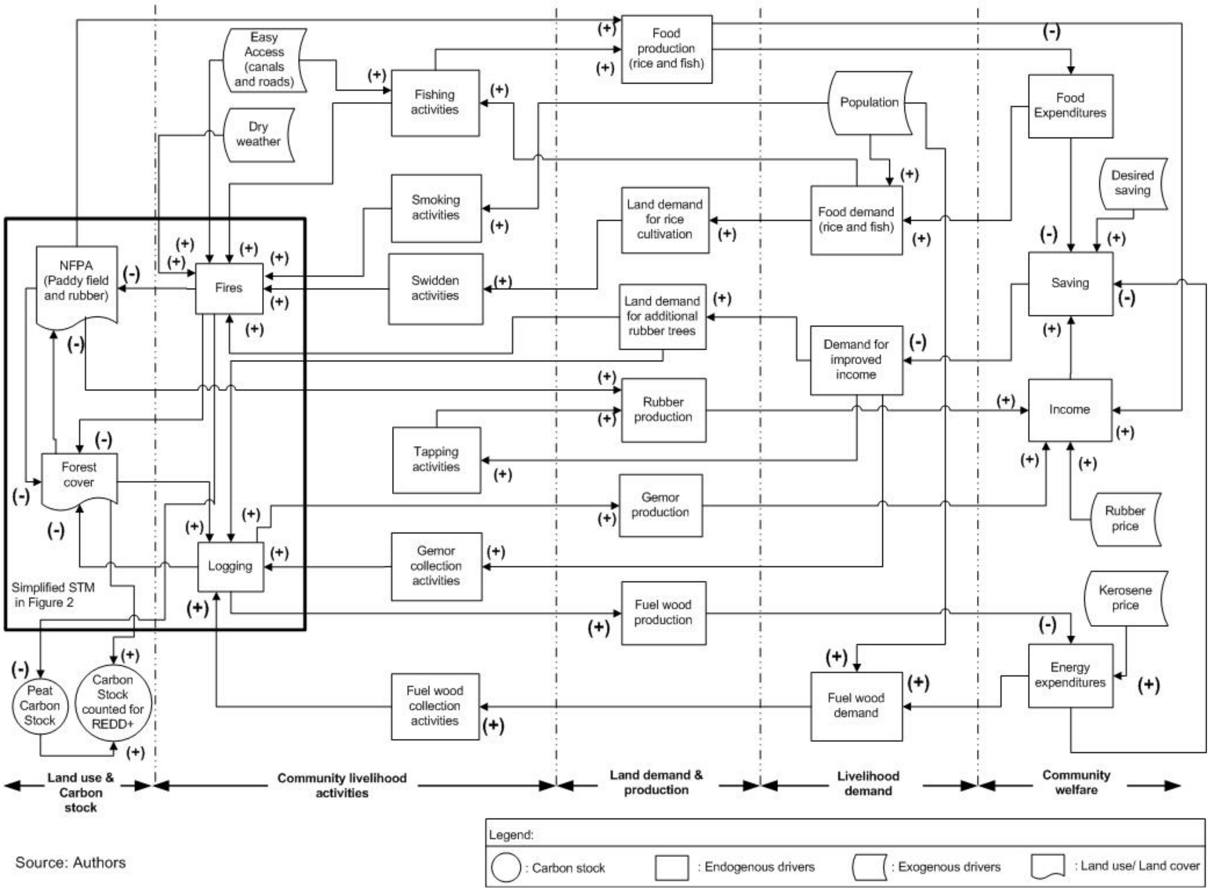


Figure 2: Causal Loop Diagram for Drivers of Land Cover at Block A-NW and Block E of the ex-MRP



Source: Authors

The category of factors described as community welfare (food expenditure, savings, income and energy expenditure) behave as anchor parameters of the drivers of most feedback loops in Figure 2, and therefore are important underlying drivers of fires and small-scale logging activities carried out by the community. Note also that because fires had a much greater impact on vegetation cover change in the case study landscape than small-scale logging activities, it is logical to prioritize intervention activities on the drivers causing local communities to carry out fire activities.

DISCUSSION

Unlike other parts of the ex-MRP region in Central Kalimantan area which have been heavily impacted on by agricultural (mostly palm-oil plantation) and mining (coal and gold) activities, the vegetation cover changes in Block A-NW and Block E are mostly influenced by the activities of local communities. Various factors influence how local communities in the case study landscape impact surrounding peatland areas: the emergence of “public good” areas in the form of open and abandoned land; easier access to abandoned land through canals built as part of the original ex-MRP development; and high levels of poverty in most of the local villages. Moreover, poverty forces the community to exploit whatever opportunities they can from the surrounding natural areas. The presumption that indigenous communities will always protect their forest ecosystems is not always true if those communities are desperately poor (CIFOR, 2011). In socio-economic circumstances such as those in the case study landscape, communities will always pursue land use activities that maximize the likelihood of improved short-term livelihood for their families, regardless of the impact those activities might have on climate change or the health of peatland ecosystems (Douglas, 2006).

The results of this study, as summarised in Figures 1 and 2, highlight the importance of the “seeing the forest for the trees” principle, and the need for policy-makers to understand the complexity of natural resource management systems prior to decision-making. If one was to consider Figure 2 in isolation for example, one might assume that preventing fires and logging in secondary forests and shrub forests would prevent the major changes in peatland vegetation cover and greenhouse gas emissions from the case study area. Governance interventions such as imposing strict regulations on the use of fires in land management or the establishment of a community fire brigade would seem reasonable. But further analysis reveals that these are not effective interventions that do not systematically resolve the direct and underlying causes that form complex feedback relationships driving peatland vegetation cover change in the region (as shown in Figure 3). It is likely that fire and logging events will continue to occur in the future in the case study landscape if the policy intervention fails to recognize the communities’ motives behind land use. We concur with Tacconi et al. (2007) that it is preferable to manage the drivers of vegetation cover change through improving land management processes instead of directly managing fires by prevention, suppression and mitigation programmes.

The findings presented here highlight the importance of a system thinking approach in analyzing the complexity of tropical peatland management and policy intervention. For further research, we suggest that the qualitative data collection and assessment undertaken in this study be extended with quantitative research methods. Some previous studies on drivers of deforestation (Sunderlin and Resosudarmo, 1996; Saxena et al., 1997; Geist and Lambin,

2001) emphasized the need for more quantitative-based research in natural resource management. The application of system dynamics analysis methodologies can assist the researcher in managing and exploring the wide range of decision choices to obtain and simulate key drivers or leverage parameters quantitatively (Wright, 2008).

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