Leaflet No. 21/2017

The Republic of the Union of Myanmar
Ministry of Natural Resources and Environmental Conservation
Forest Department

Forest carbon stock estimation at project-level REDD activity in the Paung Laung Reserve Forest, Myanmar

Billy Ne Win, (FRI, Myanmar)
Dr. Tamotsu Sato (FFPRI, Japan),
Dr. Fumiaki Kitahara, (FFPRI, Japan),
Dr. Myat Su Mon, (FD, Myanmar)
Dr. Tetsuya Michinaka, (FFPRI, Japan),
Dr. Takuya Furukawa, (FFPRI, Japan),
Dr. Thaung Naing Oo, (FRI, Myanmar)
Dr. Ei Ei Swe Hlaing, (FRI, Myanmar)

December, 2017

Contents

ပြည်နယ်အဆင့် REDD+ လုပ်ငန်းစဉ်များအတွက် ပေါင်းလောင်းသစ်တောကြိုးဝိုင်းအတွင်း သစ်တောကာဗွန် ခန့်မှန်းတွက်ချက်ခြင်း

ဘီလီနေဝင်း၊ လက်ထောက်သုတေသနအရာရှိ၊
ဒေါက်တာမြတ်စုမွန်၊ လက်ထောက်ညွှန်ကြားရေးမှူး
ဒေါက်တာအိအိဆွေလှိုင်၊ လက်ထောက်ညွှန်ကြားရေးမှူး
ဒေါက်တာသောင်းနိုင်ဦး၊ ညွှန်ကြားရေးမှူး
Tamotsu Sato, Fumiaki Kitahara,Tetsuya Michinaka, Takuya Furukawa

စာတမ်းအကျဉ်း

သစ်တောဦးစီးဌာနနှင့် ဂျပန်နိုင်ငံ သစ်နှင့်သစ်တောထွက်ပစ္စည်း သုတေသနဌာန၊ FFPRI တို့ပူးပေါင်း၍ တိုင်းဒေသကြီးနှင့် ပြည်နယ်အဆင့် ကာဗွန်တွက်ချက်ခြင်းနှင့် စောင့်ကြည့်လေ့လာရေးစနစ်အား အကောင်အထည်ဖော် ဆောင်ရွက်မည့် REDD+ စီမံကိန်းအား ၂၀၁၆ ခုနှစ်မှ စတင်၍ အကောင်အထည်ဖော် ဆောင်ရွက်ခဲ့ပါသည်။ REDD+ စီမံကိန်း မှ ကာဗွန်တွက်ချက်ခြင်း အနေဖြင့် တိုင်းဒေသကြီးနှင့် ပြည်နယ်အဆင့် ကာဗွန် ခန့်မှန်း တွက်ချက်ခြင်းမှ စတင်၍ နိုင်ငံအဆင့် ကာဗွန်တွက်ချက် ခန့်မှန်း တွက်ချက်ခြင်း လုပ်ငန်းကို ဆောင်ရွက်ရမည်ဖြစ်ပါသည်။ စာတမ်းအား စီမံကိန်းဧရိယာအတွင်း တိုင်းဒေသနှင့် ပြည်နယ်အဆင့် ကာဗွန်တွက်ခြင်းနှင့် acitivy data, Emission factors, reference level အတွက် နည်းလမ်းများ ချမှတ်နိုင်ရန်နှင့် ရရှိလာသော နည်းလမ်းများအား ကာဗွန်တွက်ချက်ခြင်း နည်းလမ်းများနှင့် စောင့်ကြည့်လေ့လာရေး နည်းစနစ်များကို အထောက်အကူပြုစေရန် စသည့် ရည်ရွယ်ချက်များနှင့် ဆောင်ရွက်ခဲ့ပါသည်။ စီမံကိန်း ဆောင်ရွက်နေ့သည့်နေရာမှာ ရှမ်းပြည်နယ်ရှိ ပေါင်းလောင်း သစ်တောကြိုးဝိုင်းအတွင်း ဆောင်ရွက်ခဲ့ပါသည်။ သစ်တော ဖုံးလွှမ်းမှုဆိုင်ရာ စာရင်းကောက်ယူမှုအနေဖြင့် စီမံကိန်းဧရိယာအတွင်း ၂၀မီတာ× ၂၀ မီတာ× အကွက် ကြီး (၅၂)ခု ကောက်ယူခဲ့ပါသည်။ ရလဒ်များအရ ဝါးများမှ ကာဗွန်ထုတ်ယူမှုကို ချန်ထားရန် မသင့်ဘဲ ၎င်းသည် Semi-evergreen သစ်တောများအတွက် အရေးကြီးသော အကြောင်းအရင်း တစ်ခုဖြစ်ပါသည်။ ကွင်းဆင်း ဆောင်ရွက်မှုများတွင် ဝါးများနှင့် dead wood များ စာရင်းကောက်ယူရာတွင် အလုပ်သမား စရိတ်များ လျော့ချနိုင်ရန်အတွက် အထောက်အကူ ပြုသည့် နည်းလမ်းများကို ဖော်ပြထားပါသည်။ စာတမ်းတွင် ကာဗွန်တွက်ချက်တိုင်းတာမှု အနေဖြင့် Above ground biomass တစ်ခုတည်းကိုသာ ကွင်းဆင်းတိုင်းတာ၍ ရရှိသော အချက်အလက်များမှ တွက်ချက်ပြီး emission factor အတွက် ၂၀၀၅ ခုနှစ်မှ ၂၀၁၅ ခုနှစ်အထိ နှစ်အလိုက် ကာဗွန်ထုတ်လွတ်မှု ပမာဏကိုလည်း ခန့်မှန်းတွက်ချက်ထားပါသည်။ ဤစာတမ်းတွင် သစ်တောများမှ ကာဗွန် တွက်ချက်မှုများကို “the REDD+ strategy in Myanmar, 2017” မှ emission factor များ နှင့် နှိုင်းယှဉ်တွက်ချက်ထားပါသည်။ ဆောင်ရွက်ခဲ့သည့် စီမံကိန်းဧရိယာအတွင်း Forest carbon stock အနေဖြင့် နှစ်စဉ်ကျဆင်းခဲ့သည်ကို တွေ့ရှိရသော်လည်း emission factor ကွာခြားမှုအလိုက် တန်းဖိုးများ ကွာခြားသွားသည်ကို တွေ့ရှိရပါသည်။ Canopy density (ရွက်အုပ်ပိတ်၊ ရွက်အုပ်ပွင့်)များ၏ emission factor များမှာ နှစ်အလိုက် သစ်တော ပြုန်းတီး ခြင်းနှင့် သစ်တောအတန်းအစား ကျဆင်းခြင်းအတွက် ရလဒ်ကောင်း များ ရရှိခဲ့ပါ သည်။

Forest carbon stock estimation at project-level REDD activity in the Paung Laung Reserve Forest, Myanmar

Billy Ne Win[1], Tamotsu Sato[2], Fumiaki Kitahara[3], Myat Su Mon[4], Tetsuya Michinaka[2], Takuya Furukawa[2], Ei Ei Swe Hlaing[1], Thaung Naing Oo[1]

[1] *Forest Research Institute, Ministry of Natural Resources and Conservation, Myanmar*

[2] *Forestry and Forest Products Research institute (FFPRI), Japan*

[3] *Shikoku Research Center, Forestry and Forest Products Research institute (FFPRI), Japan*

[4] *Forest Department, Ministry of Natural Resources and Conservation, Myanmar*

Abstract

REDD+ ("Reducing Emissions from Deforestation and Forest Degradation and the Role of Conservation, Sustainable Management of Forests and Enhancement of Forest Carbon Stocks in Developing Countries") is of central importance in mitigating climate change. Since 2015, FD/FRI (Myanmar) and FFPRI (Japan) have been conducting a collaborative research project in Myanmar entitled "Nesting a REDD+ project carbon accounting and monitoring system under the (sub-) national system". Carbon accounting of a REDD+ project should be properly nested under the (sub-) national carbon accounting system so that the project activities are consistent with the national policy and the project performance is legally registered in the national account. The aim of this study is to develop potential methods of refining activity data, emission factors and/or reference levels of the (sub-) national level for a REDD+ project in the study site.

We selected Paung Laung Reserved Forest (ca. 160,500 ha) in Shan State as the project area. We have conducted ground-based inventory of emission factors in the project area (n = 52). Our results imply that carbon stock estimation of bamboo would be hard to ignore and important to evaluate emission factors in semi-evergreen forest type. We are developing an efficient method to measure forest biomass including bamboo and dead wood mass using less effort and labor in the field.

We have calculated forest carbon stock (aboveground biomass only in this case) using activity data and our original emission factors during the ten-year period (2005–2015). We have also compared forest carbon stocks using published emission factors cited in "the REDD+ Strategy in Myanmar (2017)". Forest carbon stock in the area decreased throughout the period, but the values differed among different emission factors. The "canopy density wise" emission factor (e.g. "open" and "closed" forest types) could bring good result that reflects the reality of deforestation and forest degradation during the period.

Forest carbon stock estimation at project-level REDD activity in the Paung Laung Reserve Forest, Myanmar

1. Introduction

REDD+ ("Reducing Emissions from Deforestation and Forest Degradation and the Role of Conservation, Sustainable Management of Forests and Enhancement of Forest Carbon Stocks in Developing Countries") is of central importance in mitigating climate change. Since the measurement, reporting, and very fication (MRV) of forest carbon change are indispensable for REDD+ implementation, the combined use of ground-based inventory and remote sensing is recommended to monitor carbon stocks at national scale (UNFCCC 2009). For a ground-based inventory, permanent sample plots allow the monitoring of carbon stocks by area (e.g. Fox et al. 2010, Samreth et al. 2012, Lindsell & Klop 2013).

The Joint Crediting Mechanism (JCM) is one of various approaches based on Decision 1 CP/18, and Japan intends to contribute to elaborating the framework for such approaches under the UNFCCC. However, coherence and consistency will be even more acute when various instruments such as sub-national or project-level approaches are mixed.

Since 2016, FD/FRI (Myanmar) and FFPRI (Japan) have been conducting a collaborative research project in Myanmar entitled "Nesting a REDD+ project carbon accounting and monitoring system under the (sub-) national system". Carbon accounting of a REDD+ project should be properly nested under the (sub-) national carbon accounting system so that the project activities are consistent with the national policy and the project performance is legally registered in the national account. The aim of this study is to develop potential methods of refining activity data, emission factors and/or reference levels of the (sub-) national level for a REDD+ project in the study site.

2. Materials and Methods

2.1 Study site

We selected Paung Laung Reserved Forest (ca. 160,500 ha) in Shan State as the project area (Figure 1). It is located within the area between 19º 45' and 20°28' N latitudes and 96°22' and 96º 49' N longitudes, and elevation 300–1,700 m a.s.l. The precipitation at the study site is higher in the eastern parts, i.e. Shan State and the maximum and minimum annual total rainfalls are 2,167 mm and 812 mm, respectively (Mon et al., 2009). Forest type around the area is classified as semi-evergreen forest. Local people harvest some NTFP (non-timber forest products) such as broom grass, betel leaves, etc. in the area. A new dam along the Paung Laung river in the area had been constructed in 2015.

2.2 Plot Layout

We used a nested structure design to save time and effort (Figure 2). Sampling plot of 0.16-ha (40 m x 40m) was used to conduct inventory. All living trees larger than 10 cm in diameter at breast height (DBH) were measured within the plots. We measured smaller trees (≥ 5 cm in DBH) in the sub-plots (Figure 2). We also measured living bamboo clumps (≥ 1cm in DBH) in the plots.

2.3 Canopy Coverage

At each intersection point (n = 25), we checked canopy cover type using the following three categories: closed canopy, open canopy (canopy gap), and bamboo. Definition of each cover type was as follows:

- Closed canopy: covered by crown and more than 10 m in height
- Open canopy: lack of crown and more than 10 m in height
- Bamboo: covered by bamboo crown

We calculated percentages of canopy coverage of tree and bamboo using these 25 points data for each plot.

2.4 Aboveground biomass

Aboveground biomass (AGB) of each tree was estimated using the generic allometric equation developed by Chave et al. (2014):

$$AGB = 0.0673 * (WD * DBH^2 * H)^{0.976}$$

where WD is wood density (g cm^{-3}), DBH is in cm, H is total height (m), and AGB is in kg dry mass. WD is also an important parameter. In general, WD is unique for each species. However, the default value in Southeast Asia (0.57 g cm^{-3}; Reyes et al. 1992) can be used in this study because we have not yet finished species identification of inventory data. For aboveground biomass of bamboo, we used DBH function allometric equations developed by Chan et al. (2013). Carbon content in each biomass was calculated using a conversion factor of 0.5.

3. Results and Discussion

3.1. Changes in forest area (activity data)

We have analyzed satellite images to evaluate forest area and its changes in the study area. Forest area decreased continuously from 93% in 2005 to 78% in 2015 (Figure 3). Closed forest decreased rapidly between 2005 and 2010. On the other hand, open forest increased its area and percentages of total forest cover.

3.2 Average carbon stock (emission factor)

Tree canopy coverage varied among the sampling plots: the values ranged from 0% to 96%. After adding coverage percentages from bamboo, we classified three forest types based on percentages of canopy coverage. Ten plots were classified as "open forest" because their canopy cover was smaller than 40% (hereafter called "OF"). Although the rest of 42 plots were classified as "closed forest", the plots were divided into two sub-types based on dominant species. Plots with dense bamboo cover (i.e. more than 50% coverage by bamboo) were classified as "closed forest dominated by bamboo" (hereafter called "CBF"). On the other hand, plots with less bamboo cover were classified as "closed forest dominated by tree species" (hereafter called "CTF"). Number of each forest type was as follows: 10 plots in OF; 5 plots in CBF, 37 plots in CTF.

We estimated mean carbon stock in aboveground biomass in the area. Carbon stock of AGB showed significant differences among the three forest types ($P = 0.001$, Kruskal-Wallis test). Compared to the CBF type, the CTF type showed higher plant carbon stocks, more than 70 Mg-C/ha (Figure 4). Forest carbon stock in the three forest types were small as compared to a previous study in dry mixed deciduous forest (Aye et al. 2014: ca. 117 Mg C/ha in AGB). Forest classification based on bamboo coverage would improve the accuracy of forest carbon stock estimation. However, these classifications are difficult using middle-resolution satellite images.

3.3 Changes in forest carbon stocks in the project area

We calculated forest carbon stock (aboveground biomass only in this case) using activity data and our original emission factors during the past ten years (2005–2015). We also calculated forest carbon stocks using some published emission factors which were cited in "Draft-the REDD+ Strategy in Myanmar (2017)" (Table 1).

Forest carbon stock in the area decreased throughout the period, and the values differed among different emission factors (Figure 5). It was found that the results of canopy density wise, one of the emission factors, very well reflected the reality of deforestation and forest degradation in the project area.

4. Conclusion

Subnational REDD+ projects (e.g. the Joint Crediting Mechanism (JCM) of Japan or Voluntary Carbon Standards (VCS)) will most likely contribute to implementing the national REDD+ strategy in Myanmar. We have to consider the following issues to make a practical and operational plan of project-based REDD+ implementation:

- Avoidance of double accounting of other programs
- Consistency of carbon accounting and forest reference emission level (FREL) with the national framework

To demonstrate development of FREL in the project area, we will estimate historical carbon stocks by our method currently under development. Our socio-economic studies (e.g. the approach of panel data analysis adopted by using statistical data such as population, GDP, etc.) will contribute to the adjustment for FREL levels under national circumstances.

5. Acknowledgements

We appreciate the field assistance provided by graduates of the University of Forestry (Yezin). This study was supported by "The project to support activities for promoting REDD+ by private companies and non-governmental organizations" of the Forestry Agency, Ministry of Agriculture, Forestry and Fisheries, Japan.

References

Aye, Y.Y., Pampasit, S., Umponstira, C., Thanacharoenchanaphas, K., & Sasaki, N. (2014). Estimation of carbon emission reductions by managing dry mixed deciduous forest: case study in Popa Mountain Park. Low Carbon Economy 5(2): 80-93.

Chan, N., Takeda, S., Suzuki, R., & Yamamoto, S. (2013). Establishment of allometric models and estimation of biomass recovery of swidden cultivation fallows in mixed deciduous forests of the Bago Mountains, Myanmar. Forest Ecology and Management, 304, 427-436.

Chave, J., Réjou-Méchain, M., Búrquez, A., Chidumayo, E., Colgan, M.S., Delitti, W.B.C. et al. (2014). Improved allometric models to estimate the aboveground biomass of tropical trees. Global Change Biology 20: 3177-3190.

Fox J. C., Yosi C. K., Nimiago P., Oavika F., Pokana J. N., Lavong K. & Keenan R. J. (2010). Assessment of aboveground carbon in primary and selectively harvested tropical forest in Papua New Guinea. BIOTROPICA 42: 410-419.

Lindsell, J. A., & Klop, E. (2013). Spatial and temporal variation of carbon stocks in a lowland tropical forest in West Africa. Forest Ecology and Management 289: 10-17.

Mon, M. S., Kajisa, T., Mizoue, N., & Yoshida, S. (2009). Factors Affecting Deforestation in Paunglaung Watershed, Myanmar using Remote Sensing and GIS. Journal of Forest Planning 14(1):7-16.

Reyes, G., Brown, S., Chapman, J., & Lugo, A.E. (1992). Wood Densities of Tropical Tree Species (Vol. S0-88). New Orleans, Louisiana: United States Department of Agriculture, Forestry Service, Southern Forest Experimental Station.

Samreth, V., Chheng, K., Monda, Y., Kiyono, Y., Toriyama, J., Saito, S., Saito, H. & Ito, E. (2012). Tree biomass carbon stock estimation using permanent sampling plot data in different types of seasonal forests in Cambodia. JARQ 46: 187-192.

UNFCCC (2009). Decision 4/CP.15. FCCC/CP/2009/11/Add1: 11-12.

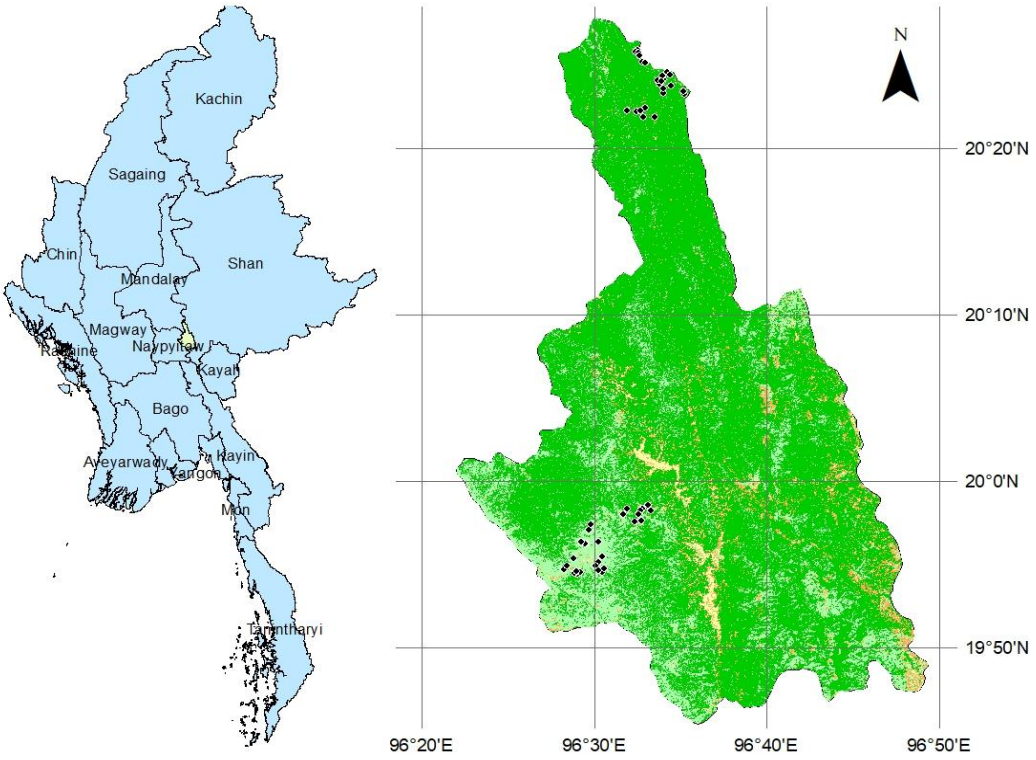

Figure 1 Location of the project area, Paung Laung Reserve Forest, Shan State.

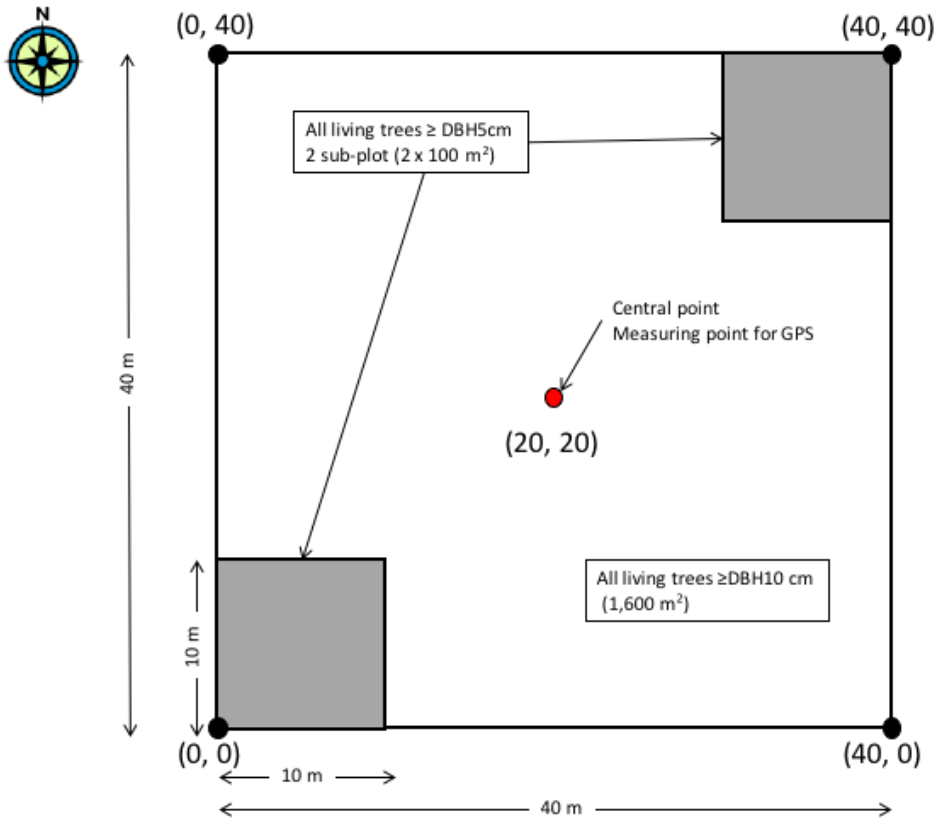

Figure 2 Design of sampling plot

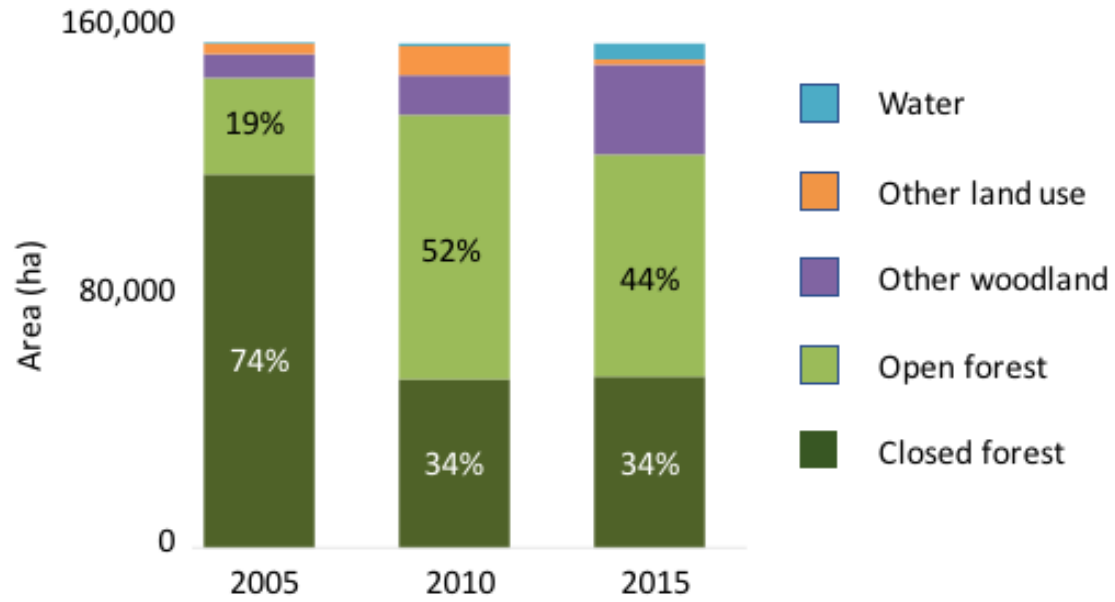

Figure 3 Temporal changes in land cover in the project area.

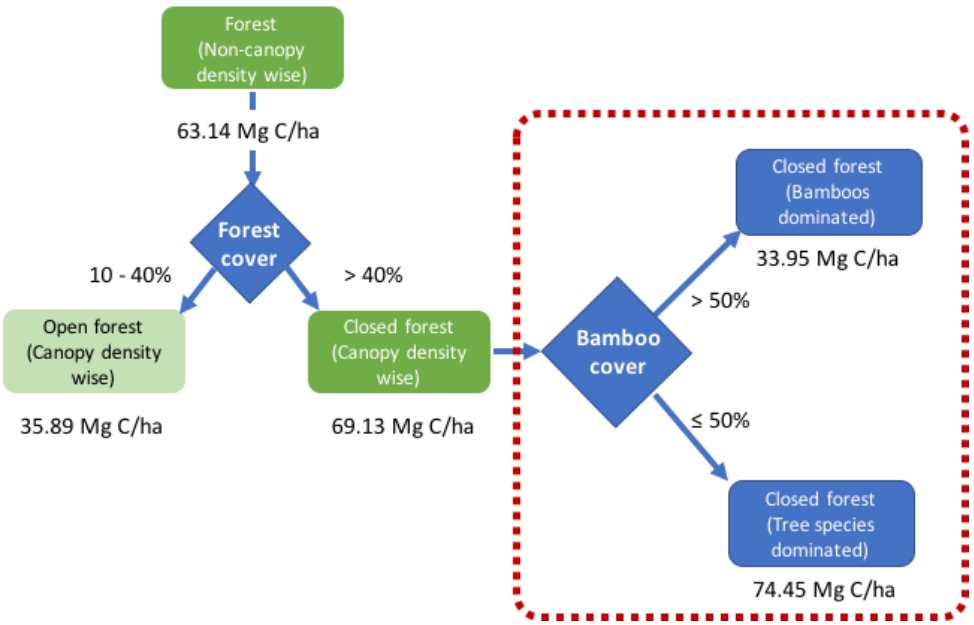

Figure 4 Emission factors developed by original ground inventory data in the project area.

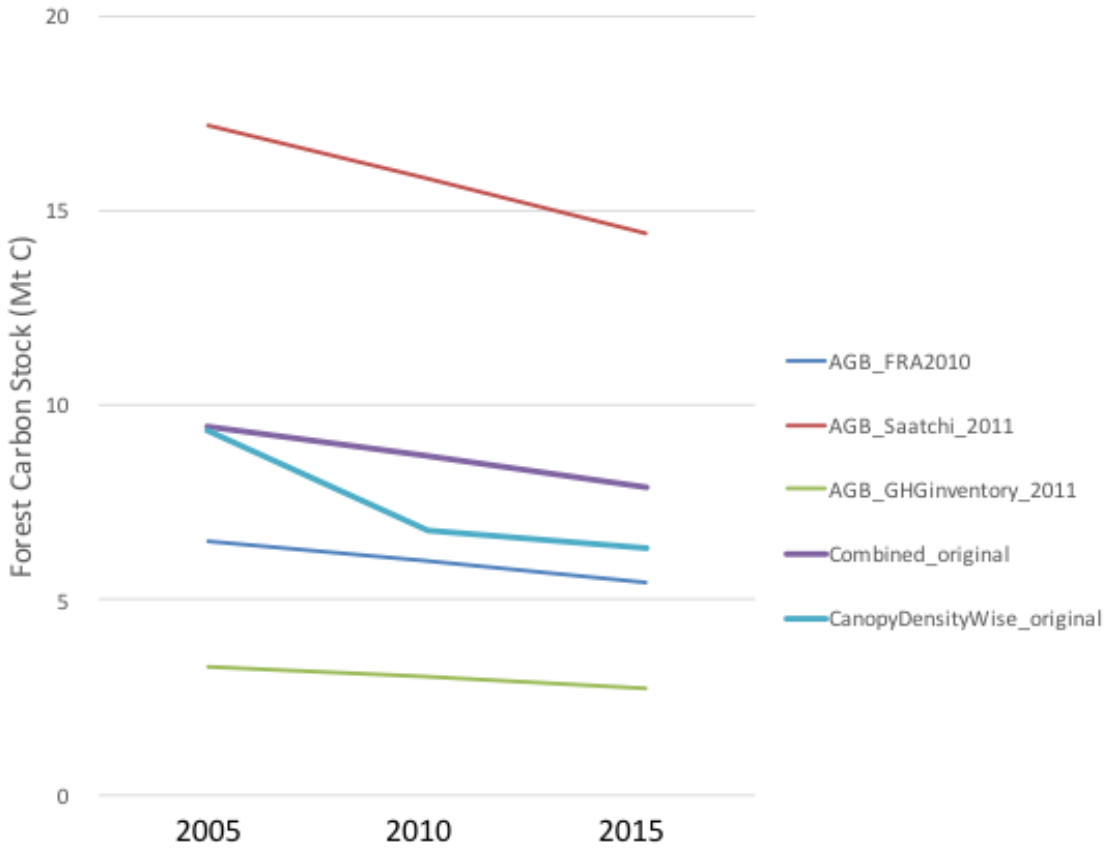

Figure 5 Comparison of forest carbon stocks in the project area using different emission factors.

Table 1 Emission factors for forest carbon stock form different data sources.

C stock in AGB in tonnes per ha	Sources
43.37	FRA, 2010
114.9	Saatchi et al., 2011
21.28	National GHG Inventory, 2011

Source: Draft- REDD+ strategy for Myanmar 2017