Research article

Reducing Deforestation and Forest Degradation in Phnom Tbeng Forests

CHAN SOMANTA*
The University of Hyogo, Kobe, Japan
Email: chan.somanta@gmail.com

NOPHEA SASAKI
The University of Hyogo, Kobe, Japan

SHUICHI KOBAYASHI
Japan Forest Technology Association, Japan

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Abstract Carbon emissions are the source of global climate change. Tropical deforestation was responsible for up to 25% of the global carbon emissions. Foreseeing the danger of losing tropical forests and impacts on local people and global climate change, world leaders have adopted the Copenhagen and Cancun Accords to fully recognize the REDD+ (Reducing Emissions from Deforestation and forest Degradation, Conservation of Carbon Stocks, Sustainable Management of Forests and the Enhancement of Forest Carbon Stocks) scheme of the United Nations Framework Convention on Climate Change. The REDD+ scheme provides financial incentives for any verified activities that result in reducing carbon emissions or increasing carbon stocks. Compensation can be made possible only when the amount of reduced emissions or increased carbon stocks is estimated. This study focuses on estimating the reduced emissions from deforestation and forest degradation and discusses the benefit sharing for local people. Phnom Tbeng forest in the Preah Vihear province was selected as a study site. There are four types of forests, namely evergreen forest, semi-evergreen forest, deciduous and others forests covering 41,530 ha. Our results suggest that a carbon project in this site is likely to result in reduced carbon emissions of about 3.7 million tCO_2 over 30-year project. Depending on carbon price, carbon revenues would be US$ 19 million or US$ 0.6 million annually for a 30-year REDD+ project cycle. In addition to carbon revenues, there are other ecosystem benefits that well-protected forests will provide to local people. Designing appropriate policies and measures to reduce the drivers of deforestation and forest degradation along with law enforcement mechanism is essential for success of the forestry carbon project.

Keywords REDD+, carbon emissions, climate change, carbon stocks, tropical deforestation

INTRODUCTION

Since the adoption of the Bali Action Plan in 2007 at the 13^{th} Conference of Parties (COP13) of the United Nations Framework Convention on Climate Change (UNFCCC), renewed interests have rapidly increased in achieving carbon and sustainable development benefits by implementing activities that result in reducing emissions from deforestation and forest degradation, conservation of carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks (REDD+). The REDD+ scheme had become the common terms referring to a scheme that provides financial compensation to developing countries for reducing carbon emissions. Accounting for up to 25% of the global emissions (Houghton, 2003), carbon emissions from deforestation and forest degradation in developing countries contribute significantly to global warming. Such emissions could be reduced at a relatively low cost compared to the reduction costs in energy sector (Stern 2006; Kinderman et al., 2007). Obviously, huge carbon emission reductions could be achieved with the appropriate compensation mechanisms. However, financial compensation could only be possible if the amount of reduced emissions and/or removals through enrichment planting is quantifiable. Until recently, there is no agreed global carbon accounting system that is applicable for estimating carbon stock changes and related emissions or removals (Angelsen, 2008). Particularly, no study of carbon accounting system for forest management at local level was conducted in Cambodia, except a handful of few general studies on carbon emissions in the whole Cambodia (Sasaki, 2006) and the opportunity costs for tropical forest management in Cambodia (Sasaki and Yoshimoto, 2010). As REDD+ projects are commonly implemented at the local level (project level), there is an urgent need to develop carbon accounting system, based upon which carbon emission reductions and related financial compensation could be estimated.

OBJECTIVE

The objectives of this study are to provide assessments of carbon emissions and emission reductions from protecting forests under the REDD+ scheme at Phnom Tbeng forests in Cambodia and to discusses the benefit sharing for local people

METHODOLOGY

Study Site and Forest Resources: In 2011, the Ministry of Economy, Trade and Industry of Japan initiated grants for feasibility study (FS) on potential new mechanisms including REDD+ scheme in developing countries. This study is continuous part of this FS on developing REDD+ project in Phnom Tbeng forests in the Preah Vihear Province, Cambodia. The study site administratively includes four districts and one municipality of Preah Vihear province. Field surveys revealed that there were more than 30 villages in 11 communes around this site (Fig. 1). Approximately 75% of rural population depends on forest and non-timber forest products such as for energy use and food particularly during drought or war time (FA, 2010).

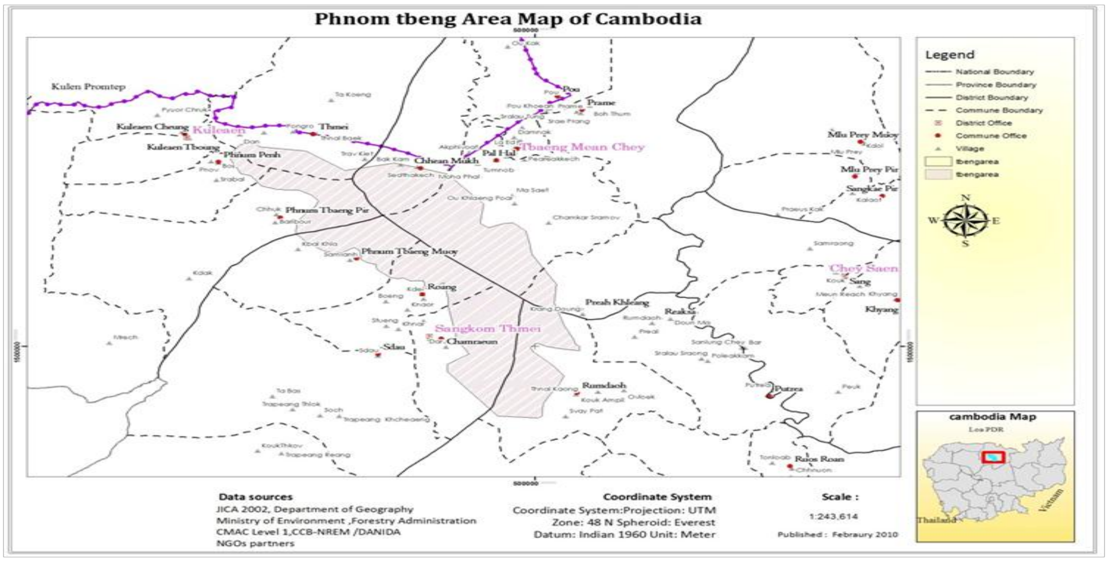

Fig. 1 Location map of the Phnom Tbeng study site

Local communities living in and around Phnom Tbeng forests depend on forests for daily subsistence, energy, and rice cultivation. Due to increasing population and fast economic growth, these forests are increasingly threatened by the clearing of forests for land speculation, the clearing of forests for industrial crop cultivation, land encroachment, and illegal logging. During the fieldwork in 2011 and with collaboration with FA's local authority of Cambodia, Japan Forest Technology Association (JAFTA) classified forests in this study site to four types, namely evergreen, mixed, deciduous, and other forests. According to JAFTA's forest land cover analysis, total forest area was 41,530 ha in 2004 and decreased to 41,038 ha in 2009 with an overall annual decrease rate of 0.24% (JAFTA's unpublished data). More specifically, evergreen forest decreased 2.71%, semi-evergreen forest 2.09%, other forests 1.53% while deciduous forest increased 5.58% annually between 2004 and 2009 (Table 1).

Table 1 Forest cover changes by type in Phnom Tbeng forest

Forest type	2004		2009		Decreasing rate/year
	Area (ha)	Percent %	Area (ha)	Percent %	2004-2009
Evergreen	14,784	34.3%	12,778	29.7%	-2.71%
Semi-evergreen	12,075	28.1%	10,816	25.1%	-2.09%
Deciduous	10,954	25.5%	14,013	32.6%	5.58%
Other forest	3,717	8.6%	3,431	8.0%	-1.53%
Total forest	41,530	96.5%	41,038	95.3%	-0.24%
None forest	1,511	3.5%	2,003	4.7%	6.51%
Total Area	43,041	100.0%	43,041	100.0%	-

Source: JAFTA's unpublished data

Based on data from 45 sample plots, mean of carbon stocks for each forest type are 102 MgC ha^{-1}, 117 MgC ha^{-1}, and 61 MgC ha^{-1}, respectively for evergreen, semi-evergreen, and deciduous forests. We assumed that carbon stocks in deciduous and other forest are equivalent. Upper confidence interval with 90% reliability (CI90%) is 111 MgC ha^{-1}, 128 MgC ha^{-1}, 69 MgC ha^{-1}, and 69 MgC $ha^{-1}$and lower CI90% is 93 MgC ha^{-1}, 105 MgC ha^{-1}, 54 MgC ha^{-1}, and 54 MgC ha^{-1} corresponding to 9%, 10%, 12% and 12% of the means, respectively for evergreen, semi-evergreen, deciduous and other forest (Table 2).

Table 2 Carbon stock of each forest (MgC ha^{-1})

Variables	Evergreen	Semi-evergreen	Deciduous	Other forest
Mean	102	117	61	61
Upper Confidence Interval with 90% Reliability	111	128	69	69
Lower Confidence Interval with 90% Reliability	93	105	54	54

Source: Result of 45 sample plots in Phnom Tbeng forest

Equations of Estimating Forest Cover Change and Carbon Emission Reductions

Change in area of forest cover by type in the study site can be estimated by

For change rate smaller than zero (a<0)

$$FA(t) = FA(0) \times e^{a \times t} \quad (1)$$

For change rate greater than zero (a>0)

$$FA(t) = FA(0) \times t^{a} \quad (2)$$

If no change in forest cover (a=0)

$$FA(t) = FA(0) \quad (3)$$

where

FA(t): area (ha) of each forest type at time t

$FA_i(0)$: area (ha) of each forest type at time t=0 (i.e. area in 2012)

a: Change rate of forest cover for each forest type

t: is time step (year)

Baseline deforestation (BD) and project deforestation (PD) can be derived by

$$BD(t) = FA(t2) - F(t1) \quad (4)$$

$$PD(t) = RPI(t) \times BD(t) \quad (5)$$

where