Report submitted to the
United States Agency for International Development
Cooperative Agreement No. EEM-A-00-03-00006-00

Carbon and Co-Benefits from Sustainable Land-Use Management

May 2007

Deliverable 24: Impact of Selective Logging on Carbon Stocks of Tropical Forests in East Kalimantan, Indonesia

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ACKNOWLEDGEMENTS

We wish to thank H. Djohansyah Ramili and H. Permana Nuryayi Jr. Direktors of Utama, and Nardi Yono of TNC for logistical support. We acknowledge critical field assistance from Nardi Yono, Pak Oman, Pak Mike and Erik from TNC, and Pak Gaguk, Pak Rudi, Pak Pandi, Pak Agus, Pak Sulaimen, Pak Sujarno, Pak Simin, Pak Yuda, Pak Tono, Ibu Susi, and Ibu Nona from Utama.

Cite report as:

Pearson, TRH, Walker, SM, Moore, N, Dushku, A., Roshetko, J., Pearson, REG, and Brown, S. 2007. Deliverable 24: Impact of Selective Logging on Carbon Stocks of Tropical Forests in East Kalimantan, Indonesia. Report submitted by Winrock International under USAID Cooperative Agreement No. EEM-A-00-03-00006-00

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1.0 INTRODUCTION

Commercial logging of native forests is integral to the economies, and central to the development, of many tropical nations (FAO 2003). At the Conference of the Parties to the United Nations Convention on Climate Change (UNFCCC) in Montreal in December 2005 there was a concerted international interest in quantifying, slowing and even providing incentives for slowing rates of deforestation and forest degradation. Deforestation is obvious and is the clearance of land for ranching or agricultural production. This form of deforestation is clearly visible from satellite imagery. A more insidious form is forest degradation that occurs through legal and illegal logging and which opens up frontiers for agricultural expansion through the construction of roads and other infrastructure. Internationally, there is interest in improved forest management, in particular conversion to reduced impact logging, motivated by biodiversity conservation, sustainable forest management, timber certification, and even the potential for increasing forest carbon stocks. The technical problems are not insignificant; to establish and credit any reduction in the rate, the carbon emissions for the business as usual must be well-defined plus the carbon impact of any activities that are taken.

Monitoring changes in carbon stocks serves as a method of assessing the impact of forest management activities, and also helps determine the role forest harvesting plays in the global carbon cycle. Land-use changes in the tropics are a significant source of atmospheric CO_2, contributing up to about 25% of current fossil fuel CO_2 emissions (Prentice et al. 2001). Logging in the tropics tends to be selective, so the impact of harvest is hard to quantify and consequently current estimates of the effects of tropical forest management are likely to be inaccurate.

Monitoring of legal and illegal logging has several purposes. For example, assessments are needed of the integrity of conserved areas, such as National Parks, with regard to incursions by loggers, or, where a logging concession has been granted, there may be a need to assess whether that concession is being fulfilled within the contractual constraints. Alternatively, in the future it is envisioned that a premium will be paid for timber that is certified to come from a sustainably managed forest. To maintain the value of the certification, monitoring would have to be carried out.

In this study we concentrated on carbon stocks, which can be used as a proxy for other monitoring purposes. To monitor logging impacts on carbon stocks, factors are required to link reported data or readily monitored components with the total carbon impact. The two most obvious factors for correlation are volume extracted (which is widely reported) and gap size (which can be determined remotely). Correlation factors can be created through an initial set of ground measurements. To our knowledge only one study has created factors linking gap size or volume extracted with biomass damaged (Brown et al. 2000). Many studies have examined logging and associated damage both in conventional and reduced impact scenarios; however, these studies have largely focused on the number of trees damaged (e.g. Uhl and Vieira 1989, Uhl et al 1991, Verissimo et al. 1991, White 1994). The studies of Pinard and Putz (1996) and Feldpausch et al. (2005) detailed the carbon impact, but not in the context of gap size or even volume of timber extracted.

This study in Indonesia represents the fourth study on selective logging under USAID Cooperative Agreement No. EEM-A-00-03-00006-00. The first three studies were in the Republic of Congo (Brown et al. 2005), Chihuahua, Mexico (Pearson et al. 2005) and the Brazilian Amazon (Pearson et al. 2006a,b).

One method of monitoring changes in carbon stocks is through remote sensing. Demand exists for a cost-effective system to remotely track changes in land use and the associated emissions. It is common practice to track large scale deforestation using satellite imagery. Selective harvesting in tropical forests, however, can not be easily or accurately monitored using inexpensive widely available satellite data. We have designed an aerial digital imagery system that collects high-resolution overlapping imagery (10 -15 cm pixels) from which we can distinguish individual trees, shrubs and the gaps left after their removal. In

essence, we created a virtual forest that we can use to measure trees, forest gaps, skid trails, roads, and other carbon-relevant factors.

This system has been successfully tested in settings as disparate as a pine savanna in Belize, tropical forests in Puerto Rico, Peru, and Costa Rica and bottomland temperate hardwoods in Mississippi. In Belize (Brown et al. 2004, 2005), we flew transects over savanna vegetation, and analyzed the imagery using 77 aerial-imagery plots. Biomass was measured with a 95 % confidence interval equal to 16 % of the mean. It was calculated that 3 x more person hours would be required to collect the same data on the ground in the field.

As part of Winrock International's larger effort to determine the impact of logging on carbon stocks, high resolution aerial digital imagery was collected in 2004 in the north of the Republic of Congo (Pearson et al. 2005b) and in 2005 in the Brazilian Amazon (Pearson et al. 2006a). Using this imagery we identified logging gaps in logged areas. Used in combination with ground data, these gaps were used to determine the amount of carbon in trees removed, as well as in those damaged in the felling and extracting processes (Pearson et al. 2005b; Pearson et al. 2006a).

This study replicates the work in the Republic of Congo and in Brazil. Our goal was to estimate the net impact of selective logging on the forest carbon stocks by:

- estimating on a gap-by-gap basis extracted volumes, the biomass carbon from the timber tree that remains in the forest, and the incidental carbon damage to surrounding vegetation;

- creating relationships between volume extracted, the size of canopy gap caused by logging and the carbon impact.

- collecting high resolution aerial imagery in transects over the logging zones of the timber concession; and

- using the measured areas of gaps, roads and skid trails in the imagery and correlation relationships created through measurements taken on the ground to estimate the logging impact per unit area and the total carbon impact over the logging zone.

We then discuss how such data and relationships can be used to estimate the impact of logging on the total carbon budget, using information such as timber extraction rates or area and number of felling gaps identified from the aerial imagery.


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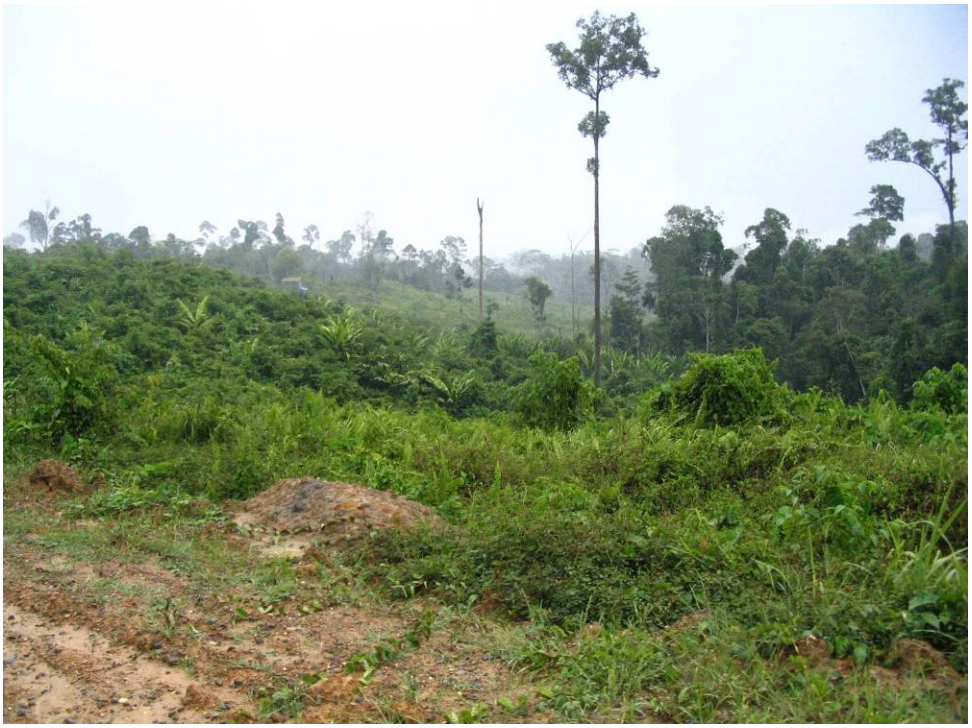

2.0 STUDY AREA

The study site was the Pt. Aditya Kirana Maniri forest concession in the province of East Kalimantan, Indonesia (Figure 1). A team from Winrock International visited the forestry concession in August 2006 and conducted measurements of logging gaps, roads, skid trails, logging decks and undisturbed forest.

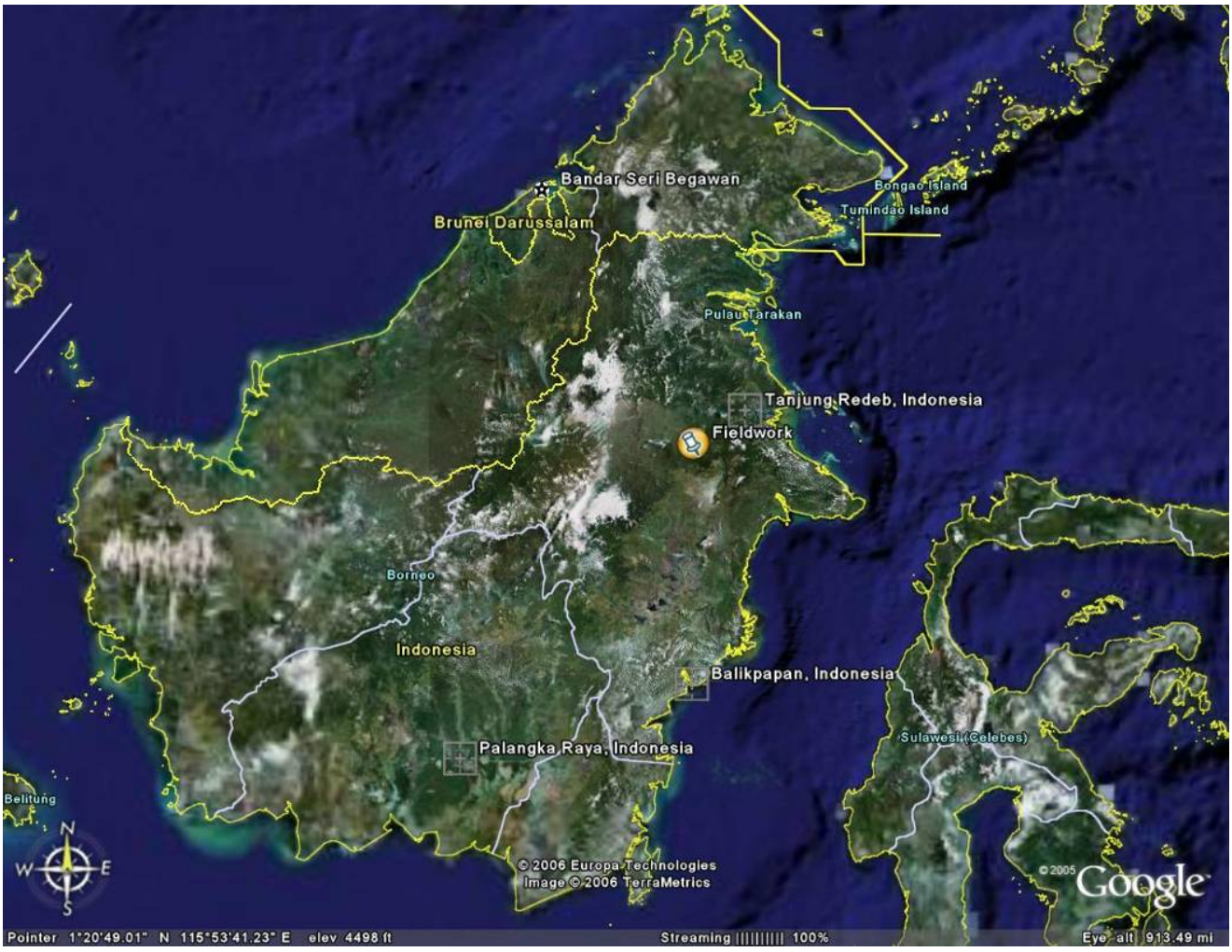

Figure 1 Location of study site in East Kalimantan, Indonesia