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# Deforestation and Greenhouse Gas Emissions Assessment for the Supporting Forests and Biodiversity Project, USAID Cambodia



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## **Summary Document Reporting on Baseline Deforestation and Greenhouse Gas Emissions or USAID-SFB Project**

July 28, 2014

### **Introduction**

The following document presents the results from the deforestation and Greenhouse Gas (GHG) analysis done by Winrock International for the USAID project Supporting Forests and Biodiversity (SFB) in Cambodia. The goal is to provide the basis for quantifying SFB's G1 indicator to decrease deforestation in priority landscapes, and G3 indicator to reduce GHG emissions. These results are presented for the two SFB regions, Eastern Plains Landscape (EPL) and Prey Long Landscape (PLL). Within these regions the results for G1 and G3 indicators are presented for community forest areas and protected areas. These results are a summary of the more detailed report in Appendix 1.

The results presented are preliminary pending a thorough review by SFB staff. The SFB staff must confirm that the project boundaries are accurate, and that the results for deforestation and GHG emissions are presented for all project locations where these indicators are intended. Also, SFB staff must critically review the baseline rate of deforestation presented in this report to ensure agreement that it is a credible projection of deforestation that is likely to occur in the SFB regions over the life of the project 2013 to 2017. Agreement that the deforestation rate is credible is important because it is the basis for both the G1 and G3 indicators.

The baseline rates of deforestation was assessed using the Hansen et al. (2013) global dataset. The Hansen et al. (2013) dataset provides spatially explicit layers for forest cover and deforestation from 2000 to 2012 at a resolution of 30x30m for the entire globe.

The GHG emissions were set using the USAID AFOLU Calculator (<http://www.afolucarbon.org/>) for community forests and the Seima REDD PD for the Seima Protection Forest. The AFOLU Calculator is a tool developed by Winrock International for USAID's reporting of GHG emission from Agriculture Forestry and Other Land Use (AFOLU).

### *Setting the Baseline Rate of Deforestation*

For the purposes of the SFB project, the baseline rate of deforestation is the rate of deforestation expected to occur in the project areas in the absence of the project. This is often called the “without project” baseline, and it is reported in hectares (ha) of deforestation per year (set in the SFB PMEP). For every hectare of deforestation there is an associated GHG emission, primarily from CO<sub>2</sub>. Emissions are reported in tons of CO<sub>2</sub> per year (t CO<sub>2</sub> y<sup>-1</sup>).

Baselines are typically set by assessing historical trends in deforestation in and around the project area, which is then used to project the most likely future scenario in the project area. For SFB the baselines will be the metric from which the project measures the success of its interventions that are aimed at reducing deforestation (G1) and reducing the GHG emission that result from that deforestation (G3). A higher rate of deforestation than the baseline would indicate the project interventions are not being successful, while a lower rate than the baseline implies success.

To determine the baseline rate of deforestation for the PLL and EPL a Reference Region (RR) was established. The Reference Region is an area that is expected to mimic the project area, and therefore is a reference for what could happen in the project area in the future (i.e. during the life of the SFB project and beyond). For the SFB project the reference region was set using the provinces to the south and west, which is toward Phnom Penh and other major urban and industrial areas. The PLL Reference Region was composed of two provinces: Kampong Tum and Kampong Cham. The reference region for EPL was made up of the province Karachen (Figure 1). These areas were selected because they have similar forest types as the EPL and PLL, they both contain some areas of protected forest, and deforestation appears to be encroaching on the EPL and PLL from the south and west (i.e. coming from the urban areas surrounding Phnom Penh). The logic behind this is that historical deforestation is encroaching on the EPL and PLL from the south and west, therefore it could be expected that future deforestation in the in the absence of the project interventions will be more similar to those reference region provinces where this encroachment has already occurred.

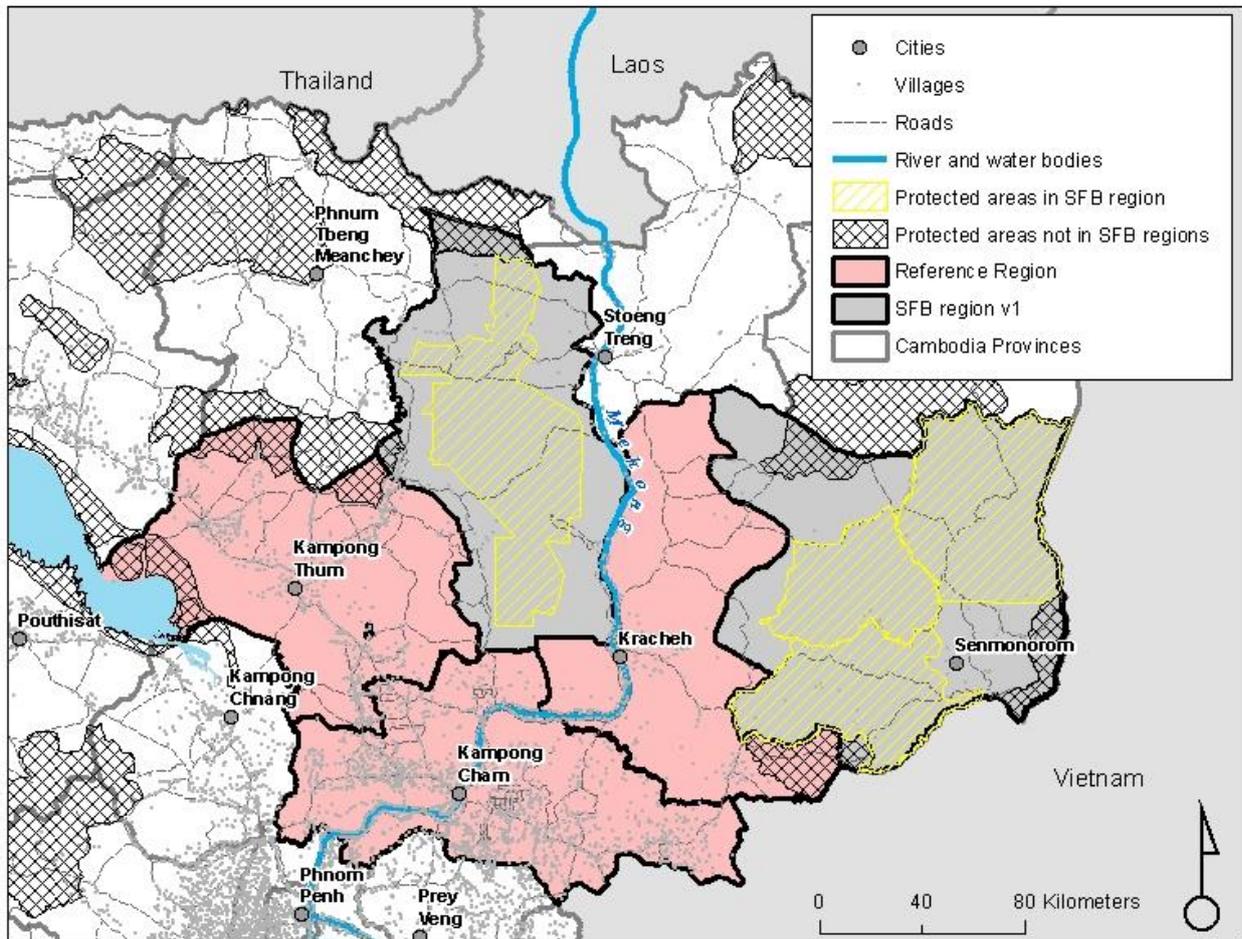


Figure 1. SFB Reference Region for setting the without project baseline deforestation rate.

**Results for Deforestation**

The results show that over the period from 2000 to 2012 historical deforestation in the EPL and PLL was 0.32% and 0.78% respectively. This equates to an average annual deforestation of 2,605ha  $y^{-1}$  for the EPL and 6,994ha  $y^{-1}$  for PLL. The annual rate of deforestation during this same period in the EPL Reference Region was 2.54% and 2.74% for PLL Reference Region. This equates to a baseline annual deforestation of 6,478ha  $y^{-1}$  for the EPL and 12,421ha  $y^{-1}$  for the PLL (Table 1).

Table 1. Results for area deforested in the Reference Regions compared to the SFB regions, and the Projected area of deforestation for the SFB project.

	Total area deforested during the historical reference period in the Reference Region	Duration of the historical reference period	Annual deforestation during the historic period in the Reference Region	Ratio of forest area in the SFB Project Regions at the start of the baseline period to the forest area of the Reference Region	Projected area of baseline deforestation in the SFB Project Regions
EPL Reference Region (Karachen)	136,461	12	11,372		
EPL	31,264	12	2,605	57%	<b>6,478</b>
PLL Reference Region (Kampong Tum and Kampong Cham)	197,712	12	16,476		
PLL	83,924	12	6,994	75%	<b>12,421</b>

Figures 2 and 3 show the cumulative historical deforestation for the EPL and PLL from 2000 to 2012, and projections of future deforestation based on 1) the historical average deforestation rate for within the EPL and PPL, and 2) the historical average deforestation rate for the Reference Region.

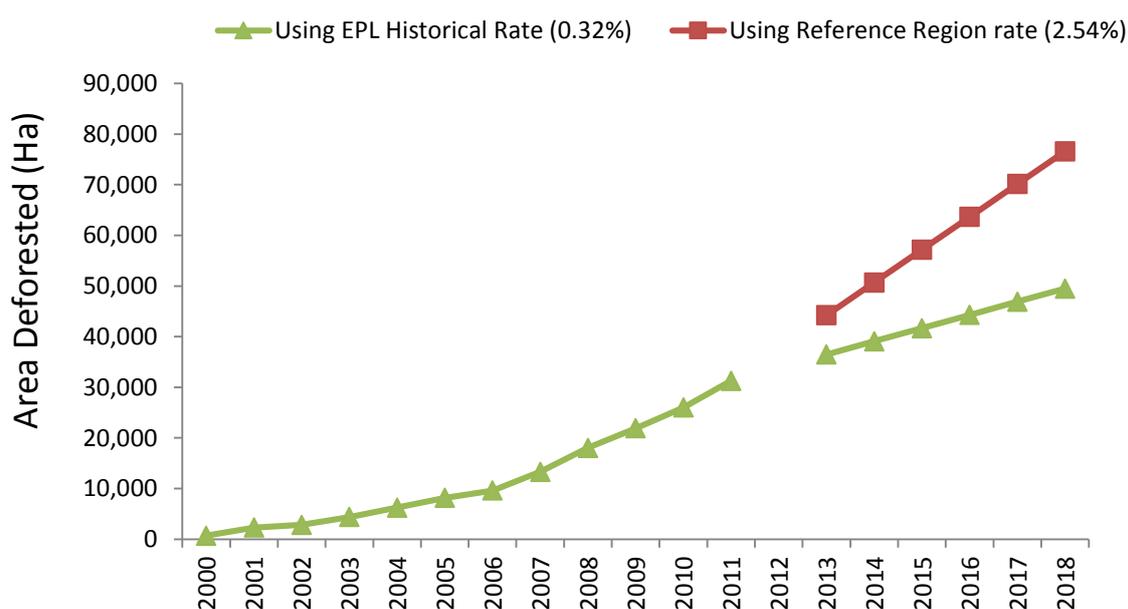


Figure 2. Cumulative historical deforestation for the EPL and projected deforestation using EPL historical rate and Reference Region (Karachen) deforestation rate.

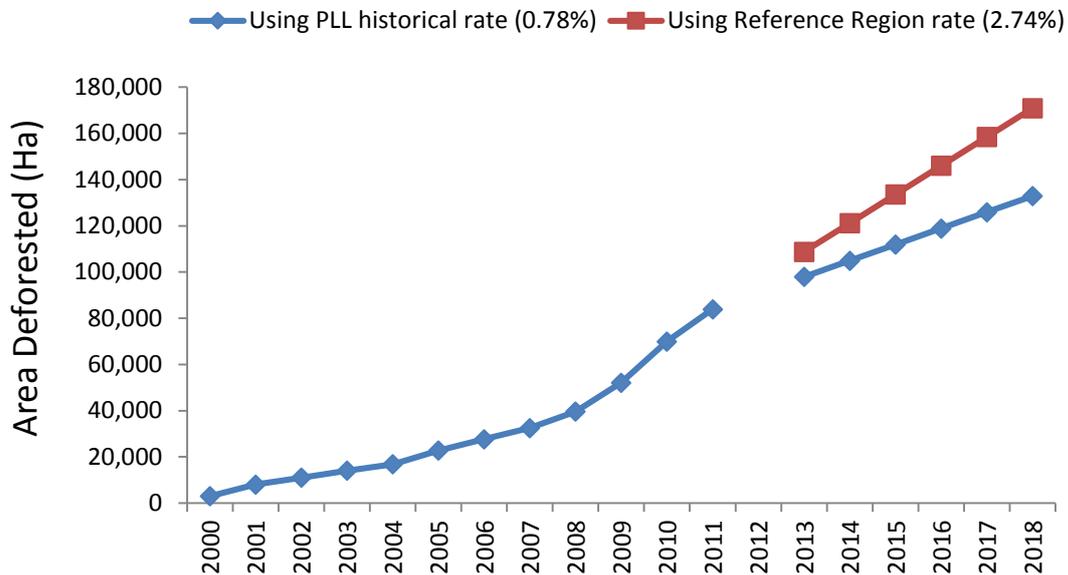


Figure 3 Cumulative historical deforestation for the PLL and projected deforestation using PPL historical rate and Reference Region (Kampong Tum and Kampong Cham) deforestation rate.

Figures 2 and 3 show that the historical deforestation for both EPL and PLL have been increasing over the period 2000 to 2012. The projected future deforestation (2013–2017) indicates that using a simple historical average for EPL and PLL (i.e. 0.32 and 0.78%) may not adequately account for future deforestation as it is clear that the rate is increasing. This helps support the use of the higher Reference Region rate for both the EPL and PLL.

Based on these results the baseline deforestation rates for the EPL and PLL are set at 2.54% for the EPL and 2.74% per year for PLL. These rates are set for all SFB community forest areas and protected forest areas. See Appendix 1 for detailed results.

The results for baseline deforestation (G1 indicator detailed in Section 4) are only intended for EPL. The EPL rate of deforestation was projected to be 2.54% ( $6,478\text{ha}^{-1}\text{y}^{-1}$ ). SFBs target is to reduce this deforestation rate by 15% over the life of the project. In EPL the successful implementation of the Seima REDD project is estimated to have reduced deforestation by 46% for all EPL over the life of the SFB project.

### Results for GHG Emissions

The Seima REDD Project was validated under the Verified Carbon Standard (VCS) in December of 2014. To achieve validation the project had to go through an extensive analysis and review process to ensure that the emission associated with deforestation are as accurate as possible without overestimation. For this reason the SFB project, instead of conducting its own emissions assessment (as has been done above), is using the deforestation and emission estimates reported directly from the Seima REDD Project Document that has been published and approved by the VCS (Table 2). The SFB project is only

accounting for deforestation and GHG emission that are occurring during the life of the SFB project 2013 to 2016.

**Table 2. Emission for Seima Protected Forest based on the Seima REDD PD**

year	Avoided deforestation	Avoided deforestation (cumulative)	GHG emission	GHG emission (cumulative)
	ha		tCO <sub>2</sub> e	
2013	3,069	3,069	5,414,601	5,414,601
2014	3,372	6,441	3,937,711	9,352,312
2015	3,606	10,047	2,934,495	12,286,808
2016	3,601	13,648	2,966,841	15,253,648

The SFB project has set a GHG reduction target of 250,000 t CO<sub>2</sub> for year 2 and 3, and 1 million t CO<sub>2</sub> for year 4, totaling 1.5 million t CO<sub>2</sub> over the life of the project. Therefore, the Seima REDD project satisfy the GHG targets by reducing GHG emission by 15million tCO<sub>2</sub>e over the life of the SFB project (2013-2016).



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## INTRODUCTION

The purpose of this report is to provide an assessment of forest cover, deforestation and Greenhouse Gas (GHG) emissions from deforestation for the USAID project Supporting Forests and Biodiversity (SFB) in Cambodia. The report provides the basis for quantifying SFB's G1 Indicator to decrease deforestation in priority landscapes, and G3 Indicator for Greenhouse Gas (GHG) emissions reduction.

The current version of this report and analysis (Version 1) remains a draft as the boundaries of the SFB project areas (and their definitions) still has to be verified and finalized by SFB staff. The rate of deforestation has been set using a reference region. This rate should be reviewed critically by SFB because it is the key variable that is used to set both the G1 and G3 indicators.

Forest cover and deforestation was assessed using the Hansen et al. (2013) global dataset. The Hansen et al. (2013) dataset provides a spatially explicit layers for forest cover and deforestation from 2000 to 2012 at a resolution of 30x30m for the entire globe. This data was assessed using GIS<sup>1</sup> programs to quantify the area and extent of forest cover and deforestation for the SFB project.

In this version of the report we have defined the "SFB regions" as 1) the Eastern Plains Landscape (EPL) which is the entire Monduliri Province including the protected areas of the Monduliri Protected Forest, Phnom Prich Wildlife Sanctuary and Seima Protected Forest; 2) the Prey Lang Landscape (PLL) which is the area of the Proposed Prey Lang Protected Forest and all the surrounding communes, located in Kampong Thum, Steung Treng, Preah Vihear, and Kratie provinces. It is understood that that the SFB project is not working in all communes within these regions, and therefore the boundaries of these regions may change given SFB review. The communes and villages that SFB is working in have been mapped based on data provided by SFB (the project area spreadsheet provided by Hoeun), but a number of these areas were not able to be linked to existing spatial data, therefore it will need to be reviewed and corrected (Figure 4).

The primary results for G1 and G3 are present for all SFB community forests and for protected areas in the EPL (Monduliri Protected Forest, Phnom Prich Wildlife Sanctuary, Seima Protected Forest) and PLL (Proposed Prey Lang Protected Forest). For the Seima Protected Forest deforestation and GHG emission will be reported from the Seima REDD Project which is still undergoing validation under the Verified Carbon Standard (VCS).

This report assesses forest cover and deforestation in four sections:

- 1) The first section of the report assesses forest cover and deforestation at a national and provincial level. This national level data provides a broader context to the forest cover and deforestation within the SFB regions.
- 2) The second section assessed forest cover and deforestation within the SFB regions including the specific communes and protected areas where SFB is working. As mentioned above these areas still need to be reviewed and finalized. This information is important for understanding the existing forest cover and deforestation at the commune level in the EPL and PLL.
- 3) The third section is an initial attempt at projecting a "without project" baseline rate of deforestation for the EPL and PLL over the SFB project period (2012-2016). The without project baseline is a projection (i.e. estimation) of the deforestation that could be expected occur in the SFB regions if none of the SFB and partner activities were implemented. The without project baseline is what SFB will use to quantify its success in reducing deforestation under Indicator G1.
- 4) Section four presents the baseline deforestation results for without project baseline deforestation for all of SFB protected areas and community forests to satisfy SFB indicator G1.
- 5) The last section details the GHG emission resulting from deforestation for all of SFB protected areas and community forests to satisfy SFB indicator G3.

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<sup>1</sup> Geographic Information Systems

To determine the baseline rate of deforestation for the PLL and EPL a Reference Region (RR) was established. The RR is an area that is expected to mimic the project area, and therefore is a reference for what will happen in the project area in the future (i.e. during the life of the SFB project and beyond). For the SFB project the RR was set using the provinces to the south and west, toward Phnom Penh and other major urban and industrial areas.

The results for baseline deforestation (G1 indicator detailed in Section 4) for EPL and PLL have been set at 2.54% ( $6,478\text{ha}^{-1}\text{y}^{-1}$ ) and 2.74% ( $12,421\text{ha}^{-1}\text{y}^{-1}$ ) respectively. SFBs target is to reduce this deforestation rate by 15%, which requires a reduction in deforestation to 2.16% for the EPL, and 2.33% for PLL.

The results for baseline GHG emissions from deforestation (G3 indicator detailed in Section 5) shows that projected annual emission in PLL community forest are  $1,181,790\text{ t CO}_2\text{ y}^{-1}$  and 7.8 million  $\text{t CO}_2\text{ y}^{-1}$  from the Propose Prey Long Protected Forest. For EPL the emission from the community forest are projected to be  $135,930\text{ t CO}_2\text{ y}^{-1}$  and about 5.4million  $\text{t CO}_2\text{ y}^{-1}$  from the protected areas of Mondulkiri and Phnom Prich. The Seima Protected Forest is reporting GHG emission reduction from the Seima REDD Project Document (PD). The Seima REDD PD shows an average annual emission reduction over the first five years of the project is to be 6.8 million  $\text{t CO}_2\text{ y}^{-1}$ .

The SFB project has set a GHG reduction target of 250,000t  $\text{CO}_2$  for year 2 and 3, and 1 million  $\text{t CO}_2$  for year 4, totalling 1.5 million  $\text{t CO}_2$  over the life of the project. Therefore, if the Seima REDD project is successful it will satisfy the GHG targets alone. If the Seima REDD project is not successful the SFB project will need to meet its target by reducing the GHG emission from community forests and other protected areas.

## **DATA ON NATIONAL FOREST COVER AND DEFORESTATION**

### **National Forest Cover**

According to the Hansen *et al* (2013) dataset, for the country of Cambodia there was approximately 8.8 million hectares of forest in 2000. By 2012 forest cover had dropped to 7.7 million hectares, about 42% of the country. Figure 1 shows the national extent of forest cover for the country of Cambodia in the year 2000. The SFB regions are outlined, but are noted as "SFB region v1" (version 1) as boundaries may change after SFB review.

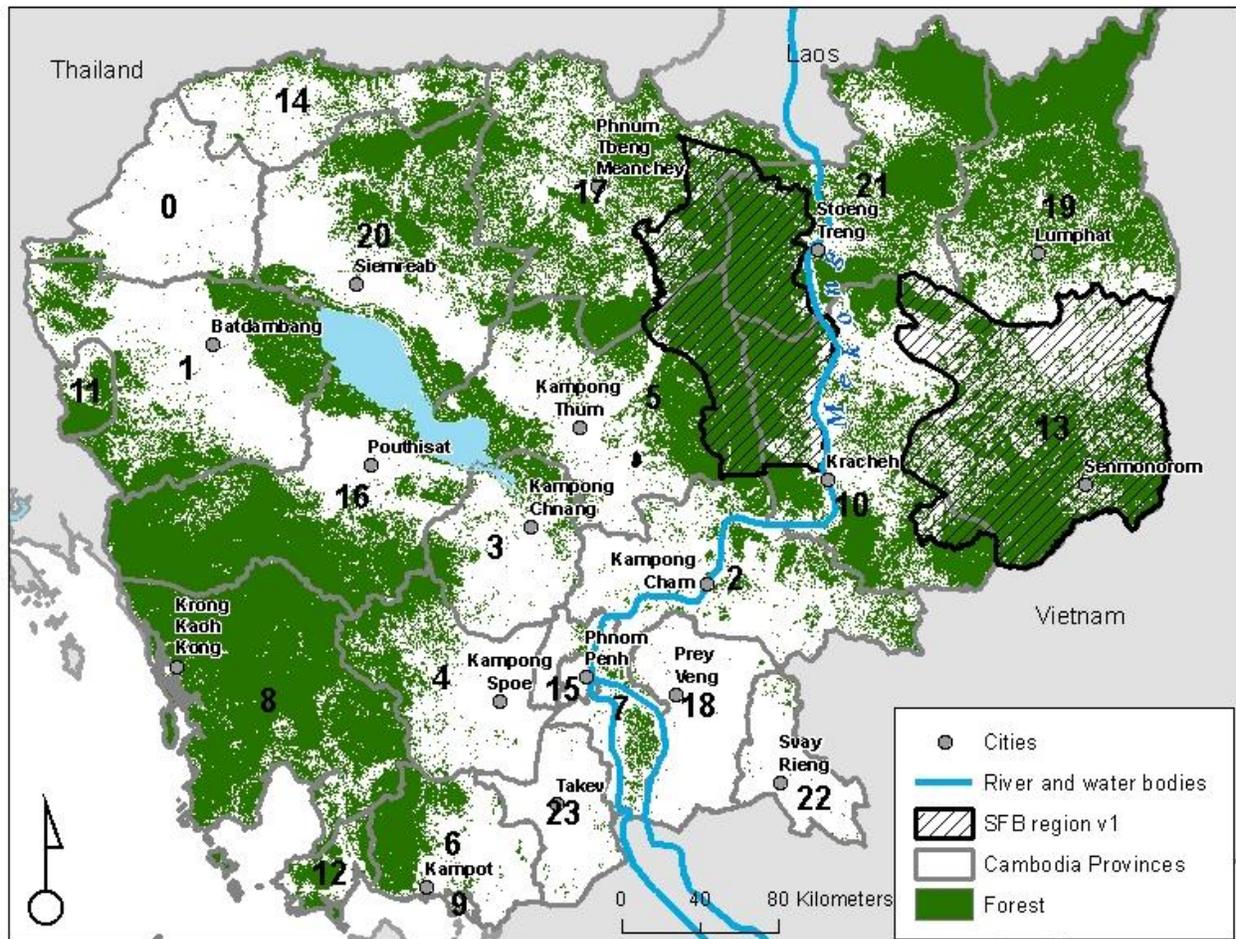


Figure 1. Map of forest cover in Cambodia in 2000 from Hansen et al. 2013.

Table 1 shows the forest cover in 2000 and 2012 at the provincial and national level. The table is sorted by the percent forest area from high to low (high being displayed as green to low yellow)

Table 1. Forest cover by Province in thousands of hectares.

Map ID	Province	Province area	Area of forest with >30% canopy cover in 2000	Area of forest with >30% canopy cover in 2012	Percent of Division area in forest 2012
		1000 ha			%
8	Kaôh Kong	1,229	1,105	1,044	84.9%
21	Stœng Trêng	1,198	892	822	68.6%
19	Rôtânôkiri	1,173	835	757	64.6%
16	Pouthisat	1,244	802	757	60.9%
17	Preah Vihéar	1,402	861	814	58.1%
13	Môndól Kiri	1,365	782	758	55.6%
12	Krong Preah Sihanouk	140	85	76	54.5%
10	Krâchéh	1,196	678	516	43.1%
5	Kâmpóng Thum	1,281	669	533	41.7%
6	Kâmpôt	472	181	157	33.3%
20	Siemréab	1,288	549	428	33.2%
11	Krong Pailin	109	69	34	30.8%
1	Bântéay Méanchey	1,211	481	329	27.2%
4	Kâmpóng Spœ	681	202	169	24.9%
3	Kâmpóng Chhnang	540	128	122	22.6%
14	Otdar Mean Chey	522	168	118	22.5%
9	Kep	15	2	2	15.5%
7	Kândal	356	52	51	14.2%
2	Kâmpóng Cham	946	206	128	13.5%
0	Batdâmbâng	616	39	23	3.7%
15	Phnom Penh	37	1	1	2.6%
22	Stœng Trêng	285	9	7	2.3%
23	Takêv	348	6	6	1.6%
18	Prey Vêng	475	4	4	0.7%
	<b>Cambodia</b>	<b>18,130</b>	<b>8,806</b>	<b>7,656</b>	<b>42.2%</b>

### National Historical Deforestation

Deforestation for the country of Cambodia between 2000 and 2012 is reported as both gross and net deforestation. Gross deforestation being total deforestation without considering areas of reforestation, and net being the difference between deforestation and reforestation:

$$\text{Equation 1: } \text{Gross Deforestation} = \sum \text{Deforestation}$$

$$\text{Equation 2: } \text{Net Deforestation} = \sum \text{Deforestation} - \sum \text{Reforestation}$$

While both gross and net are presented in the results, the results that will be used for SFB's indicators will be gross because this is what has been recommended in the scientific literature for countries reporting deforestation under REDD+ mechanism (Brown & Zarin 2013).

Figure 2 shows the extent of deforestation across Cambodia between 2000 and 2012.

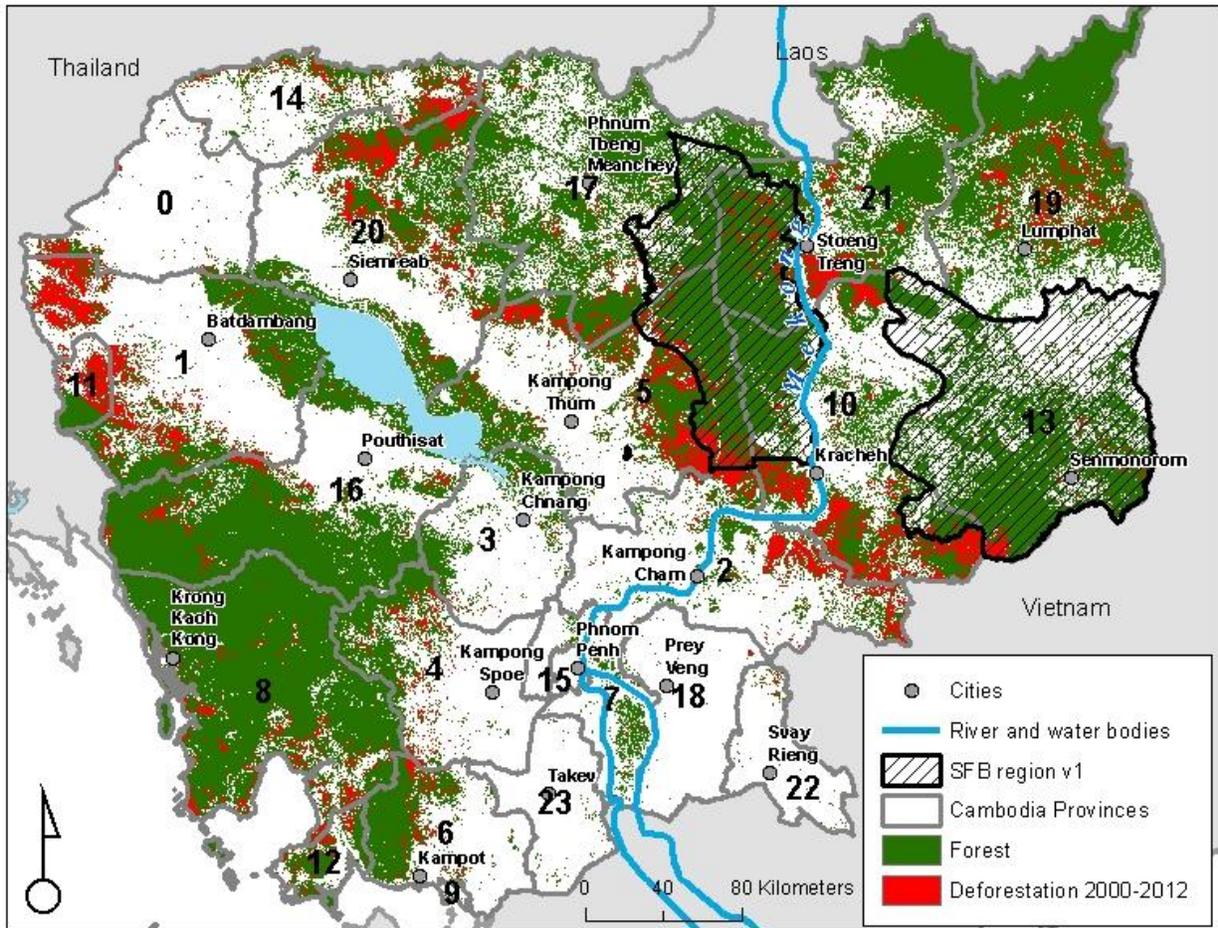


Figure 2. Forest cover and deforestation for Cambodia from Hansen et al. 2013.

Table 2 shows by province the total deforestation and reforestation between 2000 and 2012 in hectares, the average annual gross and net deforestation, and the gross and net deforestation rates. The table is sorted from high to low based on the gross deforestation rate (high being displayed as red to low blue).

$$\text{Equation 3} \quad \text{Ave. Annual Gross Deforestation} = \frac{\text{Gross Deforestation}}{\text{Years}}$$

$$\text{Equation 4} \quad \text{Gross annual deforestation rate} = \frac{\text{Ave. Annual Gross Deforestation}}{\text{Total forest area in 2000}}$$

$$\text{Equation 5} \quad \text{Ave. Annual Net Deforestation} = \frac{\text{Net Deforestation}}{\text{Years}}$$

$$\text{Equation 6} \quad \text{Net annual deforestation rate} = \frac{\text{Ave. Annual Net Deforestation}}{\text{Total forest area in 2000}}$$

Table 2. Deforestation by Province for Cambodia.

Map ID	Province	Gross deforestation 2000-2012	Reforestation 2000-2012	Average annual gross deforestation 2000-2012	Average annual net deforestation 2000-2012	Gross annual deforestation rate	Net annual deforestation rate
		Ha				%	
11	Krong Pailin	36,160	169	3,013	2,999	4.34%	4.32%
0	Batdâmbâng	15,931	119	1,328	1,318	3.44%	3.41%
2	Kâmpóng Cham	84,916	6,841	7,076	6,506	3.43%	3.16%
22	Stoeng Trêng	3,238	537	270	225	2.91%	2.43%
1	Bântéay Méanchey	153,485	1,373	12,790	12,676	2.66%	2.63%
14	Otdar Mean Chey	51,054	423	4,254	4,219	2.53%	2.51%
10	Kràchéh	166,145	3,551	13,845	13,549	2.04%	2.00%
5	Kâmpóng Thum	158,329	22,980	13,194	11,279	1.97%	1.69%
20	Siemréab	125,585	4,395	10,465	10,099	1.91%	1.84%
18	Prey Vêng	849	222	71	52	1.70%	1.26%
12	Krong Preah Sihanouk	16,072	7,626	1,339	704	1.58%	0.83%
4	Kâmpóng Spœ	37,251	4,544	3,104	2,726	1.54%	1.35%
6	Kâmpôt	24,522	925	2,044	1,966	1.13%	1.09%
19	Rôtânôkiri	94,741	16,728	7,895	6,501	0.95%	0.78%
21	Stoeng Trêng	79,199	9,391	6,600	5,817	0.74%	0.65%
9	Kep	191	58	16	11	0.65%	0.45%
23	Takêv	417	532	35	-10	0.63%	-0.17%
15	Phnom Penh	72	15	6	5	0.59%	0.47%
8	Kaôh Kong	75,416	14,595	6,285	5,068	0.57%	0.46%
17	Preah Vihéar	51,335	4,980	4,278	3,863	0.50%	0.45%
16	Pouthisat	47,707	3,343	3,976	3,697	0.50%	0.46%
3	Kâmpóng Chhnang	7,585	2,174	632	451	0.49%	0.35%
7	Kândal	1,863	171	155	141	0.30%	0.27%
13	Môndól Kiri	27,056	3,879	2,255	1,931	0.29%	0.25%
	<b>Cambodia</b>	<b>1,259,121</b>	<b>109,572</b>	<b>104,927</b>	<b>95,796</b>	<b>1.19%</b>	<b>1.09%</b>

Figure 3 shows a map of the results for gross deforestation by division for the country of Cambodia. This map along with Figure 2 is helpful for visualizing the relative deforestation across the country compared to SFB regions. It is clear from these two maps that compared with other areas in Cambodia, the EPL has low historical rates of deforestation, and the PLL has high to moderate deforestation rates. One trend shown in Figure 3 is the higher rate of deforestation south and west of the SFB regions in provinces 5, 2 and 10. This trend is also revealed in Figure 2, where a large amount of deforestation can be seen encroaching on the south and west boundaries of the PLL and EPL.

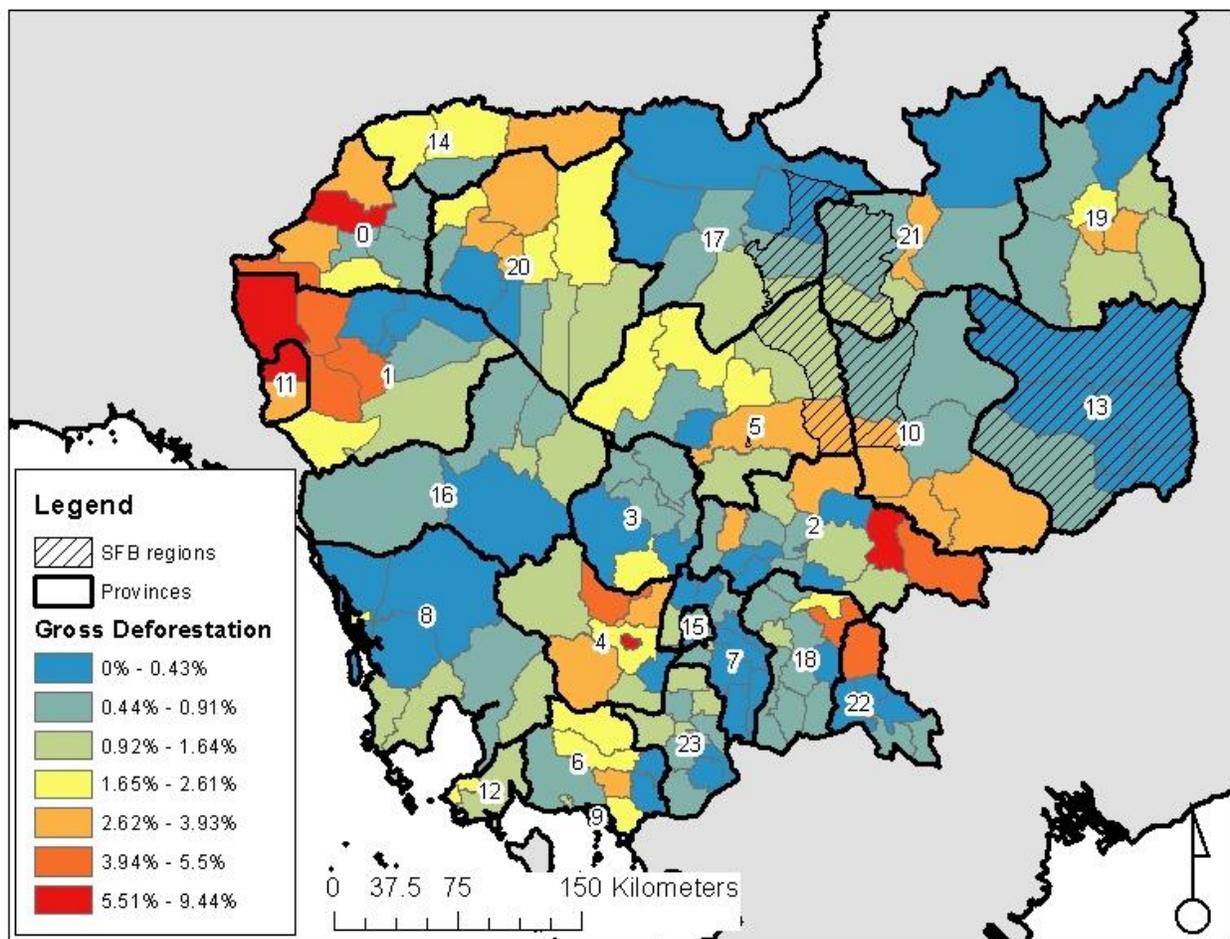


Figure 3. Mean gross annual deforestation rate by province from 2000 to 2012

## SFB PROJECT AREA FOREST COVER AND DEFORESTATION (VERSION 1)

### SFB Project Areas Version 1

Figure 4 shows a map of the SFB region, communes where there are existing SFB/partner activities, villages with existing SFB/partners activates, and SFB community forest areas (See Appendix for village and commune names). The map was made using GIS layers of communes and villages and linking them with the data provided by SFB on project activities (the project activities spreadsheet provided by Hoeun). **However, this map is not considered complete (i.e. version 1), and should be updated based on SFB staff review.** Issues for SFB review are:

- 1) Not all communes in the PLL were able to be matched with the GIS data. SFB and Eco must review Hoeun's database and the current GIS database to finalize the map.
- 2) A number of villages in both PLL and EPL were not able to be matched with the GIS data. SFB and Eco must review Hoeun's database and the current GIS database to finalize the map.
- 3) There is a question about the actual boundary of the Prey Lang Protected area. The one presented in the Figure 4 is the "Proposed Prey Lang Protected Forest," however I believe the current Prey Lang Protected Forest is patchier (i.e. smaller). I do not have another file for Prey Lang. Is there another file I should be using?
- 4) The Seima Project is still finalizing its boundaries. This will be updated once they are final.

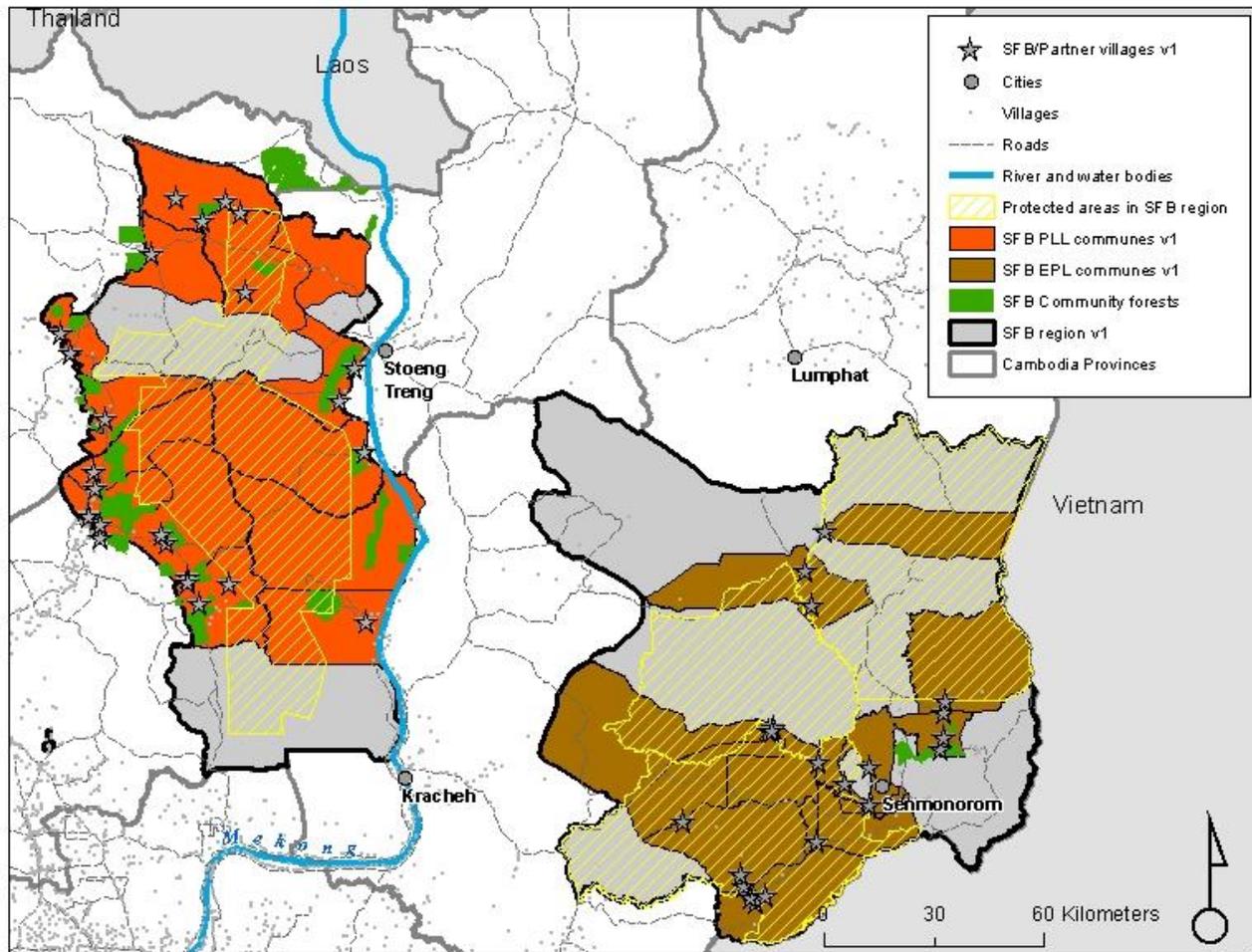


Figure 4. Version 1 of the SFB project areas, showing 1) the SFB region, 2) communes with SFB/partner activities, 3) villages where SFB/partners have activities, and SFB community forests.

### SFB Forest Cover

This section presents the forest cover for the EPL and PLL region, communes and protected areas (Figure 5).

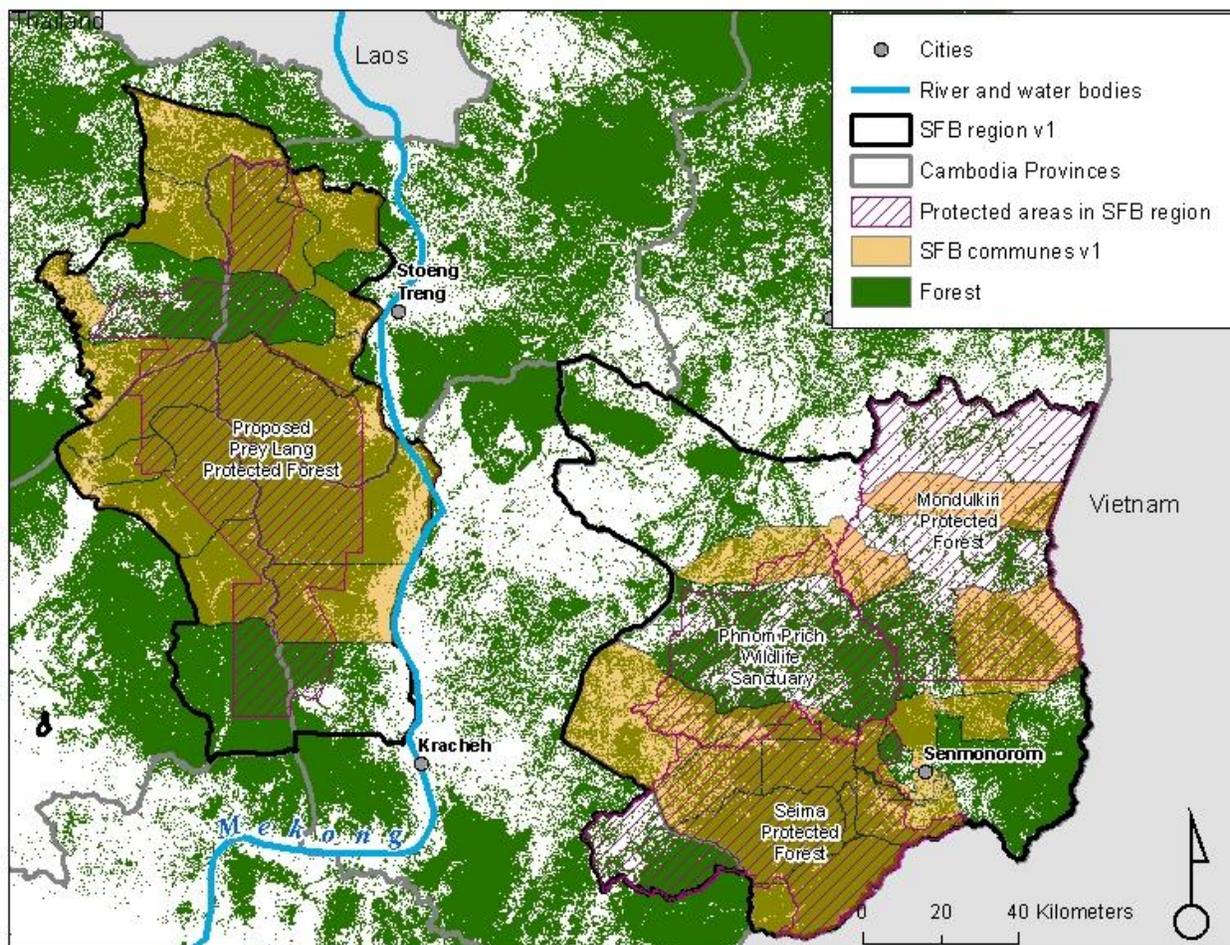


Figure 5. Forest cover for the EPL and PLL based on Hansen et al. 2013.

The total forest in 2012 for the EPL was 794 thousand hectares (56% forested), and PLL was 817 thousand hectares (77% forested). Protected forest areas comprise 64% of the total forest in the EPL and 53% of the PLL.

Table 3. Results for forest area in the EPL and PLL.

	Total area	Forest area	Forested
	1000 Ha		%
<b>EPL Total</b>	<b>1,426</b>	<b>794</b>	<b>56%</b>
Mondulkiri Protected Forest	372	121	33%
Phnom Prich Wildlife Sanctuary	222	149	67%
Seima Protected Forest	293	238	81%
Non-protected	540	285	53%
<b>PLL Total</b>	<b>1,055</b>	<b>817</b>	<b>77%</b>
Proposed Prey Lang Protected Forest	458	429	94%
Non-protected	597	387	65%

Table 4 shows the forest area for the year 2000 and 2012 for all communes where SFB/partner activities are identified (Project Areas Version 1). The table is divided by EPL and PLL. For each section the communes are sorted by percent forest cover from high to low (high being displayed as green to low yellow).

The communes where SFB/partner activities are occurring make up 48% (381 thousand ha) of the total forests in the EPL, and 75% (620 thousand ha) of the PLL forests (Table 4).

**Table 4. Results for forest area in the communes where SFB/partner activities are occurring.**

SFB Region	Communes with SFB/Partner activities	Commune area	Area of forest with >30% canopy cover in 2000	Area of forest with >30% canopy cover in 2012	Percent of Commune area in forest 2012
		1000 ha			%
EPL	Srae Preah	67	64	63	94.6%
EPL	Srae Chuk	35	32	32	90.8%
EPL	Sokh Dom	19	15	15	80.9%
EPL	Srae Khtum	58	56	45	77.0%
EPL	Senmonorom	38	30	29	77.0%
EPL	Srae Ampum	18	14	13	75.8%
EPL	Memang	46	32	32	68.7%
EPL	Romonear	18	12	12	65.8%
EPL	Krang Tes	79	45	45	56.7%
EPL	Chung Phlas	107	59	58	54.2%
EPL	Sok San	71	28	28	38.6%
EPL	Srae Huy	56	9	9	15.9%
<b>All EPL communes with SFB/partner activities</b>		<b>613</b>	<b>397</b>	<b>381</b>	<b>62.2%</b>
PLL	Siem Bouk	104	97	95	91.7%
PLL	Anlong Chrey	62	60	55	88.9%
PLL	Mean Rith	83	80	74	88.4%
PLL	Dang Kambet	45	43	39	87.1%
PLL	Sochet	49	47	42	86.4%
PLL	Beoung Cha	115	99	98	84.8%
PLL	Chhaeb Muoy	38	33	32	84.7%
PLL	Sam Ang	37	33	29	79.3%
PLL	Kaing Cham	21	18	16	75.3%
PLL	Chhaeb Pir	52	38	37	71.0%
PLL	Sandan	26	21	18	70.8%
PLL	Reab Roy	34	26	24	68.6%
PLL	Kampong Cham	65	48	44	68.1%
PLL	O'Rei	15	11	9	63.6%
PLL	Putrea	17	7	7	39.5%
<b>All PLL communes with SFB/partner activities</b>		<b>764</b>	<b>660</b>	<b>620</b>	<b>81.2%</b>

## SFB Historical Deforestation

Deforestation from 2000 to 2012 was assessed for the EPL and PLL by commune and protected area. Figure 6 shows the average annual gross deforestation rate for all communes in the EPL and PLL and by protected area.

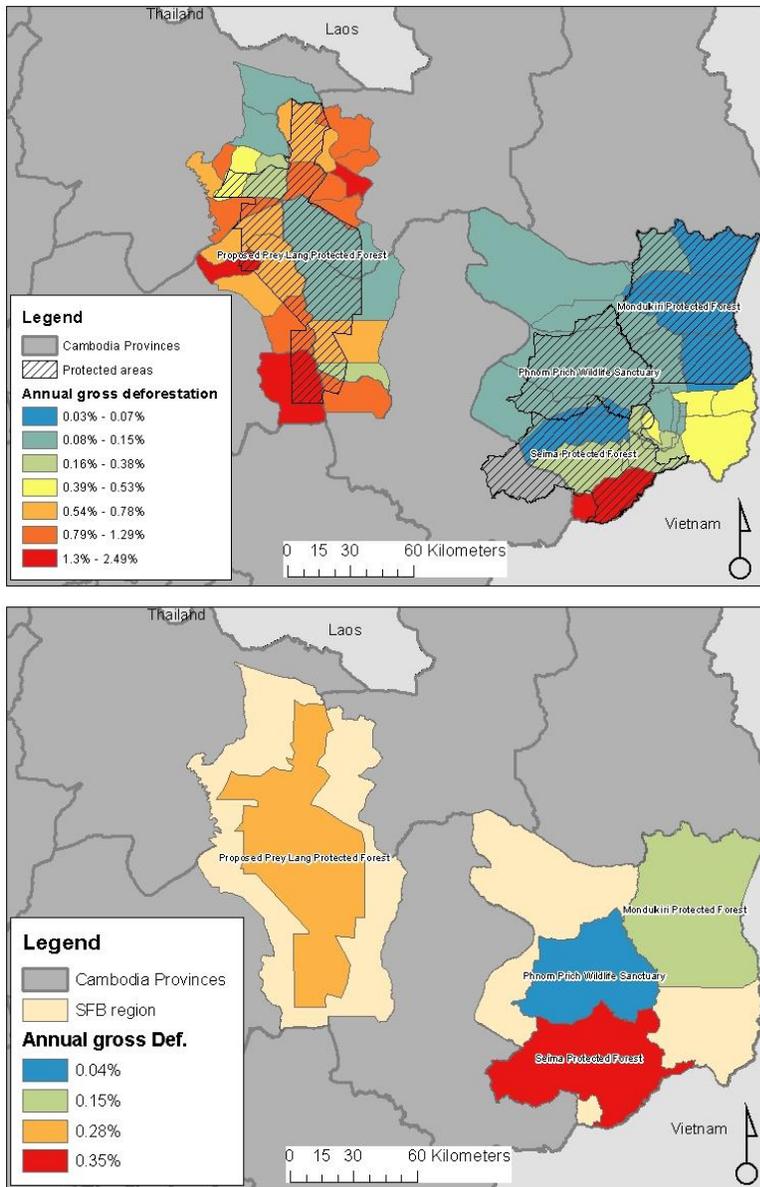


Figure 6. Gross deforestation by commune for the EPL and PLL.

Average annual gross deforestation for the EPL between 2000 and 2012 was  $2,605\text{ha}^{-1}\text{y}^{-1}$ , and  $6,994\text{ha}^{-1}\text{y}^{-1}$  for the PLL (Table 5). The highest rates of deforestation occurred outside protected areas, however the Seima Protected area and Proposed Prey Lang Protected Forest had relatively high deforestation rates.

Table 5. Results for deforestation by SFB region and protected area.

	Gross deforestation 2000-2012	Reforestation 2000-2012	Average annual gross deforestation 2000-2012	Average annual net deforestation 2000-2012	Gross annual deforestation rate	Net annual deforestation rate
	Ha				%	
<b>EPL</b>	<b>31,264</b>	<b>3,902</b>	<b>2,605</b>	<b>2,280</b>	<b>0.32%</b>	<b>0.28%</b>
Mondulkiri Protected Forest	2,151	728	179	119	0.15%	0.10%
Phnom Prich Wildlife Sanctuary	716	308	60	34	0.04%	0.02%
Seima Protected Forest	10,448	935	871	793	0.35%	0.32%
Non-protected areas	17,949	1,931	1,496	1,335	0.50%	0.44%
<b>PLL</b>	<b>83,924</b>	<b>9,518</b>	<b>6,994</b>	<b>6,201</b>	<b>0.78%</b>	<b>0.70%</b>
Proposed Prey Lang Protected Forest	14,948	3,267	1,246	973	0.28%	0.22%
Non-protected areas	68,977	6,251	5,748	5,227	1.28%	1.16%

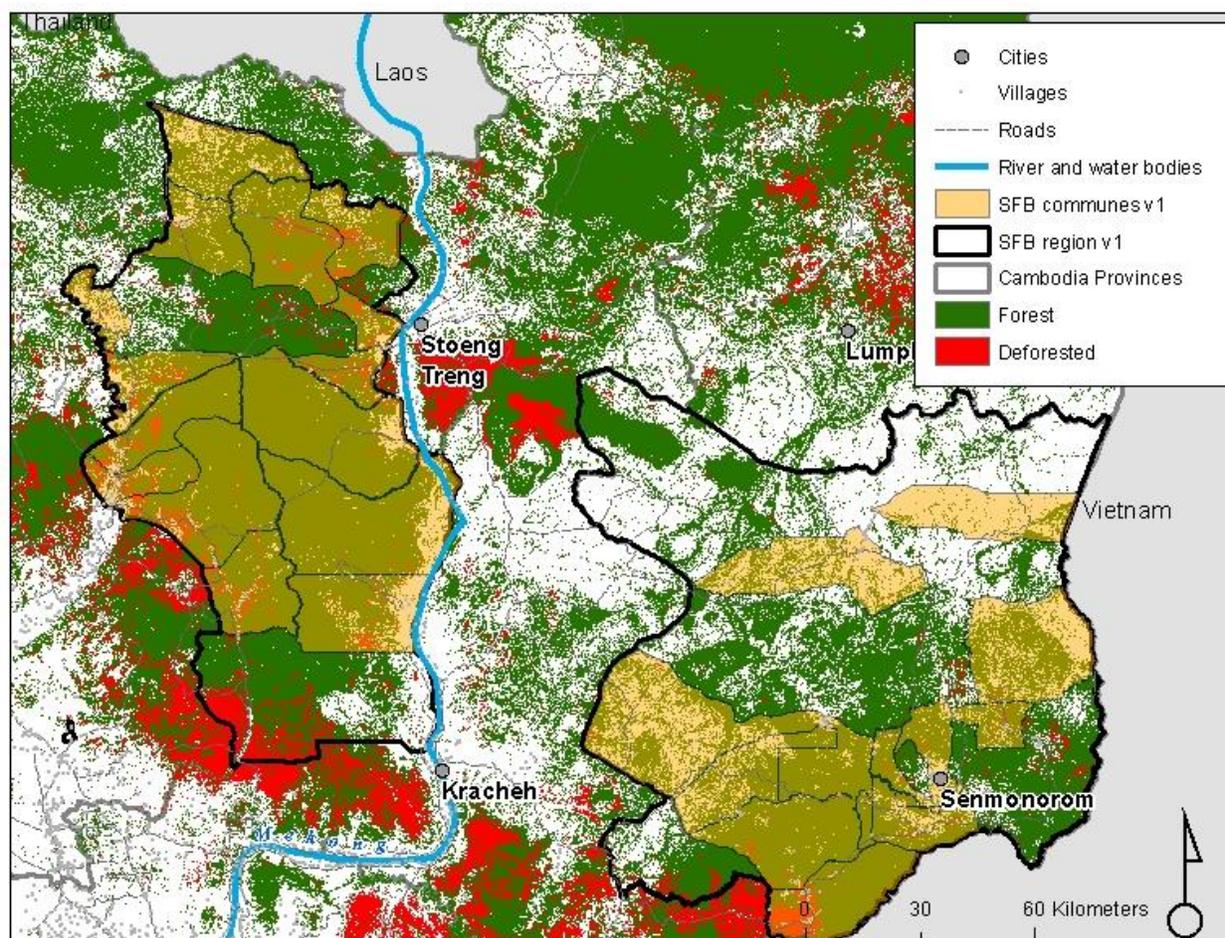


Figure 7. Forest cover for the EPL and PLL based on Hansen et al. 2013.

Table 6 shows the deforestation results for communes where SFB/partner activities are occurring. The table is divided by EPL and PLL. Each section is sorted from high to low based on the gross deforestation rate (high being displayed as red to low blue).

Table 6. Results for deforestation in the communes where SFB/partner activities are occurring.

SFB Region	Communes with SFB/Partner activities	Gross deforestation 2000-2012	Reforestation 2000-2012	Average annual gross deforestation 2000-2012	Average annual net deforestation 2000-2012	Gross annual deforestation rate	Net annual deforestation rate
		Ha				%	
EPL	Srae Khtum	11,638	273	970	947	1.72%	1.68%
EPL	Srae Ampum	744	75	62	56	0.44%	0.39%
EPL	Senmonorom	1,036	260	86	65	0.29%	0.21%
EPL	Romonear	351	76	29	23	0.24%	0.19%
EPL	Srae Preah	1,622	264	135	113	0.21%	0.18%
EPL	Sokh Dom	240	68	20	14	0.13%	0.09%
EPL	Chung Phlas	875	112	73	64	0.12%	0.11%
EPL	Sok San	350	116	29	19	0.10%	0.07%
EPL	Srae Huy	73	27	6	4	0.07%	0.04%
EPL	Srae Chuk	253	58	21	16	0.07%	0.05%
EPL	Krang Tes	338	501	28	-14	0.06%	-0.03%
EPL	Memang	176	179	15	0	0.05%	0.00%
<b>All EPL communes with SFB/Partner activities</b>		<b>17,696</b>	<b>2,008</b>	<b>1,475</b>	<b>1,307</b>	<b>0.32%</b>	<b>0.28%</b>
PLL	Sandan	4,284	962	357	277	1.66%	0.82%
PLL	O'Rei	2,218	373	185	154	1.65%	0.64%
PLL	Kaing Cham	2,763	392	230	198	1.29%	0.66%
PLL	Reab Roy	3,124	185	260	245	0.98%	0.70%
PLL	Sochet	5,312	676	443	386	0.95%	0.12%
PLL	Sam Ang	3,715	491	310	269	0.95%	0.93%
PLL	Anlong Chrey	5,566	1,156	464	368	0.78%	0.70%
PLL	Putrea	661	34	55	52	0.74%	1.37%
PLL	Mean Rith	6,900	713	575	516	0.72%	0.62%
PLL	Dang Kambet	3,655	281	305	281	0.71%	0.09%
PLL	Kampong Cham	3,823	282	319	295	0.66%	1.10%
PLL	Chhaeb Muoy	597	210	50	32	0.15%	0.09%
PLL	Siem Bouk	1,658	263	138	116	0.14%	1.29%
PLL	Beoung Cha	1,459	367	122	91	0.12%	0.62%
PLL	Chhaeb Pir	546	149	46	33	0.12%	0.10%
<b>All EPL communes with SFB/Partner activities</b>		<b>46,281</b>	<b>6,533</b>	<b>3,857</b>	<b>3,312</b>	<b>0.78%</b>	<b>0.70%</b>

## ASSESSING WITHOUT PROJECT DEFORESTATION RATES

The primary objective of this report is to set a without project baseline deforestation rates that will use to measure SFB G1 indicator for reduced deforestation. The current version of the SFB PMP states a

target for G1 at 15% reduction in deforestation below the baseline for EPL, and has left that target blank for PLL.

To determine the baseline rate of deforestation for the PLL and EPL a Reference Region (RR) was established and compared to the SFB project region. The RR is an area that is expected to mimic the project area, and therefore is a reference for what will happen in the project area in the future (i.e. during the life of the SFB project and beyond). For the SFB project the RR was set using the provinces to the south and west of PLL and EPL, which is toward Phnom Penh and other major urban and industrial areas. The PLL Reference Region was made up of two provinces Kampong Tum and Kampong Cham. The reference region for EPL was made up of province Kracheh (Figure 8). These areas were selected because they have similar forest types as SFB’s project regions in the EPL and PLL, they both contain some areas of protected forest, and deforestation appears to be encroaching on the EPL and PLL from the south and west (i.e. coming from the urban areas surrounding Phnom Penh). The logic behind this is that historical deforestation is encroaching on the EPL and PLL from the south and west, therefore it could be expected that future deforestation in the in the absence of the project interventions will be more similar to those provinces where this encroachment has already occurred.

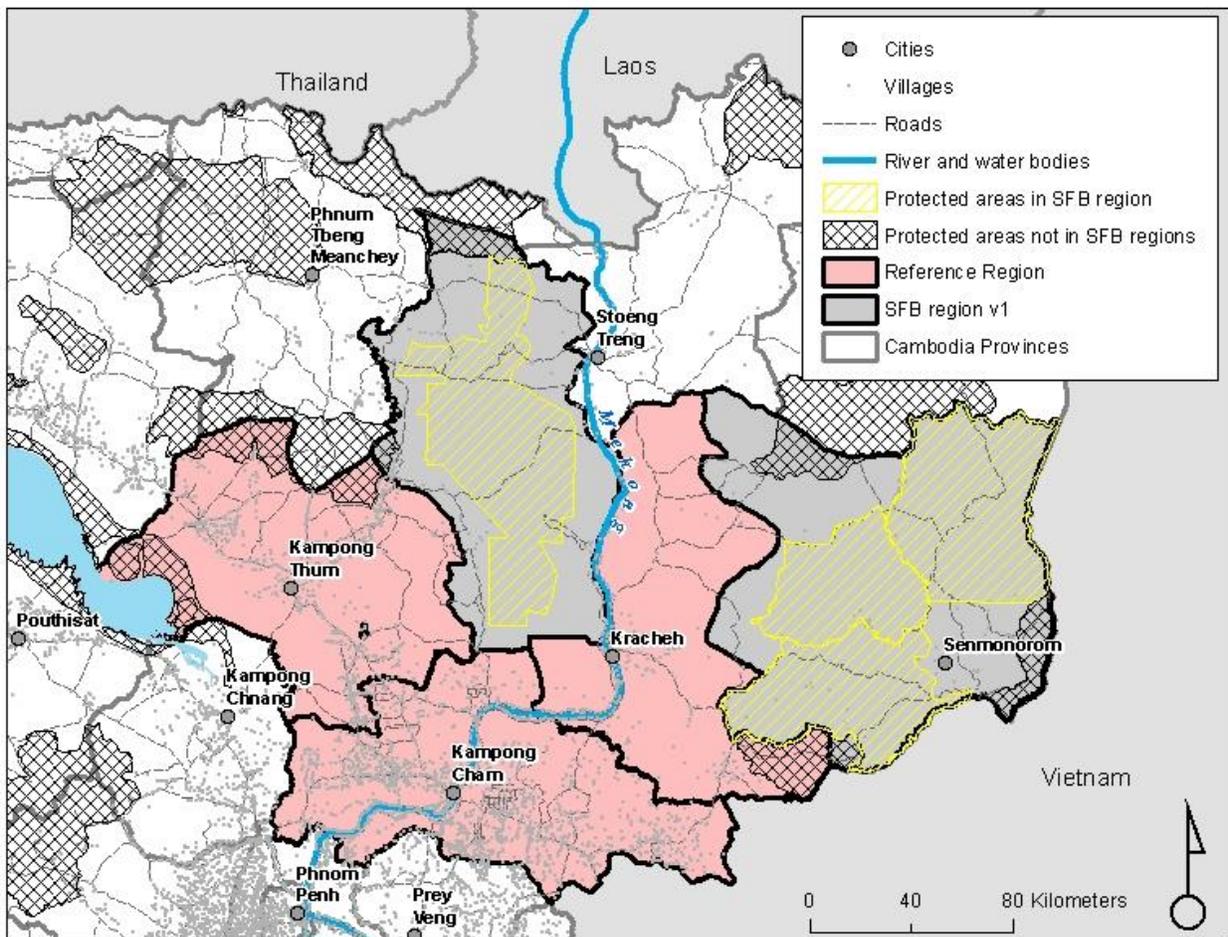


Figure 8. SFB Reference Region for setting the without project baseline deforestation rate.

This scenario assumes a deforestation rate for EPL and PLL of 2.54% and 2.74% respectively. A 15% reduction in the rate of deforestation for the EPL would equate to a reduction in deforestation to 2.16%. The PLL does not currently have a target so this may not be important, but a similar reduction in deforestation for the PLL would equate to a 2.33% deforestation rate.

Under scenario 2 the without project baseline rate of deforestation for the EPL would be 6,478ha per year and 12,421ha per year for PLL(Table 7).

Table 7. Results for area deforested in the Reference Regions compared to the SFB regions, and the projected area of deforestation for the SFB project.

	Total area deforested during the historical reference period in the Reference Region	Duration of the historical reference period	Annual deforestation during the historic period in the Reference Region	Ratio of forest area in the SFB Project Regions at the start of the baseline period to the forest area of the Reference Region	Projected area of baseline deforestation in the SFB Project Regions
EPL RR	136,461	12	11,372		
EPL	31,264	12	2,605	57%	<b>6,478</b>

PLL RR	197,712	12	16,476		
PLL	83,924	12	6,994	75%	<b>12,421</b>

Figures 9 and 10 show the cumulative historical deforestation for the EPL and PLL from 2000 to 2012, and projections of future deforestation based on 1) the historical average deforestation rate, and 2) the RR rate.

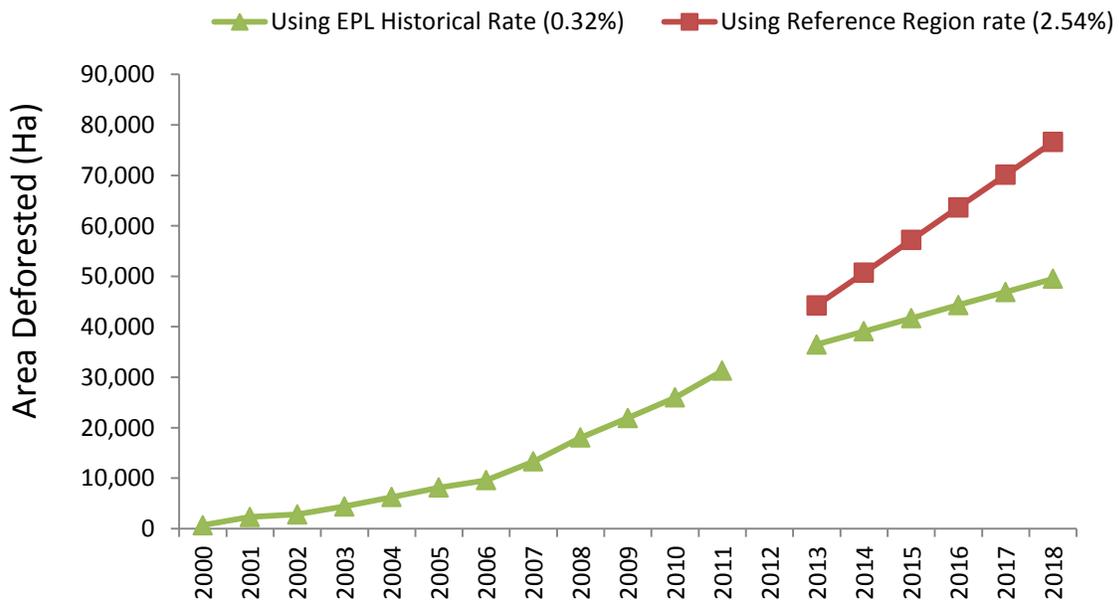


Figure 9. Cumulative deforestation for the EPL compared the Reference Region (Kracheh).

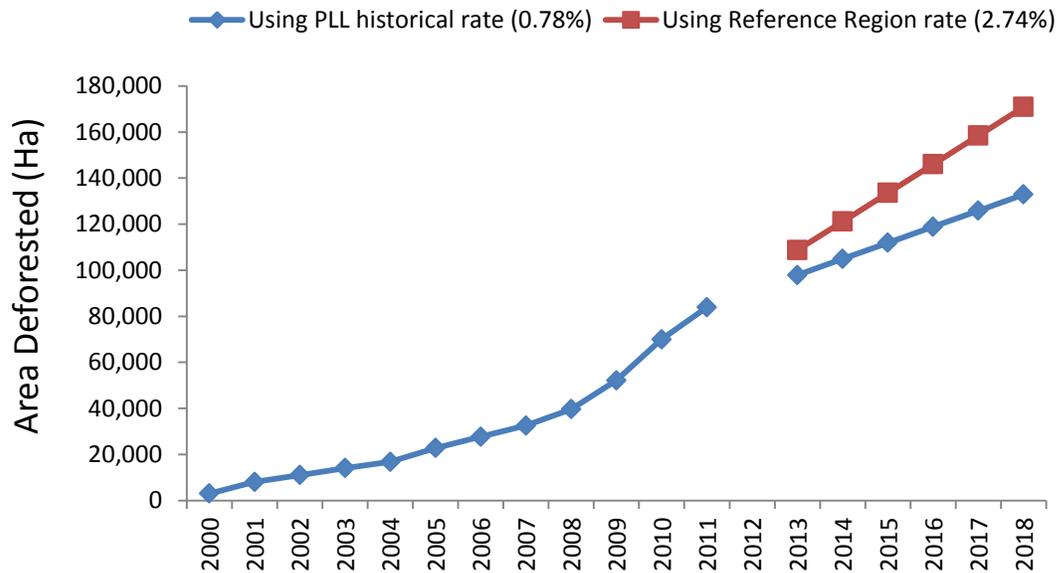


Figure 10 Cumulative historical deforestation for the PLL and projected deforestation using PPL historical rate and Reference Region (Kampong Tum and Kampong Cham) deforestation rate.

Figures 9 and 10 show that the historical deforestation for both EPL and PLL have been increasing over the period 2000 to 2012. The projected future deforestation (2013-2017) indicates that using a simple historical average for EPL and PLL (i.e. 0.32 and 0.78%) may not adequately account for future deforestation as it is clear that the rate is increasing. This helps support the use of the higher RR rate for both the EPL and PLL.

## BASELINE DEFORESTATION

Table 8 and 9 present the baseline deforestation results for SFB protected areas and community forests. The tables present: 1) forest cover in 2000 and 2012; 2) the annual rate of deforestation that occurred in the protected area and community forest between 2000 and 2012; 3) the projected baseline rate of deforestation based on the RR rates; 4) the number of hectares historically deforested; and 5) the number of hectares that are projected to be deforested in the protected areas and community forests using the RR rate. It is recommended that the SFB project use the projected annual baseline rate of deforestation to set its baseline.

Table 8. Baseline rate of deforestation for the SFB protected areas

SFB project areas to reduce deforestation	Forest 2000	Forest 2012	Historical annual rate of deforestation	Projected annual baseline rate of deforestation	Historical annual rate of deforestation	Projected annual baseline rate of deforestation
	ha		%		ha	
Mondulkiri Protected Forest	122,496	121,073	0.15%	2.54%	177	3,075
Phnom Prich Wildlife Sanctuary	149,877	149,469	0.04%	2.54%	59	3,797
Seima Protected Forest	247,539	238,026	0.35%	2.54%	837	6,046
Proposed Prey Lang Protected Forest	441,166	429,486	0.28%	2.74%	1,213	11,768

Table 9 shows the results for all the community forests. See Figure 11 for the location of the community forest (Map ID). The results show that for all community forests in the PLL the historical annual deforestation is 566ha y<sup>-1</sup> compared with the projected future rate based on the RR of 1,755ha y<sup>-1</sup>. For the EPL the historical annual deforestation is 13ha y<sup>-1</sup> compared with the projected future rate based on the RR of 172ha y<sup>-1</sup>.

Table 9. Baseline rate of deforestation for the SFB community forests

Map ID	SFB Region	SFB Community Forests	Forest 2000	Forest 2012	historical annual rate of deforestation	Projected annual baseline rate of deforestation	historical annual rate of deforestation	Projected annual baseline rate of deforestation
			ha		%		ha	
0	PLL	Prey Khum Sochet	4,375	3,856	0.99%	2.74%	38	106
1	PLL	Prey Tatey	1,387	1,127	1.56%	2.74%	18	31
2	PLL	Prey Kbal Takung	2,179	1,996	0.70%	2.74%	14	55
3	PLL	Prey Kbal Ou Kror Nhak	1,580	1,406	0.92%	2.74%	13	39
4	PLL	Prey Srea Pring	307	298	0.24%	2.74%	1	8
5	PLL	Prey Phum Rumchek	494	469	0.41%	2.74%	2	13
6	PLL	Prey Hong Chamtet	1,015	1,003	0.10%	2.74%	1	27
7	PLL	Ou Bos Leav	1,359	1,348	0.07%	2.74%	1	37
8	PLL	Ou Das Sko	1,111	1,108	0.02%	2.74%	0	30
9	PLL	Lbos Sral	1,122	1,120	0.02%	2.74%	0	31
10	PLL	Krang	777	733	0.47%	2.74%	3	20
11	PLL	Kokoh Phaaob	440	109	6.26%	2.74%	7	3
12	PLL	Prey Kbal Doun Tey	1,790	1,733	0.27%	2.74%	5	47
13	PLL	Beong Rolom	1,150	703	3.24%	2.74%	23	19
14	PLL	Ou Kra Nhoung	1,131	1,102	0.22%	2.74%	2	30
15	PLL	Svay	1,736	960	3.73%	2.74%	36	26
16	PLL	Kbal Khla	2,272	1,626	2.37%	2.74%	39	45
17	PLL	Prey Kbal Ou Thnong	2,757	2,547	0.63%	2.74%	16	70
18	PLL	Chhouk	522	360	2.59%	2.74%	9	10
19	PLL	Cho	686	256	5.22%	2.74%	13	7
20	PLL	Koh Ent Chey	1,342	1,297	0.28%	2.74%	4	36
21	PLL	Angkor Ent	1,299	1,274	0.16%	2.74%	2	35
22	PLL	O Krasang	505	491	0.23%	2.74%	1	13
23	PLL	Tonsaong Thleak	5,474	5,246	0.35%	2.74%	18	144
24	PLL	Kampong Kboeung	908	904	0.04%	2.74%	0	25
25	PLL	Kampong Damrey	1,246	1,170	0.51%	2.74%	6	32
26	PLL	Knar	250	212	1.28%	2.74%	3	6
27	PLL	Prey Snoul	177	165	0.58%	2.74%	1	5
28	PLL	Reab Roy SenChey	1,782	1,239	2.54%	2.74%	31	34
29	PLL	Prey Lang SenChey	1,606	1,558	0.25%	2.74%	4	43
30	PLL	Sampreang	471	418	0.95%	2.74%	4	11
31	PLL	Sangkae	2,215	2,116	0.37%	2.74%	8	58
32	PLL	Prey Khlong Trapeang Saang	657	645	0.15%	2.74%	1	18
33	PLL	Kravan	656	610	0.58%	2.74%	4	17
34	PLL	Preah Enn Pkay Reah	1,235	1,232	0.02%	2.74%	0	34
35	PLL	Prey Changhar Thom	1,369	1,363	0.03%	2.74%	0	37
36	PLL	Kunpheap	1,396	1,351	0.27%	2.74%	4	37
37	PLL	Prey Niyum Trapeang Chambak	3,358	3,353	0.01%	2.74%	0	92
38	PLL	Trapeang Kbal Damrei	2,733	2,719	0.04%	2.74%	1	74
39	PLL	Kampong Sranoah	2,578	2,572	0.02%	2.74%	1	70

40	PLL	Preah Lean	1,131	1,091	0.29%	2.74%	3	30
41	PLL	Chhaeb	2,592	2,505	0.28%	2.74%	7	69
42	PLL	Samaky	640	549	1.18%	2.74%	6	15
43	PLL	Kraom	550	500	0.75%	2.74%	4	14
44	PLL	Kralapeas	537	474	0.98%	2.74%	5	13
45	PLL	Samaki Preah Nimit	729	561	1.92%	2.74%	11	15
46	PLL	Phnom Prasat	2,510	1,941	1.89%	2.74%	37	53
47	PLL	Prey Tamao	3,521	2,642	2.08%	2.74%	55	72
48	PLL	Kiri Soksans	1,777	1,664	0.53%	2.54%	9	42
	<b>PLL</b>	<b>ALL</b>	<b>71,657</b>	<b>64,060</b>	<b>0.88%</b>	<b>2.74%</b>	<b>566</b>	<b>1,755</b>
49	EPL	Pukraeng	650	622	0.35%	2.54%	2	16
50	EPL	Pukrouch	1,132	1,127	0.04%	2.54%	0	29
51	EPL	Pulung	2,225	2,222	0.01%	2.54%	0	56
52	EPL	Puradaet	1,122	1,118	0.03%	2.54%	0	28
	<b>EPL</b>	<b>ALL</b>	<b>6,907</b>	<b>6,753</b>	<b>0.19%</b>	<b>2.54%</b>	<b>13</b>	<b>172</b>

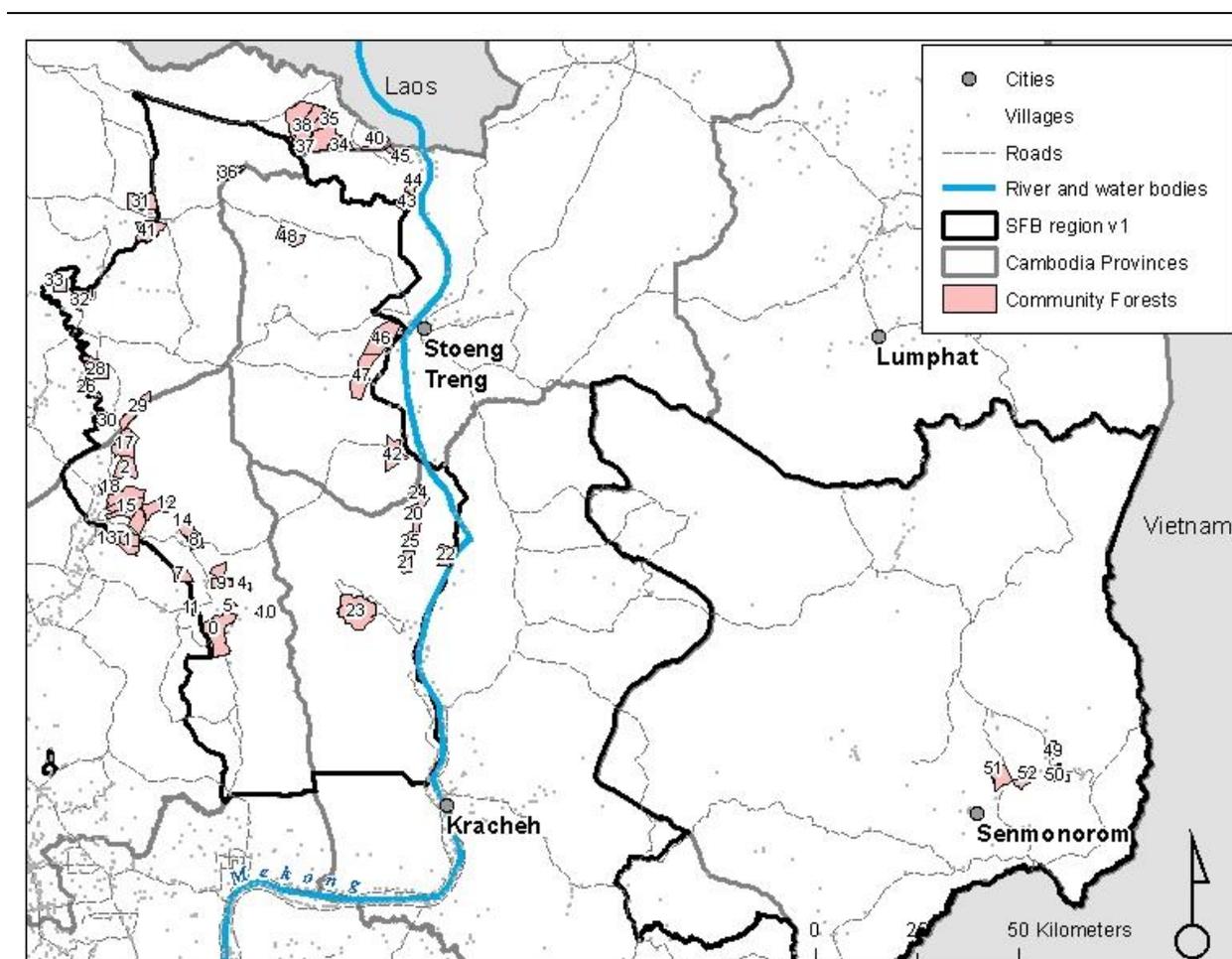


Figure 11. Map of community forest with unique ID numbers to reference Table 9

## EMISSIONS FROM DEFORESTATION

### Carbon Stocks

#### Forests

For the EPL forest carbon stocks were taken from the Seima REDD carbon project that conducted an extensive forest carbon inventory in 2010. Seventy two plots were taken in two types of forest strata, dense forest and open forest. Dense forest comprises evergreen, semi-evergreen and bamboo stands and has an above and below ground carbon stock of 298.62t C ha<sup>-1</sup> (+/- 7.4% at the 90% confidence level). Open forest stratum comprises mixed deciduous forest, deciduous dipterocarp forest and open woodland and has a stock of 150.72t C ha<sup>-1</sup> (+/- 15.6%). Because these two forest strata are not spatially delineated in the Hansen et al. (2013) maps for the EPL a mean of the two strata were taken resulting in a single carbon stock estimate for all forests in the EPL. The resulting forest carbon stocks for the EPL are 224.67t C ha<sup>-1</sup>. This is thought to be a conservative estimate as the majority of forests in the EPL are dense forest.

For the PLL forest carbon stocks were taken from the USAID AFOLU Calculator (<http://www.afolucarbon.org/>) defaults that are generated from Saatchi et al. (2011). The resulting forest carbon stock is 190.10t C ha<sup>-1</sup>.

Table 10 shows forest biomass, carbon stocks and CO<sub>2</sub> tons per hectare for the EPL and PLL. To convert biomass to carbon stocks see Equation 7, for carbon to CO<sub>2</sub> see Equation 8.

Equation 7. Carbon Stocks = Biomass x 0.5

Equation 8. CO<sub>2</sub> = Carbon Stocks x (44/12)

Table 10. Forest carbon stocks and the CO<sub>2</sub> equivalent for EPL and PLL

Forest EPL	t Biomass ha <sup>1</sup>	t C ha <sup>1</sup>	t CO <sub>2</sub> ha <sup>1</sup>
Dense Forest	597.24	298.62	1,094.94
Open Forest	301.44	150.72	552.64
<b>Mean Forest</b>	<b>449.34</b>	<b>224.67</b>	<b>823.79</b>

Forest PLL			
Forest	380.20	190.10	697.03

#### Post-deforestation

Post deforestation carbon stocks were taken from the Seima REDD project inventory that included cash crops, paddy rice, hill rice, scrub/fallow, tall grass, and cashew. This study is not aware of any post deforestation carbon stock measured in the PLL region, therefore these post-deforestation stocks are used for both EPL and PLL. Because there is no spatial delineation of these non-forest land cover types in the EPL and PLL regions a simple mean of all post deforestation carbon stocks were taken resulting in a single post-deforestation carbon stock of 18.07t C ha<sup>-1</sup> (Table11).

Table 11. Post-deforestation carbon stocks and CO2 for EPL and PLL

Non-Forest	t Biomass ha <sup>1</sup>	t C ha <sup>1</sup>	t CO <sub>2</sub> ha <sup>1</sup>
Cash crops dominated	29.14	14.57	53.42
Paddy rice dominated	22.12	11.06	40.55
Hill rice dominated	29.14	14.57	46.99
Scrub/Fallow	93.20	46.60	43.77
Tall Grass and vegetables	11.20	5.60	45.38
Cashew	32.00	16.00	44.58
<b>Mean Post-deforestation</b>	<b>36.13</b>	<b>18.07</b>	<b>45.78</b>

## Calculating Emissions

The calculation of emission from deforestation used the same methods as the USAID AFOLU Calculator (<http://www.afolucarbon.org/>). Using the AFOLU Calculator forest carbon stocks were updated to those referenced above, soil carbon was conservatively ignored and set to zero, and forest growth used the AFOLU Calculator defaults.

$$\text{Equation 9. Emission Factor} = (C_{\text{forest}} + C_{\text{growth y1}}) - C_{\text{postdeforestation}}$$

Emissions Factor: CO<sub>2</sub> emissions per hectare per year from deforestation (t CO<sub>2</sub> ha<sup>-1</sup> y<sup>-1</sup>)

C<sub>forest</sub>: Forest CO<sub>2</sub> per hectare (t CO<sub>2</sub> ha<sup>-1</sup>)

C<sub>growth y1</sub>: Forest annual growth per hectare per year (t CO<sub>2</sub> ha<sup>-1</sup> y<sup>-1</sup>)

C<sub>postdeforestation</sub>: Post-deforestation CO<sub>2</sub> per hectare (t CO<sub>2</sub> ha<sup>-1</sup>)

## Baseline Emissions

The baseline CO<sub>2</sub> emissions from deforestation are calculated as the emissions per hectare times the number of hectares deforested (Equation 10).

$$\text{Equation 10. Emissions} = \text{Emission Factor} \times \text{Area}$$

Emissions: Total CO<sub>2</sub> emissions from deforestation per year (t CO<sub>2</sub> y<sup>-1</sup>)

Emissions Factor: CO<sub>2</sub> emissions per hectare per year from deforestation (t CO<sub>2</sub> ha<sup>-1</sup> y<sup>-1</sup>)

Area: Area deforested in hectares (ha)

Based on these results the annual emissions from all SFB community forests in the PLL have historically been 381,051t CO<sub>2</sub> y<sup>-1</sup>, and the projected annual emission based in the RR rate of deforestation are expected to be 1,181,790t CO<sub>2</sub> y<sup>-1</sup> (Table 12). Therefore 1,181,790t CO<sub>2</sub> y<sup>-1</sup> are the proposed annual baseline emissions for all community forests the PLL.

Table 12 shows the baseline results for all community forests and the sum of all community forest. The projected annual baseline emission should be used as the baseline from which SFB project will measure its G3 indicator.

For the EPL, baseline emissions from the five community forests have historically been 9,910 t CO<sub>2</sub> y<sup>-1</sup>, and the projected future annual emission during the life of the SFB project are expected to be 135,930t CO<sub>2</sub> y<sup>-1</sup>. Again, this means that 135,930t CO<sub>2</sub> y<sup>-1</sup> are the proposed annual baseline emissions for the PLL that the SFB project should measure their GHG targets against.

Table 12. Emission for the SFB Project community forest in PLL and EPL.

Map ID	SFB Region	SFB Community Forests	Forest Carbon Stocks	Annual forest growth	Post-deforestation Carbon Stocks	Emission Factor	Historical annual emissions (2000-2012)	Projected annual baseline emissions
			t CO <sup>2</sup> ha <sup>1</sup>				t CO <sup>2</sup> y <sup>1</sup>	
0	PLL	Prey Khum Sochet	697.03	22.04	45.78	673	25,649	71,138
1	PLL	Prey Tatey	697.03	22.04	45.78	673	11,858	20,798
2	PLL	Prey Kbal Takung	697.03	22.04	45.78	673	9,403	36,831
3	PLL	Prey Kbal Ou Kror Nhak	697.03	22.04	45.78	673	8,714	25,930
4	PLL	Prey Srea Pring	697.03	22.04	45.78	673	491	5,498
5	PLL	Prey Phum Rumchek	697.03	22.04	45.78	673	1,292	8,658
6	PLL	Prey Hong Chamtet	697.03	22.04	45.78	673	671	18,510
7	PLL	Ou Bos Leav	697.03	22.04	45.78	673	647	24,864
8	PLL	Ou Das Sko	697.03	22.04	45.78	673	163	20,443
9	PLL	Lbos Sral	697.03	22.04	45.78	673	126	20,657
10	PLL	Krang	697.03	22.04	45.78	673	2,335	13,528
11	PLL	Kokoh Phaaob	697.03	22.04	45.78	673	4,615	2,019
12	PLL	Prey Kbal Doun Tey	697.03	22.04	45.78	673	3,115	31,969
13	PLL	Beong Rolom	697.03	22.04	45.78	673	15,325	12,972
14	PLL	Ou Kra Nhoung	697.03	22.04	45.78	673	1,616	20,325
15	PLL	Svay	697.03	22.04	45.78	673	24,077	17,701
16	PLL	Kbal Khla	697.03	22.04	45.78	673	25,941	30,000
17	PLL	Prey Kbal Ou Thnong	697.03	22.04	45.78	673	10,875	46,989
18	PLL	Chhouk	697.03	22.04	45.78	673	6,262	6,636
19	PLL	Cho	697.03	22.04	45.78	673	9,005	4,724
20	PLL	Koh Ent Chey	697.03	22.04	45.78	673	2,448	23,918
21	PLL	Angkor Ent	697.03	22.04	45.78	673	1,364	23,508
22	PLL	O Krasang	697.03	22.04	45.78	673	753	9,057
23	PLL	Tonsaong Thleak	697.03	22.04	45.78	673	12,274	96,770
24	PLL	Kampong Kboeung	697.03	22.04	45.78	673	215	16,676
25	PLL	Kampong Damrey	697.03	22.04	45.78	673	3,992	21,580
26	PLL	Knar	697.03	22.04	45.78	673	1,824	3,908
27	PLL	Prey Snoul	697.03	22.04	45.78	673	637	3,037
28	PLL	Reab Roy SenChey	697.03	22.04	45.78	673	21,182	22,862
29	PLL	Prey Lang SenChey	697.03	22.04	45.78	673	2,621	28,741
30	PLL	Sampreang	697.03	22.04	45.78	673	2,661	7,708
31	PLL	Sangkae	697.03	22.04	45.78	673	5,274	39,043
32	PLL	Prey Khlong Trapeang Saang	697.03	22.04	45.78	673	636	11,902
33	PLL	Kravan	697.03	22.04	45.78	673	2,368	11,261
34	PLL	Preah Enn Pkay Reah	697.03	22.04	45.78	673	158	22,737
35	PLL	Prey Changhar Thom	697.03	22.04	45.78	673	299	25,151
36	PLL	Kunpheap	697.03	22.04	45.78	673	2,432	24,924
37	PLL	Prey Niyum Trapeang Chambak	697.03	22.04	45.78	673	268	61,856
38	PLL	Trapeang Kbal Damrei	697.03	22.04	45.78	673	791	50,155
39	PLL	Kampong Sranoah	697.03	22.04	45.78	673	362	47,447
40	PLL	Preah Lean	697.03	22.04	45.78	673	2,150	20,127
41	PLL	Chhaeb	697.03	22.04	45.78	673	4,694	46,215
42	PLL	Samaky	697.03	22.04	45.78	673	4,363	10,132
43	PLL	Kraom	697.03	22.04	45.78	673	2,530	9,230
44	PLL	Kralapeas	697.03	22.04	45.78	673	3,136	8,745

45	PLL	Samaki Preah Nimit	697.03	22.04	45.78	673	7,243	10,357
46	PLL	Phnom Prasat	697.03	22.04	45.78	673	24,693	35,813
47	PLL	Prey Tamao	697.03	22.04	45.78	673	37,005	48,737
48	PLL	Kiri Soksas	823.79	14.45	45.78	792	6,973	33,503
	<b>PLL</b>	<b>ALL</b>	<b>697.03</b>	<b>22.04</b>	<b>45.78</b>	<b>673</b>	<b>381,051</b>	<b>1,181,790</b>
49	EPL	Pukraeng	823.79	14.45	45.78	792	1,734	12,529
50	EPL	Pukrouch	823.79	14.45	45.78	792	358	22,679
51	EPL	Pulung	823.79	14.45	45.78	792	210	44,722
52	EPL	Puradaet	823.79	14.45	45.78	792	309	22,497
	<b>EPL</b>	<b>ALL</b>	<b>823.79</b>	<b>14.45</b>	<b>45.78</b>	<b>792</b>	<b>9,910</b>	<b>135,930</b>

Baseline emissions for the protected areas in the SFB region are presented in Table 13. These results do not include the emissions from the Seima Protected Forest because these emissions will be reported under the Seima REDD project which is currently under validation by the Verified Carbon Standard (VCS).

Table 13. Emission for the SFB Project protected areas excluding the Seima Protected Forest

SFB project areas	Forest Carbon Stocks	Annual forest growth	Post-deforestation Carbon Stocks	Emission	Historical annual emissions (2000-2012)	Projected annual baseline emissions
	t CO <sup>2</sup> ha <sup>1</sup>				t CO <sup>2</sup> y <sup>1</sup>	
Mondulkiri Protected Forest	823.79	14.45	45.78	792	140,265	2,436,799
Phnom Prich Wildlife Sanctuary	823.79	14.45	45.78	792	46,755	3,008,951
Seima Protected Forest	See below	See below	See below	See below	See below	See below
Proposed Prey Lang Protected Forest	697.03	14.45	45.78	666	807,492	7,833,937

Results from the Seima REDD Project still need to be validated, however current projected annual emission reductions are expected to be around 6.8 million t CO<sub>2</sub> per year over the first 5 years (based on an average deforestation over the first 5 years). See Appendix 2 as reference of the avoided emission from the Seima REDD Project.

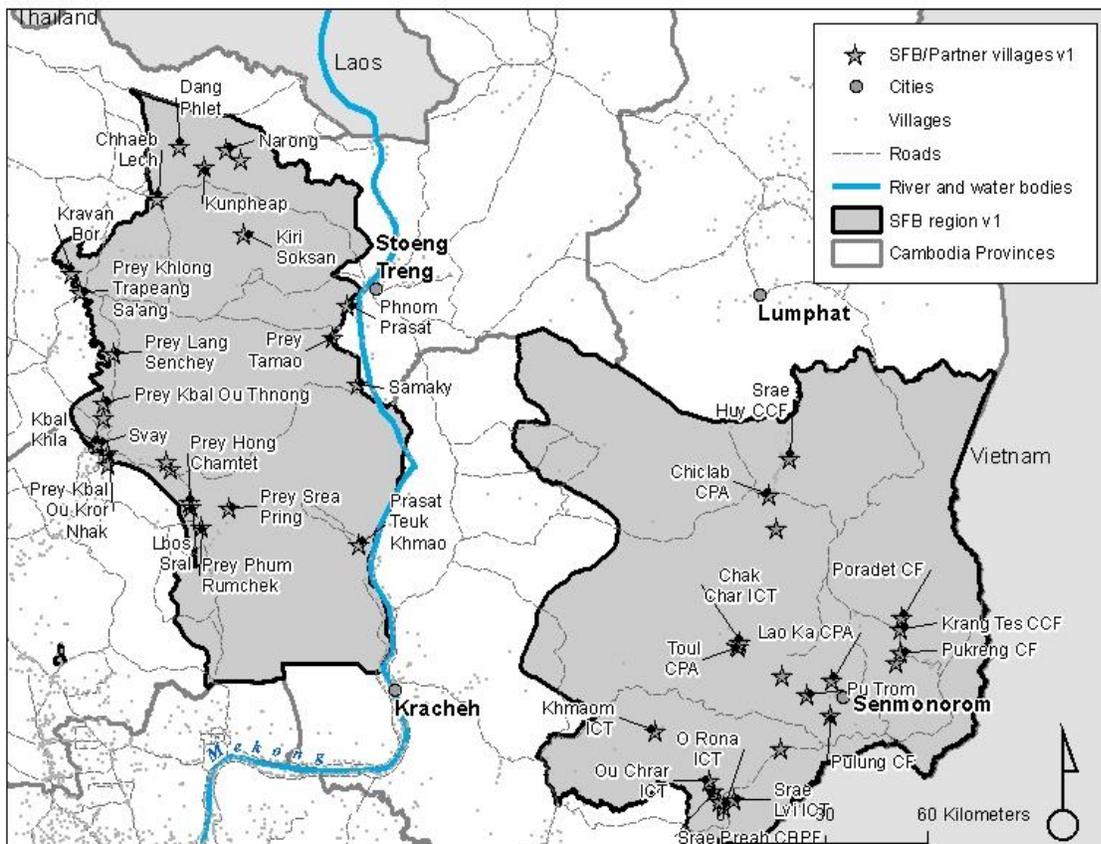
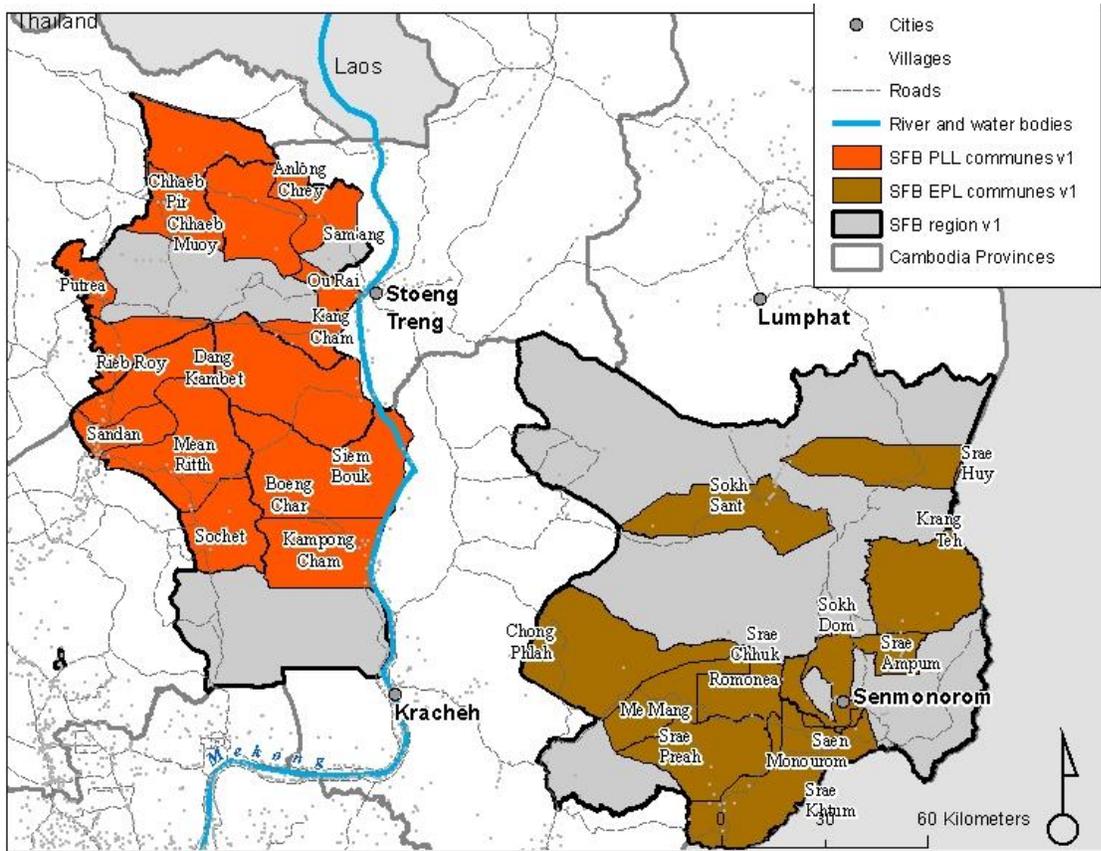
Table 14. Emission for Seima Protected Forest based on the Seima REDD PD table 5.9a (see Appendix2)

Seima Protected Forest	Area of avoided deforestation average over the first 5 years of the project	Emission	Projected annual baseline emissions
	ha	t CO <sup>2</sup> ha <sup>1</sup>	t CO <sup>2</sup>
Dense forest	5,981	758	4,532,705
Open forest	6,291	362	2,278,044
<b>Total</b>			<b>6,810,748</b>

The SFB project has set a GHG reduction target of 250,000 t CO<sub>2</sub> for year 2 and 3, and 1 million t CO<sub>2</sub> for year 4, totaling 1.5 million t CO<sub>2</sub> over the life of the project. Therefore, if the Seima REDD project is successful it will satisfy the GHG targets alone. If the Seima REDD project is not successful the SFB project will need to meet its target by reducing the GHG emission from community forests and other protected areas.

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# APPENDIX 1: MAPS WITH VILLAGE AND COMMUNE NAMES



## APPENDIX 2 SEIMA REDD PROJECT RESULTS FOR EMISSION FROM THE SEIMA PROJECT DOCUMENT

Table 5.9ai Baseline carbon stock changes in the above-ground biomass in the project area  
This table fulfills the requirement of Table 22b.1 of the methodology.

Part 1 - Fresh clearance

Project yr	Activity data x Carbon stock change factor				Total baseline carbon stock change			
	Fd/Nf		Fo/NF[PA]		Fd/Nf Annual	Fd/Nf Annual	Total Annual	Cumulative
t	ABSLPAct,t ha	$\Delta Cab[ct,t]$ tCO <sub>2</sub> e/ha <sup>-1</sup>	ABSLPAct,t ha	$\Delta Cab[ct,t]$ tCO <sub>2</sub> e/ha <sup>-1</sup>	$\Delta CabBSLPA[ct,t]$ tCO <sub>2</sub> e	$\Delta CabBSLPA[ct,t]$ tCO <sub>2</sub> e	$\Delta CabBSLPA[t]$ tCO <sub>2</sub> e	$\Delta CabBSLPA$ tCO <sub>2</sub> e
1	681	(757.8)	510	(362.1)	(516,063.8)	(184,677.6)	(700,741.5)	(700,741.5)
2	3458	(757.8)	3086	(362.1)	(2,620,482.8)	(1,117,480.7)	(3,737,963.5)	(4,438,705.0)
3	11595	(757.8)	11893	(362.1)	(8,786,725.8)	(4,306,609.9)	(13,093,335.7)	(17,532,040.7)
4	8464	(757.8)	8981	(362.1)	(6,414,044.6)	(3,252,136.9)	(9,666,181.4)	(27,198,222.1)
5	5709	(757.8)	6986	(362.1)	(4,326,297.3)	(2,529,721.4)	(6,856,018.7)	(34,054,240.8)
6	6198	(757.8)	9105	(362.1)	(4,696,863.0)	(3,297,038.9)	(7,993,901.9)	(42,048,142.7)
7	6960	(757.8)	14497	(362.1)	(5,274,308.9)	(5,249,552.2)	(10,523,861.0)	(52,572,003.7)
8	5677	(757.8)	15663	(362.1)	(4,302,047.6)	(5,671,775.9)	(9,973,823.6)	(62,545,827.3)
9	4444	(757.8)	15328	(362.1)	(3,367,676.5)	(5,550,468.1)	(8,918,144.6)	(71,463,971.9)
10	3640	(757.8)	11382	(362.1)	(2,758,402.9)	(4,121,570.2)	(6,879,973.1)	(78,343,945.0)

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