PROJECT DESCRIPTION: *VCS Version 3*

REDUCED EMISSIONS FROM DEFORESTATION AND DEGRADATION IN COMMUNITY FORESTS

ODDAR MEANCHEY, CAMBODIA

Developed by Terra Global Capital

for

The Forestry Administration of the Royal Government of Cambodia

Project Title	***Reduced Emissions from Deforestation and Degradation in Community Forests – Oddar Meanchey, Cambodia***
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Table of Contents

1 PROJECT DETAILS 5

1.1 SUMMARY DESCRIPTION OF PROJECT 5
1.2 SECTORAL SCOPE AND PROJECT TYPE 5
1.3 PROJECT PROPONENTS 6
1.4 OTHER ENTITIES INVOLVED IN THE PROJECT 6
1.1.1 Implementing Partners 6
1.4.1 Project Identification and Design 7
1.4.2 Carbon Development and Offset Marketing 8
1.4.3 Technical Partners 8
1.4.4 Legal Advisor on the Emission Reductions Purchase Agreement 8
1.5 PROJECT START DATE 8
1.6 PROJECT CREDITING PERIOD 9
1.7 PROJECT SCALE AND ESTIMATED GHG EMISSION REDUCTIONS OR REMOVALS 9
1.8 DESCRIPTION OF PROJECT ACTIVITY 10
1.9 PROJECT LOCATION 13
1.10 CONDITIONS PRIOR TO PROJECT INITIATION 19
1.10.1 Deforestation Drivers and Agents 19
1.10.2 Analysis of the Fire Dynamics in the Reference Region 25
1.11 COMPLIANCE WITH LAWS, STATUTES AND OTHER REGULATORY FRAMEWORKS 27
1.12 OWNERSHIP AND OTHER PROGRAMS 28
1.12.1 Proof of Title 28
1.12.2 Emissions Trading Programs and Other Binding Limits 28
1.12.3 Participation under Other GHG Programs 28
1.12.4 Other Forms of Environmental Credits 28
1.12.5 Projects Rejected by Other GHG Programs 28
1.13 ADDITIONAL INFORMATION RELEVANT TO THE PROJECT 28
1.13.1 Eligibility Criteria 28
1.13.2 Leakage Management 28
1.13.3 Commercially Sensitive Information 30
1.13.4 Risk of Failure of Project Implementation 30
1.13.5 Further Information 31

2 VCS METHODOLOGY 32

2.1 TITLE AND REFERENCE OF THE METHODOLOGY 32
2.2 APPLICABILITY OF METHODOLOGY 32
2.3 PROJECT BOUNDARY 36
2.3.1 Geographic Boundary 36
2.3.2 Carbon Pools, GHG Sinks and Reservoirs 36
2.3.3 GHG Sources 37
2.4 BASELINE SCENARIO 37
2.5 ADDITIONALITY 37
2.5.1 Step 1: Identification of Alternative Land Use Scenarios to the AFOLU Project Activity 37
2.5.2 Step 3: Barrier Analysis 39
2.5.3 Step 4: Common Practice Analysis 39
2.6 METHODOLOGY DEVIATIONS 40

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS 41

3.1 STEP 1 – SELECT SPATIAL AND TEMPORAL BOUNDARIES 41
3.1.1 Step 1A – Describe Spatial Boundaries of the Discrete Project Area Parcels 41
3.1.2 Step 1B and 1C – Select Size and Location of the Reference Region 41
3.1.3 Step 1D – Demonstrate the similarity between project area and reference region 41

3.1.4 Step 1E – Specify Temporal Boundaries of the Project 43
3.2 Step 2 – Analyze Historical Deforestation and Forest Degradation in the Reference Region 43
3.2.1 Step 2A – Describe Data Sources 43
3.2.2 Step 2B – Define LULC Classes and Forest Strata 47
3.2.3 Step 2C – Define Land Transitions between LULC classes and Forest Strata 53
3.2.4 Step 2D – Analyze Historical LULC Class and Forest Strata Transitions 54
3.2.5 Step 2E – Summarize all Historical Land Transitions 58
3.3 Step 3 – Analyze the Agents and Drivers of Deforestation 58
3.3.1 Step 3A – Identify Deforestation and Forest Degradation Agents and Drivers 58
3.3.2 Step 3B – Assess the Relative Importance of the Deforestation Drivers 58
3.3.3 Step 3C – Analyze of the Mobility of Each Deforestation and Forest Degradation Driver 59
3.3.4 Step 3D – Identify the Quantitative Driving Variables of Deforestation and Forest Degradation 62
3.3.5 Demonstration that the Project Has Not been Implemented to Generate GHG Emissions .. 65
3.4 Step 4 – Determine Emission Factors for All Included Transitions 66
3.4.1 Step 4A – Identify the LULC Classes and Forest Strata for which Carbon Stocks are to be Quantified. 66
3.4.2 Step 4B – Review Existing Data of Biomass Stock Densities and Biomass Net Annual Increments 67
3.4.3 Step 4C – Determine the Sample Size per LULC Class or Forest Stratum 67
3.4.4 Step 4D – Select Sampling Plot Layout and Location 68
3.4.5 Step 4E – Measure Carbon Density Stocks 68
3.4.6 Step 4F – Calculate Emission Factors and Check Compatibility with Degradation Definition 69
3.5 Step 5 – Estimate Ex-ante Land Transition Rates under the Baseline Scenario 70
3.5.1 Step 5A – Calculate Total Rates of Deforestation and Forest Degradation in the Project Area 70
3.5.2 Step 5B – Calculate LULC Class or Forest Stratum-Specific Relative forest cover increase and Regeneration Rates 71
3.5.3 Step 5C – Calibrate and Validate a Spatial Model to Predict the Suitability for Deforestation and Degradation 71
3.5.4 Step 5D – Calculate All Class or Stratum-Specific Transition Rates. 76
3.6 Step 6 – Identify Project Activities and Estimate Total Deforestation and Degradation Rates under the Project Scenario 76
3.6.1 Expected Effectiveness of Project and Leakage Mitigation Activities 76
3.6.2 Expected Level of Activity of Project and Leakage Mitigation Activities 78
3.6.3 Estimated Decrease in Deforestation Rate under the Project Scenario 93
3.7 Step 7 – Calculate Forest Strata-Specific Deforestation and Degradation Rates 93
3.8 Step 8 – Estimate GHG Emissions Sources 94
3.8.1 Step 8B – Estimate GHG Emissions from Fire Breaks and Other Fire Prevention Measures . 94
3.9 Step 9 – Estimate the Net GHG Sequestration from Assisted Natural Regeneration Activities 95
3.9.1 Step 9A – Estimate Carbon Stock Increase from Biomass 98
3.9.2 Step 9B – Calculate Baseline Emissions or Sinks on Land on which Assisted Natural Regeneration Activities are Planned 101
3.9.3 Step 9C – Calculate Emission Sources from Assisted Natural Regeneration 101
3.10 Step 10 – Estimate Leakage from Geographically Constrained Drivers 102
3.10.1 Step 10A – Calculate the Leakage-Induced Increase in Deforestation and Forest Degradation Rates 102
3.10.2 Step 10B – Demarcate the Leakage Belts 105
3.10.3 Step 10C – Calculate the Forest Strata-specific Deforestation and Degradation Rates in the Leakage Belts 105
3.10.4 Step 10D – Test Whether CH4 Emissions from Small-Scale Fires Must be Monitored 109
3.11 Step 11 – Estimate Leakage from Geographically Unconstrained Drivers 109
3.12 Step 12 – Estimate Applicability of and Emission sources from Leakage Prevention Activities 110

3.12.1 Step 12A – Check Conditions and Quantify Emissions from Intensification of Annual Cropping Systems 110
3.12.2 Step 12B – Check Conditions and Quantify Emissions from Introduction of Flooded Rice Production 111
3.12.3 Step 12C – Estimate GHG Emissions from Increased Livestock Stocking Rates, ΔElivestock 112
3.12.4 Emission Reductions from Fuel-Efficient Cookstoves 112
3.13 STEP 13 – EX-ANTE ESTIMATION OF NERS 113
3.13.1 Step 13A – Estimate carbon in long-lived wood products 113
3.13.2 Step 13B – Summarize the projected land use change 115
3.13.3 Step 13C – Test the Significance of GHG Emissions 115
3.13.4 Step 13D – Estimate Ex-ante NERs 115

4 MONITORING 117

4.1 DATA AND PARAMETERS AVAILABLE AT VALIDATION 117
4.2 DATA AND PARAMETERS MONITORED 137
4.3 DESCRIPTION OF THE MONITORING PLAN 159
4.3.1 Elements to be Monitored 159
4.3.2 Monitoring Roles and Responsibilities 160
4.3.3 Managing Data Quality 160
4.3.4 Procedures for handling internal auditing and non-conformities 160

5 ENVIRONMENTAL IMPACT 161

6 STAKEHOLDER COMMENTS 163

7 APPENDIX A: REFERENCES 166

8 APPENDIX B: ACRONYMS 168

1 PROJECT DETAILS

1.1 Summary Description of Project

The Oddar Meanchey REDD project will generate an estimated 6,143,767 VCUs over 30 years. The project area is located in the northwest Cambodian province of Oddar Meanchey. Oddar Meanchey provides an ideal site for developing a REDD project. In the 1970s during the height of the Khmer Rouge, Oddar Meanchey was one of the most remote and heavily forested regions of Cambodia. In recent years, the province's forests have been under constant and intense pressure from commercial and illegal logging, forest fires, economic land concessions, and encroachment. These issues, coupled with rapid economic growth, population expansion, migration, and land speculation have accelerated deforestation throughout the province. Between 2002 and 2006, Oddar Meanchey lost 2% of its forests annually as migrant farmers and concessionaires cleared land by felling and burning tree cover. In response, local communities have organized forest protection groups and established some of the largest Community Forestry (CF) areas in the country to conserve remaining forest lands that are important sources of water, subsistence goods and market products. These grass roots initiatives have created opportunities for the formulation of a long term forest protection initiative financed through the sale of carbon offset credits.

A partnership involving local villages, the national Forestry Administration (FA), Pact, Terra Global Capital (TGC), and Community Forestry International (CFI) has brought together key stakeholders and skills to prepare this Project Document (PD) which outlines a series of actions designed to mitigate the key drivers of deforestation. These drivers include agricultural expansion, settlement expansion, forest fire, illegal logging, timber harvesting, and fuelwood collection. Project actions will include supporting Community Forestry patrols and fire control, community-based water resource development projects, strengthening and clarifying land-tenure, sustainable farming systems, agricultural intensification, fuel efficient stoves, and livelihood activities. Local Civil Society Organizations (CSOs), including the provincial monk's network and the Children's Development Association (NGOs), will work with the Forestry Administration field offices and the national and provincial governments to build social support for the project. The project will also leverage legally-recognized Community Forestry Agreements from the Royal Government of Cambodia, and will give the 58 participating villages clear rights to the forest blocks totaling 63, 831 hectares under 15-year renewable agreements.

The project has received the support of the National Council of Ministers and will be guided by the Technical Working Group on Forestry and Environment (TWG F&E). The TWG F & E brings together senior government policy makers, donors and international organizations committed to guiding development assistance to Cambodia's forestry sector. The project will provide a proof of concept regarding the viability of financing community forestry management systems for a projected 2 million hectares of state forest lands.

1.2 Sectoral Scope and Project Type

This project is an Agriculture, Forestry and Other Land Use (AFOLU) project under the Reduced Emissions from Deforestation and Degradation (REDD) project category. Specifically, the project is of the "Avoiding unplanned mosaic deforestation and degradation" (AUMDD) typology.

This project is not a grouped project. It consists of 13 community forest areas that are known and were fixed before the first verification.

1.3 Project Proponents

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1.4 Other Entities Involved in the Project

1.1.1 Implementing Partners

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1.4.3 Technical Partners

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1.5 Project Start Date

The **VCS project crediting period start date is February 28, 2008**. This is when the first project actions took place, and the first financial commitments were established.

Following the VCS definition of start date (the date on which activities that lead to the generation of GHG emission reductions or removals are implemented), the **project start date is February 28, 2008**. This is the date on which the original agreement between the TWG-F&E Secretariat

and the CFI was signed, which committed the parties to the implementation of the project. This represents the first formal agreement for the implementation of the REDD project in Oddar Meanchey, and included in annexure a preliminary workplan and budget for the implementation of the project activities.

1.6 Project Crediting Period

The duration of the VCS project **crediting period is 30 years**, beginning on the project start date of February 28, 2008 and ending on February 28, 2037. The project crediting period is fixed at 30 years.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

The projected emission reductions over this period are summarized in Table 2. This is a project of normal scale.

Table 1. Scale of the project.

Micro-project	
Project	x
Mega-project	

Table 2. Estimated GHG emission reductions per year of the crediting period.

Project Year	Calendar Year	Estimated GHG Emission Reductions t CO_2e
1	2008	-34,844
2	2009	-68,209
3	2010	-99,627
4	2011	-134,965
5	2012	-166,655
6	2013	-187,670
7	2014	-226,106
8	2015	-259,594
9	2016	-268,214
10	2017	-273,250
11	2018	-286,316
12	2019	-306,805
13	2020	-340,920
14	2021	-369,155
15	2022	-390,825
16	2023	-391,063
17	2024	-365,856
18	2025	-363,430
19	2026	-347,786
20	2027	-343,892
21	2028	-307,173
22	2029	-294,201
23	2030	-295,645
24	2031	-283,587
25	2032	-308,188
26	2033	-328,596
27	2034	-316,648
28	2035	-300,142
29	2036	-285,509
30	2037	-242,896
SUM		-8,187,767

1.8 Description of Project Activity

The project will undertake ten types of activities to reduce degradation and deforestation. Five of these activities are taking place inside the forests of the project area, and are therefore project activities. The other five activities are taking place outside of the project area and are, therefore leakage mitigation activities. The project activities are described in this section, while the leakage mitigation activities are described in section 1.13.2. Each of the project and leakage mitigation activities is designed to target one or more of the identified deforestation drivers (Table 3).

Table 3. Summary of the project activities and which drivers of deforestation they target.

Driver of Deforestation	1. Reinforcing land-tenure	2. Land-use plans	3. Forest Protection	4. ANR	5. Fuel-efficient Stoves	6. Livestock protection from mosquitoes	7. Agricultural Intensification	8. Water Resource Development Projects	9. NTFP Development	10. Fire Prevention
1. Forest clearing for land sales	●									
2. Conversion to cropland	●	●		●			●		●	
3. Conversion to settlements	●	●								
4. Fuelwood gathering			●		●	●				
5. Forest fires induced to clear the forest understory		●	●					●		●
6. Forest fires induced by hunters			●							●
7. Illegal logging for commercial on-sale			●							
8. Timber harvesting for local use		●	●	●						
9. Large economic land concessions	●									
10. Timber concessions	●									

To optimize the activity efficiency, activities are implemented incrementally, beginning with reinforcing the land-tenure status. Total benefits of project activities will gradually increase over time. The five types of project activities are listed below.

1. **Reinforcing land-tenure status**. Reinforcing land-tenure through community forestry agreements provides exclusive management rights and responsibilities to the Community Forestry Management Committees (CFMCs) over the project area for a fifteen-year renewable period. These agreements greatly enhance the community's ability to protect and conserve forest resources. Establishing these agreements requires financial resources, which can be generated by selling carbon credits from the project. These financial resources can also be used for forest monitoring and patrolling programs, as well as for forest boundary demarcation with signs and posts to ensure that migrant populations do not encroach on forests controlled by local populations. Maintaining formal land-tenure rights is also important to ensure that agricultural conversion rights are not granted to large corporations such as Economic Land Concessions (ELCs) or timber concessions to harvest luxury woods. CFMCs will be responsible for meeting with new migrant communities, their leaders and the local government to clarify project area boundaries, resolve conflicts and emphasize the intention of the CFMCs to secure the area.

2. **Land-use plans**. Community council members and village leaders are consulted during land allocation activities. However, there are currently no land-use plans for the project areas. Developing forest and land management plans in a collaborative fashion is a key element in sustainable resource management. The project will financially and logistically support communities in developing Community Forestry Management Plans in a participatory and democratic manner. While these plans do not represent comprehensive spatial management plans for the project area, these forest management plans will increase the efficiency of the current land-use and take into account the increased need

for land for settlements and agriculture in the future. By planning the future conversion and avoiding random conversion of forest patches, forest degradation along settlement and cropland edges is reduced. During stakeholder meetings, there will also be a discussion on forest management and practices. Additionally, participatory land-use planning will provide guidance and rules in case of disputes or conflict over land or resources.

3. **Forest protection**. Project support for forest protection provides training in forest management and planning. Project support also includes uniforms, vehicles, communication equipment, patrol huts, boundary markers, signage, and employment. These actions increase the legitimacy of each CFMC and their patrol groups in the eyes of outsiders and enhance the status of CFMC members in their local communities. In addition, the project seeks to strengthen cooperative relationships between the local Forestry Administration (FA) staff, police and military in order to create a unified group of stakeholders that can prevent further forest encroachment, illegal logging, forest fires started by humans, and poaching. Similarly, forest protection activities prevent the unsustainable harvesting of fuelwood and timber for local use. The project will provide financial support to local FA staff to develop a quick-response mobile unit to deal with illegal forest activities in cooperation with local government, police and military. The project will support activities such as blocking tractor access, regular patrolling, development of a network of patrol huts and fire roads to facilitate rapid movement, rapid response and confiscation of chainsaws and other equipment, and improved communications through the use of mobile phones. In addition, a case tracking system will be set up so to facilitate the prosecution of major offenders. The project will support the CFMCs and project partners to create a cell phone network to act as an early warning system to control illegal forest activities. Cell phone communications provide a low-cost way to strengthen coordination among the inter-organizational enforcement team. Text messages sent to or from participating communities via a central server can be a rapid way to inform project partners of fire or other threats.

4. **Assisted natural regeneration (ANR)**. Scattered patches of degraded forest with 10 to 20% crown cover and a biomass density of less than 30 Mg DM ha^{-1} will be improved using silvicultural techniques for ANR. The ANR activities will be focused in areas that would regenerate poorly without any intervention due to severe degradation. Community members will be employed to plant tree seedlings in forest openings and carry out silvicultural activities such as removing competing vegetation in degraded forests and thinning multi-stemmed trees to encourage growth.

5. **Fire prevention**. The project will facilitate the implementation of fire prevention techniques in forestlands. These techniques include the creation of fire breaks, defined as a 5-m wide line in which understory and ladder fuels are almost completely removed, risk

6. areas surrounding forests and agricultural lands; removal of dead forest debris; regulation of the use of forest fires for hunting and to clean the forest understory; and educational outreach about preventing fires. CFMCs in partnership with the FA will facilitate the annual clearing of fire lines and will be responsible for forming fire brigades. Prevention and education about the effects of prevention practices, as well as implementation of fire management measures (e.g. controlled understory fires every 5 years instead of the current practice of annual fires, fire brigades, lookout towers, enhanced communication, etc.) will be organized during the stakeholder meetings and the Community Forest Management Plan discussions.

Each of the project and leakage mitigation activities listed in Table 3 will be implemented according to a detailed 30-year project implementation workplan. Certain activities will be implemented each year throughout the project lifetime, while some activities will only be implemented during a specific timeframe within the project lifetime. The lifetime of each of the Project and Leakage Prevention activities is outlined in Table 4.

Table 4. Lifetime of Project and Leakage Prevention Activities

Activity	Activity Lifetime (project years)
Reinforcing Land-Tenure	4-30
Land-Use Plans	4-30
Forest Protection	4-30
ANR	6-23
Fire Prevention	4-30
Fuel-Efficient Stoves	4-13
Livestock Protection from Mosquitoes	4-30
Agricultural Intensification	5-13
Natural Resource Management	5-30
NTFP Development Activities	4-8

1.9 Project Location

Located in the northwestern corner of Cambodia (latitude 14°20' to 13° 8', longitude 102° 54' to 104° 43'), Oddar Meanchey has historically been rich in forest resources. The terrain in the province is lightly undulating, with sporadic wet land depressions and small hills varying from 30 to 80 meters elevation up to the border with Thailand. The north and west of the area is characterized by a steep escarpment with higher hills of over 400 meters. The climate is monsoonal tropical with the rainy season extending between May and October and the dry season from November to April (Top et al. 2004a). Rainfall averages 1,300-1,500 mm per year.

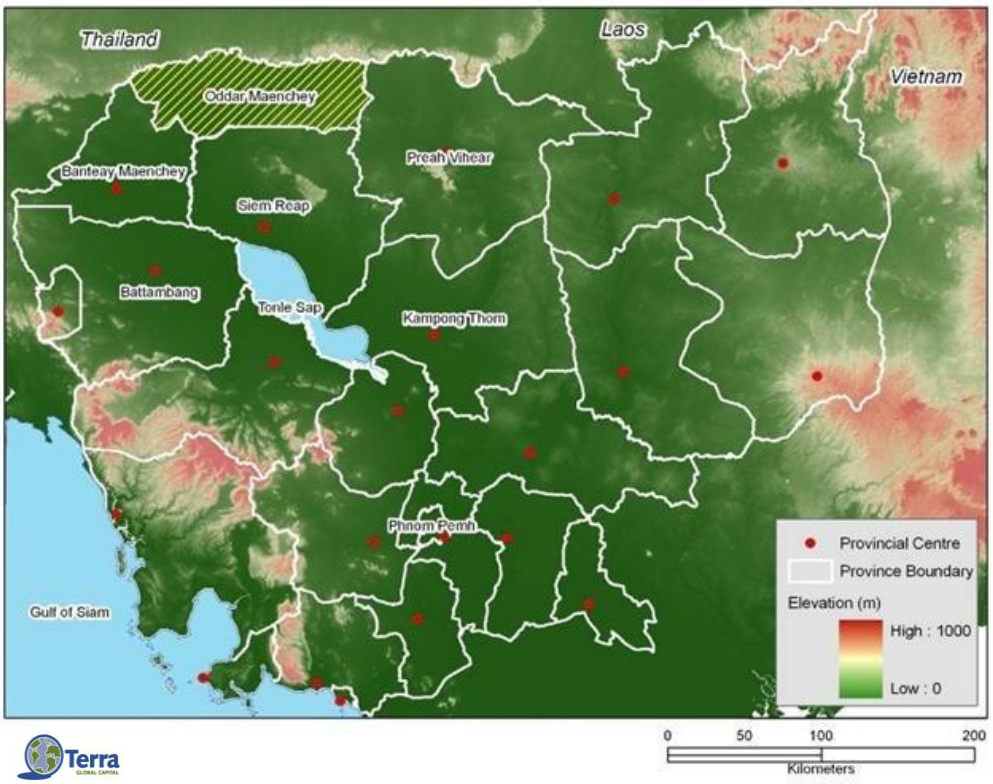


Figure 1. Position of the Oddar Meanchey within Cambodia.

The project area consists of 13 discrete parcels scattered across the central section of Oddar Meanchey (see Table 3 and Map 1). In each of these parcels, individual Community Forest Sites are located, ranging in size from 383 hectares to 17,848 hectares, adding up to a total area of 63, 831 hectares. The project area is comprised of 56,050 hectares of forested area (based on 2008 LULC) within these Community Forest Sites.

Table 5. Size and location of the participating community forest groups.

ID	Community Forest Group Name	CF Size [ha][1]	Forested [ha][2]	Forest Stratum[3]		Centroid [dd]	
				EVG	DCD	Lon (Y)	Lat (X)
1	Angdoung Bor	6,114	5,474	98%	2%	103.22645	13.97972
2	Chhouk Meas	383	370	25%	75%	103.78889	14.27255
3	Dung Beng	1,843	1,600	52%	48%	103.33325	14.04474
4	Ou Yeay Kaov	966	893	22%	78%	103.60698	14.39666
5	Phaav (Thmorda O Toekkhiev)	2,025	1,964	9%	91%	104.19031	14.36268
6	O Sophy Kiri Prey Sruorng	6,344	5,729	22%	78%	103.94002	14.03732
7	Phnom Dangrek Somrek Prey Srors	1,595	1,517	11%	89%	103.39863	14.35069

8	Ratanak Rukha	12,814	11,071	96%	4%	103.93705	14.3162
9	Rolus Thom	2,649	2,443	20%	80%	103.55344	14.37799
10	Romdoul Veasna	6,017	4,553	25%	75%	103.46286	14.35645
11	Samaky	1,079	1,031	17%	83%	103.93705	14.3162
12	Samki Sangkrous Preychheu	4,152	4,105	6%	94%	104.062	14.04641
13	Sorng Roka Vorn	17,848	15,301	85%	15%	103.81329	14.16166
	Total	**63,831**	**56,050**	**38%**	**62%**		

[1]Community Forestry size is based on agreements from the FA.

[2] Forested area based on 2008 LULC.

[3] EVG = Evergreen forest, DCD = decidious and mixed forest.

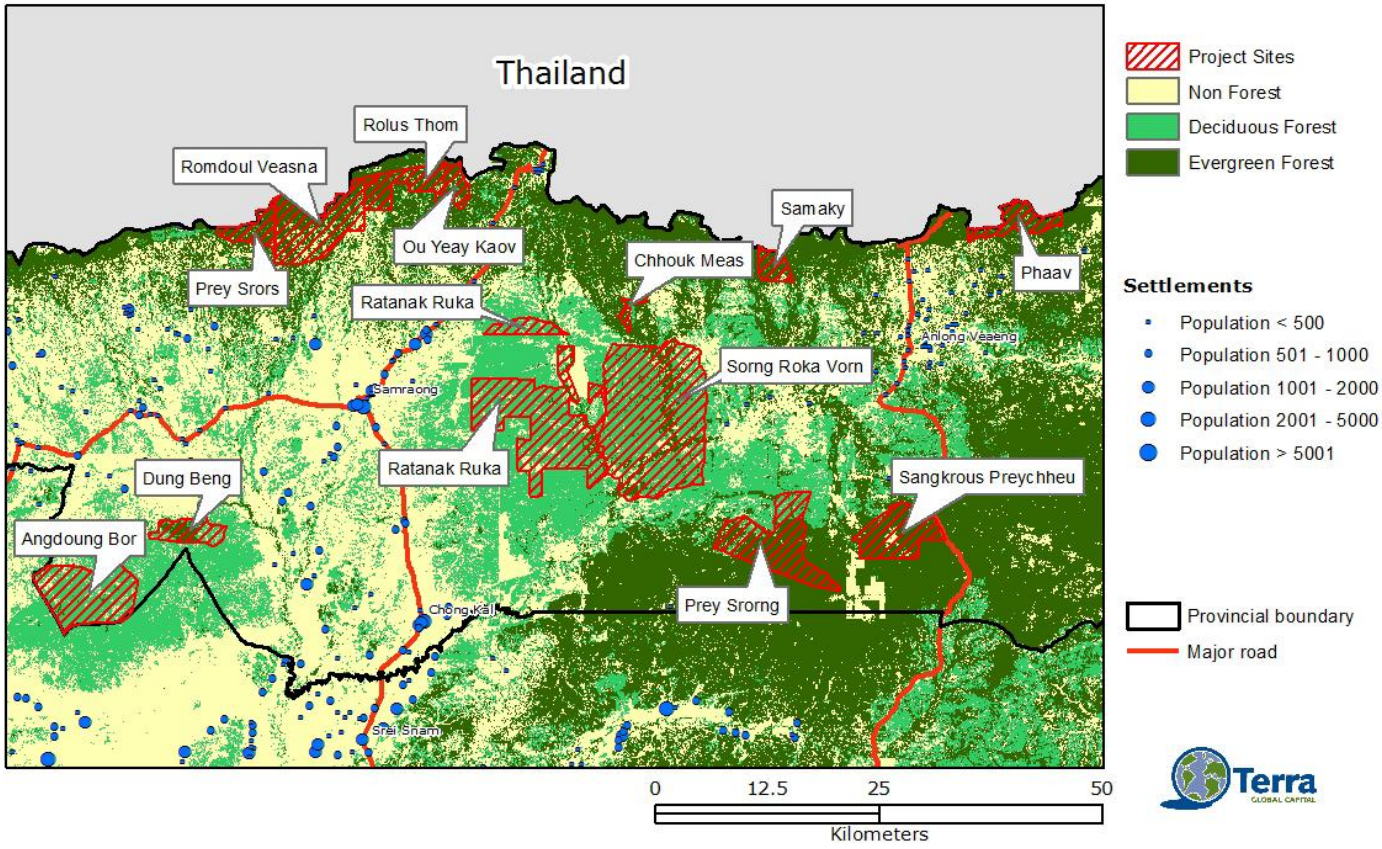
Table 6. Population and gender distribution in the participating community forest groups, and associated villages (relevant administrative unit).

			Total Population			Population of CF Members		
Nr.	**Community Forest Group Name**	**Village Name**	**House-holds**	**Male**	**Female**	**House-holds**	**Male**	**Female**
1	Angdoung Bor	Voa Yeav Village	172	662	329	172	333	329
		Samraong Tahae	37	124	62	37	62	62
		Kantuy Choun	96	360	173	96	187	173
		Dong Kao Tabuk	65	239	112	65	127	112
2	Chhouk Meas	Chhouk Meas	166	305	336	166	305	336
3	Dung Beng	Ta Mat Thmey	90	218	210	83	87	87
		Beng	104	430	214	96	120	125
		Yeay Teb	110	187	142	68	55	118
		Por Chas	254	431	447	230	179	246
4	Ou Yeay Kaov	Ou Pork	177	-239	325	155	102	94
5	Thmorda O Toekkhiev	Thnol Kaeng	412	412	373	157	119	131
		Chrok	133	602	600	133	159	170
		Ou Beng	57	151	143	57	62	69
		Ou Chik	82	164	237	82	78	90
6	O Sophy Kiri Prey Sruorng	Lumtong Chas	120	300	310	90	95	141
		Korki Kandal	151	375	348	90	174	163
		Rohal	128	280	272	116	158	155
		Kok Sampor	125	340	259	93	100	89
		Sralau Sraong	138	324	334	81	223	73
7	Phnom Dangrek Somrek Prey Srors	Chheu Slab	159	342	364	155	342	364
		Ou Tong	87	424	241	83	424	241
8	Ratanak Rukha	Chheub	163	477	394	141	169	166
		Kok Chres	104	262	295	73	83	85
		Ou Russei	43	91	128	42	90	125
		Ou Kansaeng	144	334	352	140	153	175
		Doun Kaen	407	791	1,015	232	310	262
		Chhuok	372	1,018	1,579	197	268	267
		Pol	281	781	721	144	198	198
		Bak Nim	246	696	444	236	339	230
		Koun Domrey	120	179	156	120	108	105
		Trapeang Veng	125	324	314	116	150	149
		Khtum	292	530	541	218	203	213
		Ta Man	125	281	292	120	423	134

			Total Population			Population of CF Members		
Nr.	**Community Forest Group Name**	**Village Name**	**House-holds**	**Male**	**Female**	**House-holds**	**Male**	**Female**
		Champa Sok	106	296	101	99	84	76
		Chheu Krom	195	582	432	190	155	149
		Kiri Vorn	133	327	316	123	317	316
		Bos	216	499	498	147	103	99
9	Rolus Thom	Ktoul	103	366	95	N/A	N/A	N/A
		Trapeng Thoung[1]	355	355	491	N/A	N/A	N/A
		Kouk Ampil[1]	332	840	803	N/A	N/A	N/A
10	Romdoul Veasna	Tnot	116	256	267	N/A	N/A	N/A
		Sambur Meas	525	1,138	1,240	497	890	966
		Romdoul Veasna	115	258	240	97	253	143
		Cheung Phnom Meanchey	111	265	234	80	222	234
		Kak Seportivong	127	448	429	95	329	326
11	Samaky	Ou Anrae	293	545	697	13	28	29
		Ou Sramor	105	138	127	100	117	113
		Trapeang Tav	214	455	497	148	189	167
		Trapeang Tav Chas	74	86	124	56	78	90
12	Samki Sangkrous Preychheu	Rom Chek	310	710	670	233	269	265
		Dey Thmey	138	359	115	130	216	234
		Ou Ta Meng	185	433	390	157	153	158
13	Sorng Roka Vorn	Sras Yey Chheok	116	245	228	116	245	228
		Tom Nub Thmey	175	381	329	175	381	329
		Som Pour	171	357	325	171	357	325
		Char Thmey	151	220	292	151	220	292
		Poum Thmey	203	800	226	203	800	226
		Char Chas	61	73	75	61	73	75
Total	**13 Community Forestry Groups**	**58 villages**	**9,915**	**22,627**	**21,303**	**7,126**	**11,464**	**10,317**

[1]These are not registered villages, but are significant population centers for the area. They are included to assure a conservative estimation of stakeholders or project beneficiaries.

Figure 2. Map of Oddar Meanchey with the community forestry sites.



1.10 Conditions Prior to Project Initiation

1.10.1 Deforestation Drivers and Agents

In absence of the project, it is likely that deforestation in the province will continue at the current rate of at least 1.5 – 2 % per year and will accelerate over the next decade due to the growing population. The removal of landmines has had a significant impact on the forests of Oddar Meanchey. As demining efforts have made the forest accessible, deforestation has become rampant, further accelerating the drives of deforestation. Social appraisals carried out by CFI during 2006-2008 indicated 10 distinct deforestation drivers, and five deforestation agents operating in the province (CFI, 2008) shown in Table 7.

It should be noted that the identified ten active drivers of deforestation are not, by any means, an exhaustive or complete representation of the deforestation threat in Cambodia or even within Oddar Meanchey. These ten drivers represent the ten most prevalent drivers that have been active in the past. Threats of deforestation that have not yet been identified in the past, such as deforestation due to mining, were excluded from this analysis because no quantitative data is available on their historical dynamics. When other deforestation drivers increase in significance, or when deforestation threats become active deforestation drivers, they can be added to the list of active deforestation drivers in a baseline update.

Table 7. Drivers and agents of deforestation.

	Deforestation Agents				
Active Deforestation Driver	**Migrants**	**Private Companies**	**Local Communities**	**Hunters**	**Soldiers**
1. Forest clearing for land sales	●	●	●		●
2. Conversion to cropland	●	●	●		●
3. Conversion to settlements	●	●	●		●
4. Fuelwood gathering	●		●		
5. Forest fires induced to clear the forest understory	●		●		
6. Forest fires induced by hunters				●	
7. Illegal logging for commercial on-sale	●	●	●		●
8. Timber harvesting for local use	●		●		●
9. Large economic land concessions		●			
10. Timber concessions		●			

1.10.2 Description of the Drivers and Assessment of their Future Population Size

Drivers of deforestation in the project area are described in extensive detail in the Project Document submitted to the Climate, Community and Biodiversity Alliance standard. The drivers of deforestation are described to a relevant degree below.

1. **Forest clearing for land sales.** It is estimated that over the past decade, between 8,000 and 9,000 migrants moved into Oddar Meanchey each year. These migrants were in search of agricultural land, in part due to the province's substantial forest tracts and its rapidly increasing land values. This type of forest clearing typically involves small plots

(0.5 to 2 hectares) of land along major and minor roads. Forest encroachment starts along roads and continually moves into forested areas. There is a pattern in Oddar Meanchey to grab what is seen as available public forestland and claim it until it can be resold at a higher price. The Royal Government of Cambodia and local government offices have limited resources to control immigration effectively and to demarcate the Permanent Forest Estate. As a consequence, it is likely that migrants will continue to clear forests in a without-project scenario.

Figure 3. Forest cleared for land sales near Sangkrous Preychheu CF bordering the Samraong Rubber Concession.

2. **Conversion to cropland.** The rapid increase in population due to natural growth as well as migration has led to the increased clearing of forest lands for agricultural use. Typically, subsistence agriculture is practiced in these previously forested areas. Based on surveys and social appraisals, it is estimated that 2,000 to 4,000 hectares of the project area may already be cleared for agriculture at present. This could double every ten years due to increased migration and population pressure. With the rural population expanding at a rate of approximately 15,000 migrants per year, demand for farm land will require an additional 5,000 to 6,000 hectares annually based on 2 hectares for each household.

3. **Conversion to settlements.** There are 58 villages within the project area, covering a 600 hectare area. Based on social appraisals, it is estimated that these rural settlements will grow at a rate of 4 percent per year. The growth of settlements occurs in an unplanned and uncontrolled manner and therefore uses available space inefficiently. This has a detrimental impact on the forest resources surrounding the settlements. Communities themselves are anticipating land scarcity, and the fear of future land grabbing is leading villagers to claim several plots of forest land for future settlement development.

4. **Fuelwood gathering.** Fuelwood plays a crucial role in meeting the energy needs of Cambodia. Ninety-five percent of the population is dependent on biomass for cooking (NIS 1998). There is no doubt that it will remain the dominant energy resource for many years to come. Fuelwood is also used to produce smoke to repel mosquitoes and insects from livestock and households. Although, there was no local evidence of threat to livestock from mosquito borne diseases in the project area, insects and mosquito bites to livestock can cause discomfort and irritation resulting in potential reduction in livestock

productivity. A typical household might consume between 1 to 2 Mg of fuelwood annually. Since there are about 10,000 households in the immediate vicinity of the project area, about 6,000 to 12,000 Mg of fuelwood is used in and around the project area each year. If managed sustainability, fuelwood gathering can reduce fuel load through the removal of deadwood and thinning.

5. **Forest fires induced to clear the forest understory.** Forest fires are a natural and essential part of the forest ecosystem in dry deciduous forests found within the project and surrounding areas. Naturally occurring fires are typically of a low intensity and incur minimal damage to mature trees, rarely spreading to the canopy. However, the occurrence and intensity of forest fires has increased significantly in the last 20 years, concurrent with an increase in population. Communities use fire as a management tool for instigating new vegetation growth, reducing dead wood, and clearing understory vegetation. As fire is a common practice to clear the forest understory and stimulate the growth of grasses. Fires are often left to burn uncontrolled. Historically, community forest management did not focus on fire suppression, nor was fire seen as threat to forest cover. Approximately 90% of dry season forest fires are caused by people including hunters, children, careless smokers, and farmers burning agricultural residue.

Figure 4. Public fire prevention education in Cambodia address the main causes of careless fire starts, e.g. the use of fire underneath Dipterocarp trees to stimulate resin yield, hunting, and cigarette smoking (from Savet, 1999).

6. **Forest fires induced by hunters**. Forest fires are occasionally started by hunters aiming to drive out wild game (wild pigs, turtles etc.) from heavily forested areas to concentrate the game so they are easier to catch. These fires often grow beyond their intended size and spread to other forest lands leading to significant forest degradation and deforestation. Forest fires are also carelessly started when smoke is used to drive bees away from their hives to collect honey.

7. **Illegal logging for commercial on-sale**. Illegal logging in Cambodia is widespread and poorly controlled. High-value “luxury wood” is sought after for the booming hotel construction market in Siem Reap, where over two million foreign tourist visit annually. Illegal timber smuggling is widespread and is often organized by private sector operators who obtain support from local military and police personnel. There are reports of officials

allowing illegal logging operations to continue in order to protect their own business interests. Armed soldiers often aid in the transport of illegal timber harvests for politicians. In the Ratanak Ruka CFMC an estimated 100m^3 per year has been extracted by illegal loggers (Poffenberger, 2008).

8. **Timber harvesting for domestic use**. Timber harvesting by local stakeholders is conducted to accumulate building materials for construction of lodging and basic infrastructure in settlements. Housing in rural settlements is classified as semi-permanent (roofs and walls constructed of temporary materials like bamboo, thatch, grass, reeds, etc.) and permanent (constructed with more durable materials like wood, concrete, etc.). Permanent housing requires large and straight trees to construct residences, hotels, businesses and shops. Semi-permanent housing also requires the harvesting of some trees and their temporary nature often means they are abandoned. Inhabitants of these houses move on to other areas, thereby increasing degradation on forest lands and requiring additional forest resources. These timber resources will last less than 100 years and thus do not qualify under long-lived wood product pool.

9. **Large economic land concessions (ELCs)**. Between 2007 and 2008, the Royal Government of Cambodia leased approximately 44,000 hectares of forestland in Oddar Meanchey, representing nearly 7% of the province's land area, to private companies. These land concessions are currently being cleared of forest to make way for ethanol producing crops (cassava, jatropha, sugar cane, oil palm, etc.). There is speculation that some business interests seek ELCs simply to harvest high value luxury woods, with no intention or financial capacity to invest in the development of the land. It can be expected that as long as there is demand for high-value timber and agricultural commodities such as jatropha oil, forest land will be threatened with potential ELC conversion. It must be noted that land under Community Forestry agreements will not be allowed to be leased as ELCs.

Figure 5. Cleared, burned and fenced land concession near Ratanak Ruka CF in central Oddar Meanchey.

10. **Timber coupes.** A moratorium on timber concessions (coupes) was introduced in Cambodia effective January 1, 2002. However, in 2006, the Royal Government of Cambodia re-introduced an Annual Bidding Coupe system currently operating in five provinces, including Oddar Meanchey. Small logging concessions, which have a maximum size of 1,000 hectares, are issued by the FA. In practice the concessions are issued for much larger areas of land. For example, one coupe issued on the western side of the Samaky CF block was initially granted 3,000 hectares. Annual felling coupes are designed to provide timber for provincial level markets. Only Community Forestry Agreements, of which the size and location is legally agreed upon with the FA, can prevent the loss of forest by timber concessions. Without this project, it is unlikely that effective community forestry agreements would be approved, or that the resources would be available to support CFMCs.

1.10.3 Description of the Agents of Deforestation

1. **Migrants.** The population of Oddar Meanchey has more than doubled over the past decade and a large proportion of this growth is due to an influx of migrants from other provinces within Cambodia. Historically, population density in Oddar Meanchey has been low, with most of the province covered by dense forest. As hostilities between the Khmer Rouge and government forces subsided in the 1990s, the province became a common destination for migrants from more populated areas of Cambodia. Household surveys conducted for the project revealed that 69 percent of villagers living in and around the project area have migrated to Oddar Meanchey within the last 5 years.

   New migrants require land and resources to survive. Many migrants pay nominal fees to clear and occupy land in a given commune for settlements and agriculture, although there is little oversight in the way of land-use planning. Migrants that have been recently uprooted or supplanted from other areas within Cambodia generally have less understanding of local ecosystems and can in turn cause forest degradation and deforestation due to unsustainable land-use practices. Migrants tend to have smaller

family support networks and focus on ensuring their families survival rather than on traditional community cooperation and sustainable land use (McMahon, 2008).

2. **Private companies.** The past decade has seen an increase in the number of private companies investing in land in Oddar Meanchey, driven by the availability of land and forest resources. These companies range in size from private businesspeople to large scale national and international concessionaires for crops such as sugar cane, cassava, and maize. Some organizations purchase land and leave it undeveloped, choosing instead to clear and fence the land to reinforce their ownership. Land transfers to private companies may be approved by the commune, province, or national government, with corresponding degrees of tenure security. In addition, there are several mining companies operating in Oddar Meanchey. Some of these companies have exploration licenses, while others have secured government permission for exploitation. Mining activities are currently not coordinated with the Forestry Administration and in some cases have overlapped with CF areas. (**See: Villagers, agro-biz face off in northwest, Phnom Penh Post, December 28, 2007**)
3. **Local communities.** Given that the local communities in Oddar Meanchey rely almost exclusively on forest resources for subsistence, they are responsible for a significant number of the drivers of degradation and degradation in the project area. Most of the families participating in the project come from a cultural tradition that his highly forest dependent. Most families in the project area control between two and five hectares of rain-fed agricultural land which provides subsistence food and generates a small amount of cash income. Many families only produce sufficient food for six to nine months of the year and must rely on forest products such as wild tubers, mushrooms and wild vegetables, or purchase rice in the market during the remainder of the year. Chickens, pigs, water buffalos and cattle are also raised, and can be sold for cash during emergencies. Off-farm employment pays approximately Reil 8,000 – 10,000 per day. Additional income is generated through the sale of non-timber forest products including resin oil, rattan, honey and other forest goods. Annual income for most households rarely exceeds US $1,000 to $1,500, with many households living below the poverty line. Mean monthly income for rural Cambodian families was approximately US $100 in 1999 (**Royal Government of Cambodia. "Income and Expenditure" (Council for Administrative Reform: www.car.gov.kh/Cambodia/income-expenditure**). A World Bank study reported that annual per capita income in Cambodia was around $290 in 2002.

   A minority of the members of the local communities continue to engage in activities which cause deforestation and degradation. They may work as hired labor for concessionaires to clear forest land in order to earn cash income. Others are engaged in timber or charcoal production, including most recently the collection of valuable rosewood which sells for approximately $10/kilogram in the local market. Community members may not be aware of the damaging effects of their activities on the ecosystem, or they may engage in illegal trade as a means of survival, having few if any sources of alternative income (Sepehri, 2011).
4. **Hunters.** Oddar Meanchey is home to many valuable species of wildlife. Due to poor living standards and weak law enforcement, hunting for both subsistence and commercial trade is commonplace in many parts of the province. Hunters contribute to deforestation and degradation when they set fires to facilitate hunting activities. Fires clear the long grasses and make it harder for wildlife to hide from hunters. New shoots of grass growing after a fire attract grazing animals, making them more vulnerable to hunters. Commercial hunters may travel significant distances to capture prized species, whereas local hunters rely on animals for subsistence. Some animals such as wild pig are considered a nuisance and may be killed not only for their meat but also to prevent them from eating rice crops. **(See: Men Charged for Killing Rare Cattle in O Meanchey, Cambodia Daily February 26, 2010)**
5. **Soldiers.** The military has a strong presence in Oddar Meanchey Province; in recent years, hundreds of soldiers have been posted to the area to increase security along the

border with Thailand. New military camps have been established with government as well as private sector resources directed to support expansion. Further, the government encourages soldiers to settle in Oddar Meanchey and other border provinces by allocating land to soldiers' families as an incentive. Soldiers' salaries are typically very low and leadership is weak, two factors which encourage many soldiers to seek additional income through involvement in illegal activities such as logging and land clearing. (See: Forest Monitors in O Meanchey Accuse RCAF Soldiers of Attack, Cambodia Daily)

1.10.4 Analysis of the Fire Dynamics in the Reference Region

The Fire Information for Resource Management System (FIRMS) is a remote sensing based fire mapping resource based on temperature thresholds applied to 1km resolution MODIS thermal band pixels. While this 1km resolution dataset lacks sufficient resolution to map the extent of burned area it does provide an indication of the annual seasonal window in which burn events occur. Figure 6 indicates that almost all fire events occur from December to April.

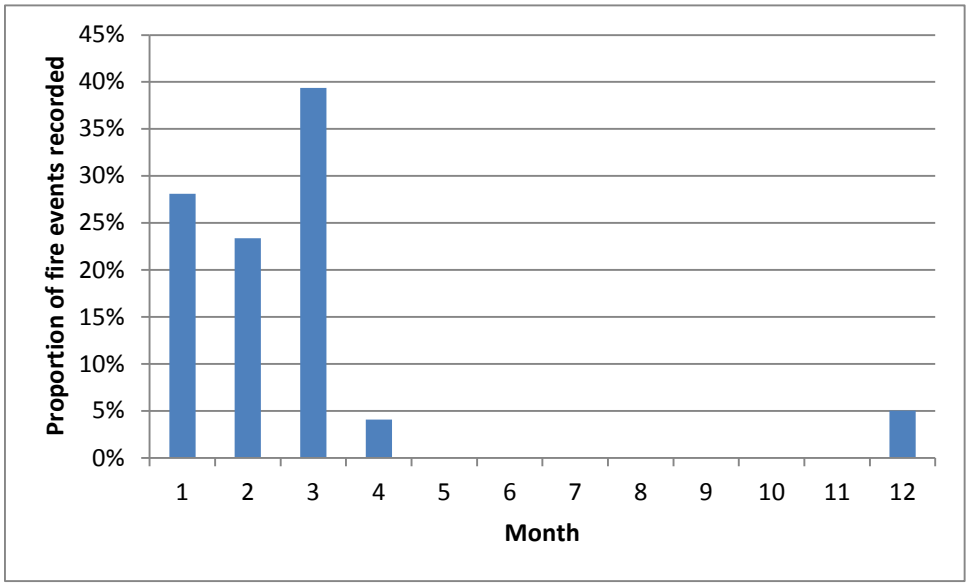


Figure 6. Seasonal variation of fire events in the reference region. Fire events are recorded by FIRMS and based on MODIS data.

Based on the seasonal variation of the fire events recorded, two Landsat scenes dates, January 29, 2003 and February 27, 2005, were selected that fall within these burn seasons. The histograms of fire event frequency from 2002 to 2008 indicate these dates have slightly higher burn activity (Figure 7).

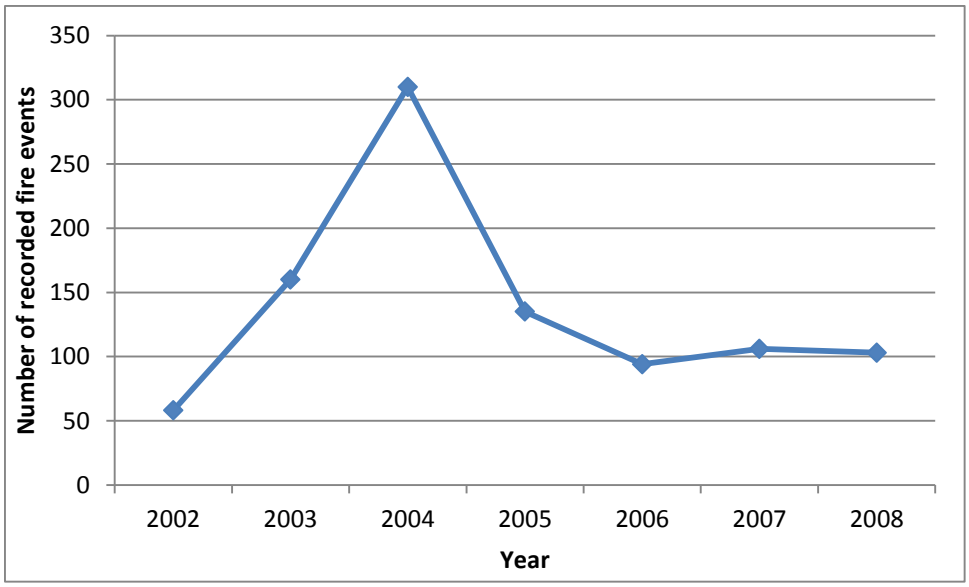


Figure 7. Annual variation in the number of fire events. Fire events are recorded by FIRMS and based on MODIS data.

Fires occur almost entirely on deciduous and mixed forest. If fires are detected in evergreen forest, they are an indication of imminent degradation and deforestation (Figure 8).

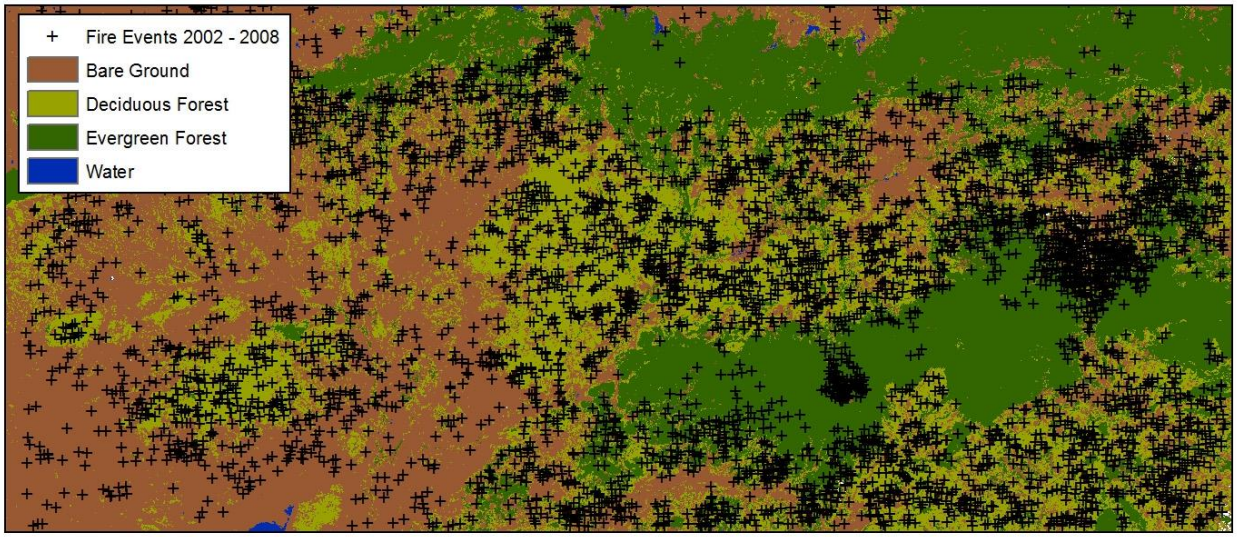


Figure 8. FIRMS fire events of 80% or greater confidence between 2002 and 2008 on top of 2008 classified LULC map.

The extent of the area affected by fires was quantified by identifying fire scars in these two remote sensing scenes. Fire scars are spectrally and visually distinct and readily identifiable with classification algorithms (Figure 9). Burn areas were a class included in the LULC classification baseline establishment effort (see section on remote sensing analysis).

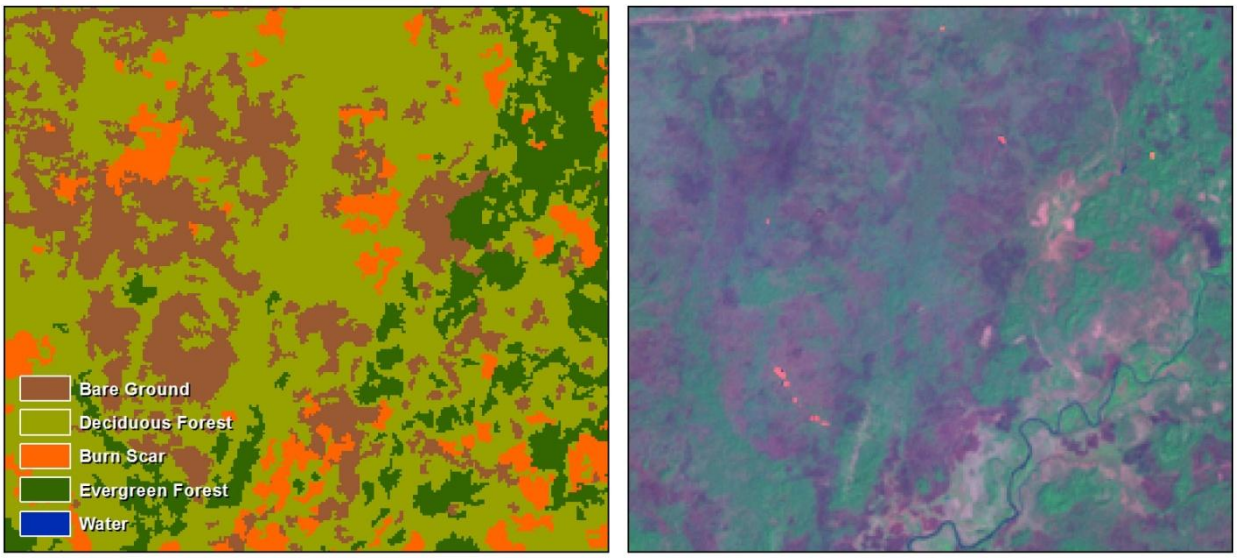


Figure 9. Example of classified image (left) and original RS image using a 7-4-2 band combination. Burn scar matrix around project areas appear as dark purple. Active fires can be seen as small bright orange areas.

Figure 9 illustrates the identification of burn scars in the 2005 Landsat image. The remote sensing analysis showed 9,262 ha of deciduous forest burned within the project areas in 2003 and 4,020 ha burned in 2005. The average of these values is 6,641 ha.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project activities comply with all Cambodian laws and specifically the Forestry Law of 2002. The Forestry Law of 2002 defines the framework for management, harvesting, development and conservation of the forests of the Kingdom of Cambodia. This law establishes the duties of the Forestry Administration, providing the framework for the FA's responsibility as project proponent for the Oddar Meanchey REDD project. This law does not make any specific mention of carbon.

The land tenure and land use rights for the project sites covered in this project are further governed by Sub-Decree on Community Forestry Management which was approved by the council of ministers and signed in December 2003. The Sub-Decree sets out the rules for the establishment, management and use of community forests in Cambodia, and gives the Forestry Administration rights to grant official recognition of the demarcation of each community forest boundary. The Sub-Decree further establishes the requirements of all CF communities, vis-à-vis by-laws, management plans and allowable use. The Sub-Decree has established the framework allowing for creation of CF groups which in turn may be partake in the implementation of community REDD carbon projects in Cambodia. The Sub-Decree makes no specific mention to ownership of or distribution of revenues from the sale of carbon credits.

This project was specifically approved by the Council of Ministers (Decision no. 699 signed May 2008), with the principle that the project ensures carbon revenues are used to: (1) improve the forest quality, (2) provide maximum benefits to local communities which participate in project activities, and (3) study the potential area for new REDD projects in Cambodia. The Oddar Meanchey REDD project is one of the country's REDD demonstration projects for Cambodia's National REDD Roadmap.

Relevant forestry laws are available on http://www.forestry.gov.kh/Law/Regulations_Eng.html.

1.12 Ownership and Other Programs

1.12.1 Proof of Title

The project has received high-level endorsement; the prime minister has issued Government Decision ("Sar. Chor. Nor.") No. 699 through the Council of Ministers, explicitly endorsing the project. In addition, all thirteen communities involved in the project have signed Community Forestry Agreements with the government, the legal land owner, which ensures the explicit and uncontested legal tenure to the local communities as well as the land management rights for the communities for 15 years with a provision for renewal. A signing ceremony for nine CF Carbon Agreements was organized in May 2009, demonstrating the full consent of these nine CFMCs, and four more have since been finalized. The Royal Government of Cambodia (RGC) has agreed to act as the seller of carbon under the ERPA and aggregate on behalf of the CMFC groups. Within the RGC, the Forestry Administration is responsible for all carbon credit transactions. Because the participating communities have the long-term tenure and usage rights of the land while the government still remains the legal owner, an agreement was signed between the communities and the government, through the FA, to clarify all rights and responsibilities regarding carbon ownership and land usage.

1.12.2 Emissions Trading Programs and Other Binding Limits

Cambodia is a non-Annex I signatory of the Kyoto protocol and it does not have an emissions trading program to binding limits on GHGs.

1.12.3 Participation under Other GHG Programs

A Project Design Document has been submitted to the Climate Community and Biodiversity Standard for recognition of its exceptional community and biodiversity benefits.

1.12.4 Other Forms of Environmental Credits

Carbon credits are currently the only environmental credit being generated from this project. In addition, the appropriate legal agreements are in place between project participants to ensure credits are not sold more than once.

1.12.5 Projects Rejected by Other GHG Programs

The project has not been rejected by any other GHG program.

1.13 Additional Information Relevant to the Project

1.13.1 Eligibility Criteria

The methodology used for this project (VM0006) is not intended to be used for grouped projects; therefore no eligibility criteria are provided here to include new instances.

1.13.2 Leakage Management

A description of the leakage mitigation activities is included in this section. Each of these activities targets one or more of the deforestation drivers outlined in Section 1.10.2. Table 3 provides an overview of which project and leakage mitigation activities are mitigating which drivers.

1. **Fuel-efficient stoves**. More than 95% of Cambodians use biomass as cooking fuel, typically fuelwood gathered from the forest in rural areas and charcoal in urban areas. While harvesting of fuelwood provides the added benefit of clearing ground detritus, which can help prevent forest fires, fuelwood is often harvested unsustainably and can lead to land degradation. The household survey results showed that current consumption of fuelwood is about 3.1 t dry matter (DM) per household per year (consistent with results from regional study by Top et al. 2003). The project will introduce fuel-efficient

woodstoves in the area. Reducing the demand for fuel will lead to a direct reduction in the unsustainable harvesting of fuelwood. The project will first target the households using the least efficient stoves and gradually replace existing stoves with efficient stoves. Such substitution is likely to reduce the fuelwood use by 15 – 65% from the current level.

2. **Livestock protection from insects**. One of the largest contributors to fuelwood consumption is the burning of wood to generate smoke for the purpose of repelling mosquitoes around cattle and water buffalo enclosures. Livestock are the most valuable possessions rural farmers have, often worth years of wages. Protection of these animals is of utmost importance, and often the lowest cost option is to generate wood-smoke to repel mosquitoes. The project would provide integrated insect repellent measures including mosquito nets treated with insecticide, insect repellent sprays or wipe-on solutions at a reduced price to local households to cover livestock pens. These measures will be corroborated by awareness activities in the project area to reduce mosquito infestation and promotion of natural repellents such as Eucalyptus oil. These measures will reduce the amount of fuelwood consumed by rural families, and will help to decrease the burden of fuelwood collection on forest land. These alternative measures will be made available through revolving credit associations, as they are often too expensive for farmers to purchase outright.

3. **Agricultural intensification**. Extensive tracts of forest land are being cleared around the project area to create additional farmland. While additional agricultural land is being created, crop yields remain very low when compared with neighboring countries in Asia (e.g. Thailand and Vietnam). Interviews with communities in Oddar Meanchey indicate that rain-fed rice yields are averaging between 1 to 1.5 metric tons per hectare, while Thai and Vietnamese farmers may obtain yields 4 to 5 times this much for the same area. Improved farming systems, as well as better access to irrigation, financing and markets could allow existing farmland to become two to three times as productive. In order to take pressure off further forest clearing for agriculture, the project would provide technical and financial support to local farmers to develop sustainable techniques to increase productivity. Techniques would include organic fertilizers, vermiculture and access to improved seed varieties (non-Genetically Modified Organisms). The project would also provide communities with the resources needed to develop better water sources for irrigation. Project support would target innovative local farmers who are willing to demonstrate the new techniques to their neighbors.

4. **Water resource development projects**. Many project communities have requested assistance to help develop their water resources and infrastructure, especially the de-silting of storage tanks. The project would give 10-15 small $1,000 to $2,000 grants each year, to project communities based on their water resource development proposals. Proposals will be evaluated on feasibility and both the immediate and long-term benefits of the proposed water resource developments. Projects will include de-silting tanks, tube well drilling, drinking water system development, and installation of appropriate purification technologies. Additionally, the project will also consider the use of irrigation and other agricultural water distribution technologies to both decrease the amount of water needed for agriculture and improve the productivity of farmland. Where possible, these water impoundments will be installed at strategic positions within the forest area to facilitate firefighting during the dry season, as well as function as additional water sources for wildlife.

5. **Non-Timber Forest Product (NTFP) development activities**. The project plans several livelihood enhancement activities to boost the incomes of project households. These include enhancing production, processing and marketing of NTFPs including honey, rattan, fruits, bamboo, and resin oil. The sustainable management and sale of these products will help increase rural income, shift the burden from the sale of agricultural and timber products and reduce the need for cropland. The project will also assist communities in establishing micro-finance accounts to generate small grants from project-derived carbon income, allowing capital to be used for revolving loans for

improved education, health and small enterprise development. Small grants will be awarded to farmer-innovators who wish to perform trials of new sustainable and intensive farming system techniques.

1.13.3 Commercially Sensitive Information

The following information is commercially sensitive and is not publically available, but will be made available to the validator.

- **Financial projections** – Detailed 30-year financial projections for the project which include all project-related costs and ex-ante carbon estimates
- **Standard Operating Procedure for field sampling** – Standardized SOP for collection of biomass field data by field teams
- **Standard Operating Procedure for ANR Silvicultural Techniques** – Standardized SOP for undertaking ANR activities in the project area by field teams
- **Forms for Monitoring of Social Appraisal** – Questionnaire forms for carrying out social appraisals for ongoing project monitoring
- **Social Appraisal reports** – Reports compiled using the data gathered from the monitoring of social appraisal data
- **Computer model code for the LULC model** – Proprietary computer code for the Terra Global Capital land-use change model
- **Electronic shape files of project areas, leakage area, reference region** – GIS boundary shape files used to delineate the project area, leakage area and reference region
- **Classified Landsat images** – Used to determine land-use classes and forest strata within the project area and reference region
- **Original data from biomass inventories and social assessments** – Hard copies and electronic copies of data sheets used to record field data for biomass inventories and social assessments
- **Agreements between implementing, technical partners and communities** – All agreements between project proponents and other implementing partners governing the implementation of project activities
- **Government approvals** – All approvals from the Forestry Administration and other relevant government agencies pertaining to the Oddar Meanchey project
- **Models used to create carbon calculations** – Computer models to generate carbon estimates from all field data and remote sensing data

1.13.4 Risk of Failure of Project Implementation

The following broad risks have been identified:

- **Lack of technical capacity to coordinate and to implement project activities among stakeholders**

  The project requires the cooperation of a variety of different stakeholders and community groups in implementing a complex set of strategies and activities to control the drivers of deforestation, and to implement comprehensive monitoring program. While the project team is highly committed and comprised of individuals with sufficient expertise and experience to carry out these activities, it is nevertheless a challenge to bring all of the objectives to fruition. The project crediting period covers a period of thirty years, and the project team will change significantly before the completion of the project, requiring the training of new stakeholders and the transfer of a significant amount of information and expertise. In addition, given that there are a variety of stakeholders involved in project implementation and ongoing monitoring, here is a possibility of irresolvable conflicts

between stakeholders. Local communities responsible for the implementation of project activities may lose confidence that the project is in their best interest from a livelihood improvement perspective, and no longer continue to participate in the project. Similarly, the project communities may not adopt project activities at the rate that has been anticipated, or some planned activities may end up being unsustainable or too difficult to implement in practice.

- **Governance & erratic development planning**

  There is also a risk that poor governance and erratic or inconsistent development planning will derail the project. Anomalies in the use of resources, non-transparent decision making on development projects such as roads and plantations (perhaps due to a change in leadership), and emergence of significantly more competitive land use options pose a risk. It is also possible that the border conflict with Thailand could re-ignite at some point in the future, leading to political instability in the area and an increased military presence.

- **Uncontrollable fires due to climate feedback loops**

  Fires are a natural occurrence in Oddar Meanchey and with better control measures it is likely that communities can manage fire more effectively. However, as the global climate continues to change, there could be feedback loops leading to a longer dry season and droughts which would exacerbate fire to a point at which it would be beyond the project's control.

- **Uncontrollable migration and clearance for agriculture**

  Population continues to grow rapidly in Oddar Meanchey primarily due to migration. There is a risk that the level of migration to Oddar Meanchey will be beyond the project's ability to control it despite concerted land use planning efforts.

- **Lack of sufficient funding prevents implementation of project activities**

  The implementation of project activities is wholly dependent on the revenues generated by the sale of carbon credits. Given that there is no guarantee that the VCUs sold from the project will generate sufficient income to allow project implementation, there is a risk that the project will be unable to undertake all currently-planned activities. This would in turn lead to the project generating less carbon revenue than currently projected, threatening the financial viability and sustainability of the project.

1.13.5 Further Information

No further information provided.

2 VCS METHODOLOGY

2.1 Title and Reference of the Methodology

"Carbon Accounting Methodology for Project Activities that Reduce Emissions from Mosaic Deforestation and Degradation", approved in December 2010, developed by Terra Global Capital, LLC.

2.2 Applicability of Methodology

Criteria related to conditions on the land before project implementation:

1. The land in project sites has qualified as forest, according to UNFCCC the forest definition for Cambodia is defined as containing at least 10% canopy cover, a tree height of 5 m, and a minimal area of 0.5 ha, for at least 10 years before the project start date. A remote sensing image from 1994 was analyzed to verify the land use and land cover status of the reference region and project areas. This 1994 image was taken 14 years before the start of the project, which is in 2008. The 1994 image demonstrates that all project sites are completely forested for at least 10 years. Table 8 indicates the percentage of cover under evergreen vs. deciduous and mixed in 1994. Table 9 indicates how much area was under cloud cover in the 2008 image. This area was excluded from the current calculations, but will be included at first verification when cloud-free imagery is available.

Table 8. Forest cover in project areas in 1994.

Project Site	Evergreen	Deciduous and Mixed
Chhouk Meas	88%	12%
Ou Yeay Kaov	97%	3%
Romdoul Veasna	93%	7%
Prey Srors	96%	4%
Prey Srorng	80%	20%
Sangkrous Preychheu	98%	2%
Samaky	90%	10%
Sorng Rokavorn	22%	78%
Andoung Bor	5%	95%
Dung Beng	45%	55%
Ratanak Ruka	10%	90%
Phaav	98%	2%
Rolus Thom	94%	6%
TOTAL	**70%**	**30%**

Table 9. Forest cover in project areas in 2008.

Project Site	Total Forest	Cloud	Evergreen	Deciduous
Chhouk Meas	357	4%	72%	24%
Ou Yeay Kaov	889	0%	78%	22%
Romdoul Veasna	4,563	0%	75%	25%
Prey Srors	1,525	0%	89%	11%
Prey Srorng	15,362	2%	15%	83%
Sangkrous Preychheu	5,477	0%	2%	98%
Samaky	1,598	0%	48%	52%
Sorng Rokavorn	10,882	0%	4%	96%
Andoung Bor	1,966	0%	91%	9%
Dung Beng	1,033	0%	83%	17%
Ratanak Ruka	3,884	6%	88%	6%
Phaav	5,731	0%	78%	22%
Rolus Thom	2,460	0%	80%	20%
TOTAL/Average	**55,727**	**1%**	**62%**	**37%**

2. The project area would be deforested in absence of the REDD project activity, as evidenced by (1) the presence of deforestation agents and drivers near the project area, quantified using social assessments, and (2) a historical deforestation rate in the reference region of *at least* 0.5%. In addition, deforestation in the reference region follows the mosaic typology. The following explanation/guidance is set forward within the VCS AFOLU requirements document:

> *The mosaic deforestation and/or degradation pattern can result when*
>
> - *Human populations and associated agricultural activities and infrastructure are spread out across the forest landscape.*
> - *Most areas of the forest landscape are accessible to human populations.*
>
> *Mosaic deforestation and/or degradation typically occur:*
>
> - *Population pressure and local land use practices produce a patchwork of cleared lands, degraded forests, secondary forests of various ages, and mature forests;*
> - *Forests are accessible*
> - *Where the agents of deforestation and/or degradation are present within the region containing the area to be protected.*

The average distance to area that was deforested within 5 years prior to the start of the crediting period is 401m. Such a small average indicates that most deforestation occurs in a patchwork manner in which the patches of deforestation are interspersed with forested land. The patchy nature of the deforestation near the project area can be easily confirmed by observing gaps in the project area. In addition, it is certain that most areas of the forest are accessible to human populations since a GIS analysis revealed the average distance from any point in the forest to a road or a track was only 1.29km. Human settlements are spread across the landscape. More specifically, a GIS analysis indicated that the average distance from any point in the forest to a village is 6.65km.

3. All communities have signed binding community forestry agreements which prevent legally sanctioned timber operations. Only some (restricted and controlled) harvesting of timber for domestic use (e.g., construction of local dwellings) is allowed. This is accounted for in the carbon calculations.
4. Deforestation and forest degradation in the project area occurs due to one or more of the following categories of drivers.
    - Driver 1: Conversion of forest land to crop-land or grazing land for subsistence and small-scale farming
    - Driver 2: Conversion of forest land to settlements
    - Driver 3: Logging of timber for commercial sale
    - Driver 4: Logging of timber for local and domestic use
    - Driver 5: Fuel-wood collection or charcoal production
    - Driver 6: Forest fires

    These drivers were identified by the project proponents through participatory rural appraisals (PRAs) carried out from September – October 2010. More specifically, 13 different PRAs were carried out in the project area, one in each of the community forest sites. A total of 202 community forestry participants (131 males and 71 females) were engaged during the PRA process, including village chiefs, Commune Councilors, local authorities, women's groups, and community forestry members. These stakeholders provided views on the issues of deforestation, forest degradation, livelihoods, and sustainable forest management. The drivers of deforestation were identified and ranked by community members based on the perceived contribution to deforestation. A summary of the ranking exercise of the drivers of deforestation in the project area is shown in Table 10. Higher-ranked drivers represent drivers that were perceived to have a greater contribution to total deforestation. The detailed procedure of this analysis and the rankings at individual community forest sites are described in PRA Assessment Report 2010, available to the auditor.

Table 10. Summary of different categories of drivers present in the project area together with their perceived ranking.

Driver Category	Rank*
Conversion to cropland	1
Timber harvesting (economic land concessions)	2
Illegal logging	3
Fuel-wood collection	4
Forest fires	5
Conversion to settlements	6

*Rank was assigned based on the score given to each category in different CF sites

5. Section 3.1.2 demonstrates that the reference region selected has similar characteristics to the project area and that the same drivers of deforestation are present in the reference region and in the project area. One map is available from 0-1 years before the project start date, four images from 2-5 years before the project start date, three images from 6-9

years before the project start date, and one image from 10-15 years before the project start date. The accuracy of broad LULC classification is at least 94% (Table 22) and exceeds the minimal required accuracy of 70%. No credits from forest degradation are included at this stage. However, credits from avoiding forest degradation may be included at a later stage, as is allowed under the methodology.

Table 11. Dates of remote sensing imagery available to calculate the historical deforestation rate.

Years before project start	Dates of Land Use Maps Available
0-1	Dec-20-2008
2-5	Dec-15-2006, Feb-27-2005, Nov-07-2004, 29-Jan-2003
6-9	Nov-10-2002, Nov-04-2000, Mar-25-2000
10-15	Jan-28-1994

6. After the removal of carbon in the aboveground live pool, carbon in the below ground biomass pool disappears within the duration of the project (Chambers et al., 2000).

Criteria related to conditions on the land after project implementation

7. Emissions from deforestation and forest degradation in the project area are reduced by implementing the following activities (see section 1.8):
    - Reinforcing Land-tenure
    - Land-use Planning
    - Forest Protection
    - ANR
    - Fuel-efficient Stoves
    - Livestock Protection from Insects
    - Agricultural Intensification
    - Water resource development Projects
    - NTFP Development
    - Fire Prevention
8. A rigorous monitoring plan consisting of social assessments, remote sensing analysis and biomass inventories in the project area and all leakage belts is implemented to quantify the magnitude of activity-shifting leakage by geographically constrained drivers.
9. All increases in CO_2, N_2O and CH_4 emissions from project or leakage prevention activities is accounted for using the procedures included in the methodology. No other significant emissions originating from any measure associated with the project are present.
10. No fossil-fuel based alternative fuel sources are promoted by the project proponents as a leakage prevention activity.
11. No commercial production of timber, fuelwood or charcoal within the project areas are allowed in the community forestry agreements.
12. The following conditions are met so that soil organic carbon can be omitted as a carbon pool.
    - The project area does not include organic soils, peatlands or (permanent) wetlands, as can be demonstrated by existing land cover layers.
    - Biomass will not be removed from the ANR areas.

- None of the project activities will remove fine litter.
- No mechanical soil disturbance is done within the project area.

13. Table 32 contains an overview of the 10 most important crops in the Oddar Meanchey Province according to the 2005-2006 agricultural census of the Ministry of Agriculture, Forestry and Fisheries of Cambodia. From this table, it can be observed that (1) there are no perennial crops and (2) there are no crops containing a significant amount of aboveground biomass cultivated within the Oddar Meanchey province. In addition, no oil palm plantations or short rotation woody crops are present within the reference region. Kiyono et al. (2010) reported values for aboveground non-tree biomass as well as aboveground tree biomass in Deciduous and Evergreen forests of Cambodia. These authors calculated a non-tree to tree biomass ratio of about 7% for both deciduous (i.e., 7.9/268.2) and evergreen (i.e., and 26.1/413.6). Applying these percentages to our biomass stocks (Table 37) yields average aboveground non-tree biomass values of 3.8 and 8.8 Mg C ha^{-1}. The aboveground biomass of rice cropping systems – the dominant cropping type – can be calculated as the average yield divided by the harvest index. Assuming a harvest index of 0.5 (FAO, 2000a) and a yield of 1.7 Mg DM ha^{-1}, the aboveground biomass of rice cropping systems in Cambodia is estimated to be 1.7 Mg C ha^{-1}. As a consequence, the aboveground non-tree biomass will decrease if forest is converted to rice paddies, and it can be concluded that the aboveground non-tree biomass pool does not increase under the baseline scenario and that the aboveground non-tree biomass can, therefore, conservatively be omitted.
14. Sufficient and appropriate data are available to quantify the carbon stored in long-lived wood products. More specifically, these data were collected within the scope of a social assessment conducted within and near the REDD project area. The social assessment included a survey questionnaire among 296 households, as well as a participatory rural appraisal (focus group discussion) in 13 community sites. The social assessment investigated the current demand as well as supply of timber in the project area. Please
15. The obtained values of timber extractions were used to account for carbon in the long lived wood product pools using the method specified in the methodology. These values are reflected in the forest management/monitoring plans for individual community forest sites in the project area. See Section 3.13.1 for a full justification of the insignificance of the carbon in the long-lived wood products.

2.3 Project Boundary

2.3.1 Geographic Boundary

The spatial boundaries of (1) the project area, (2) the leakage area and (3) the reference region are available to the verifier. The project area consists of 13 discrete project parcels, representing different community forest areas, with non-forest areas removed. Some of the project parcels are adjacent. Around each discrete project area parcel, a leakage belt was defined, as specified in section 3.10.2.

The project duration is 30 years.

2.3.2 Carbon Pools, GHG Sinks and Reservoirs

Table 12 outlines the carbon pools that are included in this project.

Table 12. Carbon pools included in this project.

Carbon Pool	Included/Excluded	Justification/ Explanation of Choice
Above-ground tree biomass	Included	Major carbon pool affected by project activities
Above-ground non-tree biomass	Excluded	Change expected to be positive or insignificant under applicability criteria and therefore can be excluded
Below-ground biomass	Included	Major carbon pool affected by project activities
Dead wood	Included	Major carbon pool affected by project activities
Litter	Excluded	Expected to decreases under the baseline scenario under the applicability criteria
Soil organic carbon	Excluded	Change expected to be positive or insignificant under applicability criteria and therefore can be excluded
Wood products	Included	Major carbon pool affected by project activities

2.3.3 GHG Sources

In accordance to the methodology and the applicability criteria, GHG emissions (other than those related to carbon pools) are taken into account by the project. Emissions included in the baseline scenario consist of CO_2 from baseline deforestation and degradation. Emissions from project activities include CO_2 and CH_4 found in the loss of biomass due to fire prevention activities. Emissions from leakage prevention activities include N_2O from fertilizer used for agricultural intensification.

2.4 Baseline Scenario

For this project, the most plausible baseline scenario under the CDM modalities and procedures, paragraph 22, is option (a): *Existing or historical, as applicable, changes in carbon stocks in the carbon pools within the project boundary*. There is no evidence to suggest that the deforestation observed in the 15 years before the project start will not continue in the future, given the number of deforestation drivers and the mosaic type of deforestation. Therefore, the most appropriate future scenario is that historical rates, change in rate, and dynamics of deforestation and forest degradation will continue in the future. No new economically attractive course of action is expected in the future, therefore option (a) was selected, and not option (b).

2.5 Additionality

The demonstration of additionality uses the VCS VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities. VT0001 prescribes a step-wise approach to the demonstration of additionality, as follows:

2.5.1 Step 1: Identification of Alternative Land Use Scenarios to the AFOLU Project Activity

2.5.1.1 Sub-step 1a: Identify credible alternative land use scenarios

Given that the project is of the mosaic typology, no single alternative land use scenario can be identified. . Instead, each of the drivers of deforestation interacts to create the alternative land use scenarios. Potential alternative land use scenarios in the project area include;

- The most likely alternative land use scenario is a continuation of the pre-project land use. This would lead to continued deforestation within the project boundary, as evidenced by the presence of deforestation agents and drivers near the project area, and the observed deforestation rate of at least 0.5% in the reference region. In absence of the planned project activity, the mosaic deforestation drivers present within the project area would continue unmitigated, due to lack of funding and enforcement capacity to implement the planned project activities. It is likely that as population pressures in the project area increase, population-driven mosaic drivers, such as fuelwood gathering, clearing to cropland and settlements and timber harvesting for local use will also increase. The specific drivers of both spatially-limited and non-spatial drivers of deforestation and their relative contribution to the alternative land use scenario are detailed in 1.9.1.
- The project plans to implement regeneration activities and tree planting in deforested and degraded areas within the project area. It is expected that some regeneration in degraded areas would occur naturally under a without-project scenario. However, under a without-project scenario, these areas will remain in a low-carbon state and will be subject to on-going degradation from the identified drivers of deforestation. Under the project scenario, assisted natural regeneration activities will accelerate the rate of regeneration of degraded areas, and will be protected from on-going degradation. Without project activities, virtually no natural reforestation has occurred during the historical reference period, indicating the significance of the pressures on the area.
- It is unlikely that the project activities planned by the project would be implemented on the land within the project boundary in absence of a registered VCS project. The planned project activities will only have funding for implementation using funding generated from the sale of carbon credits from the project. Local communities lack the training and equipment necessary to undertake the project activities without the support of the implementing partners and carbon credit revenues. No other funding will be used to support the project activities.

2.5.1.2 Sub-step 1b: Consistency of credible land use scenarios with enforced mandatory applicable laws and regulations

There are specific drivers of deforestation present in the project area which contravene the Forestry Law of 2002; Illegal logging, forest encroachment and migration for settlements in forest areas. These drivers are widespread in and around the project area, and due to lack of enforcement capacity they are difficult to control or prevent. The Oddar Meanchey province is under the jurisdiction of the Siem Reap FA cantonment, which has a total of 50 staff in 2008 staff covering a total forest area of 633,165 hectares. This requires each FA staff to be responsible for nearly 13,000 hectares of forest land. Communication challenges prevent quick reaction by FA officials, allowing illegal loggers to escape unpunished and illegal activity to occur unchallenged. Illegal loggers often have guns and other weapons used to threaten FA and CF members who may confront them. In addition, small scale illegal logging operations are mobile and can operate flexibly, using easy to hide chainsaws to cut down trees, and ox-carts to transport logs rather than tractors or trucks (See FA Cantonment Report on Forest Law Enforcement). None of the other drivers of deforestation in the project violate any Cambodian laws, statues, regulatory frameworks or policies. The User Rights of CF community members are described in Article 11 of the Sub-Decree on Community Forestry Management and in Article 40 of the Cambodian Forestry Law of 2002. All relevant forestry laws are available at http://www.forestry.gov.kh/Law/Regulations_Eng.html.

2.5.1.3 Sub-step 1c. Selection of baseline scenario

The most plausible baseline scenario, as is described in section 1.10 and in Sub-step 1a above, is the continuation of mosaic pattern deforestation in the project area.

2.5.2 Step 3: Barrier Analysis

2.5.2.1 Sub-step 3a: Identify barriers that would prevent the implementation of the type of proposed project activity

The project faces a number of barriers that prevent its implementation without the sale of carbon. Foremost, the project faces a financial barrier to implementation due to the fact that project produces no other financial benefits other than carbon sales. A limited amount of donor funding from DANIDA was secured in 2008, to begin the project actions that reduce deforestation, and cover initial activities for less than a year. Since then the project has not received any additional funding for implementation and thus has been required to postpone many of the planned project actions that will reduce deforestation in the project area, until such time as upfront payments for future carbon sales can be secured. Only when funds are secured from carbon sales will the project actions, training, capacity development, workshops, and technical assistance to support the ongoing monitoring of carbon stocks to ensure project activities are continued for the planned duration of the project. The "Project Costs" as listed in the Project Financials under 2011 represent the cost for activities that would have been implemented each year starting in 2008 if the project had funding to support these activities.

A further significant barrier is that the project is a "first of a kind" project in Cambodia as no other activities of this type are currently operational in Cambodia, as evidenced by the lack of any VCS or CCB registration of REDD project in Cambodia. Additional barriers to project implementation include, inter alia, a lack of enforcement of forest or land-use legislation in the project area, the long history of shifting agriculture, customs relating to land use, unclear or informal land tenure, demographic pressure on the land, and the presence of illegal resource use practices that are difficult to regulate and control.

2.5.2.2 Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternative land-use scenario

None of the barriers identified in Sub-step 3a prevent the implementation of the alternative land use scenarios that have been identified in Sub-step 1a. Rather, these barriers promote continued deforestation and degradation in the project area and serve to reinforce the alternative land use scenario. The financial barrier prevents the implementation of project activities to counteract the drivers of deforestation and degradation present in the project area, allowing mosaic-pattern deforestation to continue unmitigated. No financing is necessary for the continuation of mosaic-pattern deforestation and degradation in the project area. These activities have been continuing even with the formalization of the CF areas, and will continue unabated unless the project is able to implement the planned activities. Similarly, the additional barriers that have been identified in Sub-step 3a above would perpetuate deforestation and degradation in the project areas. Current customs relating to land-use and resources practices will not change without the benefit of the social and livelihood improvements that are being offered by the project. Illegal land-use activities such as hunting and illegal logging would also be expected to continue unabated given the current difficulties in preventing these activities in the project area.

2.5.3 Step 4: Common Practice Analysis

The project will undertake ten different activities to reduce degradation and deforestation in the project, five of which take place within the project area (project activities) and five of which take place outside of the project area (leakage prevention). These activities are listed in detail in Section 1.7.

While the general concept of some of the planned project activities is known and understood among local project stakeholders, the project activities have not been implemented at scale in the project area and surrounding geographical areas. The financial resources that are generated by the project will provide direct support for the implementation of, for example, forest monitoring and patrolling, boundary demarcation, installation of patrol huts and fire roads, improved communication infrastructure, ANR, and fire prevention maintenance. These activities all require

funding to support the employment and purchase of required equipment and as such, have not yet been implemented in the project area and broader geographical area. Other non-spatially-explicit project activities, such as land-use planning and agreements between communities, exist to some extent in the project area already but will require project funding to become fully effective. This is corroborated by data gathered from social appraisals and household surveys carried out in the project area and broader geographic area. These data will be made available during the validation process.

Activities related to mitigating leakage from the project have, in some cases, been implemented in the project area and broader geographical area. For example, fuel-efficient stoves are occasionally used, and it is the intention of the project to expand and reach saturation of these activities. Other activities, such as agricultural intensification, water resource development and NTFP development projects are wholly dependent on project funding.

At the time of validation, there are no known VCS REDD project activities being implemented in Cambodia. The Oddar Meanchey REDD project is expected to be the first project of its kind to be implemented in Cambodia. There are currently 57 CF areas outside of Oddar Meanchey, and therefore not included in the REDD project; 12 located in Banteay Meanchey province, 11 in Preah Vihear province and 34 in Siem Reap province. It may be possible in the future for these CF areas and other future CF areas to be developed as a REDD project.

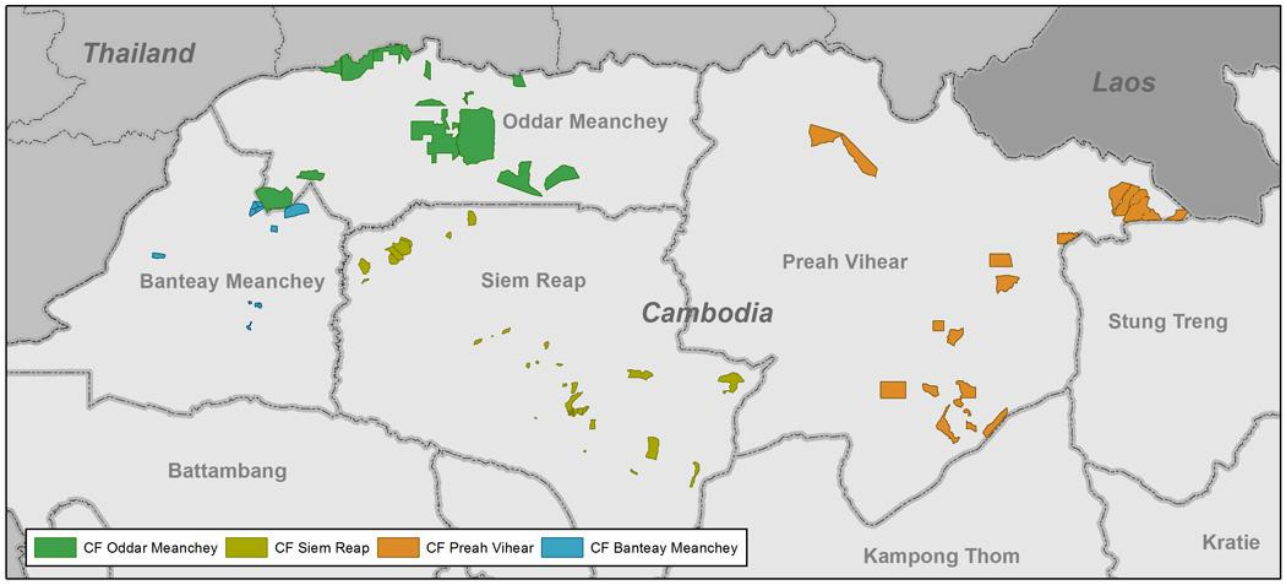


Figure 10. Community Forest areas in Cambodia

2.6 Methodology Deviations

There are no methodology deviations.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Step 1 – Select Spatial and Temporal Boundaries

3.1.1 Step 1A – Describe Spatial Boundaries of the Discrete Project Area Parcels

Shapefiles and kml files of the spatial boundaries of the discrete project area parcels are available to the auditor.

3.1.2 Step 1B and 1C – Select Size and Location of the Reference Region

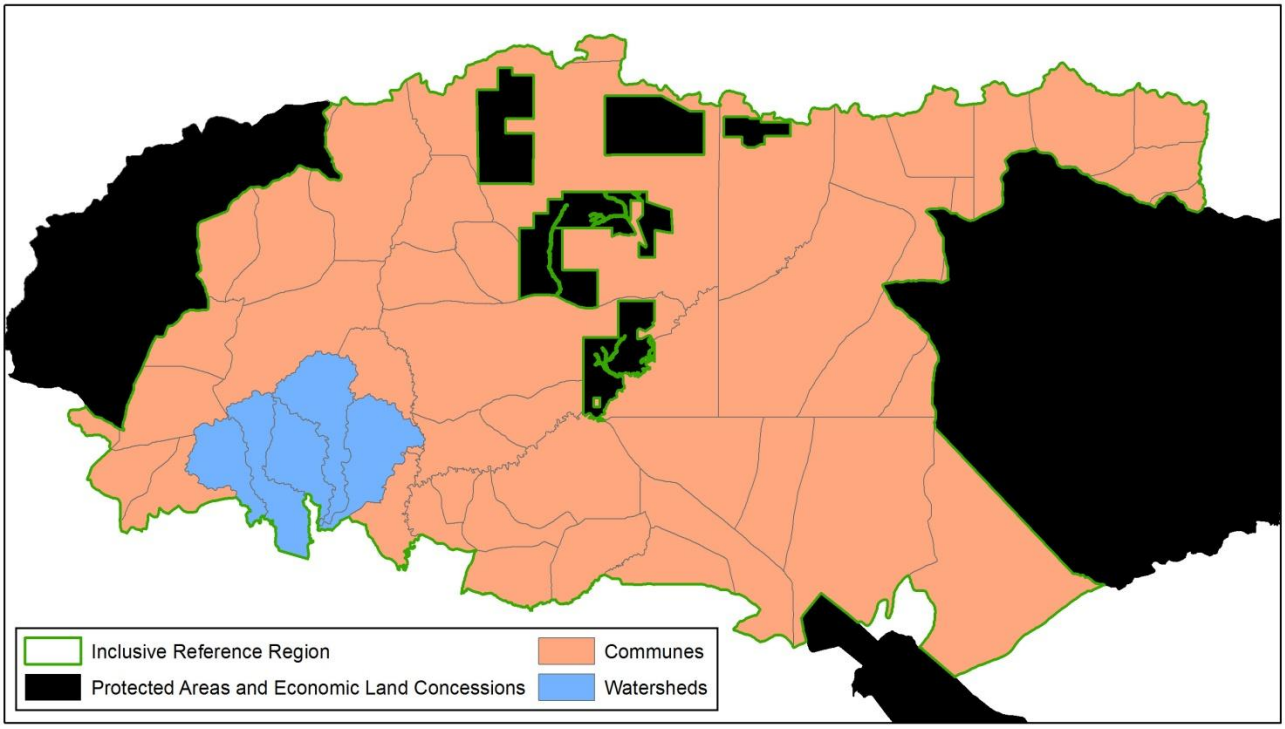
The variables considered for the selection of the size and location of the reference region were (1) forest laws and policies, (2) land use history and dynamics (forest cover, agricultural systems, etc.), (3) ecological conditions (forest types present and climatic conditions), and (4) social conditions (population density, sources of income). The selected reference region is based on subnational administrative units, Communes, which fall within the bounds of remote sensing imagery used for the LULC analysis. Watershed boundaries were used in areas where Commune boundaries exceeded the remote sensing imagery bounds Watersheds were generated using Space Shuttle Radar Topography (SRTM) elevation data. Due to differing forest laws, land use history and social conditions the buffer region was edited to exclude area that fell within:

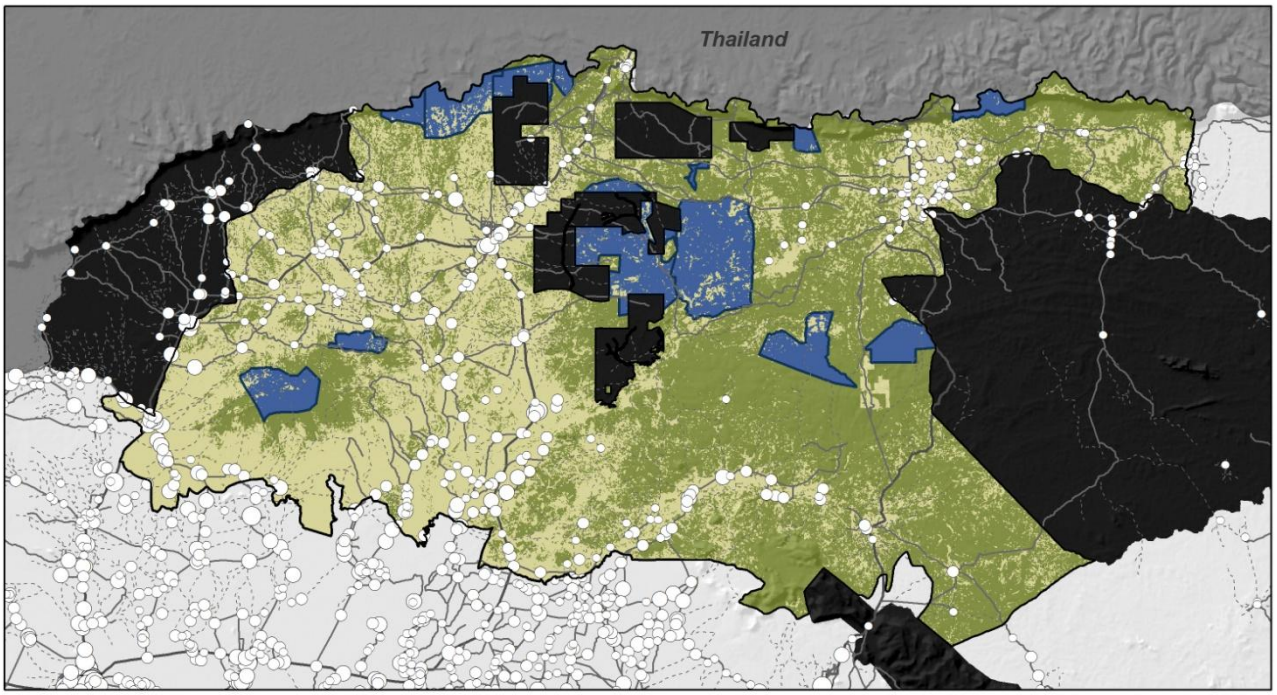
- Thailand
- All protected areas were excluded from the reference region. The protected areas included the Banteay Chhmar National Protected Area (IUCN Category IV), Kulen Promtep Protected Area (IUCN Category V), and Phnom Kulen National Park (IUCN Category II). The source of the protected areas was received from the Ministry of Environment.
- Economic Land Concessions

The total area of the reference region, excluding project areas, is 738,757 ha. The total size of the project area of 56,050 ha, the reference region is approximately 13 times larger than the size of the project area.

3.1.3 Step 1D – Demonstrate the similarity between project area and reference region

The elevation and slope in the reference region and project areas are within 10%. The soil types are similar, with about 60-70% podzols (red-yellow and plinthite), about 15% lithosols and the remainder by hydromorphs. The proportion of forest types between the project areas and the reference region does not differ with more than 10%. There is less agriculture and land conversion in the project areas and proposed leakage belt than in the reference region, primarily due to the removal of non-forest areas from the project areas. Project activities are located in regions where there is still a sufficient amount of forest cover to justify implementation of a REDD project. Disturbance by villages in the project area is slightly less than in the reference region and there is a greater degree of disturbance by roads in the project areas. There is a lower population density in the project areas, but new roads have recently been built close to the project areas, which threaten the forest resources.





Settlement Population
- < 500
- 501 - 1000
- 1001 - 2500
- 2501 - 5000
- > 5000

- CF Boundary
- Project Areas
- 2008 Forest Cover
- Reference Region
- PA and ELC

Roads
- Major Road
- Minor Road
- Track

Figure 11. Boundary components of reference region (above) and overview of the extent and location of the reference region with forest cover, roads and populated places.

Table 13. Comparison of key variables between the reference region and the project area.

Key Variables		Reference Region	Project Area
Elevation	Median	68 m	60 m
	Standard deviation	57 m	80 m
	Max	675 m	568 m
Slope (percent)	Mean	2%	4%
	Standard deviation	4%	8%
	Max	90%	78%
Slope over 10%	Percentage of total area	2%	9%
Soil types	Red-yellow podzols	31%	26%
	Plinthitepodzols	34%	36%
	Acid lithosols	10%	19%
	Cultural hydromorphs	16%	16%
	Grey hydromorphics	9%	0%
Forest type composition 2008 LULC	Deciduous/Mixed	58%	60%
	Evergreen	42%	40%
Land-use	Agriculture in 1997	13%	0%
	Cleared land between 1997 and 2002	9%	2%
Forest disturbance	By village and roads	18%	4%
	Only by villages	7%	7%
	Only by roads	10%	30%
	Other forest disturbance	19%	1%
	Total forest disturbance	83%	44%

Note that the project area, by definition, only contains forest. Therefore, the degree of disturbance is greatly reduced in the project area compared to the reference region, which explains the discrepancy in disturbance between the reference region and the project area.

3.1.4 Step 1E – Specify Temporal Boundaries of the Project

The temporal boundaries of the project are as follows;

- Historical reference period: November 17, 1990 – June 9, 2007
- Project crediting period: 30 years (February 28 2008 – February 28 2037)
- Verification frequency: 2 years
- Frequency of Baseline update: 10 years

3.2 Step 2 – Analyze Historical Deforestation and Forest Degradation in the Reference Region

3.2.1 Step 2A – Describe Data Sources

The approach used in this project was to combine remote sensing data with non-remote sensing geographical data. In total, six historical Landsat images were used, together with some high-resolution images for validation and ground-truthing purposes (Table 14). Historical Landsat images were downloaded from the decadal dataset (1990, and 2000). No image was available for 2005 at the time of the analysis. These were supplemented with recent Landsat-5 images from

the Thai remote sensing service CUDOS. Images were obtained from 2004, 2006, and 2007. For validation of the medium-resolution Landsat images, an image of the SPOT-5 satellite from around 2005 was acquired, together with airborne images from 2003-2006. Table 15 and Table 16 contain more information on the characteristics of the Landsat TM and ETM, and SPOT-5 sensors.

Administrative boundaries, map of villages, and previous LULC classification maps were available (Table 17).

Table 14. Overview and characteristics of all the remote sensing geographical and spatial available for this project.

Source	Type	Resolution	Acquisition Date	Sensor	Coordinate System and Pre-Processing
CGIAR-SRTM	Satellite, Interferometric Synthetic Aperture Radar based Elevation Model	90m	2000	SRTM	• Hole-filled (interpolated)
USGS GLOVIS	Satellite, Multispectral	30m	1/28/1994	TM	• Basic radiometric corrections • Geometric corrections for systematic effects • Ortho-rectified and projected to UTM 48N
USGS GLOVIS	Satellite, Multispectral	30m	3/25/2000	ETM+	• Basic radiometric corrections • Geometric corrections for systematic effects • Ortho-rectified and projected to UTM 48N
USGS GLOVIS	Satellite, Multispectral	30m	1/10/2002	ETM+	• Basic radiometric corrections • Geometric corrections for systematic effects • Ortho-rectified and projected to UTM 48N
CUDOS	Satellite, Multispectral	30m	11/7/2004	TM	• Basic radiometric corrections • geometric corrections for systematic effects • projected to UTM 48N
CUDOS	Satellite, Multispectral	30m	12/15/2006	TM	• Basic radiometric corrections • geometric corrections for systematic effects • projected to UTM 48N
USGS GLOVIS	Satellite, Multispectral	30m	12/20/2008	TM	• Basic radiometric corrections • geometric corrections for systematic effects • projected to UTM 48N

Table 15. Bands and resolution of the TM and ETM+ data.

Band nr.	Resolution (m)	Band name	Wavelength (µm)							
			TM				ETM+			
			from	to	mid	FWHM	from	to	mid	FWHM
1	30	Blue	0.45	0.52	0.485	0.035	0.45	0.52	0.485	0.035
2	30	Green	0.52	0.6	0.56	0.04	0.53	0.61	0.57	0.04
3	30	Red	0.63	0.69	0.66	0.03	0.63	0.69	0.66	0.03
4	30	Near infrared	0.76	0.9	0.83	0.07	0.78	0.9	0.84	0.06
5	30	Short-wave infrared	1.55	1.75	1.65	0.1	1.55	1.75	1.65	0.1
6	120	Thermal infrared	10.4	12.5	11.45	1.05	10.4	12.5	11.45	1.05
7	30	Mid infrared	2.08	2.35	2.215	0.135	2.09	2.35	2.22	0.13
8	15	Panchromatic	Not available				0.52	0.9	0.71	0.19

Table 16. Bands and resolution of the SPOT-5 data.

Band nr.	Resolution (m)	Band name	Wavelength(µm)			
			from	to	mid	FWHM*
1	2.5	Panchromatic	0.48	0.71	0.595	0.115
2	10	Green	0.5	0.59	0.545	0.045
3	10	Red	0.61	0.68	0.645	0.035
4	10	Near infrared	0.78	0.89	0.835	0.055
5	20	Mid infrared (MIR)	1.58	1.75	1.665	0.085

*FWHM = Full-width half maximum

Table 17. Overview and characteristics of all the non-remote sensing geographical and spatial available for this project.

Map	Source	Minimal Mapping Unit	Classification Method Used	Match with used classes	
				Original class	PD LULC class
Forest Cover in 1976	Mekong Secretariat	About 50 ha	Aerial photography and field surveys	"Evergreen"	EVG
				"Deciduous"	DCD
				"Woodland and Shrub"	BAR
Land use in 2002	Japanese International Cooperation Agency	About 10 ha	Automated Landsat and SPOT data interpretation	"Evergreen"	EVG
				"Mixed"	DCD (partially)
				"Deciduous"	DCD (partially)
				"Woodland and Shrub"	(part of) BAR
Forest Cover in 2006	Forest Administration	About 10 ha	Automated Landsat and SPOT data interpretation	"Evergreen"	EVG
				"Semi-evergreen"	DCD (partially)
				"Deciduous"	DCD (partially)
				"Woodshrub dry"	BAR
Road maps from 2005	Department of Geography and the Japanese International Cooperation Agency	< 30 m	Aerial photo and satellite interpretation	Not relevant	
Map of villages	Department of Geography, 2005 and Cambodia Mine Action and Victim Authority	< 30 m	Surveys	Not relevant	
Administrative boundaries	Department of Geography, 2005	< 30 m		Not relevant	

3.2.2 Step 2B – Define LULC Classes and Forest Strata

The methodology requires that the LULC classification and stratification is applicable for both the reference region and the project area. In addition, the LULC classification and stratification must be documented separately for the project area and the reference region.

3.2.2.1 LULC Classification and Stratification in the Reference Region

The following categories represent indeterminate or "no data" categories in the remote sensing data. During post-processing of imagery, these classes were reclassified into one of the primary IPCC classes, where possible, based on ancillary data and temporal filtering (cfr. infra).

1. **Burn Mark (BRN).** Much of the Oddar Meanchey project area burns every year. Even though dry deciduous forests have naturally occurring fires, the frequency of fires has increased due to human intervention. Agricultural plots are also burned resulting in BRN classification. This class is indeterminate and may be reclassified as forest, grassland, or cropland.

2. **Cloud Shadow (CLS) and Clouds (CLD).** Thick clouds and resulting shadows obscure underlying LULC classes. Satellite scenes for classification were selected based on a minimum cloud threshold of 20% resulting in a high number of dry season images.
3. **Bare or Lightly Wooded Area covered by haze (THS)** Thin and semi-transparent clouds and haze may affect spectral response of classes. Therefore, areas covered by cloud and haze must be classified separately to ensure that no spectral confusion with other land classes occurs.
4. **Forest area covered by haze (THF)**. See THS

As stipulated in the methodology, the six IPCC LULC classes are included here. The non-forest LULC classes have (by definition) a forest cover smaller than 10%. Basic criteria to identify the LULC classes based on satellite images are summarized in Table 18. Some example pictures are provided in Table 19. The full Standard Operation Procedures used for classification, containing detailed descriptions and criteria to identify the LULC classes is available to the verifier.

1. **Grassland (BAR)** is land that is bare or lightly wooded < 10% canopy cover. Most grassland used to be forested, but gradually lost forest cover through human intervention until it the cover was below the 10% threshold. It may contain some solitary trees or shrubs, but is dominated by grasses. This class also includes agricultural land that does not contain green vegetation at time of classification (i.e. fallow, tilled or harvested fields) and developed areas (i.e. roads, villages).
2. **Cropland (AGR)** is abundant in the province. According to the 2005-2006 agricultural census of the Ministry of Agriculture, Forestry and Fisheries of Cambodia (MAFF, 2006) the main crops grown are rice (94% of the area), sesame (2% of the area), and vegetables (0.5%). Rice is the most important crop in Cambodia and covers 70% of the nutritional energy needs. Cultivation almost entirely takes place during the wet season. For dry season satellite images most AGR classes are identified as BAR.
3. **Wetlands (WTS)**. This class contains open water and wet soil. Due to the monsoonal climate, many areas remain inundated during at least part of the year. This is a natural phenomenon. Although seasonal wetlands and swamps may exist naturally within the forest systems of the Oddar Meanchey Province, no perpetually flooded forests and flooded shrublands are present in the province. A few perpetually wet water ponds, lakes and rivers are present in the province.
4. **Settlement (STL).** Even though most areas in the Oddar Meanchey province are populated, the area with defined urbanized characteristics or developed infrastructure is minimal.
5. **Other Land (OTL).** No other land, as defined by the IPCC is present in the reference region.

Table 18. Basic criteria, thresholds, and characteristics for the non-forest LULC classes.

Name	Code	Criteria and Thresholds		Seasonality	Management
Grassland	BAR	Canopy Closure Tree Height Red DN NIR DN SWIR DN Boundaries	< 10% NR Medium Low High Gradient	Grasses and shrubs dominate. Grass senesces during the dry season (November through April).	Significant human intervention. Frequent fires (no understory and dry grass biomass).
Cropland	AGR	Canopy Closure Tree Height Red DN NIR DN SWIR DN Boundaries	< 10% NR Low High Medium Distinct	Main cropping season from May to September. Fallow agriculture classified as bare soil.	Significant human intervention
Wetlands	WTS	Canopy Closure Tree Height Red DN NIR DN SWIR DN Boundaries	< 10% 0 m Medium Low High Gradient	Slowly dries out during the dry season (November through April)	Occurs naturally, within forest systems and may be used for rice cultivation
Settlement	STL	Canopy Closure Tree Height Red DN NIR DN SWIR DN Boundaries	< 10% NR Medium Low High Gradient	Settlements are often created during the dry season.	Significant human intervention. Some fruit trees may be grown
Other land	OTL	Not present			

Note that the final classification was based on a much more elaborate procedure. Procedures for the final classification are available to the verifier.

Table 19. Representative pictures for the non-forest LULC classes

Grassland (BAR)	Settlement (STL)
	
Cropland (AGR)	**Wetland (WTS)**
	

6. **Forest Land.** The majority of forests in the project area are in dry-land ecosystems. With around 1,300 mm rainfall and a dry period of more than 4 months, the Oddar Meanchey Province is one of the drier regions in the country. The project site is covered by lowland evergreen, semi-evergreen, and dry deciduous forests. Semi-evergreen forests contain mixture of evergreen and deciduous trees, with the percentage of evergreen trees varying from 30% to 70%. Semi-evergreen forests appear evergreen throughout the year, despite a frequently high proportion of deciduous trees. Deciduous forests are comprised of deciduous and mixed forests and dry Dipterocarp forests, both of which drop most of their leaves during the dry season. The following sub-steps were executed:

    a. **Sub-Step 1: Assess the key factors**. They key factors identified were (1) forest type, and (2) landscape factors including slope, elevation, and aspect.

    b. **Sub-Step 2: Collect maps of key factors**. Maps of forest types were obtained from the Mekong Secretariat, the Japanese International Cooperation Agency and the Forest Administration (see Table 17 for more information on these maps). In addition, a slope, elevation and aspect map was created based on the SRTM dataset.

    c. **Sub-Step 3: Preliminary stratification.** As a preliminary stratification contained, we adopted the typical classification according to the proportion of evergreen species. Kim Phat et al. (2002) distinguish three predominant forest types:

deciduous, mixed/semi-deciduous, and evergreen. Deciduous forests contain almost exclusively deciduous tree species (>90%). Mixed forests contain both deciduous and evergreen tree species, where deciduous species represent more than 50% of the stand. Evergreen forests are dominated by evergreen tree species. In addition, we identified small areas of steep terrain as different strata.

d. **Sub-Step 4: Field survey**. During the field survey, biomass inventories were conducted in each of the preliminary strata. Pictures taken during the field survey are presented in the table below.

e. **Sub-Step 5: Final stratification**. After the field survey, it was noted that it was often difficult to distinguish between mixed and deciduous forest types in the forests of the Oddar Meanchey Province. Therefore, in the analysis of the carbon stocks, any dry-land forest system of which more than 30% of the trees are deciduous are part of a combined "mixed and deciduous" forest stratum. Combining the forest descriptions of mix deciduous and deciduous into one stratum does not reduce precision nor lower variance. Evergreen forest, in contrast, contains 70-100% evergreen species. A further subdivision of the evergreen (EVG) and deciduous and mixed (DCD) forest classes was not possible. The latter is also illustrated by a low correlation between spectral properties of Landsat imagery and on-the-ground measured biomass within the two major forest classes. This is illustrated in where NDVI regressions against field biomass values have r^2 values of 0.0032 for DCD and 0.1898 for EVG.

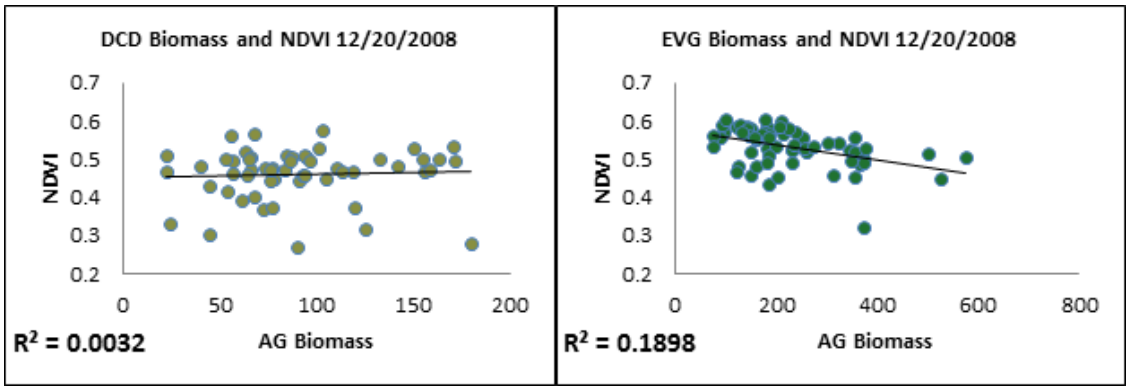


Figure 12. Relationship of NDVI and biomass for forest plots

The following is a comprehensive description of the final strata:

1. **Deciduous and Mixed (DCD)** forests are relatively open, and have low crown covers, only exhibiting a closed canopy structure during the wet season. The single-tree stratums of these forests generally feature tree diameters of less than 40 cm and are relatively species poor, dominated by Dipterocarps and a few gregarious species such as *Lagerstroemia* spp. and *Xyliadola briformis* as well as numerous scattered associated species such as *Afzelia xylocarpa*, *Pterocarpus pedatus*, *Ceiba pentandra*, and *Irvingia oliveri.* Important indigenous tree species include *Albizia lebbeck* (chres), *Fagraea fragrans* (ta trao), *Diospyro scruenata*, (cheuk mao), *Gardenia ankorensis* (daikhla), *Dalbergia oliveri*, *Pterocarpus macrocarpus*, *Dipterocarpus turbinatus*, and *Afzelia xylocarpa* (beng) a high-value deciduous broad-leaved tree. A number of bamboo species are also present in these forests. In the dry season, this forest type is subject to frequent fires. Although fire is a natural phenomenon in these systems, human intervention has exacerbated the incidence of fire due to the extremely dry conditions during the dry season. Due to fires, the understory is nearly always sparse and dominated by grasses. Kim Phat et al. (2002) estimated that the

average growing stock varies between 52 and 60 m^3 ha^{-1} with annual growth rates from 0.08 to 0.37 m^3 ha^{-1} yr^{-1}.

Human impacts, such as degradation from fire, typically occurs with more frequency in deciduous forests compared to other forest types. In contrast to the dense crown closure found in older growth evergreen forests, dry Dipterocarp forests naturally have a more open canopy leaving them more susceptible to degradation from fire. Even in an undisturbed deciduous forest, crown cover may only have a 40% closure. Approximately 20% of the forest in the project area is degraded, containing less than 20% canopy closure, especially in areas with dry deciduous forest. This forest degradation has occurred over the past 15 years, and has accelerated in the last 5 years. Annual human-caused ground fires contribute to this degradation, as they are common occurrences in the dry deciduous forest.

2. **Evergreen Forests (EVG)** in Oddar Meanchey Province are mainly dry-land evergreen forests (in contrast to highland forests or tropical rainforests). They are multistory forests with more than 70% trees of evergreen species, and a canopy cover of 80-90%. The average growing stock varies between 192 and 230 m^3 ha^{-1} with annual growth rates varying from 0.21 to 0.67 m^3 ha^{-1} yr^{-1}(Kim Phat et al., 2000). These floristically and structurally heterogeneous forests occur in humid to sub-humid areas where the rainfall exceeds 1,200 mm per year and the dry season lasts three to five months. Emergent trees such as *Ficus* spp., *Dipterocarpus alatus*, *Shorea vulgaris*, *Anisoptera cochinchinensis* and *Tetrameles nudiflora* may exceed 40 m high. These emergent species have cylindrical boles up to 20 m high, which are both aesthetically pleasing and attractive for building materials. In evergreen forests a diverse continuous tree stratum occurs between 20 to 30 m high with no species composition clearly dominating. *Ficus*, spp. *Irvingia malayana*, *Sindora cochinensis*, *Pterocarpus pedatus*, and *Pahudia cochinchinensis* are commonly found.

   Although Cambodia has a significant area of forest plantations (82,425 ha in 1997 according to DFW 1998), the plantations are mostly scattered on old paddy fields or unmanaged farms near Tonle Sap Lake or the Mekong River. Because this area is relatively small compared with the area of dry-land forests in the northern plains, the few forest plantations present were included in dry-land forests. This inclusion will not significantly affect the carbon accounting.

3.2.2.2 LULC Classification and Stratification in the Project Area

During the field visit, similar conclusions were made regarding the classification in the project area as in the reference region. More specifically (1) similar species were observed in the reference region as in the project area, (2) similar biophysical conditions and soil types were present in the project area as in the reference region. A more in-depth comparison of the similarity of the forest stratification between the project area and the reference region is presented in Table 13. Further evidence is contained in the biodiversity study.

Table 20. Representative pictures of evergreen and mixed/deciduous strata.

Examples of Evergreen forests (EVG)		
		
Examples of Deciduous and Mixed Forest (DCD)		
		

3.2.3 Step 2C – Define Land Transitions between LULC classes and Forest Strata

Deforestation (DF) is the transition of a forest class to a non-forest class (degraded land, cropland, or settlement). Reforestation is not allowed as a project activity under this methodology, under the baseline it can occur and should be accounted for. Upon **reforestation (RF)**, land can go from a non-forest class to the forest class with the lowest carbon density class. Assisted reforestation is not included in this project; natural reforestation due to natural succession is included in this project.

The period of temporarily unstocked was set to 3 years. The rationale for this duration is that when no anthropogenic pressures are present, woodlands that have a canopy cover less than 10% can grow back into a forest area with canopy cover greater than 10% given the observed forest growth rates in the province. However, in practice, it is likely that all recently deforested land will remain out of forest cover in the baseline scenario, given the pressures on the forest area. Therefore, no land was classified as temporarily unstocked forest in the project area. Another class of temporarily unstocked forests is managed forests that are frequently harvested according to a harvesting schedule. However, no large areas of commercially managed forests are present in the reference region. A theoretical period of temporarily unstocked forests was still added to Table 21.

All transitions between forest strata and non-forest LULC classes were included except for transitions from forest strata to settlements and vice versa. The latter transitions were not considered since the settlement class is insignificant in the classification. Areas that represent

hamlets, villages, and towns are present in the "grassland" category. This is conservative since grasslands have higher carbon stocks than settlements.

Table 21. LULC change category table showing all possible LULC transitions.

From Class	To Class	Transition	Period of Temporarily Unstocked
DCD	BAR	Deforestation	3 years
DCD	AGR	Deforestation	3 years
DCD	WTS	Deforestation	3 years
EVG	BAR	Deforestation	3 years
EVG	AGR	Deforestation	3 years
EVG	WTS	Deforestation	3 years
BAR	DCD	Reforestation	Not relevant
AGR	DCD	Reforestation	Not relevant
WTS	DCD	Reforestation	Not relevant
BAR	EVG	Reforestation	Not relevant
AGR	EVG	Reforestation	Not relevant
WTS	EVG	Reforestation	Not relevant

3.2.4 Step 2D – Analyze Historical LULC Class and Forest Strata Transitions

3.2.4.1 Description of Remote Sensing Procedures

A comprehensive and detailed log of all individual steps employed during remote sensing analysis and classification is available to the verifier. Briefly, the following steps were executed to obtain the historical time series of classified images.

1. First, all Landsat images were **geographically corrected** to a Level 1 Terrain correction (L1T). The Level 1T (L1T) data product provides systematic radiometric and geometric accuracy by incorporating ground control points, while also employing a Digital Elevation Model (DEM) for topographic accuracy. The ground control points used for Level 1 Terrain correction come from the GLS2005 data set. DEM data used for terrain correction include SRTM, NED, CDAD, DTED, and GTOPO 30. The Landsat images from 11/17/1990 and 11/04/2000 were obtained from NASA's decadal dataset and were already at an L1T correction. All other images were transformed into an L1T level correction by an external remote sensing firm using the same algorithm that was used in NASA's decadal dataset. The resulting RMS error was < 1 TM pixel. A Nearest Neighbor re-sampling was used during the geographical registration. Due to the great influence of seasonality on the spectral signature of different LULC classes, a separate classification for each image was conducted. Therefore, no **radio-metric correction** was applied on the images, and the digital numbers were used as input to the supervised classification algorithms.
2. After geographic registration, all bands were composited into one image and re-cut to a standard Area of Interest., the smallest rectangle covering the entire reference region.
3. The SPOT-5 image was pan-sharpened to get a 4-band multispectral image with 2.5 m resolution using a Gram-Schmidt pan sharpening algorithm.
4. All Landsat images were uploaded to a web-based reference point collection system. Six analysts interpreted 3,000 reference points based on the time series of Landsat images and high-resolution imagery from Google Maps, Microsoft Bing Maps, and the SPOT-5 and SPOT-4 imagery. Only points for which there was a 70% consensus among analysts were retained. The reference points were randomly divided into 66% training points and 33% verification points.

5. A forest type layer indicating the native locations of Deciduous forest and Evergreen forest was developed by combining the spectral bands of the 19890122 and 19901125 images and running a machine learning algorithm using the training points collected above. This forest type layer was created to be used as an ancillary data layer for the final classification.
6. All images in the historical reference period were classified using a machine learning algorithm. The forest type layer was added as ancillary data due to minimize confusion between dry-deciduous forest and bare soil during the leaf-off season.
7. After classification, the spatial coherence was improved by applying some morphological operations (clumping and sieving, and majority filtering).
8. Accuracy metrics were calculated based on the randomly selected verification points for each of the images in the historical reference region.

Figure 13 shows a time series of images and classification maps near the town of Trapping Pasay in the East of Oddar Meanchey. The gradual deforestation along the road is very prominent. Upon degradation, evergreen forest will be classified as deciduous and mixed forest. As a consequence, the fine classification procedure detects all evergreen-to-deciduous transitions and classifies these cells as “degraded evergreen”. It can be observed that the greenness of agricultural fields can differ significantly among the different years. Land that is characterized by a bare soil spectrum in some years, may have a much greener spectrum in other years, and are classified as agricultural fields.

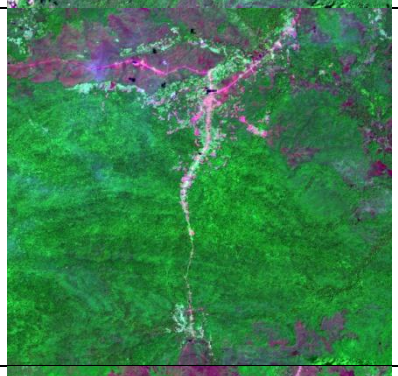
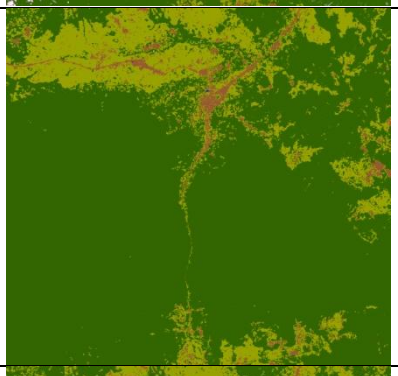
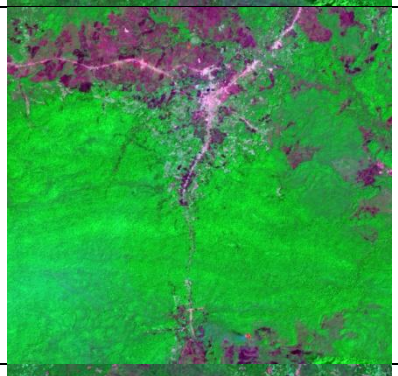
Year	Spectral Image (7-4-2 Band Combination)	Classification
1990		
2000		
2003		
2004		

Figure 13. Example of the LULC maps produced by the classification procedure near Trapping Prasat in Oddar Meanchey.

3.2.4.2 Classification Accuracy

The 30% of the reference points that were assigned as verification points were used to assess the accuracy of land use classification. Confusion matrices for each of the images were calculated. The classified images are classified with sufficiently high accuracy, as demonstrated by the confusion matrices (available to the verifier) and accuracy measures (Table 22).

Table 22. Accuracy for the verification of the classification of the images in the historical reference period.

Image (YYYYMMDD)	Overall Accuracy
19940128	98%
20000325	99%
20020110	96%
20041107	94%
20061215	94%
20081220	94%

Table 23. Omission errors of the images in the historical reference period.

Image (YYYYMMDD)	BAR	DCD	EVG	WTR
19940128	98%	91%	99%	100%
20000325	99%	94%	99%	100%
20020110	95%	88%	98%	100%
20041107	95%	89%	95%	100%
20061215	96%	89%	95%	100%
20081220	98%	87%	93%	100%

Table 24. Commission errors of the classification of the images in the historical reference period.

Image (YYYYMMDD)	BAR	DCD	EVG	WTR
19940128	98%	95%	98%	100%
20000325	99%	96%	99%	100%
20020110	96%	92%	97%	100%
20041107	96%	93%	92%	100%
20061215	97%	94%	91%	100%
20081220	98%	92%	91%	100%

3.2.4.3 Classification Change Matrices

LULC change transitions between two images are summarized using LULC change category matrices. The original change matrices are available to the validator.

Table 25. Total area per LULC class for each of the remote sensing images of the historical reference period.

	Area per LULC class (ha) for a given date (YYYYMMDD)					
LULC class	19940128	20000325	20020110	20041107	20061215	20081220
BAR	2090418	2430355	2590815	3226929	3622649	3799471
DCD	2784177	2500097	2677539	2675676	2608362	2503238
BRN	1412	0	10541	27	1926	12203
EVG	3309800	3254828	2916309	2307583	1979006	1780623
WTR	32331	30884	22934	6053	6046	5579

3.2.5 Step 2E – Summarize all Historical Land Transitions

Table 26. Transition rate between "From" and "To" class for the 5 time periods in the historical reference period.

		From 19940128 to 20000325	From 20000325 to 20020110	From 20020110 to 20041107	From 20041107 to 20061215	From 20061215 to 20081220
From Class	To Class	[ha yr^{-1}]	[ha yr^{-1}]	[ha yr^{-1}]	[ha yr^{-1}]	[ha yr^{-1}]
DCD	BAR	3490	3507	12617	12929	5983
DCD	AGR	0	0	0	0	0
DCD	WTR	50	1	1	15	6
EVG	BAR	1399	4265	7090	4351	2504
EVG	AGR	0	0	0	0	0
EVG	WTR	53	30	1	22	3
BAR	DCD	17	140	130	365	264
AGR	DCD	0	0	0	0	0
WTR	DCD	4	59	4	1	0
BAR	EVG	1	19	12	56	201
AGR	EVG	0	0	0	0	0
WTR	EVG	6	5	0	0	0

3.3 Step 3 – Analyze the Agents and Drivers of Deforestation

3.3.1 Step 3A – Identify Deforestation and Forest Degradation Agents and Drivers

See Section 1.10.1.

3.3.2 Step 3B – Assess the Relative Importance of the Deforestation Drivers

The 10 drivers of deforestation contribute to the total observed deforestation and forest degradation rates to different extents. Quantifying the relative importance of each of the drivers

to the total deforestation or degradation is important to estimate how much the proposed project activities will reduce deforestation. It is deduced from interpretation of satellite images that forest clearing for land sales and conversion to cropland or settlements account for almost all of the observed deforestation. It was found that the conversion of forest to cropland by local communities was the most important contributor to GHG emissions. The use of fires for clearing forests was the second most important contributor to GHG emissions in the project area, followed by forest clearing for land sales and conversion of forest to settlements. The contributions of timber harvesting for local use, fuelwood gathering by local communities and forest fires induced by hunters were small. The following table summarizes the relative contributions of each of the drivers of deforestation. An in-depth calculation and justification of the reliability of these values are available to the validator.

Table 27. Relative importance of the different drivers of deforestation to the total deforestation rate.

Drivers of deforestation	Importance [%]
1. Forest clearing for land sales	13%
2. Conversion to cropland	57%
3. Conversion to settlements	7%
4. Fuelwood gathering	1%
5. Forest fires induced to 'clean' the land	20%
6. Forest fires induced by hunters	0%
7. Illegal logging for commercial on-sale	2%
8. Timber harvesting for local use	0%
9. Large economic land concessions	0%
10. Timber concessions	0%

3.3.3 Step 3C – Analyze of the Mobility of Each Deforestation and Forest Degradation Driver

Under the methodology used, it is assumed that leakage through activity shifting occurs within a set region close to the project area, the leakage area. To quantify the potential for leakage, the project analyzed the possible responses when the certain uses of the project area are no longer allowed or discouraged due to a REDD project. This analysis included the size and location of the leakage area. Transportation methods include foot, bicycle, motorbike, tractor, ox-cart, and car/truck. The percentages of households utilizing these vehicles for transportation are shown in Table 28. The majority of participants use communal forms of transport such as tractors and ox-carts to travel to/from crop-fields, for fuelwood collection, etc. Meanwhile, bicycles and walking are commonly used for activities such as NTFPs and collecting small wood. The mobility of each deforestation driver, and travel distance of each deforestation agent, is shown in Table 29. Different mobile units are used by communities in the project area for extracting forest products such as timber, fuelwood, charcoal, and NTFPs.

Table 28. Different mode of transportation used by communities (%) for extraction of forest products.

Mode of transport	Timber	Fuelwood	Crop / fields	NTFP	Small wood	Sand	Charcoal
Walking	-	3%	2%	26%	13%	2%	7%
Bicycle	-	2%	1%	18%	6%	9%	7%
Motorbike	3%	2%	3%	19%	5%	9%	13%
Tractor	58%	48%	14%	32%	36%	40%	32%
Ox cart	23%	22%	49%	5%	26%	25%	19%
Car/Truck	17%	23%	30%	1%	14%	16%	21%

Large economic land concessions (driver nr. 9) are being planned at a national level. It would be extremely challenging to quantify leakage attributed to a REDD project in Oddar Meanchey at a national level. However, since the exact location of these ELCs is known, it is possible to exclude the ELC areas from the calculation of the historical and future deforestation rates in Oddar Meanchey. Thus, the calculated deforestation rate will be smaller than a deforestation rate that includes the economic land concessions. Therefore, using a deforestation which excludes concessions rate will be more conservative. The assumption behind this approach is that the gains from preventing ELCs being granted in the project area are cancelled because they will be granted elsewhere; leakage cancellation is 100%. This is a conservative assumption as it is likely that the granting of ELCs is proportional to the amount of accessible forest land, which will decrease in the project scenario.

The issuing of timber coupes (or timber concessions) is decided at a central or cantonment level. Therefore, the extent of the related leakage attributed to the REDD project will never exceed the reference region. However, it is unlikely under the project scenario that timber coupes will be moved within a set distance of the project areas. Since their location is often unknown, or unreliable, an identical approach for the large ELCs cannot be followed. To take this into account, we will monitor the area of these coupes, and decrease the annual deforestation rates calculated in the reference region with these areas. It is assumed that the area of the timber concessions is proportional to the available forestland in Oddar Meanchey over the long term. As a consequence, it is assumed that deforestation induced by this driver will decrease because the project area reduces the total available forest area in the province under the project scenario, compared to the historical reference period.

Table 29 summarizes the distance over which there will be a detectable difference in the deforestation rate due to each driver of deforestation. This information is necessary to decide the size and location of the leakage area. Please note that this table does not contain any information on the extent or quantity of leakage to be expected from each driver.

Table 29. Distance of activity shifting by individual drivers of deforestation.

Driver	Distance of Activity Shifting	Comments
1. Forest clearing for land sales	< 5 km	Migrants encroach along roads and next to already encroached areas. If one side of a road is protected, migrants will move to the nearest unprotected area. It is highly unlikely that this spatial encroachment pattern will affect encroachment patterns further than 5 km away from the project area.
2. Conversion to cropland	1-2 km	Most people living in the project communities have no motorized transport. It is therefore unlikely that they will clear land further than a few km away from their settlements for agriculture. Project support for new, more productive farming systems will help slow the rate of agricultural land expansion. In addition, democratically agreed land-use plans can maximize the efficiency of land used for agriculture.
3. Conversion to settlements	0.5 km	Most project communities are experiencing moderate settlement growth from natural increase and migration. Typically communities grow outward along roads. Future expansion would likely be limited in distance from the project area and leakage belt interface where many project hamlets are situated. Democratically agreed and organized land-use plans can prevent uncontrolled growth and maximize the efficiency of land for settlement.
4. Fuelwood collection	1 to 2 km	Given the abundance of forest resources, communities are adequately supplied with the required amount of fuelwood from project forests. Dry and deadwood collection from the project area would be permitted, reducing activity shifting to the leakage belt. The project seeks to offset future increases in fuelwood demand by introducing, monitoring and establishing the use of fuel efficient stoves. This will be accompanied by livestock protection from insects, reducing the need for wood-generated smoke.
5. Fires to induced clear the forest understory	0 km	Changes in forest management to decrease forest fires within the project area will not cause increased fire incidence outside of the project area. On the contrary, they could have a positive effect. This positive leakage is conservatively omitted.
6. Forest fires induced by hunters	< 5 km	Hunters are prevented from entering the project areas through social fencing, and empowerment of local enforcement bodies. It is expected that they will move to nearby forests. This effect will be negligible 5 km away from the project regions, compared to the effects in the reference region.
7. Illegal logging for commercial on-sale	< 5 km	Some CFMC actions have been able to reduce illegal logging by 70 to 100 % over the past 5 years. It is likely that illegal loggers will shift their activities to other nearby communes or districts. It is expected that the rate of illegal logging 5 km away from project areas will be identical to the effects in the reference region.
8. Timber harvesting for domestic use	< 2 km	No commercial timber harvesting will be permitted in the project area. Some subsistence felling for village houses will be allowed as prescribed in the management plan to ensure a sustainable yield. Low demand and well stocked forests will result in limited activity shifting for this driver.
9. Large ELCs	Spatially Excluded	Large ELCs are planned at a national level. Once granted, their exact location is known. Deforestation caused by large ELCs is excluded from the baseline deforestation rate (see main text).
10. Timber concessions	Numerically Excluded	Timber concessions are planned at a provincial level, but their location is not exactly known. A conservative estimate of their size will be subtracted from baseline deforestation rates (see main text).

3.3.4 Step 3D – Identify the Quantitative Driving Variables of Deforestation and Forest Degradation

3.3.4.1 Identification of Non-spatial Variables Driving Deforestation

- **Economic activity.** Over the past decade, Cambodia's GDP has been experiencing steady growth. Cambodia is an economy in transition and it is rapidly reaching the degree of economic activity found in its neighboring countries Vietnam and Thailand. (World Bank, 2010a). However, Cambodia is still a predominantly rural economy with very little industrial infrastructure. The industrial infrastructure present is mainly concentrated around Phnom Penh and is virtually non-existent in Northern provinces such as Oddar Meanchey. Annual per-capita GDP in rural Cambodia is less than US$ 400, and agriculture has remained the primary source of income for the majority of Cambodia (CSES 2009, World Bank 2005). Sustained increase in overall economic activity is therefore heavily dependent on agriculture and the amount of land available. Acceleration of economic activity is a direct cause of deforestation, especially in the Northern provinces where forest cover has remained high in the last two decades (SCW, 2006 – Atlas of Cambodia). The wide availability of forest lands in Oddar Meanchey has therefore induced a migration from the higher populated Southern provinces to the less populated Northern provinces (PRA 2010, NIS 2002). It is expected that there will be continuing and increasing pressure on forestlands to be converted to agriculture, especially large scale commercial plantations as private financing from other Asian countries increases.
- **Migration**. In addition to the wide availability of forestland in Oddar Meanchey, there are conflicting policies that affect the degree of in-migration. Recent efforts at the government level have attempted to decrease the size of the national army and the civil service (e.g., Phnom Penh News, 2006[1]). Part of these recent efforts is to provide land to retired soldiers and civil servants in the provinces with large forest areas, such as Oddar Meanchey (Poffenberger, 2009). In some cases, these come in the form of social concessions. As a consequence, while the FA seeks to achieve the national goal of retaining 60% of the nation's land area under forests (Ministry of Agriculture, Forestry and Fisheries, 2010), other government ministries and policy makers see economic development opportunities in converting the province's forest to uses that might generate faster economic returns or facilitate bureaucratic restructuring goals (Weiner, 2003).
- **Population growth**. As the economy of Cambodia has improved in the past decade, the population has grown steadily (CNISC, 2002, 2005). This trend is expected to continue. Cambodia has shifted to a more open and democratic society, strengthening ties with neighboring counties and presenting new opportunities to international trading partners (World Bank, 2010). Relatively stable political and economic conditions are attracting business and migrants and have increased population growth rates to more than 2% per year (CNISC, 1998, 2005), one of the highest in the region. Similarly, death rates fall as access to improved healthcare becomes more available. Increased population ultimately leads to deforestation and land degradation as more space is needed for agricultural and industrial expansion, as well as the creation of new settlements. The less populated and heavily forested Oddar Meanchey presents a valuable tract of land in which to expand.

[1] Available at http://www.khmerfuture.com/index.php/index.php?name=News&file=article&sid=1782

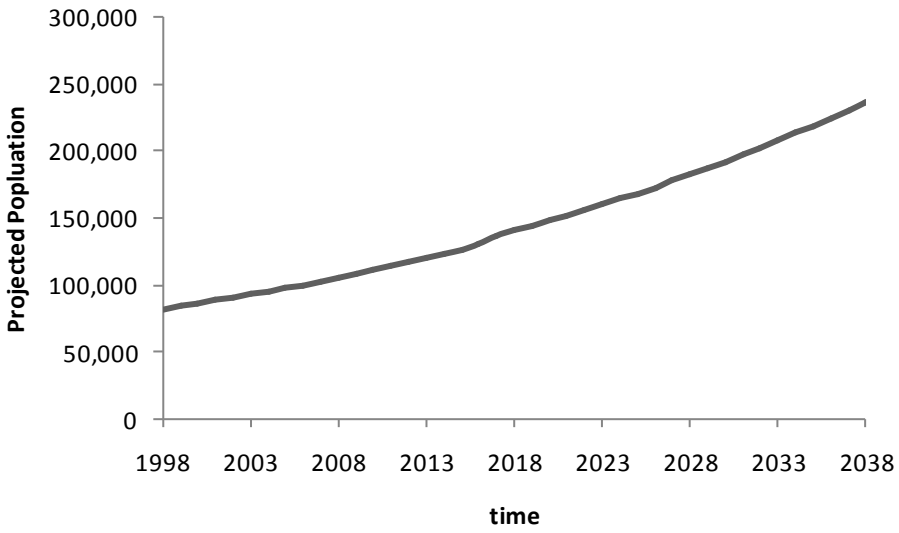


Figure 14. Projected population of Oddar Meanchey. Source: Cambodian National Institute for Statistics, Census of 1998 and 2005.

- **Rural wages.** It is expected that an increase in deforestation rates and pressure on forest lands will follow as rural wages derived from the sale of forest and agricultural products increase (see Table 30). Farmers and land users will further degrade the land extracting maximum production from soils, and clearing new forest areas to make way for agricultural land, as forest and agricultural products become more valuable (De Lopez, 2002). Therefore, it is important that policies and resources are put in place educate of rural populations about sustainable land use practices to reduce deforestation and degradation.

Table 30. Selected average daily wages for unskilled rural men and women between 1997 & 1999.

Daily Wage (USD)							
	Ploughing		Planting		Construction		Rural Labor
	1997	1999	1997	1999	1997	1999	2008
Men	1.88	1.76	1.07	0.96	1.58	1.38	2.5
Women	1.76	1.61	1.02	0.95	1.39	1.21	N/A

Source: http://www.adb.org/Documents/CERs/CAM/cam0101.asp for the 1997 and 1999 data, and the CFI Oddar Meanchey Social Appraisal for the 2008 value.

- **Demand for fuelwood**. More than 95% of the population of Cambodia depends on biomass for cooking (NIS 1998). Demand for fuelwood is not expected to decrease unless alternatives are readily available and cost-competitive. Wood gathered from forest areas is the most common form of fuel used (Top et al. 1994b). Additionally, wood smoke is used to repel pests from settlements and animals. Charcoal is increasingly in demand as it is often required in industrial activities and fetches a high price as a cooking fuel in urban areas (NIS 1998). Increased efficiency in stoves has the potential to significantly decrease the amount of fuelwood used in cooking. Options such as biogas, solar, sustainable woodlots, and rural electrification could decrease not only rural fuelwood use but also industrial demand.

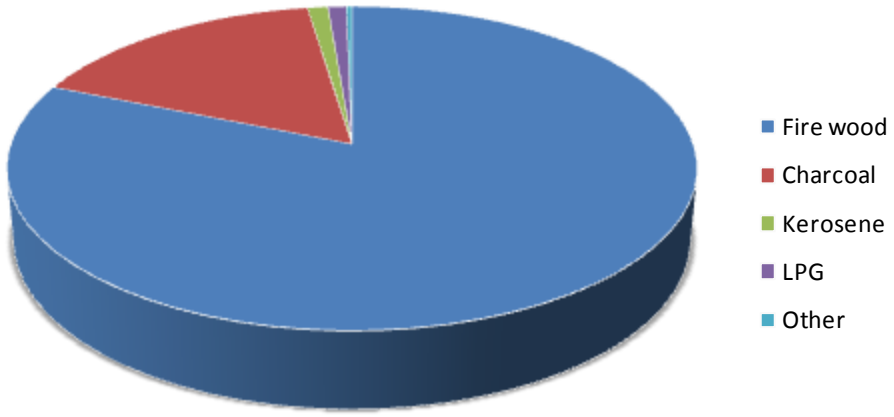


Figure 15. Energy sources used for cooking in Oddar Meanchey. (Source: CIPS 2004, NIS).

- **Prices of agricultural products**. The prices of agricultural commodities on international markets play a crucial role in determining the level of pressure on land that leads to deforestation. As global oil prices increase, biofuel crops such as jatropha and oil palm have fuelled the interest of large corporations to convert forestland into plantations (UN SRSG, 2004[2]). In addition, rice prices have increased significantly on the international market in response to the international rising cost of agricultural inputs (CDRI, 2008[3]). As the price for these key agricultural products on the market increases, the demand for agricultural land will increase. Though rice is almost exclusively the agricultural crop of choice in Cambodia (Mund 2011), rising prices of other food products, as well as luxury wood harvesting, could motivate corporate interest in farming operations. Currently, the large majority of agricultural activities are conducted by subsistence farmers (Mund 2011). However, should the market price of food staples and biofuel production crops keep increasing, there could be a shift to more cash-crops and industrial agriculture and a concurrent demand for land leading to increased levels of deforestation.

Table 31. Prices of key agricultural products; 2003 & 2008 comparison.

Prices of Agricultural Products (USD/MT)		
	2003	**2008**
Rice	$110	$700
Maize	$98	$350
Soybeans	$335	N/A

[2] Available at http://www.twgfe.org/Docs/OtherReports/UNSRSG%20Report%20on%20Land%20Concessions%20for%20Economic%20Purposes%20in%20Cambodia%20-%20A%20Human%20Rights%20Perspective%20%2806-Nov-2004%29.pdf

[3] http://www.cdri.org.kh/webdata/policybrief/highfoodpricesE.pdf

Table 32. Ten most important crops in Oddar Meanchey in 2005-2006.

	Cultivated Area (ha)	Relative Abundance	Yield (Mg DM ha^{-1})
Rice	44,956	94.06%	1.7
Sesame	993	2.08%	0.5
Vegetable	235	0.49%	1.6
Soybean	221	0.46%	0.5
Mungbean	210	0.44%	1.7
Maize	193	0.40%	1.8
Banana	185	0.39%	-
Peanut	136	0.28%	0.7
Cassava	132	0.28%	2.3
Sugarcane	95	0.20%	12.6

Source: Ministry of Agriculture, Forestry and Fisheries of Cambodia, agricultural census of 2005-2006

3.3.4.2 Identification of Spatial Variables Driving Deforestation

Six spatial drivers were identified that affect the deforestation likelihood. Each of the spatial drivers will affect one or more deforestation driver. These spatial drivers are used in a predictive statistical model to predict the location of future deforestation (). The model is calibrated based on data from the historical reference period. The model is re-calibrated during every baseline verification event.

Table 33. List of spatial drivers explaining the location of Land Use/Land Cover (LULC) change.

	Spatial Driving Variable					
Deforestation Driver	**Proximity to Roads**	**Population Density**	**Forest Type**	**Proximity to Forest Edge**	**Slope**	**Proximity to Thailand**
1. Forest clearing for land sales	●			●	●	
2. Conversion to cropland	●	●	●	●		
3. Conversion to settlements		●		●	●	
4. Fuelwood gathering	●	●	●	●	●	
5. Forest fires induced to clear the forest understory		●	●			
6. Forest fires induced by hunters						
7. Illegal logging for commercial on-sale	●		●		●	●
8. Timber harvesting for local use	●	●	●		●	
9. Large economic land concessions			●			●
10. Timber Concessions			●			

3.3.5 Demonstration that the Project Has Not been Implemented to Generate GHG Emissions

Deforestation has been occurring over a number of years in Cambodia based on many factors including illegal logging, economic land concessions and migrant encroachment. Deforestation has averaged 1.5%, country-wide, from 1990 to 2005 based on FAO estimates (Global Forest Resource Assessment, FAO, 2000b and 2005). There is however, large provincial variation in the annual net deforestation rates, with the highest being in the northwest provinces including Oddar Meanchey, estimated to be 3% annually as calculated by the Forestry Administration and supported by GRAS A/S of the University of Copenhagen between 2002 and 2006 (see Table 25).

The major factors that have led to deforestation have been widespread and not directly controlled by the project participants. Thus, project actions respond to the communities' desire to protect and sustainably manage their land, and have not been implemented to generate GHG emissions, apart from some indirect emissions that cannot be avoided and are outweighed by GHG benefits.

3.4 Step 4 – Determine Emission Factors for All Included Transitions

3.4.1 Step 4A – Identify the LULC Classes and Forest Strata for which Carbon Stocks are to be Quantified.

Based on direct estimates, modeling and remote sensing studies, it was found that similar forest systems as the ones found in our project region, contain carbon stock densities ranging from 127–195 Mg C ha^{-1} for evergreen forests, and ranging around 112 – 133 Mg C ha^{-1} for deciduous forests. There is less consistent data available on deciduous forests.

Table 34. Overview of the relevant available existing carbon density data for the forest types available in the project area.

Source	Total C [Mg C ha^{-1}]	Method	Forest Type and Species	Location	No. of Sample Plots	Minimum DBH [cm]
Brown et al. (1989)	114	Forest inventory	Undisturbed	All tropics	43	15
Kim-Phat et al. (2000)	190 ± 10	Forest inventory	Evergreen rich	Kampong Thom, Cambodia	63	5
Kim-Phat et al. (2000)	171 ± 18	Forest inventory	Evergreen medium	Kampong Thom, Cambodia	63	5
Kim-Phat et al. (2000)	127 ± 27	Forest inventory	Evergreen poor	Kampong Thom, Cambodia	36	5
Sasaki (2006)	154	Literature review	Production forest	Central Cambodia	127	4.5
Sasaki (2006)	190	Literature review	Protected forest	Central Cambodia	7	4.5
Sasaki (2006)	127	Literature review	Potential conversion forest	Central Cambodia	4	4.5
Top et al. (2004b)	151	Forest inventory	Evergreen	Kampong Thom, Cambodia	192	10
Top et al. (2004b)	133	Forest inventory	Mixed and Semi-deciduous	Kampong Thom, Cambodia	302	10
Top et al. (2004b)	112	Forest inventory	Deciduous	Kampong Thom, Cambodia	46	10
Top et al. (2004b)	125	Forest inventory	Average	Kampong Thom, Cambodia	540	10

Note: biomass estimates include total above- and belowground carbon pools. If no belowground carbon estimates were available, standard root-to-shoot ratios were used, following the IPCC GPG AFOLU guidelines. All tree species were sampled.

3.4.2 Step 4B – Review Existing Data of Biomass Stock Densities and Biomass Net Annual Increments

Project proponents have established permanent biomass inventory plots. These plots will be measured over time to estimate annual forest growth. As these plots have not yet been remeasured, and no nationally accepted growth curves are available, scientific literature is used to estimate net annual increment. Top et. al (2004b) established permanent plots in Kampong Thom Provence, a Provence with similar ecosystem characteristics.

Table 35. Existing data on net annual increments of biomass carbon stocks.

Source	Annual Increment [AG DM ha^{-1} yr^{-1}]	Method	Forest Type and Species	Location	No. of Sample Plots	Minimum DBH [cm]
Top et al. (2004b)	4.59	Forest inventory	Deciduous	Kampong Thom, Cambodia	4	7.5
Top et al. (2004b)	4.99	Forest inventory	Mixed/Semi-deciduous	Kampong Thom, Cambodia	8	7.5
Top et al. (2004b)	5.30	Forest inventory	Evergreen	Kampong Thom, Cambodia	20	7.5
Top et al. (2004b)	4.77[1]	Forest inventory	Province	Kampong Thom, Cambodia	32	7.5

[1] Averaged with regrowth and inundated forests.

3.4.3 Step 4C – Determine the Sample Size per LULC Class or Forest Stratum

In the spring of 2008 an initial network of permanent biomass inventory plots was established to measure carbon stock densities in all the forest systems within the reference region. In the spring of 2009, additional permanent biomass inventory plots were established inside the forest areas in combination with non-permanent plots outside of the forest area i.e., in settlements, shrub-land, degraded woodland, and cropland. Throughout the life of the project, extra sampling plots will be established as needed, as described in the methodology. In addition, when ANR activities are carried out, extra sampling plots will be installed to follow and monitor the biomass increase in these areas. These ANR sampling plots will use the same measurement methods for forest inventories, and the number of plots and locations will be stratified based on LULC classes. Permanent forest sampling plots will be re-measured for each VCS verification period.

The size and layout of the plots was selected to be compatible with the Cambodian forest inventory system. The selected plots size, 50 m x 50 m, was designed to be half of the size of the standard Cambodian forest sample plot. Within each plot every tree with a diameter at breast height (DBH) greater than 5 cm, lying deadwood, standing deadwood, stumps, and canopy cover were measured. Forest areas were sub-divided into different strata/LULC class. A stratified random sampling approach was used to locate sample plots. At the time of forestry inventory, no consistent and accurate classification into appropriate LULC classes was available. As a consequence, we employed a remote-sensing image assisted stratified sampling design, mainly based on the observed NDVIs of the forests in the reference region. This classification was less rigorous than the final classification, but sufficient for sample size determination. The anticipated coefficients of variation (CVs) were based on the study of Kim Phat et al. (2000) from the Kampong Thom Province in Cambodia. This study was done using the Cambodian field inventory protocol, in which the field measurement staff of this project was trained. Therefore, it was expected that the CVs in our forest systems would be similar to the Kim Phat et al. (2000) study. The original sampling plan requirement was to sample approximately a total of 70 plots i.e. 48 in evergreen strata, 24 in deciduous and mixed strata and 3 in non-

forest strata. The CVs for the sampling were increased to remain conservative and additional sample plots were measured. The final number of samples collected was 152, with 61 in the evergreen forest, 55 in the deciduous and mixed forest and 36 in non-forest strata. The sampling design with exact locations for each of the biomass inventory plots and the procedures to measure each of the biomass pools are described in detail in the Standard Operations Procedure for biomass inventories. This manual is available to the verifiers in a non-public attachment.

Table 36. Sample design and required number of samples per LULC class/forest strata.

Preliminary Forest Carbon Density Class	Relative Area	Size (ha)	CV (%)		Number of Sample Plots
Evergreen	36%	22174	49%		61
Deciduous and Mixed	53%	33762	41%		55
Non Forest	13%	8161	126%		36
TOTAL					**152**

Note: The sample size calculation was done for a desired precision of 10% at a significance of 95%.

The sample plots were established in the field such that (1) all of the project areas contained measurement plots, (2) all of the identified forest LULC classes were included in the sampling design. A grid-based randomization of the sampling locations was used, in order to maximize the spatial representativeness of the samples. Since some of the land may contain landmines, the pre-determined position of some plots was altered to safer terrain, though this was only the case for a minimal proportion of the sampling plots.

3.4.4 Step 4D – Select Sampling Plot Layout and Location

Biomass inventory plots were located through a stratified random sampling design. Forest plots in Oddar Meanchey are square 50 m x 50 m permanent plots. Significant carbon pools (live trees, standing dead trees, lying dead trees and logged tree stumps), and other measurements (canopy cover) were measured within the plot. A permanent plot marker was left at the southwest corner of the plot for relocation.

- Trees greater than or equal to 5 cm at DBH (1.3 meters) within the plot were tagged, measured and species was recorded.
- Standing deadwood greater than or equal to 5 cm at DBH was measured, and the decomposition class was recorded.
- Lying deadwood with a diameter greater than or equal to 10 cm at center was measured along tow transect lines within the plot. Diameter at center, log length, and decomposition class were recorded.
- Logged tree stump diameter, height, and decomposition classes were recorded.
- Canopy cover was recorded throughout the plot in grid-like-fashion using a spherical densitometer.

In depth sampling procedures, steps, pictures, and diagrams are thoroughly described in the Standard Operating Procedure given to the validator.

3.4.5 Step 4E – Measure Carbon Density Stocks

The definition of a forest according to the IPCC is dependent on three criteria: (1) minimal tree height, (2) minimal forest cover, and (3) minimal area. Of these three, the minimal forest cover is most crucial. Although the Cambodian Designated National Authority (DNA) has not yet decided on an exact definition of forests, it is anticipated that the minimal crown cover will be set at 10%. A letter of intent from the Cambodian DNA is included in an Appendix. To verify that the land in the project areas met the minimal crown cover requirement, crown cover in each plots were also measured and tested for the applicable thresholds of 10%.

Carbon stock densities were found to be significantly higher in the evergreen forest compared to the deciduous and mixed forest ($P = 0.001$). The average carbon stock density in the deciduous and mixed forest types was 56.63 Mg C ha^{-1}, and 139.38 Mg C ha^{-1} in the Evergreen forest type (Table 37). The

average for the deciduous and mixed forest type was smaller than the values from the literature review (Table 34), while the value of the evergreen carbon density was in line with the literature review. The histograms indicated that the distribution of the carbon stock density was skewed to the right (Figure 16) this was also indicated by the relatively large value of the maximal carbons tock density.

An analysis of the carbon stock measurements per carbon stock density class can only occur after the remote sensing analysis, which is explained in the next section.

Table 37. Basic statistical measures of the field measurements in different LULC classes.

Carbon Stock Density	Unit	Deciduous and Mixed Forest	Evergreen Forest	Non-forest
Average	Mg C ha-1	56.72	139.87	1.62
Standard deviation	Mg C ha-1	23.51	70.16	2.04
Maximum	Mg C ha-1	108.43	412.63	8.98
Number of observations (n)	-	55.00	61.00	36.00
Standard error of the mean	Mg C ha-1	3.17	8.98	0.34
Lower Confidence Limit of the mean (LCL)	Mg C ha-1	50.37	121.91	0.93
Upper Confidence Limit of the mean (UCL)	Mg C ha-1	63.07	157.84	2.31

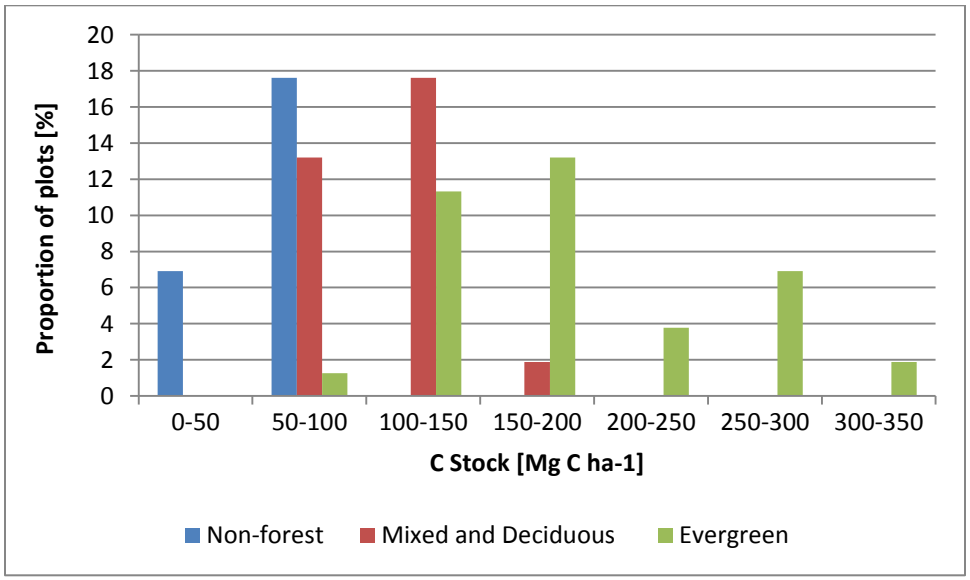


Figure 16 .Histograms of the carbon stock density measurements in different LULC classes.

During the validation visit, about 250 trees were re-measured for Quality Assurance and Quality Control (QA/QC). It was found that the remeasured trees were on average 1 cm DBH wider than the original measurements. In relative terms, trees were on average 5% wider than the original measurements. For 95% of the trees, the deviation was greater than 90%. Therefore, we propose an additional factor to correct for potential bias of 0.90 to be applied to the emission factors. This factor is applied directly in the next step.

3.4.6 Step 4F – Calculate Emission Factors and Check Compatibility with Degradation Definition

The appropriate emission factors associated with the land cover transitions i.e. from one LULC class to another LULC class were calculated from the inventoried plots. The uncertainty is expressed as the half-width of the 95% confidence interval around the mean of the difference between the carbon stocks between

the LULC classes. The applicable emission factors and uncertainty discounting factor for applicable LULC are shown in Table 38.

Table 38. Emission factors and discounting factors for LULC transition.

LULC Transition	Emission Factor [t CO_2e ha^{-1}]	Emission Factor (Conservative) [t CO_2e ha^{-1}]	HWCI [t CO_2e ha^{-1}]	Average Uncertainty [%]	Uncertainty Discounting Factor [-]
Evergreen to Deciduous	303.42	273.08	68.54	23%	0.77
Evergreen to Non-Forest	505.13	454.61	64.51	13%	1.00
Deciduous to Non-Forest	-303.42	-273.08	68.54	23%	0.77
Deciduous to Evergreen	201.70	181.53	23.42	12%	1.00
Non-Forest to Evergreen	-505.13	-454.61	64.51	13%	1.00
Non-Forest to Deciduous	-201.70	-181.53	23.42	12%	1.00

3.5 Step 5 – Estimate Ex-ante Land Transition Rates under the Baseline Scenario

No regional or national baselines approved by the competent national authority are present. Therefore, the historical deforestation rates were analyzed using remote sensing data. These historical deforestation rates are extrapolated to quantify future deforestation rates. Since future rates may be highly dependent on factors that may not be known or present at the time of the historical analysis, the historical deforestation rate will be frequently updated using new remote sensing data and information from social appraisals.

3.5.1 Step 5A – Calculate Total Rates of Deforestation and Forest Degradation in the Project Area

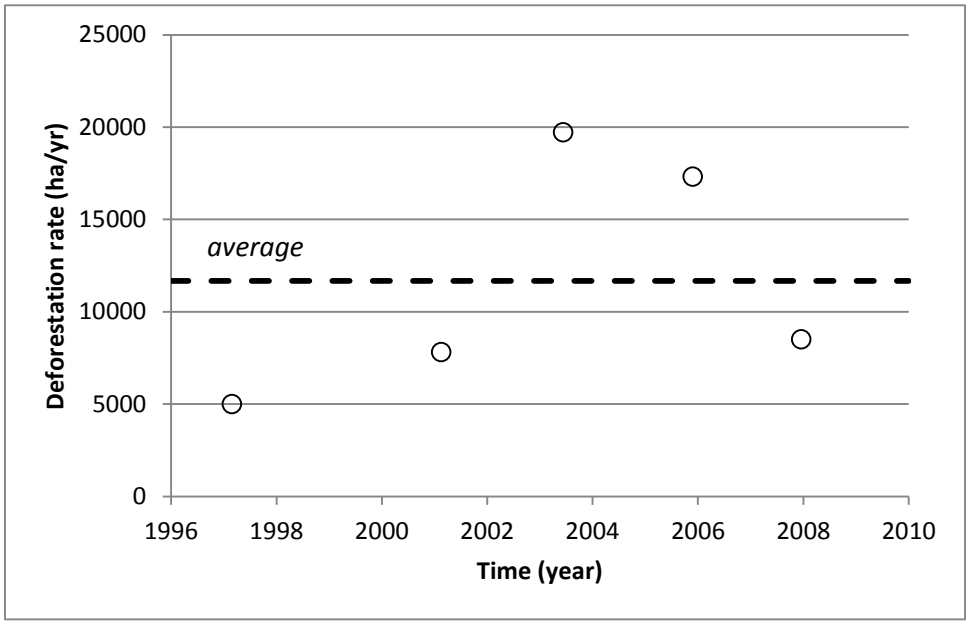


Figure 17. Historical deforestation rate in the reference region, and conservative deforestation rate projection.

Given that there are about 335,000 ha of forest remaining in the reference region in 2008, the deforestation rates calculated in the analysis conducted for this project correspond to 3.03% loss of forest cover per year. This rate is very close to the deforestation rates calculated in the Forestry Administration study supported by GRAS A/S of the University of Copenhagen between 2002 and 2006 (Table 39).

Table 39. Oddar Meanchey forest cover change for 2002-2006 (source: Forestry Administration and GRAS A/S of the University of Copenhagen).

Forest Type	% Annual Loss
Evergreen Forest	3.0%
Deciduous Forest	1.1%
Total Forest	**2.5%**

No significant linear trend in the deforestation rate was observed. Therefore, it was assumed that the deforestation rate remains constant during the crediting period.

3.5.2 Step 5B – Calculate LULC Class or Forest Stratum-Specific Relative forest cover increase and Regeneration Rates

Even though an overall downward trend in forest cover was observed, a significant number of pixels changed from non-forest to forest during the historical reference period. This indicated that some areas increased in forest cover under the baseline. The relative rate of forest cover increase was calculated using equation [39] in the methodology and averaged over all time periods. A deciduous forest cover increase was observed at a rate of 0.057% per year, relative to the non-forest area, while the evergreen forest cover increase rate was 0.017% per year.

$$RFRGrate(BAR \rightarrow DCD) = 0.00057[yr^{-1}]$$

$$RFRGrate(BAR \rightarrow EVG) = 0.00017[yr^{-1}]$$

3.5.3 Step 5C – Calibrate and Validate a Spatial Model to Predict the Suitability for Deforestation and Degradation

A logistic regression model was used to relate the occurrence of deforestation or degradation with a number of spatial drivers, identified and outlined in Section 1.10.1. Figure 18 and Figure 19 show two examples of the effect of spatial driver variables on deforestation: the distance to district center, and the proportion of forest land within 1.5 km of a certain location. The closer forest land is located near a district settlement, or the higher the proportion of already deforested land in the neighborhood of a certain location, the higher the probability that this location will be deforested. It can be observed that the relationship with distance to district center is logarithmic, while the relationship with the proportion of forest land is linear. This illustrates the need for a mathematical transformation of some spatial driver variables.

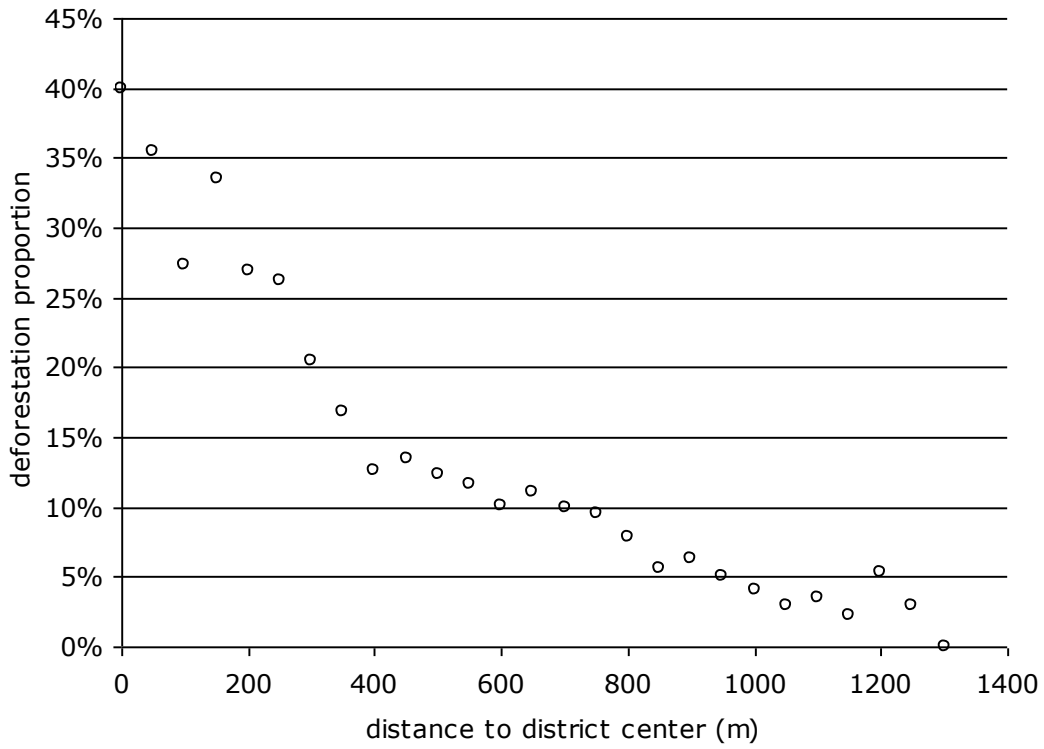


Figure 18. The relationship between the distance to a district center (large settlement) and the proportion of forest cells that were deforested.

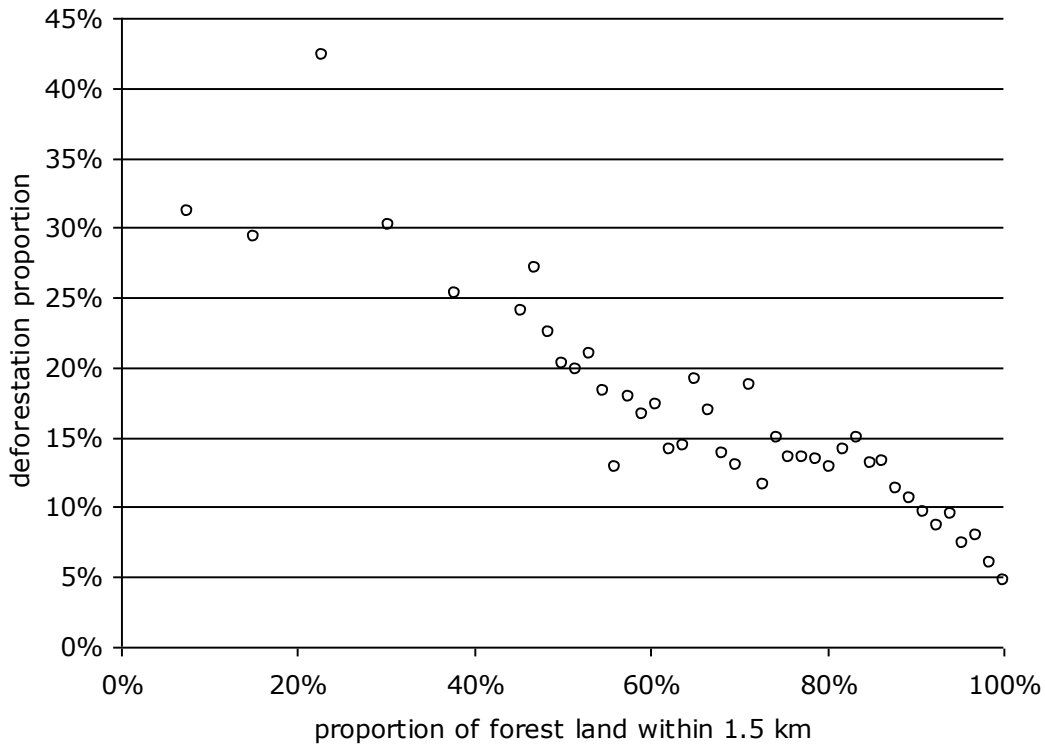


Figure 19. Relationship between the proportion of forest land (compared to the total land within 1.5 km of each position) and the proportion of forest cells that were deforested.

A full list of all the spatial driver variables with a graphic representation can be found in Table 42. Table 40 indicates that the deforestation model was highly significant.

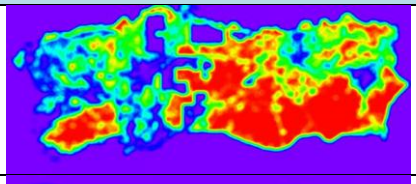
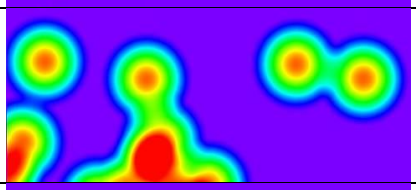
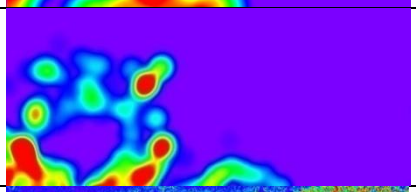
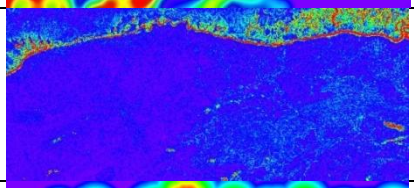
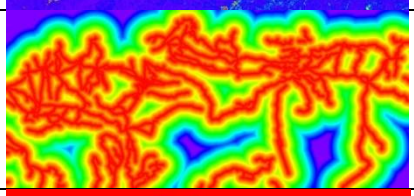
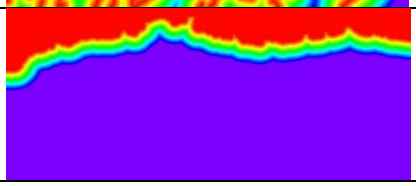
Table 40. Overview of the significance of the logistic regression models.

Model	- log ℓ	DF	Δ-2 log ℓ	$P > \chi^2$
Full Model	6823			
Reduced	7893			
Difference	1071	13	2141	<.0001

Table 41. Overview of the significance of the different spatial driver variables in the logistic regression models for deforestation and forest degradation.

	Deforestation	
Spatial Variable	**Δ-2 log ℓ**	***P*> χ^2**
Deciduous Forest Density	507	<.0001
Evergreen Forest Density	401	<.0001
District center density	89	<.0001
Village density	51	<.0001
Slope	32	<.0001
Minor roads distance	23	<.0001
Distance from Thailand	5.4	0.02

Table 42. Graphic representation and -2 log likelihoods and significances for each spatial variable for the deforestation model.

Variable	Graphic representation	Importance (ranking – smaller is more important)
Forest Density		1 and 2 (deciduous vs. evergreen)
District Center Density		3
Village Density		4
Slope		5
Minor Roads Distance		6
Distance from Thailand		7

3.5.4 Step 5D – Calculate All Class or Stratum-Specific Transition Rates.

After applying the Land-use change model, the following transitions were obtained.

Table 43. Land transitions under the baseline scenario. All values are in hectare per year.

	Area without ANR				Area with ANR			
From	DCD	EVG	BAR	BAR	DCD	EVG	BAR	BAR
To	BAR	BAR	DCD	EVG	BAR	BAR	DCD	EVG
1	1,446	167	1	0	59	21	0	0
2	1,363	242	2	1	70	17	0	0
3	1,340	266	3	1	66	21	0	0
4	1,311	275	4	1	75	30	0	0
5	1,284	283	5	1	86	40	0	0
6	1,272	287	5	2	82	51	0	0
7	1,182	335	6	2	104	72	0	0
8	1,133	370	7	2	85	104	0	0
9	1,091	438	8	2	72	92	0	0
10	1,103	435	9	3	68	86	0	0
11	1,115	407	10	3	82	88	0	0
12	1,127	382	11	3	87	96	0	0
13	1,115	373	12	4	90	115	0	0
14	1,076	377	12	4	119	120	0	0
15	1,113	321	13	4	120	137	0	0
16	1,092	351	14	4	114	135	0	0
17	1,111	359	15	5	88	134	0	0
18	1,128	355	16	5	71	137	0	0
19	1,123	365	17	5	59	142	0	0
20	1,137	351	17	5	52	146	0	0
21	1,104	386	18	6	55	139	0	0
22	1,116	385	19	6	37	138	0	0
23	1,112	400	20	6	19	133	0	0
24	1,054	467	21	6	6	114	0	0
25	972	529	22	7	0	104	0	0
26	901	575	23	7	0	70	0	0
27	622	816	23	7	0	26	0	0
28	408	935	24	7	0	10	0	0
29	271	941	25	8	0	11	0	0
30	170	916	25	8	0	0	0	0
SUM	**31,392**	**13,088**	**406**	**124**	**1,766**	**2,528**	**0**	**0**

3.6 Step 6 – Identify Project Activities and Estimate Total Deforestation and Degradation Rates under the Project Scenario

3.6.1 Expected Effectiveness of Project and Leakage Mitigation Activities

1. **Forest clearing for land sales**. Forests are cleared by migrants and other forest encroachers to be sold by middlemen. This pattern reflects attempts to grab available public forest land and hold it until it can be resold at a higher price. After clearing, a minimum amount of time is required to establish settlements on the cleared land. Therefore, routine weekly forest patrols and increased monitoring

activity will ensure clearing of lands are identified and stopped quickly. Forest protection activities involving local communities are expected to prevent 100% of forest clearing for land sales within the project area.

2. **Conversion to cropland**. Adoption of land-use planning and agricultural intensification will significantly reduce deforestation by increasing the efficiency and yield of already existing croplands. Implementation of land-use planning and agricultural intensification should be able to decrease the amount of land deforested for cropland conversion by 50%. An additional 10% reduction can be achieved by an increase in harvesting of non-timber forest products (5%) which can supplement agricultural crops, and from assisted natural regeneration (5%) which will restore forest cover, effectively reducing the amount of land available for agricultural. Some new cropland will need to be converted as soils are exhausted and population increases. These factors, as well as leakage, account for the remaining 40% of deforestation.

3. **Conversion to settlements**. Land-use planning, by implementing community-wide plans for sustainable land and resource management, will exclude land within the project area from conversion to settlement by local communities or migrant encroachers. Land-use planning should prevent 50% of deforestation resulting from the conversion of forest to settlements. Leakage from the conversion of forestland outside the project area is inevitable, and will continue to contribute 50% of the deforestation resulting from this practice.

4. **Fuelwood gathering**. Fuelwood is primarily used in communities as cooking fuel and to repel mosquitoes from livestock. The distribution of 8,000 fuel-efficient stoves within the project area will decrease the overall amount of fuel-wood needed by 35%. This number was derived by assuming a 70% adoption rate of stoves within project communities and a 44% efficiency gain on overall fuel-wood consumption using improved cook stoves. In total, 5600 mosquito prevention measures will be applied in communities participating in the project. These measures will effectively repel mosquitoes without having to burn wood to generate smoke and will account for a further 25% reduction in fuel-wood use. Land-use planning, which limits the amount of fuel-wood allowed to be harvested from the project areas is expected to account for another 25% in reductions. Deforestation resulting from fuel-wood gathering cannot be completely eliminated as it is necessary for the livelihoods of local communities. Additionally, leakage outside of the project area will account for some deforestation.

5. **Forest fires induced to clear the forest understory**. Four different measures are being undertaken in the project area to prevent the use forest fires to clear the understory in an attempt to stimulate the growth of grasses. Land use plans restrict the use of intentional forest fires within the project area; fire prevention measures like the clearing of organic debris from the forest floor will help to prevent the spread of intentional and natural forest fires; forest protection measures including forest patrols and education about the dangers of forest fires. Each of these measures will account for a 20% reduction in associated deforestation.

6. **Hunters inducing forest fires**. Hunting activities involving fire within the project area will be discouraged through the use of forest protection activities including regular patrols through forest lands and distribution of patrol and monitoring equipment. While forest patrols will not be able to deter every hunter, they will be able to significantly reduce the use of forest fire as a hunting tool, decreasing deforestation from hunting-induced forest fires by at least 50%. Fire prevention to prevent the spread of hunting-caused fires will account for another 25% in decreased deforestation.

7. **Illegal logging for commercial sale**. Cooperation between local communities, police, the Forestry Administration and the distribution of equipment to aid in patrols should be able to reduce 90% of deforestation associated with illegal logging. Illegal logging operations require large amounts of equipment, and sufficient time to fell trees. Frequent patrols will eventually persuade illegal loggers to discontinue operating in the project area. Ideally all illegal logging would be prevented through the use of forest protection activities, but leakage resulting from illegal logging operations moving outside the project activity will account for 10% of continuing deforestation.

8. **Timber harvesting for local use**. Communities can agree on decreasing timber harvesting for local use through the use of land-use plans, but without forest protection and patrol measures to back up these agreements deforestation will likely continue. Land-use plans will account for a 20% decrease

in deforestation from local timber harvesting, while forest protection, patrolling, and monitoring activities will account for another 50%. ANR activities will reduce deforestation from local timber harvesting another 20% by providing a sustainable source of wood, hence reducing the burden on existing forests.

9. **Large economic land concessions**. The reinforcement of the land tenure status of local populations is essential for the reduction of deforestation from large economic land concessions. Creation of legally binding community forestry agreements establishing land rights provides proof of land ownership, and will prevent 100% of the deforestation associated with the granting of ELCs. The MAFF will have a map available to them clearly showing the location of rural land ownership, and can avoid these areas when assigning large ELCs.

10. **Timber concessions**. Community forestry agreements reinforcing land tenure will prevent 100% of the deforestation associated with the granting of timber concessions within the project area. Backed by the Forestry Administration, community forestry agreements restrict all harvesting of timber in the project area, and therefore no timber concessions will be granted.

Table 44. Relative reduction (%) in the impact of drivers of deforestation due to project activities.

Driver of Deforestation	1. Reinforcing land-tenure	2. Land-use plans	3. Forest Protection	4. ANR	5. Fuel-efficient Stoves	6. Livestock Protection from Mosquitoes	7. Agricultural Intensification	8. Water Resource Development Projects	9. NTFP Development	10. Fire Prevention	TOTAL REDUCTION
1. Forest clearing for land sales	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
2. Conversion to cropland	5%	25%	0%	5%	0%	0%	25%	0%	5%	0%	60%
3. Conversion to settlements	5%	50%	0%	0%	0%	0%	0%	0%	0%	0%	50%
4. Fuel-wood gathering	0%	0%	25%	0%	35%	25%	0%	0%	0%	0%	85%
5. Forest fires induced to clear the forest understory	0%	20%	20%	0%	0%	0%	0%	20%	0%	20%	80%
6. Hunters inducing forest fires	0%	0%	50%	0%	0%	0%	0%	0%	0%	25%	75%
7. Illegal logging for commercial on-sale	0%	0%	90%	0%	0%	0%	0%	0%	0%	0%	90%
8. Timber harvesting for local use	0%	20%	50%	20%	0%	0%	0%	0%	0%	0%	90%
9. Large economic land concessions	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
10. Timber Concessions	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Net Effect on Total Deforestation (Excl. Leakage)	16%	22%	6%	3%	0%	0%	14%	4%	3%	4%	

3.6.2 Expected Level of Activity of Project and Leakage Mitigation Activities

Table 46 gives a basic timeline of and description for each of the project actions and leakage mitigation activities that will take place over the 30 years of the project.

Table 45. Responsibility for the implementation of planned project activities.

Project Activity	Implementer	
	Y4-Y8	Y9+
Reinforcing land tenure	FA	FA
Land-use plans	Pact, FA, CDA	FA, CDA
Forest protection	Pact, FA, CFN	FA, CFN
ANR	FA, CFMC	FA, CFMC
Fuel-efficient stoves	Pact, CDA	FA, CDA
Livestock protection	Pact, CDA	FA, CDA
Agricultural intensification	CFN, CDA	FA
Natural resource management projects	Pact, CFMC, CDA	FA, CFMC, CDA
NTFP development	Pact	FA
Fire Prevention	Pact, CFN, CFMC, CDA	FA, CFN, CFMC, CDA

Table 46. Timeline and description for each of the project and leakage mitigation activities.

Year	Project Year	1. Reinforcing Land-tenure	2. Land-use plans	3. Forest Protection	4. ANR	5. Fuel-Efficient Stoves	6. Livestock protection from insects	7. Agricultural Intensification	8. Natural Resource Management Projects	9. NTFP Development	10. Fire Prevention
2008	1	Training, , FA officials meet with MAFF to solve issues			Conduct sketch mapping with communities to identify treatment areas	Conduct assessment on fuelwood use in the target communities	Conduct assessment on fuelwood use in the target communities				
2009	2	Organization of the CF groups and submission, Demarcate all discrete project parcels			Id	Id	Id				
2010	3	Resolve any overlapping CF claims, CF agreement is in place and secure land tenure is established			Id	Id	Id				
2011	4	Sign CF Agreement for Phaav and Rolus Thom (2 remaining sites), Meetings with all other relevant government agencies for understanding and awareness of the project, Provide annual updates to all	Community-wide discussions/ workshops on forest management, Conduct workshop to draft management plans specific to each CF, submit to FA, and include in relevant commune council plans, Prepare large-	Maps of management strategies and challenges transferred into the GIS database, Manufacturing and installation of additional 100 cement boundary posts, 300 signs, and two sign boards per CF, Organize	Demarcate exact areas to receive ANR and Enrichment Planting, Construct 6 well-managed tree nurseries generating 70,000 seedlings per year, Provide training on nursery management, Maintain nurseries and	Develop a strategy on introduction of fuel-efficient stoves, Review and provide feedback to improve wood fuel reduction	Review and evaluation of protection strategy			Establish village cooperatives (13 in 3 years), build capacity and create a cooperative management structure, Product development and assessment of markets linkages	Research assessment on fire dynamics, Review monitoring data for fire behavior, Integrated forest fire regulation into quarterly CF meeting so that all communities have clear regulations about fire,

Year	Projec Year	1. Reinforcing Land-tenure	2. Land-use plans	3. Forest Protection	4. ANR	5. Fuel-Efficient Stoves	6. Livestock protection from insects	7. Agricultural Intensification	8. Natural Resource Management Projects	9. NTFP Development	10. Fire Prevention
		ministries and agencies during TWG/FE meeting, Request and sign letters of cooperation with all ministries and agencies	scale maps for communities to track management tasks and achievements	regular village patrols and establish protection contracts, Organize, equip, and support FA mobile enforcement unit, Construct 44 guard posts and 4 wooden towers (total over 5 years), Strengthen relations between communities, FA and Police for enforcement, Establish and maintain case tracking & reporting system at community and FA Cantonment level	supplies						Prepare posters and signs on fire prevention

Year	Projec Year	1. Reinforcing Land-tenure	2. Land-use plans	3. Forest Protection	4. ANR	5. Fuel-Efficient Stoves	6. Livestock protection from insects	7. Agricultural Intensification	8. Natural Resource Management Projects	9. NTFP Development	10. Fire Prevention
2012	5	Provide annual updates to all ministries and agencies during TWG/FE meeting, Request and sign letters of cooperation with all ministries and agencies	Conduct workshop to draft management plans specific to each participating community and submit to FA	Id	Establish fire lines around ANR areas, Maintain nurseries and supplies	Distribute 1,000 fuel-efficient woodstoves	Id	Conduct soil assessment to better understand soil quality and type, Identify techniques for increasing yields, Select model farmers and demonstration sites, Provide training and technical assistance to increase farmer skills, Provide micro-grants to CFMCs/farmer groups for farmers to implement new techniques	Assessment of irrigation improvement potential & establish priorities, New pond construction and desilting of existing ponds for irrigation in the dry season, Development planning with village and commune so more families have irrigated fields and water storage	ibid, Assess feasibility for NTFP enterprise development to identify potential products per CF	Review monitoring data for fire behavior, Purchase new fire management equipment, Create and maintain fire breaks in CFs, Integrated forest fire regulation into quarterly CF meeting, Include fire prevention information in CF meetings, Community patrollers report fires, Prepare posters and signs on fire prevention, Integrate fire prevention lesson in school curriculum

Year	Projec Year	1. Reinforcing Land-tenure	2. Land-use plans	3. Forest Protection	4. ANR	5. Fuel-Efficient Stoves	6. Livestock protection from insects	7. Agricultural Intensification	8. Natural Resource Management Projects	9. NTFP Development	10. Fire Prevention
2013	6	Provide annual updates to all ministries and agencies during TWG/FE meeting		Id	Train community teams to conduct ANR, ANR activities carried out: 498 ha treated, and 60,000 seedlings planted, Maintain nurseries and supplies	Id, Review and provide feedback to improve wood fuel reduction	700 mosquito nets or insecticide application for cattle introduced, Review and evaluation of applied strategy	Provide training and technical assistance to increase farmer skills, Provide micro-grants to CFMCs/farmer groups for farmers to implement new techniques	New pond construction and desilting of existing ponds for irrigation in the dry season, Development planning with village and commune so more families have irrigated fields and water storage	Establish village cooperatives (13 in 3 years), build capacity and create a cooperative management structure, Product development and assessment of markets linkages	Review monitoring data to understand fire behavior, Create and maintain fire breaks in CFs, Include fire prevention information in CF meetings, Community patrollers report fires, Prepare posters and signs on fire prevention, Integrate fire prevention lesson in school curriculum
2014		Id		Maps of management strategies and challenges transferred into the GIS database, Construct 44 guard posts and 4 wooden towers (total over 5 years), Continued boundary maintenance, Organize regular village	ANR activities carried out: 997 ha treated, and 60,000 seedlings planted, Maintain nurseries and supplies	Distribute 1,000 fuel-efficient woodstoves	Id	Id	Id	Product development and assessment of markets linkages	Id

Year	Projec Year	1. Reinforcing Land-tenure	2. Land-use plans	3. Forest Protection	4. ANR	5. Fuel-Efficient Stoves	6. Livestock protection from insects	7. Agricultural Intensification	8. Natural Resource Management Projects	9. NTFP Development	10. Fire Prevention
				patrols and establish protection contracts, Organize equip and support FA mobile enforcement unit, Strengthen relations between communities, FA and Police for enforcement, Establish and maintain case tracking & reporting system at community and FA Cantonment level							
2015	7	Id		Id	ANR activities carried out: 1,495 ha treated, and 60,000 seedlings planted, Maintain nurseries and supplies	Id, Review and provide feedback to improve wood fuel reduction	Id	Id	Id	Id	Id
2016	8	Id		Maps of management strategies and challenges transferred into the GIS	ANR activities carried out: 2,000 ha treated, and 60,000 seedlings	Distribute 1,000 fuel-efficient woodstoves	Id	Provide micro-grants to CFMCs/farmer groups for farmers to implement new	Id		Review monitoring data to understand fire behavior, Create and

Year	Projec Year	1. Reinforcing Land-tenure	2. Land-use plans	3. Forest Protection	4. ANR	5. Fuel-Efficient Stoves	6. Livestock protection from insects	7. Agricultural Intensification	8. Natural Resource Management Projects	9. NTFP Development	10. Fire Prevention
				database, Continued boundary maintenance, Organize regular village patrols and establish protection contracts, Organize equip and support FA mobile enforcement unit	planted, Maintain nurseries and supplies			techniques			maintain fire breaks in CFs, Include fire prevention information in CF meetings, Community patrollers report fires
2017	9	Id		Id	Id	Id, Review and provide feedback to improve wood fuel reduction	Id	Id	Id		Id
2018	10	Id		Id	Id	Distribute 1,000 fuel-efficient woodstoves	Id	Id	Id		Id
2019		Id		Id	Id	Id, Review and provide feedback to improve wood fuel reduction	Id	Id	Id		Id
2020	11	Id		Id	Id	Distribute 1,000 fuel-efficient woodstoves	Id	Id	Id		Id
2021	12	Id		Id	Id	33% of households will purchase fuel-efficient	Review and evaluation of applied strategy		Id		Id

Year	Projec Year	1. Reinforcing Land-tenure	2. Land-use plans	3. Forest Protection	4. ANR	5. Fuel-Efficient Stoves	6. Livestock protection from insects	7. Agricultural Intensification	8. Natural Resource Management Projects	9. NTFP Development	10. Fire Prevention
						woodstoves, Review and provide feedback to improve wood fuel reduction					
2022	13	Id		Id	Id	33% of households will purchase fuel-efficient woodstoves	Id		Id		Id, Purchase new fire management equipment
2023	14	Id		Id	Id	Id, Review and provide feedback to improve wood fuel reduction	Id		Id		Review monitoring data to understand fire behavior, Create and maintain fire breaks in CFs, Include fire prevention information in CF meetings, Community patrollers report fires
2024	15	Id		Id	Id	33% of households will purchase fuel-efficient woodstoves	Id		Id		Id
2025	16	Id		Id	Id	Id, Review and provide feedback to improve wood fuel reduction	Id		Id		Id

Year	Projec Year	1. Reinforcing Land-tenure	2. Land-use plans	3. Forest Protection	4. ANR	5. Fuel-Efficient Stoves	6. Livestock protection from insects	7. Agricultural Intensification	8. Natural Resource Management Projects	9. NTFP Development	10. Fire Prevention
2026	17	Id		Id	Id	33% of households will purchase fuel-efficient woodstoves	Id		Id		Id
2027	18	Id		Id	Id	Id, Review and provide feedback to improve wood fuel reduction	Id		Id		Id, Purchase new fire management equipment
2028	19	Id		Id	Id	33% of households will purchase fuel-efficient woodstoves	Id		Id		Review monitoring data to understand fire behavior, Create and maintain fire breaks in CFs, Include fire prevention information in CF meetings, Community patrollers report fires
2029	20	Id		Id	Id	Id, Review and provide feedback to improve wood fuel reduction	Id		Id		Id
2030	21	Id		Id	Id	33% of households will purchase fuel-efficient woodstoves	Id		Id		Id
2031	22	Id		Id		Id, Review	Id		Development		Id

Year	Projec Year	1. Reinforcing Land-tenure	2. Land-use plans	3. Forest Protection	4. ANR	5. Fuel-Efficient Stoves	6. Livestock protection from insects	7. Agricultural Intensification	8. Natural Resource Management Projects	9. NTFP Development	10. Fire Prevention
						and provide feedback to improve wood fuel reduction			planning with village and commune so more families have irrigated fields and water storage		
2032	23	Id		Id		33% of households will purchase fuel-efficient woodstoves	Id		Id		Id, Purchase new fire management equipment
2033	24	Id		Id		Id, Review and provide feedback to improve wood fuel reduction	Id		Id		Review monitoring data to understand fire behavior, Create and maintain fire breaks in CFs, Include fire prevention information in CF meetings, Community patrollers report fires
2034	25	Id		Id		33% of households will purchase fuel-efficient woodstoves	Id		Id		Id
2035	26	Id		Id		Id, Review and provide feedback to improve wood fuel reduction	Id		Id		Id

Year	Projec Year	1. Reinforcing Land-tenure	2. Land-use plans	3. Forest Protection	4. ANR	5. Fuel-Efficient Stoves	6. Livestock protection from insects	7. Agricultural Intensification	8. Natural Resource Management Projects	9. NTFP Development	10. Fire Prevention
2036	27	Id		Id		33% of households will purchase fuel-efficient woodstoves	Id		Id		Id
2037	28	Id		Id		Id, Review and provide feedback to improve wood fuel reduction	Id		Id		Id, Purchase new fire management equipment
2038	29	Id		Id		33% of households will purchase fuel-efficient woodstoves	Id		Id		Review monitoring data to understand fire behavior, Create and maintain fire breaks in CFs, Include fire prevention information in CF meetings, Community patrollers hired to report fires
2039	30	Id		Id		Id, Review and provide feedback to improve wood fuel reduction	Id		Id		Id

The expected relative degrees of activity in Table 47 are relative measures, meaning that 100% activity represents the maximum possible effectiveness of a specific project activity within the limitations of the project. All activities have conservative assumptions so not to overestimate the effectiveness of any project action. Many of the project activities are assumed to decrease in effectiveness as their budgeted funding runs out.

A number of the project activities have no precedent in Cambodia, at least insofar as they have been implemented together in a single project. As such, the adoption rates for each project activity used to create the ex-ante carbon calculations in this PD were based on information gathered from social assessments conducted in the project area, literature review and expert opinions. These adoption rates are of course only assumptions and are liable to differ from actual adoption rates observed after project implementation (ex-post). Ongoing project monitoring, including social appraisals and household surveys, will ensure that the real adoption rates are accurately recorded.

1. As of May 2011, **land tenure of** the 13 CF areas and CFMCs has been officially recognized by the FA.
2. **Land-use plans** for the management of forest areas will be created once communities have agreed upon management decisions. All land-use plans will take effect by 2012, and once land-use plans are agreed upon, the action will be 100% effective.
3. Though some communities have already established **forest protection** through patrolling and better communication with law enforcement, full protection will not be 100% effective until 2015. From the project start date to 2015, the project proponents will be hard at work clearly demarcating CF boundaries, strengthening forest law enforcement, increasing community patrolling, and bringing offenders to justice. Community Forests will have constant protection through the life of the project to reach 100% effectiveness.
4. The implementation of **Assisted Natural Regeneration silvicultural techniques** will start at the end of 2011. From 2011-2013 communities will receive ANR techniques training, build nurseries, and learn nursery management. After 2013, all nurseries and ANR teams will be fully operating and be 100% effective. ANR activities are only budgeted until 2030, at which point ANR activities are expected to decrease to 80% of their potential.
5. One thousand **fuel-efficient stoves** will be distributed each year from 2013 to 2020. Communities will be slow to adopt the new technology, and adaption rates will lag causing 100% efficiency to be reached only in 2016. The stoves distributed will likely fall into disrepair without upkeep, and the effectiveness will slowly decrease. After 2020, it is assumed that 33% of the CF communities will adopt the new technology and will purchase the stoves themselves.
6. In total, 700 **Livestock Protection Measures** will be placed or distributed in years 2013-2020, greatly reducing the need for burning wood to keep mosquitoes off cattle. These measures are currently being researched and may include one or more of the strategies: mosquito nets, using insecticide spray or wipes on cattle. Like fuel-efficient wood stoves, communities' initial adoption rates will be slow, and 100% efficiency will be reached in 2016. After 2020 nets will fall into disrepair and the effectiveness will decrease quickly as cattle can be damaging to the nets.
7. **Agricultural intensification** will start to become effective in 2012, after soil quality and appropriate farming techniques will have been identified. This new technology will take a long time for communities to accept, and will not becoming 100% effective until 2027. Though training and micro-grants will only be available in the first few years of the project, farmers will see the benefits, and continue to practice agriculture intensification.
8. The creation of **Water Resource Development** initiatives including the construction of new ponds and de-silting of existing ponds will start in 2012, and will become fully effective in 2015. These water resource development projects will be 100% effective until their funding runs out in 2020. It is expected that these water resource

development projects will very slowly decrease in effectiveness as they slowly fill with silt.

9. **Enterprise development for Non-timber Forest Products (NTFPs)** will become effective 2011. With the increase in forest cover and biodiversity, more products will become accessible to community members. As markets and livelihoods may take time to change, the effectiveness of this action will not reach full effectiveness until 2028. Once these markets are established, NTFPs will continue to be a 100% effective activity.
10. **Fire Prevention measures** will have continual upkeep and community support for the life of the project. For this reason fire prevention will be 100% effective starting in 2015. From 2011-2015 communities will take actions to prevent fire by installing fuel breaks, educating about fire prevention, and including fire regulations in their CFMCs.

Table 47. Relative degree of effectiveness during the project period.

Calendar Year	1. Reinforcing land-tenure	2. Land-use plans	3. Forest Protection	4. ANR	5. Fuel-efficient Stoves	6. Livestock Protection from Mosquitoes	7. Agricultural Intensification	8. water resource development Projects	9. NTFP Development	10. Fire Prevention
2008	25%	0%	10%	0%	0%	0%	0%	0%	0%	0%
2009	50%	21%	20%	0%	0%	0%	0%	0%	0%	0%
2010	75%	48%	30%	0%	0%	0%	0%	0%	0%	0%
2011	100%	74%	40%	0%	0%	0%	0%	0%	6%	10%
2012	100%	100%	50%	0%	13%	0%	17%	25%	11%	25%
2013	100%	100%	70%	11%	25%	33%	22%	50%	17%	50%
2014	100%	100%	90%	22%	38%	66%	28%	75%	22%	75%
2015	100%	100%	100%	33%	50%	99%	33%	100%	28%	100%
2016	100%	100%	100%	44%	63%	100%	39%	100%	33%	100%
2017	100%	100%	100%	56%	75%	100%	44%	100%	39%	100%
2018	100%	100%	100%	67%	88%	100%	50%	100%	44%	100%
2019	100%	100%	100%	78%	100%	100%	56%	100%	50%	100%
2020	100%	100%	100%	89%	100%	100%	61%	100%	56%	100%
2021	100%	100%	100%	100%	100%	78%	67%	100%	61%	100%
2022	100%	100%	100%	100%	100%	60%	72%	100%	67%	100%
2023	100%	100%	100%	100%	100%	47%	78%	100%	72%	100%
2024	100%	100%	100%	100%	100%	36%	83%	100%	78%	100%
2025	100%	100%	100%	100%	100%	28%	89%	100%	83%	100%
2026	100%	100%	100%	100%	100%	22%	94%	100%	89%	100%
2027	100%	100%	100%	100%	100%	17%	100%	100%	94%	100%
2028	100%	100%	100%	100%	100%	13%	100%	100%	100%	100%
2029	100%	100%	100%	100%	100%	10%	100%	100%	100%	100%
2030	100%	100%	100%	100%	100%	8%	100%	100%	100%	100%
2031	100%	100%	100%	100%	100%	6%	100%	98%	100%	100%
2032	100%	100%	100%	100%	100%	5%	100%	96%	100%	100%
2033	100%	100%	100%	100%	100%	4%	100%	93%	100%	100%
2034	100%	100%	100%	100%	100%	3%	100%	89%	100%	100%
2035	100%	100%	100%	100%	100%	2%	100%	85%	100%	100%
2036	100%	100%	100%	100%	100%	2%	100%	81%	100%	100%
2037	100%	100%	100%	100%	100%	1%	100%	76%	100%	100%

3.6.3 Estimated Decrease in Deforestation Rate under the Project Scenario

Figure 20 indicates that project activities are expected to reduce deforestation to 30% of the baseline deforestation rate.

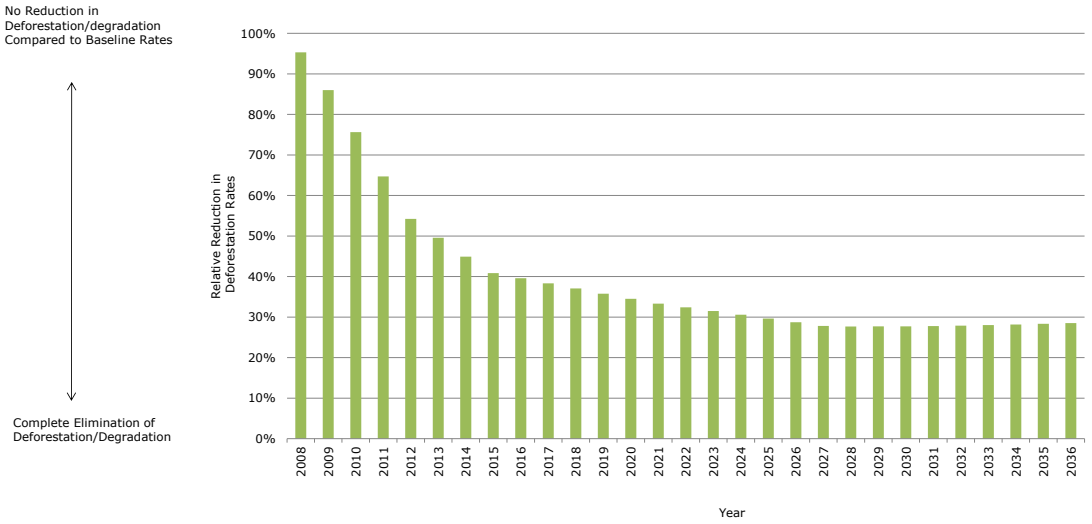


Figure 20. Estimated decrease in deforestation rate under the project scenario due to project activities; 100% = no decrease in deforestation compared to baseline conditions, 0% = absolute halting of deforestation.

3.7 Step 7 – Calculate Forest Strata-Specific Deforestation and Degradation Rates

The deforestation rate relative to baseline conditions as shown in Figure 20 was multiplied with the deforestation rate under the baseline scenario to estimate the absolute deforestation under the project scenario. The land-use change simulation model was then run using these values to estimate the rates for each relevant transition. Transitions from non-forest to forest were calculated by extrapolating the observed baseline transition rate. Table 48 summarizes the transitions for the area without and with ANR.

Table 48. Expected land transitions under the project scenario. All values are in hectares per year. DCD = deciduous forest, BAR = bare soil and agriculture, EVG= evergreen forest.

	Area without ANR				Area with ANR			
From	DCD	EVG	BAR	BAR	DCD	EVG	BAR	BAR
To	BAR	BAR	DCD	EVG	BAR	BAR	DCD	EVG
1	1,437	176	1	0	0	0	0	0
2	1,236	220	2	1	0	0	0	0
3	1,076	204	2	1	0	0	0	0
4	912	183	3	1	0	0	0	0
5	773	145	4	1	0	0	0	0
6	693	146	4	1	0	0	0	0
7	623	137	5	1	0	0	0	0
8	565	126	5	2	0	0	0	0
9	524	146	5	2	0	0	0	0
10	507	141	6	2	0	0	0	0
11	476	151	6	2	0	0	0	0
12	439	166	6	2	0	0	0	0
13	398	186	7	2	0	0	0	0
14	381	183	7	2	0	0	0	0
15	372	177	7	2	0	0	0	0
16	379	154	8	2	0	0	0	0
17	373	145	8	2	0	0	0	0
18	358	144	8	3	0	0	0	0
19	348	139	9	3	0	0	0	0
20	339	131	9	3	0	0	0	0
21	336	132	9	3	0	0	0	0
22	329	140	9	3	0	0	0	0
23	333	136	10	3	0	0	0	0
24	335	135	10	3	0	0	0	0
25	341	131	10	3	0	0	0	0
26	346	128	10	3	0	0	0	0
27	348	129	11	3	0	0	0	0
28	343	137	11	3	0	0	0	0
29	341	141	11	3	0	0	0	0
30	334	152	12	4	0	0	0	0
SUM	**15,594**	**4,559**	**215**	**65**	**0**	**0**	**0**	**0**

3.8 Step 8 – Estimate GHG Emissions Sources

3.8.1 Step 8B – Estimate GHG Emissions from Fire Breaks and Other Fire Prevention Measures

During the project crediting period a total of 200 km long and 5 m wide firebreaks will be installed and maintained. The fire breaks will be installed at the rate of 20 km per year beginning year 2012. This activity corresponds to clearing of 10 ha per year. The risk of fire lies in deciduous and mixed forests and therefore, firebreaks will be installed in deciduous and mixed forests. For installing a firebreak, most of the fire-prone understory must be removed. Therefore, this treatment is considered “intense”. Therefore, the carbon difference of the firebreak was estimated to be equal to the average carbon density of dry deciduous forests. Removal of biomass will be done manually and without using prescribed burning.

Table 49. Parameters used to estimate GHG emissions from fire prevention measures.

Variable	Acronym/ symbol	Value	Unit
Annually treated area (without fire)	$area_{biomassLoss}$	10	[ha yr^{-1}]
Carbon stock in treated area (without fire)	$C(treatedArea)$	30	[Mg C ha^{-1}]
Annually treated area (with fire)	$area_{fireBiomassLoss}$	0	[ha yr^{-1}]
Carbon stock in treated area (with)	$C(fireTreatedArea)$	30	[Mg C ha^{-1}]

3.9 Step 9 – Estimate the Net GHG Sequestration from Assisted Natural Regeneration Activities

Forest protection measures will be complemented with cost-effective assisted natural regeneration (ANR) to enhance and restore carbon sequestration rates on 4,485 hectares of degraded forest within the project area. Each year between 2013 and 2021, 498 new ha will be treated while the some areas that were treated previously will be given maintenance treatments. The project proponents have the capability to manage maximally a total of 2,000 ANR ha per year including new treatment areas and revisiting treated areas for years 2013 to 2030. Training of ANR silvicultural activities and tree nursery management will be continuous from 2011 to 2030. These ANR activities will assist and stimulate the regeneration of degraded forest areas to their natural (native) condition. Without the project these forests would remain in a low carbon state, or become deforested. *Afzelia xylocarpa* (beng) will receive priority during ANR treatments. Other desirable species will be encouraged, including *Albizia lebbeck* (chres), *Hopea helferi* (kokidek), *Shorea cochinchinenesis* (porpel), *Fagrea fragrans* (ta trao), *Diospyros cruenata* (cheuk mao), and *Gardenia ankorensis* (daikhala). Most of these species have multiple uses, generate high value timber, and are endangered or threatened.

The following activities are planned within the context of ANR

- **Site preparation** includes preparing a site for new regenerating trees to grow, i.e. the removal of unwanted vegetation like shrubs, climbers, herbs and grasses within the ANR area to improve the growth of regenerating species. Biomass removal shall be minimal and only where necessary to remove competition for trees.
- **Pruning** the removal low branches to help the tree's branches get out of reach of fire and grazing animals. Pruning low branches stimulates vertical growth and the removed foliage is used for fodder, mulch and erosion control.
- **Enrichment planting** to establish trees in places where natural regeneration has not been successful and the seedbank is insufficient. CFMCs will plant approximately 60,000 tree seedlings each year in severely degraded forest designated for ANR. These priority areas for enrichment planting will be assessed in the first years of the project, where natural regeneration potential is lowest. Nursery construction, and management will take place in years 2011-2013, and the first seedlings will be planted in 2013. Trees to be planted will include the unique endemic species *Afzelia xylocarpa* (beng), a high valued deciduous, broadleaved tree which coppices well. Enrichment planting will be done in forest gaps with indigenous companion species. Additionally, some common fruit tree species such as cashew, jackfruit, and mangoes, while not native to Cambodia, may be planted on a limited basis in some degraded forest areas with high human use. Local high quality seeds will be used in all planting and regeneration activities, as the use of high quality seed typically results in a considerably healthier seedlings and saplings.
- **Stem thinning** the removal of stems on a multiple-stemmed tree to assist the formation of a tall single-stemmed tree. ANR activities in the project area will emphasize the rehabilitation of indigenous tropical hardwood species that are currently endangered or threatened. Recently logged forests in the project area still

possess substantial beng root stock that can be regenerated through stem thinning and protection from fire.

- **Stand thinning** the removal of small trees in an overstocked small-tree stand to assist the creation of a stand with fewer bigger trees.
- **Fire control activities** will be practiced in areas identified by communities as high-potential regrowth areas based on the density and health of shoots and seedlings, soil moisture, and location. Both fuel breaks and the removal of competing vegetation will not occur on more than 10% of the areas designated for ANR, avoiding a decrease in soil carbon in the project scenario related to a decrease in plant biomass soil inputs. Vegetation removal is described in the ANR Standard Operating Procedure. Fire control in dry deciduous forests is a key to forest restoration and successful ANR.

Community members will be employed to execute ANR activities. ANR activities are expected to generate approximately 20 days of employment per household per year during the times when agricultural employment is minimal (February through April). The project plans to treat about 498 ha of new degraded forest land every year beginning year 2013 and through 2021 and maintain these areas through year 2030 after which no ANR treatment may be necessary in the area. Table 50 provides details on estimated areas where ANR activities will be implemented for the period 2013-2030. A Standard Operations Procedure describing the ANR activities in detail is developed and available to the verifier.

Table 50. Estimated ha of new areas (ha) that will be subject to ANR activities in community forest sites. Note that up to 2,000 ha will be continuously maintained until year 2030.

CF Site	Year								
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Andong Bor	77	77	77	77	77	77	77	77	77
Chhouk Meas	0	0	0	0	0	0	0	0	0
Dung Beng	17	17	17	17	17	17	17	17	17
Ou Yeay Kaov	0	0	0	0	0	0	0	0	0
Phaav	0	0	0	0	0	0	0	0	0
Prey Srorng	38	38	38	38	38	38	38	38	38
Prey Srors	5	5	5	5	5	5	5	5	5
Ratanak Ruka	14	14	14	14	14	14	14	14	14
Rolus Thom	0	0	0	0	0	0	0	0	0
Romdoul Veasna	27	27	27	27	27	27	27	27	27
Samaky	26	26	26	26	26	26	26	26	26
Sangkrous Preychheu	134	134	134	134	134	134	134	134	134
Sorng Rokavorn	160	160	160	160	160	160	160	160	160
Total	**498**	**498**	**498**	**498**	**498**	**498**	**498**	**498**	**498**

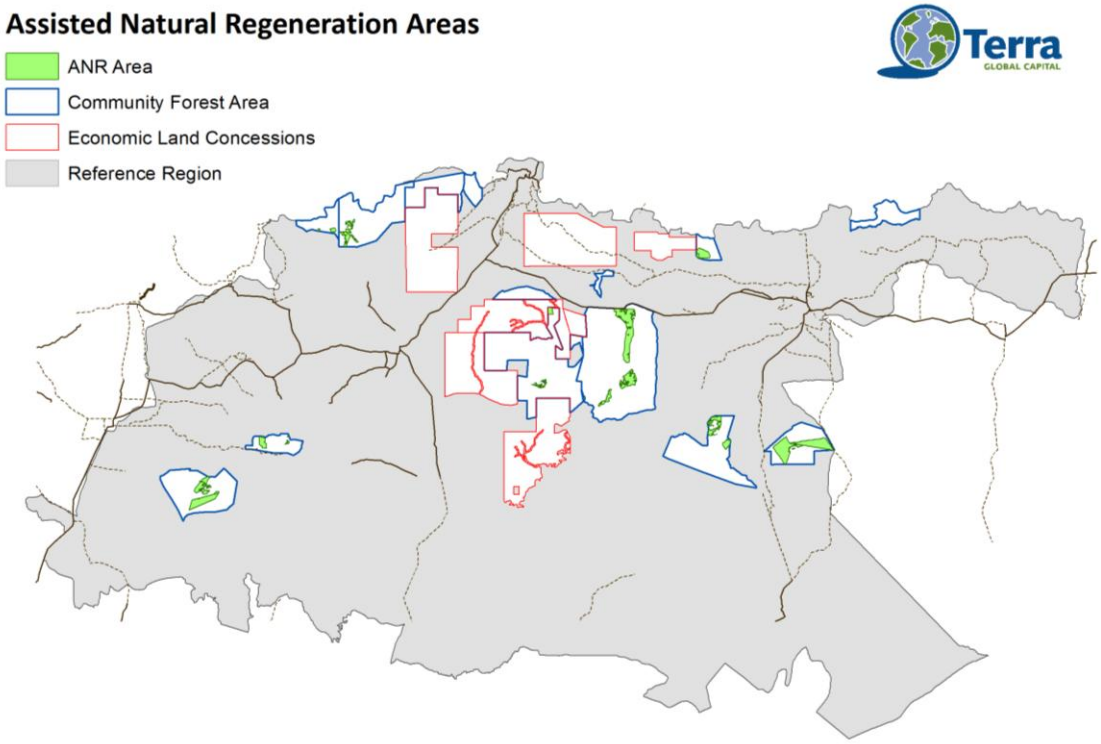


Figure 21. Locations of potential ANR areas based on community input and direct field mapping.

Exact procedures for conducting the assisted natural regeneration activities are described in the ANR Standard Operating Procedure (SOP). The procedure helps project proponents and communities (1) identify forest strata (2) select ANR silvicultural activities appropriate for the strata and (3) provide detailed descriptions of each silvicultural activity.

Community members and Pact employees were engaged in the initial field demarcation process. Areas identified were not only degraded based on "indicators of degradation" (as described in the ANR SOP), but also on the capability of the community to conduct the ANR treatments and their ability for upkeep and continual management. In general, severely degraded areas with biomass stocks of less than 30 Mg DM ha^{-1} were prioritized for ANR activities. Community focus groups identified manageable locations of degraded forest areas expected to have a biomass stock density of less than 30 Mg DM ha^{-1} and demarcated the area using a GPS. Once sufficient funds are available, ANR areas will be stratified with more detail, according to existing LULC class, growth potential, management and year. For carbon accounting purposes, no further distinction was made according to the conditions prior to the treatment. Biomass in ANR areas and GHG emissions specific to ANR implementation are accounted for separately from the areas on which no ANR is implemented to reliably estimate any increase in carbon stocks and emissions related to ANR. Further specifics:

- **Future division into forest strata according to the specific silvicultural management activities**. Project proponents have focused on identification of ANR areas, and gaining community participation. When funds become available, the communities and the project proponents will focus on further stratifying the ANR areas. The next steps for ANR activities will focus on identifying forest strata (states of degradation) within the ANR areas using the ANR SOP.
- **Variables that influence biomass growth**. Degradation status, availability of existing rootstock and seedbank, proximity to fully-stocked forests, inherent fertility of the soil, frequency of flooding in the wet season. Biomass inventories will be conducted in all ANR strata to measure increases in forest biomass, and the success of the activities.
- **Stratification based on existing LULC class, growth potential, management and year**. All ANR areas are within the forest LULC class, and are farther stratified to

evergreen and mixed and deciduous forest stratums. Once the identification degradation state is carried out, the forest will be further stratified into six strata;

- Evergreen semi-degraded
- Evergreen degraded
- Evergreen severely degraded
- Mixed deciduous semi-degraded
- Mixed deciduous degraded
- Mixed deciduous severely degraded

If significant differences in biomass are found within each ANR forest stratum, additional stratification may be necessary.

- **Stand Models to be implemented, and defining the stand model timing.** Stand growth models will be identified for the final selected strata, and will be verified by revisiting biomass plots over time. The growth potential will be modeled based on the implementation dates of silvicultural activities.
- **Maps of stratified ANR Areas.** Since preliminarily, only one single stratum for ANR areas was identified, the overview map above contains the preliminary stratification. As funds become available, the ANR areas will be further stratified. Strata identification is expected to be carried out during the next dry season in Oddar Meanchey. Each stratum will be identified in a spatially explicit shapefile. As the ANR silvicultural activities are carried out, date and specific silvicultural techniques used will be recorded providing detailed information on each stratum.

3.9.1 Step 9A – Estimate Carbon Stock Increase from Biomass

Ex-ante estimate of both baseline and project scenario for ANR activities are presented in Table 52. These estimates are generated based on forest growth and yield modeling with following underlying assumptions:

- The implementation of ANR activities will effectively stop the deforestation in ANR area.
- Regeneration will occur with a focus on common broadleaved species.
- The most representative values for the mean and maximum aboveground biomass growth for the ANR area are 7.8 Mg DM ha^{-1} yr^{-1} and 13.5 Mg DM ha^{-1} yr^{-1}, respectively (based on IPCC GPG LULUCF Table 3A 1.6, value for plantations). Using a growth rate representing plantations is justified since ANR will be carried out in the areas that where natural growth rates can be enhanced. The ANR activities resemble the growth enhancement and tending activities of plantation forestry in the respect that those areas will receive site preparation, some plantation and other silvicultural activities. Given the resemblance of ANR activity with that of plantation forestry, the plantation growth rate is the best value to predict the ex-ante estimation of the biomass growth after ANR.

  The baseline aboveground biomass growth rate (without ANR activities) for these areas is assumed be similar to natural regeneration rate of the forest type which is 2 Mg DM ha^{-1} yr^{-1} for age class > 20 yr based on IPCC GPG LULUCF Table 3A 1.5. Using satellite imagery of the year 1989 (see Figure 22), it can be demonstrated that the project areas have been forest for at least 20 years. Therefore, it is reasonable to consider and use aboveground biomass growth rate applicable to age class > 20 years.

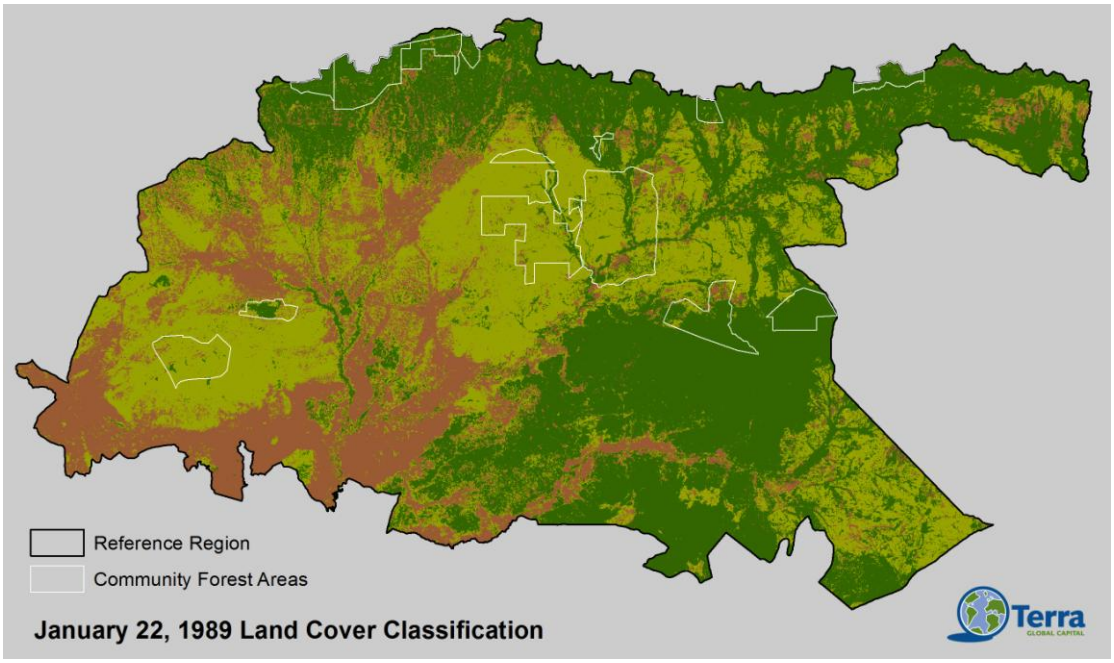


Figure 22. Land cover classification for January 22 1989.

Using the natural regeneration rate as the baseline regeneration rate in absence of project activities is conservative since the actual baseline regeneration rate will likely be smaller due to on-going degradation and anthropogenic influences. It is highly unlikely that the actual baseline regeneration rate will be greater than the natural regeneration rate in absence of any silvicultural activities or assistance.

- The biomass stock and growth belowground was based on the relationship of a root to shoot ratio of 0.29. This value was conservatively estimated following the procedures described in Cairns et al. (1997). Combining the baseline regeneration rate of 2 Mg DM ha^{-1} yr^{-1} (IPCC GPG LULUCF Table 3A 1.6) with a carbon fraction of 0.5 and a root-to-shoot ratio of 0.29 (Cairns et al., 1997), one attains a NAI of 1.29.
- The growth rate is greatest during the first year of the treatment and decreases exponentially after the first year of the treatment. The mean aboveground biomass growth for the ANR area, 7.8 Mg DM ha^{-1} yr^{-1}, is the average over a 15-year period. The maximum aboveground biomass growth for the ANR area, 13.5 Mg DM ha^{-1} yr^{-1}, is attained at year 1. A 15 year period was selected since most of the impacts from the planned silvicultural activities will be present in the first 15 years. The ANR growth model was derived from the Bertalanffy equation (Bertalanffy 1957; Rammig et al. 2005; Vanclay 1994) which is a member of a family of asymptotic nonlinear growth equations was used. Specifically, the following equation as used to model cumulative biomass after ANR:

$$Y(t) = B_{max,ANR}\,(1 - e^{-kt})$$

Where $Y(t)$ is the total biomass stock at time t, $B_{max,ANR}$ is the maximal biomass stock and k is the e-folding depth. Values for the e-folding depth k and the maximal biomass stock, $B_{max,ANR}$ were selected so that the average regeneration rate using the equation above was 7.8 Mg DM ha^{-1} yr^{-1} and the biomass growth at year 1 was 13.5 Mg DM ha^{-1} yr^{-1}. The equation used to model ex-ante change in carbon stocks for ANR areas under the project scenario is:

$$\begin{array}{ll} for\ t < t_0(i) & NAI(i) \\ for\ t \geq t_0(i) & EF_{CO2} \cdot CF \cdot B_{max,ANR} \cdot \left(e^{-k(t-1)} - e^{-k \cdot t}\right) \end{array}$$

The net increase in carbon stocks due to ANR, $\Delta C(t,i)$, can be derived by subtracting the natural regeneration rate $NAI(i)$:

$$for\ t < t_0(i) \qquad \Delta C(t,i) = 0$$
$$for\ t \geq t_0(i) \quad \Delta C(t,i) = EF_{CO2} \cdot CF \cdot \left[B_{max,ANR} \cdot \left(e^{-k(t-1)} - e^{-k \cdot t}\right) - NAI(i)\right]$$

These assumptions are summarized in the following table.

Table 51. Parameters used to estimate the emissions the baseline emissions or sinks on land with ANR. Justification for these parameters is provided above.

Variable	Acronym/ Symbol	Value	Unit
Number of ANR strata	$nrStrata$	1	[-]
Project area with ANR under the baseline scenario	$area_{projectAreaWithANR,baselineScenario}$	498 for $2013 \leq t \leq 2012$	[ha yr-1]
Net annual increment under baseline conditions (aboveground and belowground)	$NAI(i)$	1.29	[Mg C ha^{-1} yr^{-1}]
Net anthropogenic GHG removals due to biomass increase in assisted natural regeneration areas	$\Delta C(t,i)$		[t CO_2e]
Maximum increase in regeneration rate compared to baseline conditions	$B_{max,ANR}$	80	[Mg C ha^{-1} yr^{-1}]
e-folding depth for exponential decay of increase in regeneration rate	k	0.088	[-]
Year of start of the ANR treatment for ANR stratum i	$t_0(i)$	See Table 50	[yr]

Table 52. Ex-ante estimate of carbon stock and GHG benefits from ANR activities for the crediting period.

Time after project start	Year	ΔC_{ANR}	$E_{ANR,biomassLoss}$	$\Delta C_{ANR,BSL}$	LK_{ANR}	$GHG_{E,ANR}$	C_{ANR}
		[t CO_2e]	[t CO_2e]	[t CO_2e]	[t CO_2e]	[t CO_2e]	[t CO_2e]
1	2008	0	0	20,016	0	0	-20,016
2	2009	0	0	20,512	0	0	-20,512
3	2010	0	0	21,504	0	0	-21,504
4	2011	0	0	27,308	0	0	-27,308
5	2012	0	0	33,599	0	0	-33,599
6	2013	-3,834	0	38,027	0	0	-52,085
7	2014	-7,303	0	51,261	0	0	-78,038
8	2015	-10,438	0	62,541	0	0	-100,812
9	2016	-13,266	0	54,545	0	0	-103,188
10	2017	-15,815	0	51,016	0	0	-109,003
11	2018	-18,107	0	54,761	0	0	-121,151
12	2019	-20,163	0	59,112	0	0	-133,044
13	2020	-22,005	0	68,059	0	0	-148,743
14	2021	-23,649	0	75,812	0	0	-162,526
15	2022	-21,279	0	83,792	0	0	-161,816
16	2023	-19,109	0	81,498	0	0	-151,564
17	2024	-17,121	0	76,360	0	0	-139,138
18	2025	-15,301	0	74,592	0	0	-130,696
19	2026	-13,634	0	74,641	0	0	-124,634
20	2027	-12,108	0	75,433	0	0	-119,829
21	2028	-10,710	0	72,336	0	0	-111,607
22	2029	-9,430	0	68,750	0	0	-103,327
23	2030	-8,258	0	63,024	0	0	-93,304
24	2031	-7,185	0	52,180	0	0	-78,524
25	2032	-6,202	0	46,443	0	0	-69,182
26	2033	-5,301	0	31,259	0	0	-50,697
27	2034	-4,477	0	10,919	0	0	-27,334
28	2035	-3,722	0	3,847	0	0	-17,494
29	2036	-3,031	0	4,328	0	0	-15,440
30	2037	-2,398	0	0	0	0	-8,791
SUM	**0**	**-293,845**	**0**	**1,457,473**	**0**	**0**	**-2,534,905**

3.9.2 Step 9B – Calculate Baseline Emissions or Sinks on Land on which Assisted Natural Regeneration Activities are Planned

See Table 52.

3.9.3 Step 9C – Calculate Emission Sources from Assisted Natural Regeneration

No biomass from trees with DBH>5 cm will be removed during ANR. No other significant removal of biomass will take place during site preparation. In addition, no fire or chemical fertilizer will be used as part of the ANR activities. All management activities are carried out by hand within the ANR area. Therefore, $E_{ANR,biomassLoss}$ and $GHG_{E,ANR}$ can both assumed to be zero. Table 52 includes $E_{ANR,biomassLoss}$ and $GHG_{E,ANR}$.

3.10 Step 10 – Estimate Leakage from Geographically Constrained Drivers

3.10.1 Step 10A – Calculate the Leakage-Induced Increase in Deforestation and Forest Degradation Rates

Leakage from geographically constrained drivers (see methodology VM0006 for definition) is expected to take place in areas adjacent to the project area i.e. in the leakage belts. Seven of the 10 drivers identified in the project areas are geographically constrained drivers, for which the deduction is based on empirical monitoring. Leakage from geographical unconstrained drivers, in contrast, is based on ex-ante fixed factors. Therefore, the ex-ante leakage cancellation rate for geographical unconstrained drivers is explained in further detail. Leakage cancellation rates are summarized in Table 53. A justification of each of the leakage cancellation rates is provided below.

1. **Forest clearing for land sales**. Almost all of the land cleared for land sales is cleared by migrants who may eventually settle in the area or sell the cleared land to others. A previous Participatory Rural Appraisal (PRA) recognized the importance of migration as a driver of deforestation in the area. The household survey data conducted by the project proponents confirms migration to the project area as high, especially in recent years. Of 294 valid cases, 115 (39.1%) reported they had been born in the village. 179 people (60.9%) responded that they had migrated to the village. 30 people (10% of the respondents) indicated that they migrated in the past five years. Given the population among which the survey was conducted, this corresponds to about 200 household per year. It can be assumed that forest are cleared for land sales at about 1 ha per year, which is the average area ownership of land per household in rural Cambodia according to the official census. As a consequence, the area that may be converted due to people migrating to the villages around the project area is around 200 ha yr^{-1}. This value is close to the value of 135 ha yr^{-1}, which was obtained during participatory mapping exercises in the PRA conducted by the project proponents in which participants were asked to estimate the amount of forest land in the area close to their village that was converted annually for land sales. The project will attempt to include migrants as much as possible in the project actions. However, in the worst case scenario, this may not be possible, and 100% leakage would occur. Assuming a conservative conversion rate of 250 ha yr^{-1}, as well as an annual increase of 2% due to population growth, about 16,000 ha would be deforested over the 30-year crediting period due to migrants alone. The leakage belt, in which increases in deforestation are monitored and deducted from gross project credits, contains 78,000 ha of forest (see Section 3.10.4). Therefore, it seems very unlikely that leakage from migrants will extend beyond the leakage belt. However, to remain conservative, we will still assume a total leakage percentage of 50% beyond the leakage belts.

2. **Conversion to cropland**. Project participants will have approved binding forestry agreements that prevent the expansion of croplands within the project areas. The availability of arable land is typically less of a constraint than the availability of farm inputs or water. Improvements in agricultural efficiency will improve crop yields from existing agricultural land, preventing the need for further deforestation to create new land to grow crops.

3. **Conversion to settlements**. Project participants will be bound by approved forestry agreements that prevent the clearing of the community forests for the creation of new settlements. The project will support participatory land planning to increase the efficiency in land use. In addition, improvements in infrastructure including water distribution and purification in existing settlements will reduce the need for settlement expansion.

4. **Fuelwood gathering**. Adoption of more efficient cooking stoves and alternative measures to protect livestock from mosquito will significantly reduce the amount of fuel-wood use, and shouldn't result in significant leakage. There will not be, however, be a 100% adoption rate for these new technologies, so we conservatively estimate a 15% leakage cancellation rate.

5. **Forest fires Induced to clear the forest understory**. The adoption of alternative land management techniques will replace the need to use forest fires to clean the understory. These alternative techniques will be implemented on existing forest and agriculture lands and will not lead to leakage greater than 10% in the surround areas.
6. **Hunters inducing forest fires.** Hunters denied access to the project areas by forest patrols will shift the location of their hunting grounds to alternate locations. The use of forest fires to concentrate and drive animals from forest cover will shift to the leakage belt, resulting in a 90% leakage cancellation rate.
7. **Illegal logging for commercial sale.** Illegal loggers denied access to the project areas by forest patrols will also shift the location of their logging operations to alternate locations outside of the project area. Illegal logging operations in these new locations will likely continue at the same pace, resulting in a 90% leakage cancellation rate.
8. **Timber harvesting for local use.** The need for timber on a local level will not decrease as a result of project implementation. Local communities will shift the location of their timber harvesting to the leakage belt surrounding the project areas to harvest wood. We anticipate timber harvesting for local use to continue at a steady pace, resulting in a 100% leakage cancellation rate.

If the project is successfully able to reduce degradation and deforestation in the project areas, solely to be transferred to areas outside the project boundaries, this would not achieve the desired environmental benefits of the project. This risk is mitigated by incorporating leakage prevention activities into the project activities and by estimating and deducting leakage from the carbon estimates based on the chosen methodology which is designed specifically to monitor and quantify any leakage effects on an on-going basis. The project actions designed to reduce potential leakage include; fuel-efficient stoves, agricultural intensification and assigned natural regeneration. The leakage cancellation rates for each of the identified drivers are shown in Table 53.

Table 53. Anticipated leakage cancellation rates per deforestation driver.

	Leakage cancellation rate (%)	
Driver of Deforestation	**Geographically constrained**	**Geographically unconstrained**
1. Forest clearing for land sales	0%	50%
2. Conversion to cropland	0%	0%
3. Conversion to settlements	0%	0%
4. Fuel-wood gathering	15%	0%
5. Forest fires induced to clear the forest understory	10%	0%
6. Hunters inducing forest fires	90%	0%
7. Illegal logging for commercial on-sale	90%	0%
8. Timber harvesting for local use	100%	0%
9. Large economic land concessions	0%	0%
10. Timber Concessions	0%	0%

The implementation of the leakage prevention activities will reduce the leakage and bring the benefits in effectively reducing the deforestation in the project area. Leakage prevention measures start at the beginning of the project and become increasingly intense, resulting in net project gains in terms of reduction in deforestation and thereby emissions as shown in **Figure 23**.

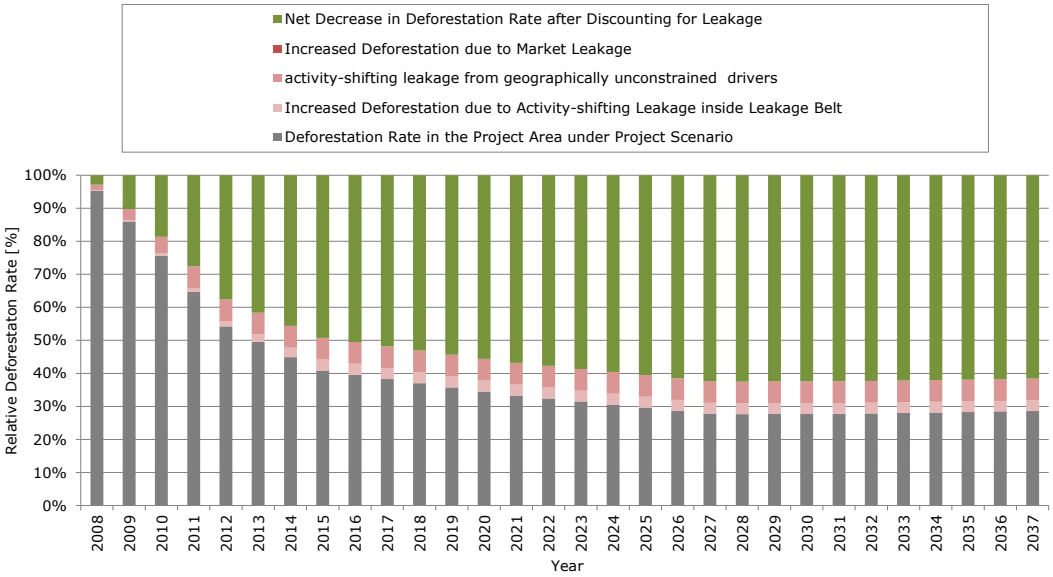


Figure 23. Summary of the anticipated (gross) decrease in deforestation rate in the project areas, the cancellation of a part of this avoided deforestation through activity-shifting leakage, and the net project gains. All values are scaled relative to the original baseline deforestation rate.

Table 54. Relative leakage impact as a function of year during the crediting period.

Year	$RelativeLeakageImpact_{DF}(t)$
2008	2%
2009	4%
2010	6%
2011	8%
2012	8%
2013	9%
2014	9%
2015	10%
2016	10%
2017	10%
2018	10%
2019	10%
2020	10%
2021	10%
2022	10%
2023	10%
2024	10%
2025	10%
2026	10%
2027	10%
2028	10%
2029	10%
2030	10%
2031	10%
2032	10%
2033	10%
2034	10%
2035	10%
2036	10%
2037	10%

3.10.2 Step 10B – Demarcate the Leakage Belts

Leakage belts are areas around the project area in which activity-shifting leakage will be monitored. Leakage belts are delineated at validation and fixed for the remainder of the baseline validation period, as described in the methodology.

It is well known that there is a strong correlation between the accessibility of forest land and deforestation (Chomitz and Grey, 1996). More specifically, roads – whether they are tracks, minor roads, or highways, have been identified as catalysts to deforestation (Cropper et al., 1999). The latter study found that in Thailand, deforestation happens along major roads even in areas with low population. To account for the influential role of roads and tracks on leakage a cost-weighted distance value was used around each project site instead of a constant distance buffer. Using “distance to roads” and transport costs to create distance cost-weights around project areas is a well-established technique. It is very similar to the development of accessibility catchments around villages based on estimated transport costs and distance from roads as used in Bigman and Deichmann (2000) and Muller and Munroe (2005). Peter et al (2004) used a cost-weighed distance function to quantify the area at risk of deforestation

based on the time per day an agent of deforestation was willing to spend to engage in activities that may decrease deforestation.

The leakage belt was created using two main input variables

1) **Speed of traveling on different terrain and roads**

   Some of the project areas border regions (such as Thai territory, or large ELCs) that are inaccessible to deforestation agents. Alternately, there is a dense network of tracks, minor roads and major roads throughout the province that facilitate the accessibility of the forest. Costs were assigned to each category of terrain, track, or road using typical travel speeds on different terrains and for different categories of roads (Peter et al., 2004). The costs to cross the Thai border or travel through large ELCs were set to 50, all other costs, and related speeds are summarized in Table 55. A cost-weighed distance function was then used to calculate a map with the cost distance to reach project area in a GIS.

Table 55. Travel speeds for different types of road based on Peter et al. (2004)

Road Type	Transport Type	Travel speed in dry season (km/h)	Travel speed in wet season (km/h)	Assigned cost (arbitrary values)
Roadless	Foot	1.0	1.0	20
Track or path	Foot	2.0	2.0	15
Minor road	Bike or tractor	7.1	5.3	10
Major road	Bike or tractor	7.1		5
Major road	Car	14.4	10.8	Not considered since cars are not typically used by deforestation agents in this region.

2) **Distance communities are willing to transport for timber harvesting and agriculture**

   In the household survey, interviewees were asked how many kilometers they travel to harvest timber from their house. The median distance that was reported is 2 km. Likewise, interviewees were asked how many kilometers that travel each day for any activity, including agriculture. The median distance that was reported was around 5 km per day. Given that the latter value includes the time to walk to markets or other villages, a distance of 5 km was selected for the minimal width of the leakage where there is only a track or path.

The cost leakage area boundary was delineated by selecting a cost threshold below which leakage was expected to be likely. This cost threshold was calibrated so that the width of the buffer area corresponded to the distance selected above, 5 km, in cases when only tracks or paths were available. By using this value as the threshold, the width of the buffer area increased around minor roads and major roads. For example, the width of the leakage buffer increased to 12 km if a major road was available. The cost-distance map and the leakage belt delineated are shown in the following figure.

The leakage area has to be sufficiently large so that enough forest is encompassed for activity shifting. This can be done be comparing the anticipated deforestation rate (in ha year^{-1}) with the actual area of forests available in the leakage area. Therefore, the focus of this analysis is on the first 10 years of the project. It is anticipated that patterns of deforestation will change drastically during the course of the 30 year project. The analysis of the leakage area will be revisited and updated after ten years. This is anticipated as a monitoring activity.

Table 56. Summary of the size of the leakage area vs. the size of the project areas per group of project sites, and analysis of the forest area available for leakage in the proposed leakage belt. Forest areas based on 2006 Landsat classification.

Project site group	Total area (ha)		2006 Forest area (ha)	
	Community Forestry sites	Leakage belt	Project sites	Leakage
Angdoung Bor Dung Beng	7,957	34,186	7,120	14,273
Ou Yeay Kaov Romdoul Veasna Prey Srors Rolus Thom	11,228	12,457	9,696	7,906
Chhouk Meas Sorng Roka Vorn Ratanak Ruka	31,045	32,585	27,794	23,253
Samaky	1,079	5,676	1,042	4,660
Sangkrous Preychheu Prey Srorng	10,496	23,753	9,920	21,806
Phaav	2,025	8,149	1,978	5,709
TOTAL	63, 831	116,806	57,550	77,608

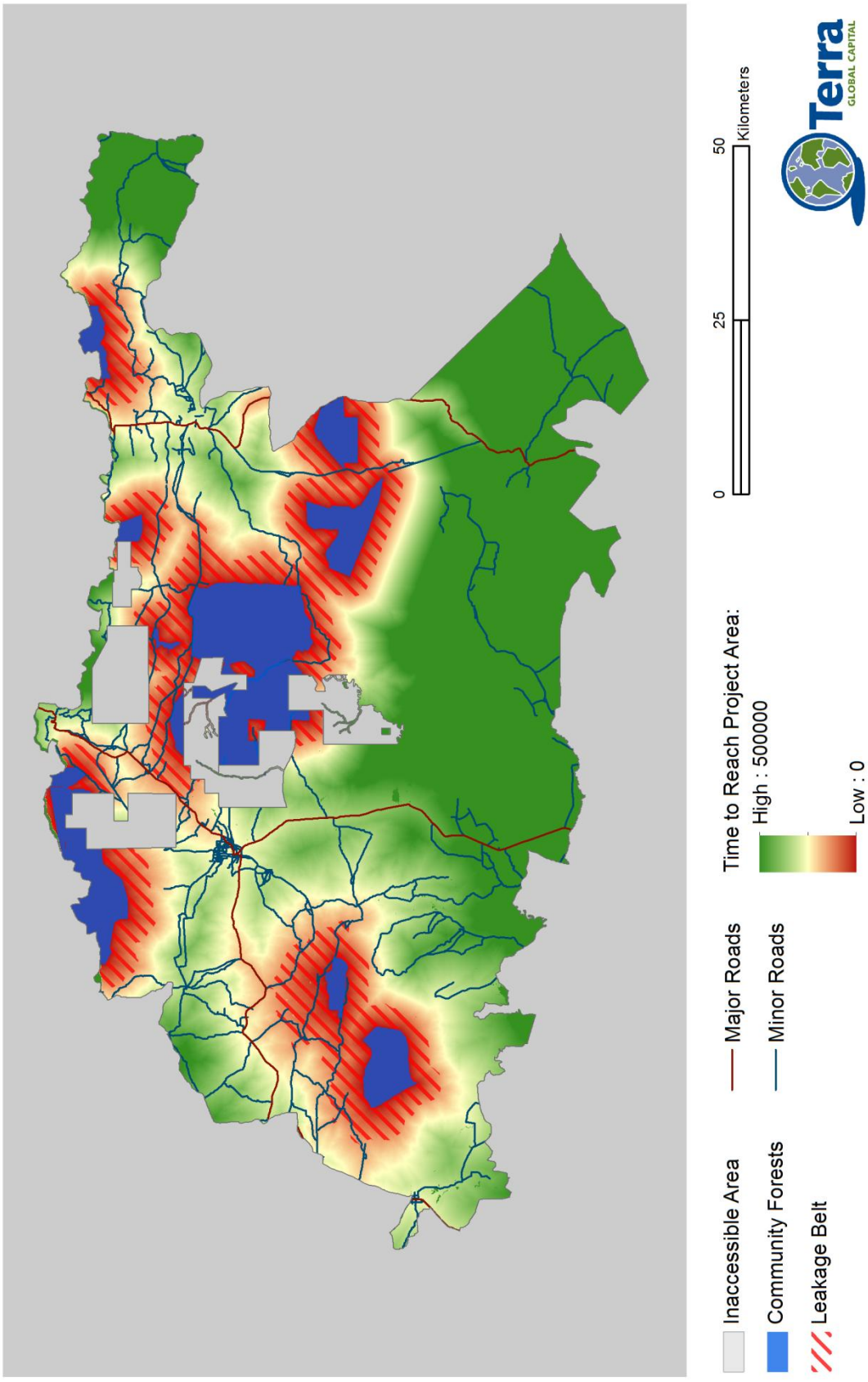


Figure 24. Location and extent of the leakage area.

3.10.3 Step 10C – Calculate the Forest Strata-specific Deforestation and Degradation Rates in the Leakage Belts

The land transitions in the leakage area under both the project and baseline scenario are summarized in the following table.

Table 57. Simulated land transitions for the leakage belts.

	Baseline Scenario				Project Scenario			
From	DCD	EVG	BAR	BAR	DCD	EVG	BAR	BAR
To	BAR	BAR	DCD	EVG	BAR	BAR	DCD	EVG
1	2,074	119	1	0	2,078	119	1	0
2	1,975	218	3	1	1,983	219	3	1
3	1,936	258	4	1	1,947	260	4	1
4	1,882	311	5	1	1,899	314	5	2
5	1,901	292	6	1	1,923	298	6	2
6	1,867	327	8	1	1,900	332	8	2
7	1,859	335	9	1	1,899	343	9	3
8	1,806	387	10	2	1,847	403	10	3
9	1,756	437	11	2	1,796	453	11	3
10	1,705	489	13	2	1,742	507	13	4
11	1,621	573	14	2	1,651	598	14	4
12	1,588	605	15	2	1,626	624	15	5
13	1,578	615	16	2	1,622	627	17	5
14	1,584	609	18	2	1,629	620	18	5
15	1,596	597	19	2	1,645	604	19	6
16	1,653	540	20	2	1,703	545	20	6
17	1,690	502	21	2	1,746	502	22	7
18	1,717	474	23	3	1,770	477	23	7
19	1,707	483	24	3	1,741	504	24	7
20	1,674	513	25	3	1,706	535	26	8
21	1,677	506	26	3	1,711	524	27	8
22	1,660	515	28	3	1,688	537	28	9
23	1,622	539	29	3	1,630	575	29	9
24	1,540	598	30	3	1,510	664	31	9
25	1,402	698	31	3	1,344	778	32	10
26	1,204	835	32	3	1,113	930	33	10
27	1,007	944	34	3	943	987	34	10
28	787	1,044	35	3	547	1,238	35	11
29	413	1,269	36	3	304	1,312	36	11
30	236	1,281	36	4	149	1,290	37	11
SUM	**46,718**	**16,918**	**580**	**65**	**46,791**	**17,721**	**590**	**180**

3.10.4 Step 10D – Test Whether CH4 Emissions from Small-Scale Fires Must be Monitored

3.11 Step 11 – Estimate Leakage from Geographically Unconstrained Drivers

Leakage from geographically unconstrained drivers can occur in areas beyond and far away from project area vicinity. Forest clearing for land sale is the only geographically unconstrained driver that is relevant in the project. Other drivers that are geographically unconstrained are large economic land concessions and timber concessions. These were

excluded from the reference area and not included in the carbon accounting. The latter is conservative since a leakage cancellation rate of 100% is assumed; no project activities will affect the hectares of forest being cleared by large economic land concessions or timber concessions. Leakage cancellation rates are summarized in Table 53. Further substantiation of the leakage rates is provided below.

1. **Forest clearing for land sales.** Migrants unable to settle and encroach within the project area are likely to shift to the land immediately surrounding the project. The majority of these migrants will stay within the leakage belt, and we estimate conservatively that migrant encroachment and resulting deforestation within the leakage area will cancel approximately 50% of avoided deforestation within the project area.
2. **Large economic land concessions**. Economic Land Concessions granted by the MAFF and provincial governments will not be allowed within the project areas. However, large ELCs will continue to be granted outside the project area, effectively cancelling through leakage 100% of the avoided deforestation within the project area. Since ELCs were excluded from the reference region, no further adjustment has to be done to the carbon accounting.
3. **Timber concessions**. Timber concessions are not allowed in the project area, but will continue to be granted in the surrounding areas and leakage belt. We anticipate timber concessions to be granted with the same frequency regardless of project implementation, and estimate a 100% leakage cancellation rate as a result. Since Timber concessions were excluded from the reference region, no further adjustment has to be done to the carbon accounting.

3.12 Step 12 – Estimate Applicability of and Emission sources from Leakage Prevention Activities

3.12.1 Step 12A – Check Conditions and Quantify Emissions from Intensification of Annual Cropping Systems

The project plans to initiate pilot projects to educate local communities on certain agricultural practices which can increase yields and decrease the pressure on forest land to be converted to agricultural land. This will involve an increase in the use of fertilizer, especially from synthetic sources. Since the amount of livestock and cattle is limited in the project area, it is assumed that increases in fertilizer will mainly come from synthetic fertilization. As the pilot projects mature and the techniques become more wide-spread, it is assumed that local farmers will gradually adopt these techniques. Although fertilizer will not be provided for free or subsidized to the farmers, it is expected that the pilot projects will increase the purchase and use of fertilizer by local farmers. It is expected that the fertilizer application rate increases to 100 kg per ha from 55 kg per ha with average increase of 80%.

Table 58. GHG emissions from increased fertilization.

Variable	Acronym/ Symbol	Value	Unit
Volatilization factor for synthetic fertilizer	f_{GASF}	0.1	[-]
Volatilization factor for organic fertilizer	f_{GASM}	0.2	[-]
Emission factor for N_2O	EF	0.0125	[-]
Global Warming potential for N_2O	GWP_{N2O}	310	[-]
Baseline synthetic fertilizer rate		55	[kg ha-1 yr-1]
Project synthetic fertilizer rate		100	[kg ha-1 yr-1]
Synthetic fertilizer rate above the baseline		45	[kg ha-1 yr-1]

Table 59. Annual areas of agricultural intensification and total GHG emissions from increased fertilization.

	Adoption area	Increase in Organic Fertilization Rate	Increase in Synthetic Fertilization rate	Sum of GHG emissions from Fertilization
Year	[ha]	[kg N yr^{-1}]	[kg N yr^{-1} ha^{-1}]	[t CO_2e yr^{-1}]
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	438	0	45	108
2013	875	0	45	216
2014	1,313	0	45	324
2015	1,750	0	45	432
2016	2,188	0	45	539
2017	2,625	0	45	647
2018	3,063	0	45	755
2019	3,500	0	45	863
2020	3,938	0	45	971
2021	4,375	0	45	1,079
2022	4,813	0	45	1,187
2023	5,250	0	45	1,295
2024	5,688	0	45	1,403
2025	6,125	0	45	1,511
2026	6,563	0	45	1,618
2027	7,000	0	45	1,726
2028	7,000	0	45	1,726
2029	7,000	0	45	1,726
2030	7,000	0	45	1,726
2031	7,000	0	45	1,726
2032	7,000	0	45	1,726
2033	7,000	0	45	1,726
2034	7,000	0	45	1,726
2035	7,000	0	45	1,726
2036	7,000	0	45	1,726
2037	7,000	0	45	1,726

3.12.2 Step 12B – Check Conditions and Quantify Emissions from Introduction of Flooded Rice Production

Project activities do not impact the total area of flooded rice production, but only the yields. Therefore,

$$\Delta A_{rice}(t) = 0$$

$$\Delta E_{flooded\ rice}(t) = 0$$

3.12.3 Step 12C – Estimate GHG Emissions from Increased Livestock Stocking Rates, $\Delta E_{livestock}$

Livestock stocking rates will not increase due to project actions, therefore,

$$\Delta E_{livestock} = 0$$

3.12.4 Emission Reductions from Fuel-Efficient Cookstoves

The household survey results showed that current consumption of fuelwood is about 3.1 t dry matter (DM) per household per year (consistent with results from regional study by Top et al. 2003). Reducing the demand for fuel will lead to a direct reduction in the unsustainable harvesting of fuelwood. Different types of cook stoves are in use in the project area ranging from least efficient type such as three stone stoves to high efficient types such as Neang Kongrey Stove. Approximately 9 percent of households have already adopted most efficient stoves. Given that fuel-efficient stoves are available at the rate of $3 – 3.75, it is highly unlikely that the households would adopt efficient stoves under baseline scenario. Over one third of the households are using traditional three stone stoves which uses 4.02 Mg DM per households. The social assessments indicated that people are willing to substitute their stoves with the most efficient stoves. The project will first target the households using the least efficient stoves and gradually replace existing stoves with efficient stoves. Such substitution is likely to reduce the fuelwood use by 15 – 65% from the current level. The project expects (conservatively) that only 70% of the households will immediately adopt improved cook stoves in their households and given the fact that some of the households, the implementation of the cook stove program is likely to reduce fuel consumption by about 44% which corresponds to reduction of consumption of 1.36 Mg DM of fuel-wood per household per year, or an annual CO_2 emission reduction of 1.75 t CO_2e per household per year. These fuelwood savings are achieved through the redesign of the Lao bucket stove, which specifically improves insulation and airflow. Some further research is still necessary to optimize the design of the stoves and outreach activities will be required to maximize adoption rates. The project will work with local NGOs to extend fuel-efficient stoves to 8,000 households in the project area. Fuel-efficient stoves would be distributed at a rate of 1,000 cook stoves per year during 2012 – 2021. These cookstoves would be maintained throughout the project crediting period.

Table 60. Energy efficiency gain by implementing improved cook stoves program in project area.

Type of stoves	Percentage of households using different type of stoves [%]	Fuel use [Mg DM yr^{-1} $Household^{-1}$]	Relative fuel use compared to three stone stove [%]	Net reduction in fuelwood with Neang Kongrey or similar stove [Mg DM yr^{-1} $Household^{-1}$]
Neang Kongrey stove	8.79	2.85	35	0
New Lao stove	26.74	2.63	55	0.52
Seam stove	1.10	3.29	75	1.31
Three stones	35.90	4.02	100	2.61
Traditional Lao Kg Chhnang stove	2.56	2.56	80	1.14
Traditional Lao stove	24.91	2.40	85	1.20

Since degradation is excluded from the carbon accounting, benefits from stoves can be added to the GHG benefits from avoided deforestation. The following table summarizes the GHG benefits from introducing fuel efficient stoves as a project activity. Note that the required 0.75 uncertainty deduction was applied during the calculation of VCUs.

Table 61. Carbon accounting for fuel-efficient stoves.

Year	Number of fuel-efficient stoves in use [-]	GHG benefits from fuel-efficient stoves [t CO_2e]
2008	0	0
2009	0	0
2010	0	0
2011	0	0
2012	1,000	-1,750
2013	2,000	-3,500
2014	3,000	-5250
2015	4,000	-7,000
2016	5,000	-8,750
2017	6,000	-10,500
2018	7,000	-12,250
2019	8,000	-14,000
2020	8,000	-14,000
2021	8,000	-14,000
2022	8,000	-14,000
2023	8,000	-14,000
2024	8,000	-14,000
2025	8,000	-14,000
2026	8,000	-14,000
2027	8,000	-14,000
2028	8,000	-14,000
2029	8,000	-14,000
2030	8,000	-14,000
2031	8,000	-14,000
2032	8,000	-14,000
2033	8,000	-14,000
2034	8,000	-14,000
2035	8,000	-14,000
2036	8,000	-14,000
2037	8,000	-14,000

3.13 Step 13 – Ex-ante Estimation of NERs

3.13.1 Step 13A – Estimate carbon in long-lived wood products

The survey found an average demand of 3.58 m3 per household per year. In addition, the household survey found that only 4% of this timber demands were coming from the

community forests. There are 7971 households, therefore the volume of wood extracted out of the project area under the baseline scenario is:

$$V_{ex,baseline} = 3.58 \cdot 0.04 \cdot 7971 = 1141\ m^3 yr^{-1}$$

To remain conservative, it is assumed that all wood is coming from Dipterocarp species with an average density of 1.2 g cm^3, therefore:

$$C_{HWP,baseline} = 1141 \cdot 1.2 \cdot 0.5 = 685\ Mg\ C\ yr^{-1}$$

Further assuming a wwf of 0.24, slp of 0.4, fo of 0.99:

$$C_{LWP,baseline} = 685 \cdot (1 - 0.24) \cdot (1 - 0.4) \cdot (1 - 0.84) = 50\ Mg\ C\ yr^{-1}$$

	Fire Breaks	Biomass loss from ANR	GHG emissions loss from ANR burning	GHG emissions from ANR fertilization	Increased emissions from rice	Increased emissions from fertilizer	Increased emissions from livestock	Total Emissions
Year	[t CO_2e yr^{-1}]	[t CO_2e yr^{-1}]	[t CO_2e yr^{-1}]	[t CO_2e yr^{-1}]	[t CO_2e yr^{-1}]	[t CO_2e yr^{-1}]	[t CO_2e yr^{-1}]	[t CO_2e yr^{-1}]
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	108	0	108
2013	1,100	0	0	0	0	216	0	1,316
2014	1,100	0	0	0	0	324	0	1,424
2015	1,100	0	0	0	0	432	0	1,532
2016	1,100	0	0	0	0	539	0	1,639
2017	1,100	0	0	0	0	647	0	1,747
2018	1,100	0	0	0	0	755	0	1,855
2019	1,100	0	0	0	0	863	0	1,963
2020	1,100	0	0	0	0	971	0	2,071
2021	1,100	0	0	0	0	1,079	0	2,179
2022	1,100	0	0	0	0	1,187	0	2,287
2023	0	0	0	0	0	1,295	0	1,295
2024	0	0	0	0	0	1,403	0	1,403
2025	0	0	0	0	0	1,511	0	1,511
2026	0	0	0	0	0	1,618	0	1,618
2027	0	0	0	0	0	1,726	0	1,726
2028	0	0	0	0	0	1,726	0	1,726
2029	0	0	0	0	0	1,726	0	1,726
2030	0	0	0	0	0	1,726	0	1,726
2031	0	0	0	0	0	1,726	0	1,726
2032	0	0	0	0	0	1,726	0	1,726
2033	0	0	0	0	0	1,726	0	1,726
2034	0	0	0	0	0	1,726	0	1,726

2035	0	0	0	0	0	1,726	0	1,726
2036	0	0	0	0	0	1,726	0	1,726
2037	0	0	0	0	0	1,726	0	1,726
Total	**11,000**	**0**	**0**	**0**	**0**	**31,937**	**0**	**42,937**

This volume is by far insignificant for every year of the project period, even if this value is increased for conservativeness.

3.13.2 Step 13B – Summarize the projected land use change

See tables in sections 3.5.4 and 3.7.

3.13.3 Step 13C – Test the Significance of GHG Emissions

Sources of increased GHG emissions in the project are emission from vehicular use for patrolling and increased use of synthetic fertilizer. Sources of decrease in GHG sinks are biomass loss arising from installation of firebreaks and implementation of ANR activities. The estimation of GHG emissions due to project activities over the crediting period is shown in Table 62.

Table 62. Estimation of GHG emissions due to project activities.

The total net benefits of the project (without ANR) are around 6.5 million t CO_2e. All GHG emissions account for less than 5% of the net anthropogenic emissions reduction from project activities and thus are considered insignificant. Sum of GHG emissions in decreasing order of magnitude with significant test parameters specified in the Methodology is in Table 63.

Table 63. Summary of total GHG emissions.

Source	GHG Emission [t CO_2e yr^{-1}]	% of Total GHG Removal	Rank
Biomass removal for firebreaks	11,000	0.17%	1
Fertilizer application	31,937	0.49%	2
Biomass removal for ANR	0	0%	3
Total	42,937	0.66%	-

3.13.4 Step 13D – Estimate Ex-ante NERs

This section provides summarizes the Ex-Ante estimation of GHG benefits.

Table 64. Overview of ex-ante estimation of NERs through the project crediting period.

	1	2	3	4	5	6	7	8	9				
YEAR	ΔGHG from avoided deforestation	ΔGHG from deforestation due to leakage	ΔGHG from avoided degradation	ΔGHG from avoided degradation due to leakage	GHG from leakage by unconstrained geographic drivers	ΔGHG from assisted natural regneration	ΔGHG from changes in long lived wood products	GHG from improved cookstoves	GHG from Emission sources	NER	Risk Buffer	Buffer	VCU
	[t CO_2e]	[t CO_2e]	[t CO_2e]	[t CO_2e]	[t CO_2e]	[tCO2e]	[t CO_2e]	[t CO_2e]	[t CO_2e]	[t CO_2e]	[%]	[t CO_2e]	[t CO_2e]
2008	-19,475	3,467	0	0	1,180	-20,016	0	0	0	-34,844	19.75	6,882	27,045
2009	-61,245	7,257	0	0	6,290	-20,512	0	0	0	-68,209	19.75	13,471	52,063
2010	-105,261	11,263	0	0	15,875	-21,504	0	0	0	-99,627	19.75	19,676	74,591
2011	-153,889	16,048	0	0	30,185	-27,308	0	0	0	-134,965	19.75	26,656	99,178
2012	-189,224	19,626	0	0	37,854	-33,599	0	-1,313	0	-166,655	19.75	32,914	122,648
2013	-204,032	28,681	0	0	42,392	-52,085	0	-2,625	0	-187,670	19.75	37,065	137,087
2014	-232,823	41,761	0	0	46,931	-78,038	0	-3,938	0	-226,106	19.75	44,656	164,711
2015	-251,703	47,765	0	0	50,407	-100,812	0	-5,250	0	-259,594	19.75	51,270	189,972
2016	-254,939	45,441	0	0	51,034	-103,188	0	-6,563	0	-268,214	19.75	52,972	197,484
2017	-257,074	49,043	0	0	51,661	-109,003	0	-7,875	0	-273,250	19.75	53,967	200,949
2018	-258,127	49,859	0	0	52,291	-121,151	0	-9,188	0	-286,316	19.75	56,547	211,409
2019	-277,858	61,680	0	0	52,917	-133,044	0	-10,500	0	-306,805	19.75	60,594	225,652
2020	-283,411	48,187	0	0	53,546	-148,743	0	-10,500	0	-340,920	19.75	67,332	255,570
2021	-290,442	40,147	0	0	54,166	-162,526	0	-10,500	0	-369,155	19.75	72,908	279,694
2022	-293,504	20,373	0	0	54,623	-161,816	0	-10,500	0	-390,825	19.75	77,188	300,899
2023	-312,472	28,398	0	0	55,075	-151,564	0	-10,500	0	-391,063	19.75	77,235	299,416
2024	-311,146	39,410	0	0	55,518	-139,138	0	-10,500	0	-365,856	19.75	72,256	276,925
2025	-312,738	34,547	0	0	55,957	-130,696	0	-10,500	0	-363,430	19.75	71,778	275,852
2026	-313,625	44,595	0	0	56,378	-124,634	0	-10,500	0	-347,786	19.75	68,688	261,229
2027	-310,830	40,498	0	0	56,769	-119,829	0	-10,500	0	-343,892	19.75	67,919	258,837
2028	-298,952	57,194	0	0	56,692	-111,607	0	-10,500	0	-307,173	19.75	60,667	226,087
2029	-298,619	61,797	0	0	56,448	-103,327	0	-10,500	0	-294,201	19.75	58,105	214,817
2030	-313,238	65,351	0	0	56,045	-93,304	0	-10,500	0	-295,645	19.75	58,390	215,353
2031	-321,114	71,238	0	0	55,313	-78,524	0	-10,500	0	-283,587	19.75	56,008	204,659
2032	-336,720	54,075	0	0	54,139	-69,182	0	-10,500	0	-308,188	19.75	60,867	228,022
2033	-343,838	24,154	0	0	52,285	-50,697	0	-10,500	0	-328,596	19.75	64,898	250,675
2034	-332,743	4,458	0	0	49,472	-27,334	0	-10,500	0	-316,648	19.75	62,538	245,532
2035	-317,642	0	0	0	45,494	-17,494	0	-10,500	0	-300,142	19.75	59,278	233,952
2036	-299,897	0	0	0	40,328	-15,440	0	-10,500	0	-285,509	19.75	56,388	223,230
2037	-257,878	0	0	0	34,273	-8,791	0	-10,500	0	-242,896	19.75	47,972	190,229
Total	**-7,814,461**	**1,016,310**	**0**	**0**	**1,381,539**	**-2,534,905**	**0**	**-236,250**	**0**	**-8,187,767**	**0**	**1,617,084**	**6,143,767**

4 MONITORING

4.1 Data and Parameters Available at Validation

Data/parameter [EA 1]:	$nrFNFtransitions$
Data unit:	Count
Description:	Number of forest/non-forest transitions among land classes or forest strata, meaning transitions in which either the "from" or the "to" class are non-forests
Source of data:	Field measurement
Value applied:	4
Justification of choice:	Upon deforestation, a forest type transitions into either bare soil, burned area, wet soil, or agriculture
Any comment:	

Data/parameter [EA 2]:	$\Delta area_{projectAreaWithoutANR,projectScenario}(t,i)$
Data unit:	[ha yr-1]
Description:	Hectares undergoing transition i within the project area, excluding the ANR area, under the project scenario for year t
Sources of data:	Land-use change model
Value applied:	See spreadsheet submitted to validator
Justification of choice:	Calculated using the land use change model
Any comment:	

Data/parameter [EA 3]:	$\Delta area_{projectAreaWithoutANR,baselineScenario}(t,i)$
Data unit:	[ha yr-1]
Description:	Hectares undergoing transition i within the project area, excluding the ANR area, under the baseline scenario for year t
Sources of data:	Land-use change model
Value applied:	See Table 43
Justification of choice:	Calculated using the land use change model
Any comment:	

Data/parameter [EA 4]:	$\Delta area_{projectAreaWithANR,baselineScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Hectares undergoing transition i within the leakage area under the project scenario for year$t$.
Sources of data:	Land-use change modeling
Value applied:	See spreadsheet
Justification of choice:	Calculated using the land use change model
Any comment:	

Data/parameter [EA 5]:	$\Delta area_{leakageArea,projectScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Hectares undergoing transition i within the leakage area under the project scenario for year t
Sources of data:	Land-use change modeling
Value applied:	See spreadsheet

Justification of choice:	Calculated using the procedures described in the methodology
Any comment:	

Data/parameter [EA 6]:	$\Delta area_{leakageArea,baselineScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Hectares undergoing transition i within the leakage area under the baseline scenario during year t
Sources of data:	Land-use change modeling
Value applied:	
Justification of choice:	See methodology
Any comment:	

Data/parameter [EA 7]:	$nrANRstrata$
Data unit:	Count
Description:	Number of strata within the project area on which ANR activities are proposed
Sources of data:	Field survey with community members, soil maps, land-cover maps
Value applied:	1
Justification of choice:	The number of ANR strata (i.e., 1) was selected based on the ANR management plan designed by the project proponents.
Any comment:	A suite of ANR activities is implemented on degraded forest.

Data/parameter [EA 8]:	$NAI(i)$
Data unit:	[Mg DM ha-1 yr-1]
Description:	Net annual increment due to natural regeneration and succession for the “from” class of transition i
Sources of data (*):	Values from peer-reviewed literature
Value applied:	See Table 35
Justification of choice:	Followed the procedures further described in the methodology
Any comment:	To be updated during monitoring.

Data/parameter [EA 9]:	Locations of discrete project parcels
Data unit:	Digital boundaries
Description:	Locations of all individual discrete project parcels in electronic format
Sources of data:	Project design decision
Value applied:	Shapefile is available to verifier
Justification of choice:	
Any comment:	UTM 48N / WGS84 projection

Data/parameter [EA 10]:	Geographical location of reference region
Data unit:	Digital boundaries
Description:	Geographical locations of the reference region in electronic format
Sources of data:	GIS analysis
Value applied:	Shapefile is available to verifier
Justification of choice:	
Any comment:	UTM 48N / WGS84 projection

Data/parameter [EA 11]:	Description of LULC classes and forest strata
Data unit:	Narrative
Description:	Detailed description of the LULC classes and forest strata used for classification, including criteria and thresholds used, pictures, seasonality, and any other aspect determining the carbon stock differences
Sources of data:	Field survey, literature
Value applied:	See section 3.4.1
Justification of choice:	
Any comment:	

Data/parameter [EA 12]:	Description of drivers of deforestation
Data unit:	Narrative
Description:	Detailed description of the drivers of deforestation, including the agents of deforestation, main socio-economic features, underlying motivation, population size, and future development of population size and driving variables
Sources of data:	Field survey, literature
Value applied:	See section **Error! Reference source not found.**
Justification of choice:	
Any comment:	

Data/parameter [EA 13]:	Historical LULC and forest strata transition matrix
Data unit:	[ha yr^{-1}]
Description:	Matrix of historical land transition rates between LULC classes and forest strata
Sources of data:	Remote sensing analysis
Value applied:	See spreadsheet
Justification of choice:	
Any comment:	

Data/parameter [EA 14]:	$FW_{baseline}$

Data unit:	[m^3 yr^{-1}]
Description:	Annual volume of fuelwood gathered in the baseline scenario
Sources of data (*):	Participatory rural appraisals conducted by project proponents
Value applied:	22,629.33
Justification of choice:	Emission reductions from avoided degradation were excluded due to insufficient accuracy and emission reductions from fuel-efficient woodstoves are included. Therefore, $FW_{baseline}$ was measured using social assessments.
Any comment:	

Data/parameter [EA 15]:	ρ_{wood}
Data unit:	[Mg DM m^{-3}]
Description:	Basic wood density
Sources of data:	GPG-LULUCF
Value applied:	Relevant species in GPG-LULUCF Table 3A.1.9
Justification of choice:	
Any comment:	

Data/parameter [EA 16]:	BEF_2
Data unit:	[-]
Description:	Biomass expansion factor for converting volumes of extracted roundwood to total aboveground biomass (including bark)
Sources of data:	Literature (UNDP/MOE Cambodia 2003) combined with inventory data
Value applied:	1.74
Justification of choice:	National study
Any comment:	

Data/parameter [EA 17]:	CF
Data unit:	[Mg C $(Mg\ DM)^{-1}$]
Description:	Carbon fraction of dry matter in wood
Sources of data:	IPCC
Value applied:	0.5
Justification of choice:	Default value
Any comment:	

Data/parameter [EA 18]:	$area_{baseline,fire}(i)$
Data unit:	[ha yr^{-1}]
Description:	Forest area in the project area affected by disturbances from forest fires in forest stratum i
Sources of data (*):	Participatory rural appraisals conducted by project proponents
Value applied:	{408,592} for i = 1 and 2 Where i = 2 represents strata receiving induced by hunters and i =2 is fire induced to clear the understory
Justification of choice:	
Any comment:	

* lower-ranked options may only be used if higher-ranked options are not available.

Data/parameter [EA 19]:	E
Data unit:	
Description:	Average combustion efficiency of the above-ground tree biomass
Sources of data (*):	IPCC
Value applied:	0.5
Justification of choice:	Default factor
Any comment:	

* lower-ranked options may only be used if higher-ranked options are not available.

Data/parameter [EA 20]:	P
Data unit:	
Description:	Average proportion of mass burnt from the above-ground tree biomass
Sources of data:	GPG-LULUCF Table 3A.1.12
Value applied:	42.2
Justification of choice:	
Any comment:	Fixed for the entire crediting period

Data/parameter [EA 21]:	$\Delta B_{forestFires}$
Data unit:	[Mg DM ha^{-1}]
Description:	Biomass consumption for forest fires
Sources of data:	GPG-LULUCF Table 3A.1.13
Value applied:	11.47
Justification of choice:	
Any comment:	Fixed for the entire crediting period

Data/parameter [EA 22]:	$\Delta area_{baseline,cropland}(i)$
Data unit:	[ha yr^{-1}]
Description:	Forest area converted from forest stratum i to cropland in the project area under baseline conditions at the start of the project
Sources of data (*):	Social assessments conducted by project proponents
Value applied:	300
Justification of choice:	The remote sensing images have a significant confusion between bare soil and agricultural land. Therefore, remote sensing analysis was deemed inaccurate to quantify areas converted into cropland.
Any comment:	

Data/parameter [EA 23]:	$\Delta area_{baseline,settlement}(i)$
Data unit:	[ha yr^{-1}]
Description:	Average forest area converted from forest stratum i to settlements in the reference region under baseline conditions
Sources of data (*):	Social assessments conducted by project proponents
Value applied:	68
Justification of choice:	The resolution of the remote sensing images used was too small to distinguish forests cleared into settlements from any other land-use transition.
Any comment:	

Data/parameter [EA 24]:	$CT_{baseline}$
Data unit:	[m^3 yr^{-1}]
Description:	Annually extracted volume of harvested timber roundwood for commercial on-sale
Sources of data (*):	Participatory rural appraisals conducted by project proponents
Value applied:	0
Justification of choice:	
Any comment:	

Data/parameter [EA 25]:	$DT_{baseline}$
Data unit:	[m^3 yr^{-1}]
Description:	Annually extracted volume of timber for domestic and local use, roundwood
Sources of data (*):	Participatory rural appraisals conducted by project proponents
Value applied:	46155.86
Justification of choice:	
Any comment:	

Data/parameter [EA 26]:	$nrDrivers$
Data unit:	Count
Description:	Number of drivers of deforestation or forest degradation
Sources of data:	Selection procedure described in "Analyze the Agents and Drivers of Deforestation" in the methodology
Value applied:	8
Justification of choice:	Two of the 10 identified drivers were excluded geographically from the reference region.
Any comment:	

Data/parameter [EA 27]:	$size_{projectArea}$
Data unit:	[ha]
Description:	Total project area
Sources of data:	Field measurement
Value applied:	56,050
Justification of choice:	
Any comment:	

Data/parameter [EA 28]:	AP
Data unit:	[ha]
Description:	Sample plot size (constant for all strata)
Sources of data:	GPG-LULUCF 2003 , local biomass inventory protocols or Pearson et al. (2005)
Value applied:	0.25
Justification of choice:	A standard square plot of 50 m x 50 m was used.
Any comment:	

Data/parameter [EA 29]:	$area(i,t)$
Data unit:	[ha]
Description:	Total area of class or stratum $\boldsymbol{i}$ during time t
Sources of data:	Remote sensing analysis and stratification procedure
Value applied:	See Table 25
Justification of choice:	
Any comment:	

Data/parameter [EA 30]:	Q_i
Data unit:	[Mg DM ha^{-1}]
Description:	Approximate average value of the aboveground tree biomass of class or stratum i
Sources of data:	Peer-reviewed literature
Value applied:	See Table 34
Justification of choice:	Followed description in the methodology
Any comment:	To be updated during monitoring

Data/parameter [EA 31]:	p
Data unit:	

Description:	Desired level of precision
Sources of data:	Project design decision
Value applied:	10%
Justification of choice:	
Any comment:	

Data/parameter [EA 32]:	α
Data unit:	
Description:	Minimal confidence level for the biomass stock density measured with a biomass inventory
Sources of data:	Project design decision
Value applied:	95%
Justification of choice:	
Any comment:	To be updated during monitoring

Data/parameter [EA 33]:	st_i
Data unit:	[Mg DM ha^{-1}]
Description:	Ex-ante expected standard deviation of the aboveground biomass of class or stratum i
Sources of data:	Peer-reviewed literature, reports, or preliminary measurements
Value applied:	See Table 34
Justification of choice:	
Any comment:	

Data/parameter [EA 34]:	$cost_i$
Data unit:	[-]
Description:	Cost to sample stratum i
Sources of data:	Estimated from preliminary sampling in different forest strata
Value applied:	1
Justification of choice:	Costs are identical for all strata
Any comment:	

Data/parameter [EA 35]:	$nrTrees(i,p)$
Data unit:	Count
Description:	Number of trees in sample plot $\boldsymbol{p}$ of LULC class or forest stratum $\boldsymbol{i}$
Sources of data:	Field measurements
Value applied:	See Spreadsheet
Justification of choice:	
Any comment:	

Data/parameter [EA 36]:	$f_{allometric}(y)$
Data unit:	Equation
Description:	Allometric relationship to convert DBH into biomass
Sources of data (*):	Equation “D” in Chave et al. 2005
Value applied:	
Justification of choice:	Equation "D" in Chave et al. (2005) was found to be conservative in both evergreen and deciduous forest types as verified using

	destructive sampling techniques derived from forests near the project area. A detailed report on the verification of the allometric equation is available to the verifier.
Any comment:	

Data/parameter [EA 37]:	$DBH(t,i,p)$
Data unit:	[cm]
Description:	DBH of tree t within plot p of LULC class or forest stratum i
Sources of data:	Field measurements
Value applied:	See Spreadsheet
Justification of choice:	
Any comment:	

Data/parameter [EA 38]:	$\theta(i,p)$
Data unit:	Degrees
Description:	Slope of the land of plot $\boldsymbol{p}$ of LULC class or forest stratum $\boldsymbol{i}$ (see section 8 in Pearson et al., 2005).
Sources of data:	Field measurement
Value applied:	See Spreadsheet
Justification of choice:	Measured in sampling plots
Any comment:	Almost all of the project area is located on flat terrain.

Data/parameter [EA 39]:	$f_{belowground}(y)$
Data unit:	Equation
Description:	Relationship between aboveground and belowground biomass, such as a root-to-shoot ratio
Sources of data (*):	Equation from Pearson et al., 2005
Value applied:	$BBD = e^{(-1.0587+0.8836 \ln ABD)}$ Where ABD = belowground biomass, and BBD = belowground biomass
Justification of choice:	
Any comment:	

Data/parameter [EA 40]:	$nrDecompClasses$
Data unit:	1=sound; 2=intermediate; 3=rotten
Description:	Number of decomposition classes
Sources of data:	Field observations
Value applied:	3
Justification of choice:	
Any comment:	

Data/parameter [EA 41]:	$D(d,i,p)$
Data unit:	[m]
Description:	Sum of diameters in biomass class d of sampling plot p of LULC class or forest stratum i
Sources of data:	Field measurements
Value applied:	See Biomass Inventory Database
Justification of choice:	
Any comment:	

Data/parameter [EA 42]:	L
Data unit:	[m]
Description:	Length of the transect
Sources of data:	Project design decision
Value applied:	50
Justification of choice:	
Any comment:	

Data/parameter [EA 43]:	$\rho_{DW}(d)$
Data unit:	[kg.DM m^{-3}]
Description:	Basic density of dead wood in the density class d
Sources of data:	GPG LULUCF
Value applied:	GPG LULUCF Tables 3A.1.9-1 and 3A.1.9-2
Justification of choice:	
Any comment:	

Data/parameter [EA 44]:	$D_{referenceRegion,baselineScenario,DF}(t)$
Data unit:	[ha yr^{-1}]
Description:	Rate of deforestation within the reference region for year t
Sources of data:	Linear interpolation of remote sensing data
Value applied:	See Figure 17
Justification of choice:	Followed procedures in the methodology
Any comment:	To be updated at the baseline update

Data/parameter [EA 45]:	$D_{referenceRegion,baselineScenario,DG}(t)$
Data unit:	[ha yr^{-1}]
Description:	Rate of degradation within the reference region for year t
Sources of data:	*4.1.1.1 Not applicable*
Value applied:	*Not applicable*

Justification of choice:	*Not applicable*
Any comment:	

Data/parameter [EA 46]:	GWP_{N2O}
Data unit:	
Description:	Global Warming Potentials for N_2O
Sources of data:	IPCC
Value applied:	310
Justification of choice:	IPCC default value
Any comment:	Fixed for the entire crediting period

Data/parameter [EA 47]:	GWP_{CH4}
Data unit:	
Description:	Global Warming Potentials for CH_4
Sources of data:	IPCC
Value applied:	21
Justification of choice:	IPCC default value
Any comment:	Fixed for the entire crediting period

Data/parameter [EA 48]:	ER_{N2O}
Data unit:	Proportion
Description:	Emission ratios for N_2O
Sources of data:	Table 3A.1.15 in IPCC GPG-LULUCF 2003
Value applied:	0.007
Justification of choice:	IPCC default value
Any comment:	Fixed for the entire crediting period

Data/parameter [EA 49]:	ER_{CH4}
Data unit:	Proportion
Description:	Emission ratios for CH_4
Sources of data:	Table 3A.1.15 in IPCC GPG-LULUCF 2003
Value applied:	0.012 (IPCC default value)
Justification of choice:	
Any comment:	Fixed for the entire crediting period

Data/parameter [EA 50]:	r
Data unit:	Proportion
Description:	Carbon-to-Nitrogen ratio of the wood
Sources of data (*):	A measured value based on leaf litter analyses,
Value applied:	100
Justification of choice:	Conservative value allowed by methodology
Any comment:	Fixed for the entire crediting period

Data/parameter [EA 51]:	$size_{referenceRegion}$
Data unit:	[ha]
Description:	Total size of the reference region

Sources of data:	Project design decision
Value applied:	The total size of the reference region is 621,860 ha
Justification of choice:	Followed the procedure in the methodology
Any comment:	Fixed for the entire crediting period

Data/parameter [EA 52]:	$\Delta area_{historical}(CS_1 \rightarrow CS_2, t_1 \rightarrow t_2)$
Data unit:	[ha]
Description:	Area of transition from LULC class or forest stratum 1 to 2 from time 1 to 2 during the historical reference period
Sources of data:	Remote sensing analysis
Value applied:	See spreadsheet submitted to validator
Justification of choice:	
Any comment:	

Data/parameter [EA 53]:	$area_{historical}(CS_1, t_1)$
Data unit:	[ha]
Description:	Total area of LULC class or forest stratum 1 during time 1
Sources of data:	Remote sensing analysis
Value applied:	Table 25
Justification of choice:	
Any comment:	

Data/parameter [EA 54]:	$f_{scarcity}(t)$
Data unit:	
Description:	Forest scarcity factor used to reduce the historical deforestation rate as a function of remaining forest cover [-]
Sources of data:	Methodology
Value applied:	$f_{scarcity}(t) = \frac{1}{1 + e^{sc_1\left(sc_2 - \frac{area(t,nonForest)}{size_{projectArea}}\right)}}$
Justification of choice:	
Any comment:	

Data/parameter [EA 55]:	sc_1
Data unit:	
Description:	First shape factor for the forest scarcity equation; steepness of the decrease in deforestation rate (greater is steeper)
Sources of data:	Statistical fitting procedure
Value applied:	20
Justification of choice:	This scarcity function was calibrated using observations from Meyfroidt and Lambin (2008). The shape factors were set so that deforestation starts to decrease when around 50% of the current forest area in the project area is deforested, and completely stops when around 80% of the forest area has disappeared. This pattern was reported by Meyfroidt and Lambin (2008) in neighboring Vietnam. Deforestation rates started decreasing when 50% of forest cover remained, and halted in 1991-1993 at around 25% forest cover. Due to its cultural and ecological similarity to Cambodia, the forest transition trends observed in Vietnam are a valid reference for the situation in

	Cambodia.
Any comment:	

Data/parameter [EA 56]:	sc_2
Data unit:	0.7
Description:	Second shape factor for the forest scarcity equation; relative deforested area at which the deforestation rate was 50% of the initial deforestation rate
Sources of data:	Statistical fitting procedure
Value applied:	
Justification of choice:	
Any comment:	

Data/parameter [EA 57]:	$area(t, nonForest)$
Data unit:	[ha]
Description:	Total area that is not forest within the project area at time t after project start
Sources of data:	Land use change model
Value applied:	See spreadsheet
Justification of choice:	
Any comment:	

Data/parameter [EA 58]:	$effectiveness_{DG}(a, d)$
Data unit:	
Description:	The relative effectiveness of project action a in reducing the forest degradation caused by driver d
Sources of data:	Pilot projects, social assessments
Value applied:	See Table 44
Justification of choice:	
Any comment:	

Data/parameter [EA 59]:	$nrActivities$
Data unit:	Count
Description:	Total number of project activities
Sources of data:	Project design decision
Value applied:	5
Justification of choice:	Estimated based on the allocated funds, the capacity of implementing organization, and the motivation of participating communities
Any comment:	Fixed for the entire crediting period

Data/parameter [EA 60]:	$rate(a,t)$
Data unit:	Count
Description:	Adoption rate or relative degree of activity for activity a during year t. A value of 100% indicates that the activity cannot be more efficient in reducing deforestation or forest degradation than estimated.
Sources of data:	Project design decision
Value applied:	See Table 47
Justification of choice:	
Any comment:	

Data/parameter [EA 61]:	$nrFireClasses$
Data unit:	Count
Description:	Number of forest strata in which fire breaks were installed
Sources of data:	Project design decision
Value applied:	2
Justification of choice:	
Any comment:	To be updated at baseline update

Data/parameter [EA 62]:	$area_{biomassLoss}(i)$
Data unit:	[ha yr^{-1}]
Description:	Total annual area of forest stratum i that was cleared
Sources of data:	Project design decision
Value applied:	0
Justification of choice:	
Any comment:	

Data/parameter [EA 63]:	$area_{fireBiomassLoss}(i)$
Data unit:	[ha yr^{-1}]
Description:	Annual area of forest stratum i that was cleared by using prescribed burning
Sources of data:	Project design decision
Value applied:	0
Justification of choice:	No area will be cleared by using prescribed burning.
Any comment:	

Data/parameter [EA 64]:	$nrStrata$
Data unit:	Count
Description:	Number of forest strata
Sources of data:	Project design decision
Value applied:	2
Justification of choice:	Two strata were identified: evergreen forest and deciduous forest.
Any comment:	To be updated at baseline update

Data/parameter [EA 65]:	$area_{projectAreaWithANR,projectScenario}(t,i)$
Data unit:	[ha]
Description:	Area of land on which ANR activities were planned under the project scenario for year $\boldsymbol{t}$ and in stratum i
Sources of data:	Project design decision
Value applied:	5,355
Justification of choice:	
Any comment:	To be updated during monitoring

Data/parameter [EA 66]:	Locations of ANR activities
Data unit:	Digital boundaries
Description:	Locations of all individual parcels on which ANR activities are planned in electronic format
Sources of data:	Project design decision
Value applied:	
Justification of choice:	
Any comment:	Shapefile is provided to the verifier

Data/parameter [EA 67]:	$area_{biomassLoss,ANR}(t,i)$
Data unit:	[ha]
Description:	Area of biomass removed within ANR stratum i during year t
Sources of data:	Project design decision
Value applied:	0 ha
Justification of choice:	
Any comment:	To be updated once ANR management plan is finalized

Data/parameter [EA 68]:	$area_{fireBiomassLoss,ANR}(t,i)$
Data unit:	[ha]
Description:	Area of biomass removed using prescribed burning within ANR stratum i during year t
Sources of data:	Project design decision
Value applied:	0
Justification of choice:	No prescribed burning will be executed inside of the project area
Any comment:	

Data/parameter [EA 69]:	$nrCDrivers$
Data unit:	Count
Description:	Number of geographically constrained drivers
Sources of data:	Literature/ Participatory rural appraisals
Value applied:	3
Justification of choice:	
Any comment:	

Data/parameter [EA 70]:	$leakage_{constrained}(d)$
Data unit:	
Description:	Leakage cancellation rate for avoiding deforestation/degradation of driver $\boldsymbol{d}$from geographically constrained drivers
Sources of data:	Calculation
Value applied:	Table 53
Justification of choice:	Estimated using the "leakage cancellation rate" procedure in the methodology
Any comment:	To be updated at the baseline update

Data/parameter [EA 71]:	$FW_{baseline}$
Data unit:	[m^3 yr^{-1}]
Description:	Biomass (dry matter) of fuel-wood collected by project participants under the baseline scenario
Sources of data (*):	Social appraisals in the project area
Value applied:	22,629
Justification of choice:	
Any comment:	

Data/parameter [EA 72]:	$FW_{allowed}$
Data unit:	[m^3 yr^{-1}]
Description:	Biomass (dry matter) of allowed fuel-wood collection in the project area under the project scenario
Sources of data:	Management plans
Value applied:	14709
Justification of choice:	
Any comment:	35% less than baseline

Data/parameter [EA 73]:	$nrfuelWoodReductionActions$
Data unit:	Count

Description:	The number of project activities that reduce the need for fuel-wood.
Sources of data:	Project design decision
Value applied:	2
Justification of choice:	Two project activities are planned: promotion of fuel-efficient wood-stoves and livestock prevention from insects.
Any comment:	

Data/parameter [EA 74]:	$adoption(i)$
Data unit:	
Description:	Adoption rate of project activity i which reduces fuel-wood consumption
Sources of data:	Literature/ pilot studies
Value applied:	70 %
Justification of choice:	Conservatively estimated based on a prediction of the willingness of local communities to adopt the alternative practice
Any comment:	

Data/parameter [EA 75]:	$efficiency(i)$
Data unit:	
Description:	Rate at which project activity i reduces fuel-wood consumption
Sources of data:	Literature/ pilot studies
Value applied:	44%
Justification of choice:	Although modern wood stoves are proved to be 75% more efficient than traditional stoves, the conservative estimate of 44% efficiency was applied.
Any comment:	To be updated during monitoring

Data/parameter [EA 76]:	$\Delta area_{settlement,baseline}$
Data unit:	[ha yr^{-1}]
Description:	Area that would be converted to settlements by participating communities under the baseline scenario
Sources of data (*):	Remote sensing analysis in the project area before start of the crediting period
Value applied:	68
Justification of choice:	
Any comment:	To be updated at baseline update

Data/parameter [EA 77]:	$\Delta area_{settlement,project}$
Data unit:	[ha yr^{-1}]
Description:	Area that will be converted to settlements by participating communities under the project scenario
Sources of data:	Literature
Value applied:	0
Justification of choice:	Estimated area that will be converted to cropland based on an understanding of the area required per household dwelling when participatory land use plans are in place and the anticipated population increase
Any comment:	To be updated during monitoring

Data/parameter [EA 78]:	$\Delta area_{settlement,allowed}$
Data unit:	[ha yr^{-1}]
Description:	Area that will be converted to settlements after within the project area under the project scenario
Sources of data:	Project design decision
Value applied:	0
Justification of choice:	No conversion to settlement is allowed within the project area.
Any comment:	To be updated at baseline update

Data/parameter [EA 79]:	$\Delta area_{cropLand,baseline}$
Data unit:	[ha yr^{-1}]
Description:	Area that would be converted to cropland by participating communities under the baseline scenario
Sources of data (*):	Social appraisals in the project area before start of the crediting period
Value applied:	300
Justification of choice:	
Any comment:	

Data/parameter [EA 80]:	$\Delta area_{cropLand,project}$
Data unit:	[ha yr^{-1}]
Description:	Area that will be converted to cropland by participating communities under the project scenario
Sources of data:	Literature/pilot studies
Value applied:	0
Justification of choice:	Estimated based on the understanding of cropland area required per household when support for agricultural intensification is provided and anticipated increase in population
Any comment:	To be updated during monitoring

Data/parameter [EA 81]:	$\Delta area_{cropLand,allowed}$
Data unit:	[ha yr^{-1}]
Description:	Area that will be converted to cropland after within the project area under the project scenario
Sources of data:	Project design decision
Value applied:	0
Justification of choice:	Land-use plans prohibit forest area to be converted to cropland
Any comment:	

Data/parameter [EA 82]:	Geographical location of the leakage belts
Data unit:	Shape file
Description:	Exact geographical location of the leakage belt(s) in electronic form
Sources of data:	
Value applied:	Shape file is provided to verifier
Justification of choice:	
Any comment:	

Data/parameter [EA 83]:	$size_{leakageArea}$
Data unit:	[ha]
Description:	Size of the leakage area
Sources of data:	
Value applied:	116,806
Justification of choice:	Selected based on the procedure in the methodology
Any comment:	

Data/parameter [EA 84]:	Historical fire significance of emissions from small-scale fires
Data unit:	Narrative
Description:	Test whether the CH_4 emissions from fires were significant during the past five years in the project area and leakage belts
Sources of data (*):	Social appraisals or remote sensing analysis
Value applied:	
Justification of choice:	Selected based on the procedure in the methodology
Any comment:	Social appraisals from all 13 community forests indicate that fire has been, and continues to be, a significant occurrence throughout the project area. Remote sensing from 1994 to 2008 supports the social appraisals. Remote sensing also shows that fire is much more of common disturbance in deciduous and mixed forest than in evergreen forest. To be updated at baseline update

Data/parameter [EA 85]:	$leakage_{unconstrained}(croplandconversion)$
Data unit:	Proportion
Description:	Leakage cancellation rate for avoiding deforestation/degradation from migrants clearing forest area for cropland conversion [-]
Sources of data:	Project area circumstances
Value applied:	50%
Justification of choice:	Migrants unable to settle and encroach within the project area are likely to shift to the land immediately surrounding the project. The majority of these migrants will stay within the leakage belt, and we estimate conservatively that migrant encroachment and resulting deforestation within the leakage area will cancel approximately 50% of avoided deforestation within the project area.
Any comment:	To be updated at baseline update

Data/parameter [EA 86]:	$nrEmissions$
Data unit:	Count
Description:	Total number of sources of GHG emissions considered
Sources of data:	Project area circumstances
Value applied:	3
Justification of choice:	Three emission sources are considered: fertilizer, biomass removed from ANR strata, biomass removed from for fire breaks
Any comment:	Fixed for the entire crediting period

Data/parameter [EA 87]:	Description of event, condition, or circumstance affecting land-use dynamics

Data unit:	Narrative
Description:	A description of a potential change affecting the land-use
Sources of data:	Literature
Value applied:	Significant military activity, significant mining activity, changes in land-use policy, social unrest increasing pressure on forest areas, drastic increases in in-migration
Justification of choice:	
Any comment:	

Data/parameter [EA 88]:	x
Data unit:	Year
Description:	Number of years of long term persistent increase/decrease in forest carbon stock used in definition of forest degradation, and forest regeneration.
Sources of data:	Theoretical thresholds
Value applied:	Currently 10 years
Justification of choice:	
Any comment:	

Data/parameter [EA 89]:	y
Data unit:	
Description:	Minimum percentage of change in forest carbon stock used in definition of forest degradation, and forest regeneration
Sources of data:	Theoretical threshold
Value applied:	10%
Justification of choice:	
Any comment:	

Data/parameter [EA 90]:	t
Data unit:	Year
Description:	Measurement time period for estimating persistent increase/decrease in forest carbon stock used in definition of forest degradation, and forest regeneration
Sources of data:	Theoretical thresholds
Value applied:	10
Justification of choice:	Value used from VCS standards
Any comment:	

Data/parameter [EA 91]:	$V_{ex,h,ty,j}$
Data unit:	[M^3 Yr^{-1}]
Description:	The volume of timber extracted from within the project boundary during harvest h by species$j$and wood product class ty
Sources of data (*):	Social assessments conducted by project proponents
Value applied:	387.96
Justification of choice:	
Any comment:	

Data/parameter [EA 92]:	$nrLyingWood$

Data unit:	[-]
Description:	Total number of lying dead wood pieces on a transect line within a sample plot.
Sources of data:	Field measurement
Value applied:	See Spreadsheet
Justification of choice:	
Any comment:	

4.2 Data and Parameters Monitored

Data/parameter [MN 1]:	Locations of discrete project parcels
Data unit:	Digital boundaries
Description:	Locations of all individual discrete project parcels in electronic format
Sources of data:	Project design decision
Description of methods:	All necessary meta-data to correctly display the files must be included.
Frequency of monitoring:	Every 2 years after the validation of the project
Value applied:	Discrete project parcels available at validation
Monitoring equipment:	
QA/QC procedures:	Boundaries must be compared with boundaries visible on RS imagery such as roads
Calculation method:	
Any comment:	

Data/parameter [MN 2]:	$size_{projectArea}$
Data unit:	[ha]
Description:	Total project area
Sources of data:	Field measurement
Description of methods:	Use a GIS to calculate the area
Frequency of monitoring:	Every 2 years after the validation of the project
Value applied:	56,050 ha
Monitoring equipment:	
QA/QC procedures:	none
Calculation method:	
Any comment:	

Data/parameter [MN 3]:	Historical LULC and forest strata transition matrix
Data unit:	[ha yr^{-1}]
Description:	Matrix of historical land transition rates between LULC classes and forest strata
Sources of data:	Remote sensing analysis
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	See spreadsheet submitted to validator
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented
Calculation method:	
Any comment:	

Data/parameter [MN 4]:	$\Delta area_{projectAreaWithoutANR,projectScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Hectares undergoing transition i within the project area, excluding the ANR area, under the project scenario for year t. [ha yr^{-1}].
Sources of data:	Remote sensing analysis
Description of methods:	

Frequency of monitoring:	Annually after the validation of the project
Value applied:	See spreadsheet submitted to validator
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented
Calculation method:	
Any comment:	

Data/parameter [MN 5]:	$\Delta area_{projectAreaWithoutANR,baselineScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Hectares undergoing transition i within the project area, excluding the ANR area, under the baseline scenario for year t. [ha yr^{-1}].
Sources of data:	Land-use change modeling
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	See Table 43
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented
Calculation method:	
Any comment:	

Data/parameter [MN 6]:	$\Delta area_{projectAreaWithANR,baselineScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Hectares undergoing transition i within the leakage area under the project scenario for year t.
Sources of data:	Land-use change modeling
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	See spreadsheet submitted to validator
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented
Calculation method:	
Any comment:	

Data/parameter [MN 7]:	$\Delta area_{leakageArea,projectScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Hectares undergoing transition i within the leakage area under the project scenario for year t
Sources of data:	Remote sensing analysis
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	See spreadsheet submitted to validator
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented
Calculation method:	
Any comment:	

Data/parameter [MN 8]:	$\Delta area_{leakageArea,baselineScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Hectares undergoing transition i within the leakage area under the baseline scenario during year t
Sources of data:	Land-use change modeling
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project

Value applied:	See spreadsheet
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented
Calculation method:	
Any comment:	

Data/parameter [MN 9]:	Household count
Data unit:	Count
Description:	Number of households in the project area
Sources of data:	Official records and census data
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	7,971
Monitoring equipment:	
QA/QC procedures:	Cross-validate with independent sources, if available.
Calculation method:	
Any comment:	

Data/parameter [MN 10]:	Household size
Data unit:	Count
Description:	Average size of a household in the project area
Sources of data:	Official records and census data
Measurement procedures:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	6.5
Monitoring equipment:	
QA/QC procedures:	Cross-validate with independent sources, if available.
Calculation method:	
Any comment:	

Data/parameter [MN 11]:	$FW_{baseline}$
Data unit:	[m^3 yr^{-1}]
Description:	Annual volume of fuelwood gathering in the baseline scenario
Sources of data (*):	Social assessments
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	22,629
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 12]:	ρ_{wood}
Data unit:	[Mg DM m^{-3}]
Description:	Basic wood density.
Sources of data:	GPG-LULUCF Table 3A.1.9.
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	GPG-LULUCF Table 3A.1.9.
Monitoring equipment:	
QA/QC procedures:	none
Calculation method:	
Any comment:	

Data/parameter [MN 13]:	BEF_2
Data unit:	[-]
Description:	Biomass expansion factor for converting volumes of extracted

	roundwood to total aboveground biomass (including bark).
Sources of data:	Literature
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	
Monitoring equipment:	
QA/QC procedures:	Use value that leads to conservative results
Calculation method:	
Any comment:	

Data/parameter [MN 14]:	$area_{baseline,fire}(i)$
Data unit:	[ha yr^{-1}]
Description:	Forest area in the project area affected by disturbances from forest fires in forest stratum i
Sources of data (*):	Social assessments
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 15]:	$\Delta area_{baseline,cropland}(i)$
Data unit:	[ha yr^{-1}]
Description:	Forest area converted from forest stratum i to cropland in the project area under baseline conditions at the start of the project
Sources of data (*):	Social assessments
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	300
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 16]:	$\Delta area_{baseline,settlement}(i)$
Data unit:	[ha yr^{-1}]
Description:	Average forest area converted from forest stratum i to settlements in the reference region under baseline conditions
Sources of data (*):	Social assessments
Description of methods:	See methodology for further guidance on remote sensing
Frequency of monitoring:	At baseline update
Value applied:	68
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 17]:	$CT_{baseline}$
Data unit:	[m^3 yr^{-1}]
Description:	Annually extracted volume of harvested timber round-wood for commercial on-sale
Sources of data (*):	Social assessments
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	0

Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 18]:	Timber price
Data unit:	Local currency
Description:	Prices of timber on local markets
Sources of data:	Field measurement/survey
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	
Monitoring equipment:	
QA/QC procedures:	Cross-validate with independent sources, if available.
Calculation method:	
Any comment:	

Data/parameter [MN 19]:	$DT_{baseline}$
Data unit:	[m^3 yr^{-1}]
Description:	Annually extracted volume of timber for domestic and local use, roundwood
Sources of data (*):	Social assessments
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	46155.86
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 20]:	$nrDrivers$
Data unit:	Count
Description:	Number of drivers of deforestation or forest degradation
Sources of data:	
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	8
Monitoring equipment:	
QA/QC procedures:	
Calculation method:	
Any comment:	

Data/parameter [MN 21]:	$area(i,t)$
Data unit:	[ha]
Description:	Total area of class or stratum i during time t
Sources of data:	Remote sensing analysis
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	See spreadsheet
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented
Calculation method:	
Any comment:	

Data/parameter [MN 22]:	$nrTrees(i,p)$
Data unit:	Count
Description:	Number of trees in sample plot p of LULC class or forest stratum i

Sources of data:	Measure in sampling plots
Description of methods:	
Frequency of monitoring:	Every 2 years after the validation of the project
Value applied:	See spreadsheet
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in biomass inventory SOP
Calculation method:	
Any comment:	

Data/parameter [MN 23]:	$DBH(t,i,p)$
Data unit:	[cm]
Description:	DBH of tree t within plot p of LULC class or forest stratum i
Sources of data:	Measure in sampling plots
Description of methods:	Measured at 1.3 m above the ground for trees with DBH > 5 cm.
Frequency of monitoring:	Every 2 years after the validation of the project
Value applied:	See spreadsheet
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in biomass inventory SOP
Calculation method:	
Any comment:	

Data/parameter [MN 24]:	$\theta(i,p)$
Data unit:	degrees
Description:	Slope of the land of plot p of LULC class or forest stratum i
Sources of data:	Measure in sampling plots
Description of methods:	See section 8 in Pearson et al., 2005
Frequency of monitoring:	Every 2 years after the validation of the project
Value applied:	See spreadsheet
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in biomass inventory SOP
Calculation method:	
Any comment:	

Data/parameter [MN 25]:	$f_{allometric}(y)$
Data unit:	
Description:	Allometric relationship to convert DBH into biomass
Sources of data (*):	Peer-reviewed literature
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	Equation “D” in Chave et al. 2005
Monitoring equipment:	
QA/QC procedures:	Verify allometric relationship with destructively sampled trees
Calculation method:	
Any comment:	

Data/parameter [MN 26]:	$D(d,i,wp,p)$
Data unit:	[cm]
Description:	Diameter of piece wp of lying wood along the transect in decomposition class d (1=sound, 2=intermediate, 3=rotten) of sampling plot p of LULC class or forest stratum i.
Sources of data:	Measure in sampling plots
Description of methods:	
Frequency of monitoring:	Every 2 years after the validation of the project
Value applied:	See spreadsheet
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in biomass inventory SOP
Calculation method:	
Any comment:	

Data/parameter [MN 27]:	$\Delta area_{historical}(CS_1 \rightarrow CS_2, t_1 \rightarrow t_2)$
Data unit:	[ha yr^{-1}]
Description:	Area of transition from LULC class or forest stratum 1 to 2 from time 1 to 2 during the historical reference period
Sources of data:	Remote sensing analysis
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	See spreadsheet
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented
Calculation method:	
Any comment:	

Data/parameter [MN 28]:	$area_{historical}(CS_1, t_1)$
Data unit:	[ha]
Description:	Total area of LULC class or forest stratum 1 during time 1
Sources of data:	Remote sensing analysis
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	See spreadsheet
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented
Calculation method:	
Any comment:	

Data/parameter [MN 29]:	$D_{referenceRegion,baselineScenario,DF}(t)$
Data unit:	[ha yr^{-1}]
Description:	Rate of deforestation within the reference region for year t.
Sources of data:	
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	See Figure 17
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented
Calculation method:	Linear interpolation of remote sensing data
Any comment:	

Data/parameter [MN 30]:	$D_{referenceRegion,baselineScenario,DG}(t)$
Data unit:	[ha yr^{-1}]
Description:	Rate of forest degradation within the reference region for year t.
Sources of data:	Linear interpolation of remote sensing data
Description of methods:	
Frequency of monitoring:	Degradation is not included in the project
Value applied:	
Monitoring equipment:	
QA/QC procedures:	
Calculation method:	
Any comment:	

Data/parameter [MN 31]:	$area(t, nonForest)$
Data unit:	[ha]
Description:	Total area that is not forest within the project area at time t after project start.

Sources of data:	Remote sensing analysis
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	See spreadsheet
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented
Calculation method:	
Any comment:	

Data/parameter [MN 32]:	$effectiveness_{DG}(a,d)$
Data unit:	
Description:	The relative effectiveness of project action a in reducing the forest degradation caused by driver d
Sources of data:	Pilot projects, social assessments
Description of methods:	
Frequency of monitoring:	Degradation is not included in the project
Value applied:	
Monitoring equipment:	
QA/QC procedures:	
Calculation method:	
Any comment:	

Data/parameter [MN 33]:	$rate(a,t)$
Data unit:	Count
Description:	Adoption rate or relative degree of activity for activity a during year t. A value of 100% indicates that the activity cannot be more efficient in reducing deforestation or forest degradation than estimated
Sources of data:	Project design decision
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	See Table 47
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures on recording project activities in methodology
Calculation method:	
Any comment:	

Data/parameter [MN 34]:	Forest patrolling labor
Data unit:	[hrs]
Description:	Labor hours used for forest patrolling
Sources of data:	Records of implemented activities
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures on recording project activities in methodology
Calculation method:	
Any comment:	

Data/parameter [MN 35]:	Description of fire prevention measures
Data unit:	text
Description:	Information on fire prevention measures
Sources of data:	Records of implemented activities
Description of methods:	Record dates of implementation of fire prevention measures, type of activity, and location (lat/lon coordinates)
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none

Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures on recording project activities in methodology
Calculation method:	
Any comment:	

Data/parameter [MN 36]:	$area_{biomassLoss}(i)$
Data unit:	[ha yr^{-1}]
Description:	Total annual area of LULC class i that was cleared
Sources of data:	Records of implemented activities
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures on recording project activities in methodology
Calculation method:	
Any comment:	

Data/parameter [MN 37]:	$area_{fireBiomassLoss}(i)$
Data unit:	[ha yr^{-1}]
Description:	Annual area of forest stratum i that was cleared by using controlled burning
Sources of data:	Records of implemented activities
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	0
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures on recording project activities in methodology
Calculation method:	
Any comment:	

Data/parameter [MN 38]:	$nrStrata$
Data unit:	Count
Description:	Number of forest strata
Sources of data:	Project design decision
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	2
Monitoring equipment:	
QA/QC procedures:	
Calculation method:	
Any comment:	

Data/parameter [MN 39]:	$adoption(i)$
Data unit:	Proportion
Description:	Adoption rate of project activity i which reduces fuel-wood consumption
Sources of data:	social assessments
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	70 %
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 40]:	$efficiency(i)$
Data unit:	Proportion

Description:	Rate at which project activity i reduces fuel-wood consumption
Sources of data:	Field measurements
Description of methods:	Measure efficiency in at least 10 randomly selected households. Only to be included if activities that reduce fuel-wood consumption are implemented.
Frequency of monitoring:	Every 2 years after the validation of the project
Value applied:	44%
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 41]:	$\Delta area_{settlement,baseline}$
Data unit:	[ha yr^{-1}]
Description:	Area that would be converted to settlements by participating communities under the baseline scenario
Sources of data:	Remote sensing analysis in the reference region after the start of the crediting period
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	68
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented
Calculation method:	
Any comment:	

Data/parameter [MN 42]:	Description of agricultural intensification
Data unit:	Narrative
Description:	Detailed description of the implemented agricultural intensification projects
Sources of data:	Records of implemented activities
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures on recording project activities in methodology
Calculation method:	
Any comment:	

Data/parameter [MN 43]:	Area under agricultural intensification
Data unit:	[ha]
Description:	Size of the area of agricultural intensification separated for each agricultural intensification measure
Sources of data:	Participatory rural appraisals
Description of methods:	Calculate based on areas of fertilized cropland in the leakage and project areas Only to be included if agricultural intensification activities are implemented.
Frequency of monitoring:	Annually after the validation of the project
Value applied:	
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 44]:	Yields under agricultural intensification
Data unit:	[Mg ha^{-1}]

Description:	Harvested yield for agricultural intensification practices
Sources of data:	Participatory rural appraisals
Description of methods:	Only to be included if agricultural intensification activities are implemented.
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 45]:	Agricultural outreach activity
Data unit:	Narrative
Description:	A detailed description of the different activities and meetings done for agricultural outreach
Sources of data:	Records of implemented activities
Description of methods:	Provide dates and reports of demonstration meetings or agricultural outreach and extension activities for agricultural intensification practices
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures on recording project activities in methodology
Calculation method:	
Any comment:	

Data/parameter [MN 46]:	Fuel-efficient stoves acquired
Data unit:	Count
Description:	Number of fuel-efficient stoves acquired per year
Sources of data:	Participatory rural appraisals.
Description of methods:	Only to be included if fuel-efficient stoves are introduced.
Frequency of monitoring:	Annually after the validation of the project
Value applied:	
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 47]:	Fuel-efficient stoves used
Data unit:	Count
Description:	Number of fuel-efficient stoves effectively used by project participants
Sources of data:	Participatory rural appraisals.
Description of methods:	Only to be included if fuel-efficient stoves are introduced.
Frequency of monitoring:	Every 2 years after the validation of the project
Value applied:	
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 48]:	$nrANRstrata$
Data unit:	Count
Description:	Number of strata within the project area on which ANR activities are proposed
Sources of data:	Field measurement
Description of methods:	The number of ANR strata is dependent on the ANR management plan designed by the project proponents. Only to be included if ANR activities are implemented.

Frequency of monitoring:	Once at first verification
Value applied:	1
Monitoring equipment:	
QA/QC procedures:	See ANR SOP
Calculation method:	
Any comment:	

Data/parameter [MN 49]:	Locations of ANR activities
Data unit:	Digital boundaries
Description:	Locations of all individual parcels on which ANR activities are planned in electronic format
Sources of data:	Project design decision
Description of methods:	Only to be included if ANR activities are implemented.
Frequency of monitoring:	Once at first verification
Value applied:	
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures on recording project activities in methodology
Calculation method:	
Any comment:	

Data/parameter [MN 50]:	Geographical location of the leakage belts
Data unit:	Digital boundaries
Description:	Exact geographical location of the leakage belt(s) in electronic form
Sources of data:	Project design decision/GIS analysis
Description of methods:	
Frequency of monitoring:	Once at first verification
Value applied:	
Monitoring equipment:	
QA/QC procedures:	See methodology
Calculation method:	
Any comment:	

Data/parameter [MN 51]:	$size_{leakageArea}$
Data unit:	[ha]
Description:	Size of the leakage area
Sources of data:	
Description of methods:	
Frequency of monitoring:	Once at first verification
Value applied:	116,806
Monitoring equipment:	
QA/QC procedures:	See methodology
Calculation method:	
Any comment:	

Data/parameter [MN 52]:	Description of ANR activities
Data unit:	Narrative
Description:	Detailed description regarding the ANR activities, including dates and locations
Sources of data:	Records of implemented activities
Description of methods:	Provide dates, locations (Digital boundaries), areas, and types of biomass removal (coppicing, removal of invasive species, thinning), and dates, locations (Digital boundaries or geographic coordinates), areas, species, and planting density of enrichment planting
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	See ANR SOP

Calculation method:	
Any comment:	

Data/parameter [MN 53]:	$NAI(i)$
Data unit:	[Mg C ha^{-1} yr^{-1}]
Description:	Net annual biomass increment for forest stratum i under the baseline scenario.
Sources of data:	Estimate within the biomass inventory plots outside of the ANR area
Description of methods:	Only to be included if ANR activities are implemented.
Frequency of monitoring:	Every 2 years after the validation of the project
Value applied:	See Table 35
Monitoring equipment:	
QA/QC procedures:	See biomass inventory SOP
Calculation method:	
Any comment:	

Data/parameter [MN 54]:	$\Delta C(t,i)$
Data unit:	[Mg C ha^{-1} yr^{-1}]
Description:	Increase in forest biomass in ANR forest stratum i at time t.
Sources of data:	Estimate within the biomass inventory plots inside of the ANR area
Description of methods:	
Frequency of monitoring:	Every 2 years
Value applied:	
Monitoring equipment:	
QA/QC procedures:	See biomass inventory SOP
Calculation method:	
Any comment:	

Data/parameter [MN 55]:	ANR tree survival rate
Data unit:	proportion
Description:	Survival rate of planted or regenerating trees as an ANR activity
Sources of data:	Estimate within the biomass inventory plots inside of the ANR area
Description of methods:	
Frequency of monitoring:	Every 5 years after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	See ANR SOP
Calculation method:	
Any comment:	

Data/parameter [MN 56]:	$area_{fireBiomassLoss,ANR}(t,i)$
Data unit:	[ha]
Description:	Area of biomass removed by controlled burning within ANR stratum i during year t
Sources of data:	Records of implemented activities
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	0
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures on recording project activities in methodology
Calculation method:	
Any comment:	

Data/parameter [MN 57]:	$area_{biomassLoss,ANR}(t,i)$
Data unit:	[ha]
Description:	Area of biomass removed within ANR stratum i during year t, by coppicing, removing of invasive species, or thinning

Sources of data:	Records of implemented activities
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	0
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures on recording project activities in methodology
Calculation method:	
Any comment:	

Data/parameter [MN 58]:	$area_{projectAreaWithANR,projectScenario}(t,i)$
Data unit:	[ha]
Description:	Amount of land on which ANR activities are planned under the baseline scenario for year t and in stratum i
Sources of data:	Records of implemented activities
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures on recording project activities in methodology
Calculation method:	
Any comment:	

Data/parameter [MN 59]:	$nrFireClasses$
Data unit:	Count
Description:	Number of LULC classes in which fire breaks were installed
Sources of data:	Records of implemented activities
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	2
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures on recording project activities in methodology
Calculation method:	
Any comment:	

Data/parameter [MN 60]:	$size_{projectArea}$
Data unit:	[ha]
Description:	Total size of all strata, e.g. the total project area
Sources of data:	Project design decision
Description of methods:	
Frequency of monitoring:	Once at verification
Value applied:	56,050
Monitoring equipment:	
QA/QC procedures:	See methodology
Calculation method:	
Any comment:	

Data/parameter [MN 61]:	Evidence of land-tenure strengthening
Data unit:	narrative
Description:	Information and data on land-tenure strengthening
Sources of data:	Records of implemented activities
Description of methods:	Record dates and reports of all meetings with stakeholders regarding land-tenure status strengthening, original agreements strengthening the land-tenure status, dates when the land-tenure status strengthening agreements were signed, and dates and reports of all meetings with stakeholders regarding forest and land-use plans
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none

Monitoring equipment:	
QA/QC procedures:	See methodology
Calculation method:	
Any comment:	

Data/parameter [MN 62]:	Fire prevention labor
Data unit:	[hrs]
Description:	Labor hours used to implement the measure fire prevention measure
Sources of data:	Records of implemented activities
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Cross-validate with multiple, independent, sources, if available
Calculation method:	
Any comment:	

Data/parameter [MN 63]:	NTFP harvest rate
Data unit:	[m^3 yr^{-1}] or [kg yr^{-1}]
Description:	Annual volumes of non-timber forest products extracted
Sources of data:	Participatory rural appraisals
Description of methods:	Estimate among participating communities and communities living in the leakage area.
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Cross-validate with multiple, independent, sources, if available
Calculation method:	
Any comment:	

Data/parameter [MN 64]:	Local NTFP price
Data unit:	local currency
Description:	Price of non-timber forest products on local markets
Sources of data:	Participatory rural appraisals
Description of methods:	
Frequency of monitoring:	Every 5 years after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Cross-validate with multiple, independent, sources, if available
Calculation method:	
Any comment:	

Data/parameter [MN 65]:	Location of timber harvesting
Data unit:	Digital boundaries
Description:	Location of timber harvested within the project area
Sources of data:	Management plans and social assessments
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Boundaries must be cross-checked by overlaying with remote sensing imagery
Calculation method:	
Any comment:	

Data/parameter [MN 66]:	Timber harvesting rate
Data unit:	[m^3]
Description:	Volume of timber harvested within the project area

Sources of data:	Participatory rural appraisals
Description of methods:	Estimate among participating communities and communities living in the leakage area.
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	See SOP for Social Assessments
Calculation method:	
Any comment:	

Data/parameter [MN 67]:	Location of fuel-wood collection
Data unit:	Digital geographic coordinates
Description:	Location of fuel-wood collected within the project area
Sources of data:	Participatory rural appraisals
Description of methods:	Estimate among participating communities and communities living in the leakage area.
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	See SOP for Social Assessments
Calculation method:	
Any comment:	

Data/parameter [MN 68]:	Wood harvested for charcoal
Data unit:	[m^3]
Description:	Volume of green wood harvested for charcoal production within the project area per forest stratum
Sources of data:	Participatory rural appraisals
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	See SOP for Social Assessments
Calculation method:	
Any comment:	

Data/parameter [MN 69]:	$leakage_{constrained}(d)$
Data unit:	
Description:	Leakage cancellation rate for avoiding deforestation/degradation of driver $\boldsymbol{d}$
Sources of data:	Calculation
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	Table 53
Monitoring equipment:	
QA/QC procedures:	
Calculation method:	See “leakage cancellation rate” in methodology II.3.2.1
Any comment:	

Data/parameter [MN 70]:	$leakage_{unconstrained}(cropland\ conversion)$
Data unit:	Proportion
Description:	Leakage cancellation rate for avoiding deforestation/degradation from migrants clearing forest area for cropland conversion [-]
Sources of data:	Project area circumstances
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	50%

Monitoring equipment:	
QA/QC procedures:	Cross-validate with multiple, independent, sources, if available
Calculation method:	
Any comment:	

Data/parameter [MN 71]:	$\Delta area_{settlement,project}$
Data unit:	[ha yr^{-1}]
Description:	Area that will be converted to settlements by participating communities under the project scenario
Sources of data:	Literature
Description of methods:	Expert knowledge
Frequency of monitoring:	Every 2 years after the validation of the project
Value applied:	
Monitoring equipment:	
QA/QC procedures:	Cross-validate with multiple, independent, sources, if available
Calculation method:	
Any comment:	

Data/parameter [MN 72]:	$\Delta area_{settlement,allowed}$
Data unit:	[ha yr^{-1}]
Description:	Area that will be converted to settlements after within the project area under the project scenario
Sources of data:	Project design decision
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	0
Monitoring equipment:	
QA/QC procedures:	none
Calculation method:	
Any comment:	

Data/parameter [MN 73]:	$\Delta area_{cropLand,baseline}$
Data unit:	[ha yr^{-1}]
Description:	Area that would be converted to cropland by participating communities under the baseline scenario
Sources of data (*):	Social assessment
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	300
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 74]:	$\Delta area_{cropLand,project}$
Data unit:	[ha yr^{-1}]
Description:	Area that will be converted to cropland by participating communities under the project scenario
Sources of data:	Literature/pilot studies
Description of methods:	
Frequency of monitoring:	Every 2 years after the validation of the project
Value applied:	0
Monitoring equipment:	
QA/QC procedures:	Cross-validate with multiple, independent, sources, if available
Calculation method:	
Any comment:	

Data/parameter [MN 75]:	$\Delta area_{cropLand,allowed}$
Data unit:	[ha yr^{-1}]
Description:	Area that will be converted to cropland after within the project area under the project scenario
Sources of data:	Project design decision
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	0
Monitoring equipment:	
QA/QC procedures:	none
Calculation method:	
Any comment:	

Data/parameter [MN 76]:	Description of natural disturbance (except for fire)
Data unit:	Narrative, maps of the areas
Description:	A detailed description of the circumstances and impacts of a natural disturbance
Sources of data:	Field observations
Description of methods:	Provide the following items type, i.e. flood/earthquakes/ pest/…, date, location and area affected (provide digital boundaries/geographic locations), and the area within the project area and leakage areas for every natural disturbance. Estimate of proportion of biomass lost during disturbance by comparing the maps of the areas with the LULC maps Record every time a natural disturbance decreasing the biomass in the project area is occurring.
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Cross-validate with multiple, independent, sources, if available
Calculation method:	
Any comment:	

Data/parameter [MN 77]:	$\Delta area_{large\ scale\ fires}\ (t,i)$
Data unit:	[ha]
Description:	Area of large-scale fires detectable by medium-resolution satellite imagery in the project area or leakage belts
Sources of data:	Remote sensing analysis
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented
Calculation method:	
Any comment:	

Data/parameter [MN 78]:	Maps of the large-scale burned areas
Data unit:	Digital boundary
Description:	Maps of large-scale (10 ha) fires detectable by medium-resolution satellite imagery in the project area or leakage belts [ha]
Sources of data:	Remote sensing analysis
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Uncertainty analysis must be carried out and a confusion matrix must be presented

Calculation method:	
Any comment:	

Data/parameter [MN 79]:	National, local and sectoral forest-use policies
Data unit:	Narrative
Description:	Describe any recent national, local and/or sectoral policies that are implemented that have affected or will affect allowable forest use
Sources of data:	legal documents, policy documents, etc.
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Cross-validate with multiple, independent, sources, if available
Calculation method:	
Any comment:	

Data/parameter [MN 80]:	Changes of political, social or economic nature
Data unit:	narrative
Description:	Describe significant changes of political, social or economic nature have occurred or will occur, making the current baseline estimates inaccurate
Sources of data:	Literature, Planning documents
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Cross-validate with multiple, independent, sources, if available
Calculation method:	
Any comment:	

Data/parameter [MN 81]:	Land-use opportunity cost
Data unit:	Narrative
Description:	The risk that alternative land uses on the land become much more attractive than the REDD project
Sources of data:	Literature, Planning documents
Description of methods:	Describe and analyze market effects such as a significant price rising of timber and non-woody products, or the increase of prices of agricultural commodities would increase the deforestation pressure on the current forest land
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Cross-validate with multiple, independent, sources, if available
Calculation method:	
Any comment:	

Data/parameter [MN 82]:	New Roads
Data unit:	Narrative
Description:	A description of the location and size of new roads that have been built since the last verification or roads that will be built before the following verification
Sources of data:	Literature, Planning documents
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Cross-validate with multiple, independent, sources, if available
Calculation method:	

Any comment:	

Data/parameter [MN 83]:	Other change affecting land-use
Data unit:	Narrative
Description:	A description of any potential change affecting the land-use in as set at validation or the previous baseline update
Sources of data:	Literature, Planning documents
Description of methods:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Cross-validate with multiple, independent, sources, if available
Calculation method:	
Any comment:	

Data/parameter [MN 84]:	Description of event, condition, or circumstance affecting land-use dynamics
Data unit:	Narrative
Description:	A description of a potential change affecting the land-use
Sources of data:	Literature
Description of methods:	Describe any potential event, condition, or circumstance in the project area that is not covered in the list in section III.4 and that would trigger a baseline update.
Frequency of monitoring:	At baseline update
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Cross-validate with multiple, independent, sources, if available
Calculation method:	
Any comment:	

Data/parameter [MN 85]:	Historical significance of emissions from small-scale fires
Data unit:	Narrative
Description:	Test whether the CH4 emissions from fires were significant in the project area and leakage belts during the past five years.
Sources of data:	Participatory rural appraisals and remote sensing analysis
Description of methods:	
Frequency of monitoring:	At baseline update
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Cross-validate remote sensing analysis with social assessments
Calculation method:	
Any comment:	

Data/parameter [MN 86]:	ER_{CH4}
Data unit:	
Description:	Emission ratio for CH_4
Sources of data:	Table 3A.1.15 in IPCC GPG-LULUCF (2003).
Description of methods:	Use default value of 0.012.
Frequency of monitoring:	Only to be included if the historical fire emissions are significant (see before).
Value applied:	0.012 (IPCC default value)
Monitoring equipment:	
QA/QC procedures:	none
Calculation method:	
Any comment:	

Data/parameter [MN 87]:	$\Delta C_{fire}(i)$
Data unit:	[tCO_2-eq ha^{-1}]

Description:	Biomass lost due to small-scale fires
Sources of data:	Field inventories
Description of methods:	Calculate as the difference in carbon stock densities between the "from" and "to" class and stratum for transition i.
Frequency of monitoring:	Every 5 years or at least once before every verification, whichever is more frequent
Value applied:	
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in biomass inventory SOP
Calculation method:	
Any comment:	

Data/parameter [MN 88]:	$fireExtent(t,i)$
Data unit:	
Description:	Proportion of project area and leakage belts that were affected by small-scale fires.
Sources of data:	Default factor or remote sensing analysis
Description of methods:	By default, assume 100% or substantiate a smaller percentage using remote sensing data products, on the condition that the quantification is conservative. Only to be included if the historical fire emissions are significant.
Frequency of monitoring:	Annually after the validation of the project
Value applied:	
Monitoring equipment:	
QA/QC procedures:	Cross-validate estimates among multiple data sources or using independent data and reports
Calculation method:	
Any comment:	

Data/parameter [MN 89]:	x
Data unit:	Year
Description:	Number of years of long term persistent increase/decrease in forest carbon stock used in definition of forest degradation, and forest regeneration.
Sources of data:	
Measurement procedures:	Use degradation definition from VCS
Frequency of monitoring:	At baseline update
Value applied:	
Monitoring equipment:	
QA/QC procedures:	none
Calculation method:	
Any comment:	

Data/parameter [MN 90]:	y
Data unit:	
Description:	Minimum percentage of change in forest carbon stock used in definition of forest degradation, and forest regeneration.
Sources of data:	
Measurement procedures:	Use degradation definition from VCS
Frequency of monitoring:	At baseline update
Value applied:	
Monitoring equipment:	
QA/QC procedures:	none
Calculation method:	
Any comment:	

Data/parameter [MN 91]:	t
Data unit:	Year

Description:	Measurement time period for estimating persistent increase/decrease in forest carbon stock used in definition of forest degradation, and forest regeneration.
Sources of data:	
Measurement procedures:	Use degradation definition from VCS
Frequency of monitoring:	At baseline update
Value applied:	
Monitoring equipment:	
QA/QC procedures:	none
Calculation method:	
Any comment:	

Data/parameter [MN 92]:	Forest definition consistency
Data unit:	
Description:	The consistency of the selected forest definition with applicable compliance REDD schemes must be regularly evaluated.
Sources of data:	
Measurement procedures:	Use degradation definition from VCS
Frequency of monitoring:	At baseline update
Value applied:	none
Monitoring equipment:	
QA/QC procedures:	Primary publications or reports on compliance REDD schemes must be used
Calculation method:	
Any comment:	

Data/parameter [MN 93]:	$V_{ex,h,ty,j}$
Data unit:	[Mg C]
Description:	The volume of timber extracted from within the project boundary during harvest *h* by species *j* and wood product class *ty* [m^3]
Sources of data:	Social assessments
Measurement procedures:	
Frequency of monitoring:	Annually after the validation of the project
Value applied:	1141
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 94]:	$M_{SFi,t}$
Data unit:	[kg N yr^{-1}]
Description:	Mass of synthetic fertilizer type i applied in year t.
Sources of data:	Social assessments
Description of methods:	100 kg N ha^{-1} yr^{-1}
Frequency of monitoring:	Every 2 years after the validation of the project
Value applied:	
Monitoring equipment:	
QA/QC procedures:	See QA/QC procedures in social assessment SOP
Calculation method:	
Any comment:	

Data/parameter [MN 95]:	$M_{OFj,t}$
Data unit:	[kg N yr^{-1}]
Description:	Mass of organic fertilizer type j applied in year t.
Sources of data:	Social assessments
Description of methods:	
Frequency of monitoring:	Every 2 years after the validation of the project

Value applied:	0
Monitoring equipment:	
QA/QC procedures:	
Calculation method:	
Any comment:	

Data/parameter [MN 96]:	$\Delta A_{rice}(t)$
Data unit:	[ha]
Description:	Annual increase in harvested area of rice due to leakage prevention measures.
Sources of data:	
Description of methods:	Does not have to be monitored since rice production is not increased.
Frequency of monitoring:	
Value applied:	0
Monitoring equipment:	
QA/QC procedures:	
Calculation method:	
Any comment:	

Data/parameter [MN 97]:	$t_{flooded,max}$
Data unit:	[days yr^{-1}]
Description:	Maximal period of time a field is flooded
Sources of data:	Participatory rural appraisals
Description of methods:	Does not have to be monitored since rice production is not increased.
Frequency of monitoring:	
Value applied:	
Monitoring equipment:	
QA/QC procedures:	
Calculation method:	
Any comment:	

Data/parameter [MN 98]:	$EF_{rice,max}$
Data unit:	[kg CH_4 ha^{-1} day^{-1}]
Description:	Maximal emission factor for methane
Sources of data:	Literature
Description of methods:	
Frequency of monitoring:	
Value applied:	
Monitoring equipment:	
QA/QC procedures:	none
Calculation method:	
Any comment:	

4.3 Description of the Monitoring Plan

4.3.1 Elements to be Monitored

This project will monitor all required components according to the methodology. In general, the following components for calculating actual GHG benefits generated by the REDD project, or Net anthropogenic Emission Reductions (NERs) are included in the monitoring plan.

- Monitoring of deforestation drivers, project activities and emission sources related to REDD project activities inside and outside of the project area.
- Monitoring LULC class and forest strata transitions in the project area, leakage area and reference region using remote-sensing technologies and validated with ground-truthing data.
- Monitoring carbon stock densities in LULC classes and forest strata.

- Monitoring carbon stock increases in the area on which ANR is performed.
- Monitoring of any natural disturbances regardless of the cause of the loss.

Before every verification event, a monitoring report will be produced which contains all of the information above, and which outlines the calculations for actual NERs generated. At every verification event, project proponents will attest that no other land-based carbon projects registered under any other carbon trading scheme (both voluntary and compliance-oriented) are present in the project area.

4.3.2 Monitoring Roles and Responsibilities

- **Pact Cambodia**. During the first five years after validation of the project, the implementing partner (Pact) is responsible for managing, outsourcing and collecting the results of (1) biomass inventory measurements, (2) social assessments, (3) recording action activity implementation, and (4) any other data required to be monitored under this methodology. Pact will execute first-pass of quality assurance and quality control (QA/QC) checks on all of the data collected by them or any other partner. Pact will keep records of all field inventory and social appraisal data sheets and all other evidence demonstrating the correct execution of project implementation. During the first five years of the project, Pact will provide training to the FA to monitor all required elements so that the FA can continue the monitoring process five years after validation of the project.
- **Forestry Administration**. During the first five years of the project, the FA will provide assistance in the annual field inventory measurements and social assessments, and review the monitoring reports. The FA will be trained to become the responsible party for all monitoring requirements five years after validation of the project.
- **Technical Working Group**. The Technical Working Group will review and provide feedback on preliminary versions of the monitoring reports, and verify all quality assurance and quality control (QA/QC) measures.
- **Terra Global Capital**. During the first five years after validation of the project, Terra Global Capital is responsible for verifying that the required elements are monitored, overseeing or executing all modeling and calculations, and performing second-pass QA/QC checks. In addition, Terra Global Capital is responsible for developing the monitoring reports during the first five years after validation of the project.
- **Children's Development Organization**. Children's Development Organization will assist in the field inventories, social appraisals and recording execution of project activities.
- **Community Forestry Federation, Monk's Community Forests and the CFMCs**. The communities involved in the REDD project will be asked to collaborate in the social appraisal projects, report natural disasters and all challenges related to forest protection to the implementing organization.

4.3.3 Managing Data Quality

The data quality will be maximized and ensured during all aspects of the monitoring process by quality assurance and quality control (QA/QC) procedures. To monitor field inventory data, data analysts, and involved individuals/institutions in evaluating the quality of analytical data, rigorous QA/QC procedures are developed relevant to this project. The QA/QC procedures include specific criteria to evaluate the quality of analytical data that has been gathered. The QA/QC procedures are therefore an absolutely essential part of monitoring.

4.3.4 Procedures for handling internal auditing and non-conformities

The Oddar Meanchey involves a wide range of stakeholders at village, commune, district, provincial, and national levels. The success of this long-term project depends on the ability of the stakeholders to effectively and amicably resolve any problems and issues that arise during implementation. As such, the project has developed policies and procedures providing guidance to project stakeholders on how to resolve resolving complaints and grievances.

The Project Stakeholders are defined as any individual with a stake in the implementation and outcomes of the OM CF REDD project. These include community forestry members, local authorities, and NGOs.

The Project Team is defined as the core project management group composed of the Forestry Administration, Children's Development Association, Community Forestry Network (CFN), Pact (1st 5 years), and the Oddar Meanchey Provincial Government. Each institution shall assign one individual as its focal point member on an annual basis. In addition, one Project Team member shall be designated as the group's Secretary responsible to keep and track records of meetings and correspondence.

Project Stakeholders may raise complaints and grievances to the Project Team or its member either verbally or in writing. The Project Team's Secretary is obliged to (1) record every complaint and keep track of the status, and (2) keep complaints and grievances confidential unless otherwise directed by the Project Stakeholder. If there is reason to believe that the Project Team will not provide an objective review of the concern, the matter may be taken up directly with the Secretariat of the Technical Working Group on Forestry and the Environment for further review and decision-making.

After a complaint or grievance is received, the Project Team member(s) shall discuss the problem fully with the Project Stakeholder(s) at a time that is mutually convenient. The Project Team shall conduct an investigation as appropriate and provide the Project Stakeholder(s) with a written response within 30 days of receipt. The Project Team will not retaliate against any Project Stakeholder(s) for registering a complaint or grievance through this process. All submitted complaints, written responses, and any other evidence that supports the complaint or response must be recorded and filed by the Project Team Secretary and made available to third-party auditors and the TWG F&E.

Following receipt of the Project Team's response, a Project Stakeholder who finds the response unsatisfactory should submit a signed and dated written statement to the Secretariat of the Technical Working Group with copies to the Co-Chairs of this body, containing the facts of the complaint or problem; the adjustment or relief the Project Stakeholder is seeking and the reason(s) why the Project Team's solution was not acceptable.

The TWG F&E Secretariat will select and convene an adhoc Appeals Committee of three or more persons. The TWG F&E will provide this committee with staff assistance to arrange for meetings, take meeting minutes, and conduct investigations as necessary. The Committee will give full consideration to the facts presented, conduct any further investigations needed, and render a final decision in writing to the Project Stakeholder with a copy to the TWG F&E and the Project Team.

The adhoc Appeals Committee has full authority to make any adjustments deemed appropriate.

5 ENVIRONMENTAL IMPACT

The major positive environmental impact of the project is ensuring the conservation of critical forest areas, as well habitat for threatened flora and fauna. With 63,831 hectares of community forestry sites included in the project, the project area represents nearly 10% of the land area of Oddar Meanchey and approximately 15% of its remaining evergreen forest. In the absence of the project it is likely that forest in the project area will be reduced by approximately 25% in the next 10 years through land clearing, illegal logging and forest fires. The project seeks to conserve and regenerate dry deciduous and evergreen forest ecosystems through improved protection from illegal logging, fire, and assisted natural regeneration activities. This strategy will restore unique habitat for amphibians, reptiles, mammals, and birds, while restoring high value and endangered tree species (see the Annex in the CCB PD for a list of potential species, as well as the biodiversity survey prepared for the project in January 2011 by Birdlife International).

High market prices and growing demands for luxury hardwoods (often originating from endangered and slowly growing tree species) in Cambodia, China, Thailand and Vietnam have placed growing pressures on Cambodia's forest, much of which is harvested illegally. Logging bans and the decline of natural forest resources in Thailand and Vietnam have

increased the pressure on Cambodia's forests. Many of the species with the highest value are already listed on the IUCN threatened species list. As these trees and forests are depleted, so too are important indigenous sources of seed, which reduces the potential for regeneration. In addition, hunting and poaching are wide-spread resulting in an increasing number of endangered fauna species. Moreover, biodiversity reduction will occur from the clearing of forest for commercial agriculture, which is rapidly reducing the habitat for many flora and fauna species. Without the project, community efforts to control poaching and regulate hunting will not be implemented. Without these projections, rampant hunting and deforestation will almost certainly lead to the extinction of the last tiger population in northwest Cambodia.

Oddar Meanchey has experienced severe erosion as forest cover has been removed. Erosion problems have accelerated over the past decade. This region experiences an extended dry season and an often torrential wet season. This mosaic of open dry deciduous forest, combined with lowland evergreen or semi-evergreen, transitions to extensive wetlands and swampy areas during the annual monsoon. The lowland forests of Oddar Meanchey supply the Tonle Sap (Great Lake) with water, helping regulate the annual hydrological cycle of the greater Mekong basin. The clearing of forests from the upper watersheds of Oddar Meanchey province accelerates erosion of soil and promotes the sedimentation of the Tonle Sap, currently estimated at 20 to 40 mm per year. Forest conservation is a key element in any strategy to preserve Cambodia's complex hydrological systems and avoid further loss of soil through erosion.

During the extended dry season, many rural areas in Oddar Meanchey experience chronic water shortages. Forest loss exacerbates these drought conditions by creating a hotter microclimate and accelerating water run-off rates. Without the project, land degradation will be more extensive; there will be greater soil erosion and reduced water infiltration and aquifer recharge. Also, it is expected that existing water tanks will fill with silt rapidly since there is currently no financing mechanism in place to de-silt water tanks or build new water storage facilities.

The introduction of a small quantity of exotic fruit trees are not expected to negatively impact indigenous species in the project area and reference region. These fruit trees may reduce the consumption of native fruits and other native foods, aiding the distribution and propagation of native vegetation. Cashew, jackfruit, and mango trees will provide subsistence crops to local communities, reducing dependence on agricultural production. The three suggested non-native species above are commonly planted in Cambodia and are likely already introduced to the project area. These species are not known to be naturally invasive nor do they carry any disease unknown to the region. Without the project local communities will continue to utilize forest foods at an increasing rate that may exhaust the supply for native regeneration. If alternatives are not provided, agriculture will continue to increase in order to feed the growing population at the expense of forest cover.

6 STAKEHOLDER COMMENTS

More than a dozen stakeholders are involved in the project funding, design and implementation, each of which has a critically important role. Stakeholder comments were solicited from participating communities, the Monks Community Forest, local government officials, civil society organizations, and the Forestry Administration. A summary of these comments are reproduced below:

1. **Specific Inputs from Participating Communities**. Forest dependent communities are the primary stakeholders in the project area, since their livelihoods are heavily dependent on forest resources. Elected Community Forestry Management Committees (CFMCs) have been formed to organize and represent local forest-based villages in the project area. The project developers met with CFMC representatives from all 12 CFMC sites to understand their goals, expectations and opinions and get input on the project design, key problems, and other development priorities. Local NGOs, Pact, and CFI staff have been discussing and implementing forest protection activities with a number of the communities since 2004 and the communities are both aware and committed to the forest conservation project. For the most part, the problems and needs mentioned by the communities were very similar, as were their requests for support. All CFMCs have asked legal approval of their forest management agreements by the RGC. The Royal Government of Cambodia granted all 13 forestry agreements between November, 2008 and March 2011.

   Communities reported that forest fires remain a problem, though this mainly affects the dry deciduous forests in the lowland areas. They expressed that they would like to cut fire lines to better control the severity of forest fires, as well as mount an education campaign to discourage hunters from starting fires. A number of communities wanted to build more patrol posts. Water is also a problem for them in most of the project villages. Some wells have gone dry and the ponds are full of silt, reducing the water holding capacity in the dry season. Several villages requested support to hire local people to de-silt the ponds. Communities also requested employment opportunities to be built into the project design, especially during the off-season when there is little agricultural work available.

   Communities have requested support from the Forestry Administration to address encroachment by more powerful stakeholders including the military and economic land concessionaires. The Forestry Administration organized a series of meetings in 2008 and 2009 to inform other stakeholders of the project's goals and requested that they respect the boundaries of the CF areas.

   The CFMCs also requested that the project design include funds for the construction of new ponds to harvest rain water during the rainy season. They noted that they would like to restore their forests and would like to regenerate species like beng (*Afzelia xylocarpa*), a species that will regenerate naturally and coppices well if protected. Other desirable species include chres (*Albizia lebbeck*), kokidek (*Hopea helferi*), porpel (*Shorea cochinchinenesis*), ta trao (*Fagrea fragrans*), cheuk mao (*Diospyros cruenata*), and daikhala (*Gardenia ankorensis*). Most of these species have multiple uses and are endangered or threatened. In addition, villagers would like to enrich plant species that are valuable, including cashew (*Anacardium occidentale*), jack fruit (*Artocarpus heterophyllus*), mango (*Mangifera indica*), and other fruit bearing species.

   Some CFMC leaders reported that while initially the CFMC group members were reluctant to confront migrant encroachers, they are now actively confronting individual engaged in illegal forest activities, as they have become better organized and have a stronger mandated since CF legalization. The CFMC groups are also putting in place guidelines for the allocation of forest products. The CFMC groups have requested more of the following to strengthen protection: patrol posts, boundary posts, fire lines, walking paths around boundaries, two-way radios, motorcycle for patrols, some salary subsidies for night patrols, and uniforms. In addition, the communities would like to receive some livelihood development support including training on processing of hard resin, rattan, mushrooms, and poultry rearing. The villages also expressed a need for improved access to schools. At the same time, the community requests the

support of the local FA at the Triage (District level) to provide both technical training and guidance, as well as backstop community forest protection activities. Community members expressed that their biggest problems are food shortages during the dry season.

The primary stakeholder input has been the key to the design of the project support activities which will directly build their capacity to protect forests, while generating employment and income to local communities. Special activities funded under the project will reflect community priorities including water resource development, livelihood training and micro-financing, agricultural intensification, and related needs. Community consultations helped identify inholdings, which will be mapped, clearly recognized to not expand. Since annual work plans will be formulated with each CFMC, it will be possible to address real-time community needs during implementation.

2. **Specific Inputs from Buddhist Monks.** Another group of primary stakeholders are the Buddhist monks from Samroang Pagoda who established an 18,261 hectare community forest. The monks reported that there are a number of key needs to improve CF management:
    - CF signs around the perimeter of the CF area indicating the land-tenure;
    - Water harvesting tanks to create small reservoirs to fight forest fires;
    - Border demarcation (pillars);
    - Trenches ("canals") surrounding the CF area (5km has already been constructed;
    - Better cooperation with the Forestry Administration and local government
    - Financial support for CF patrols;
    - Encroachment by the commune chief in the southern part of the forest block.

    The monks seek financial assistance as well as support from the FA to deal with more politically powerful actors that are involved in forest crimes.

3. **Specific Inputs from Local Government**. Local Government representatives noted that they have no funding for meetings to discuss community forestry management issues at the provincial, district, or commune level. They requested funding to allow provincial and district officials to travel to proposed and potential CF areas, as well to meetings with stakeholders to resolve forest conflicts.

4. **Specific Inputs from Civil Society Organizations**. The Children's Development Association (CDA), a local NGO, noted that they require salary and travel support for extension agents who are assisting the CFMCs. They requested support to begin active capacity building and training activities. They also seek assistance to cover the expenses of inviting FA officials to visit field sites and attend meetings of the CFMC groups in order to better resolve problems and provide guidance. CDA has played a strategic role catalyzing and supporting CFMCs emerging in the province. CDA has been included in the project design and budgets and would be responsible for institution building of the CFMCs, facilitating meetings and networks, and guiding forest management activities in conjunction with the FA.

5. **Specific Inputs from the Technical Working Group and the Forestry Administration.** In November 2007, CFI presented the Oddar Meanchey project concept to the TWG-F&E which is comprised of donor agencies working in the forestry sector in Cambodia and co-chaired by the Forestry Administration. The group unanimously approved the project concept of conducting a REDD pilot project in Oddar Meanchey. In March 2008, the Forestry Administration and DANIDA allocated funding to CFI to develop the project design and carbon certification and marketing. On May 26th, the Council of Ministers issued a legal proclamation Sor. Chor. Nor. 699 authorizing the Forestry Administration to work with CFI to sell carbon on behalf of the Community Forestry Groups (see Annex 3). The Forestry Administration is not

only the seller, but a major stakeholder in the Oddar Meanchey REDD project. It also aims to develop additional REDD projects in Cambodia.

6. **The Forestry Administration staff** at the Cantonment, Division, and Triage levels are also important stakeholders in this project with specific needs. Local FA staff comment that they have limited resources with which to provide extension and custodial support to the CFMC groups. They have requested project support to cover travel expenses to the forest areas including, transportation, gas and maintenance, and per diem for accommodation and food.

   The project will continue to ensure regular community feedback through discussions between the CFMC and the implementing partner organizations including the local Forestry Administration, CDA, Pact, and the Buddhist Monk's Association. Project feedback will also be channeled through the Oddar Meanchey Community Forestry Federation with representatives from project communities. Carbon and biodiversity monitoring systems will also be effective mechanisms to evaluate the impact of project management and its sustainability. The supporting NGO (CDA or the Monk's Community Forestry Association), will play an active role in distributing key project documents to affected community members and key stakeholders as well as publicizing community events/meetings. This documentation will be made available in Khmer where relevant.

7. **The project design team** is committed to sharing learning regarding project design and implementation in a transparent manner. Quarterly community feedback sessions together with socio-economic, biodiversity, and carbon stock monitoring conducted every 2 years will provide a steady stream of information that will be analyzed and disseminated in project reports and periodic working papers. Periodic focus group discussions will be used to document how key activities are progressing and identify problems and issues. Case studies will be written by project staff and consultants to ensure lessons are captured. In addition, annual surveys concerning household livelihood indicators and leakage attributed to project activities will be conducted to assess project impact.

   Project documents and biodiversity and community monitoring data will be available on the FA, Pact, and implementing agency website. The Oddar Meanchey Community Forestry Federation will meet quarterly to review experience and best practices to identify innovations for extension. These practices will receive special attention for inclusion in the coming year's work plan.

   Monthly team meetings among local FA, NGO, and community leaders will be held to discuss issues, problems, and strategies and to share information. Quarterly meetings of the provincial working group and the Oddar Meanchey Community Forestry Federation will be used to inform local government representatives regarding project achievements and experiences.

7 APPENDIX A: REFERENCES

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8 APPENDIX B: ACRONYMS

AFOLU	Agriculture, Forestry and Other Land Use
ANR	Assisted Natural Regeneration
AUMDD	Avoiding Unplanned Mosaic Deforestation and Degradation
C	Carbon
CCB	Climate, Community and Biodiversity Alliance
CDA	Children's Development Association
CDM	Clean Development Mechanism
CF	Community Forestry
CFMC	Community Forestry Management Committee
CFI	Community Forestry International
CIPS	Inter-Censual Population Survey
CO_2e	Carbon Dioxide Equivalent
CV	Coefficients of Variation
DBH	Diameter at Breast Height (1.3m)
DANIDA	Danish International Development Assistance
DM	Dry Matter
DNA	Designated National Authority
ELC	Economic Land Concession
FA	Forestry Administration
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GHG	Green House Gas
GPG	Good Practice Guidelines
GPS	Global Positioning System
GRAS	Geographic Resource Analysis and Science
ha	hectares
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
km	kilometer
LULC	Land Use / Land Cover
LULUCF	Land use, Land-Use Change, and Forestry
MAFF	Ministry of Agriculture, Forestry and Fisheries

Mg	Mega gram
MT	Metric Ton
N	Nitrogen
N_2O	Nitrous Oxide
NDVI	Normalized Difference Vegetation Index
NER	Net anthropogenic Emission Reductions
NGO	Non-Governmental Organization
NIS	National Institute of Statistics
NTFP	Non-Timber Forest Products
PRA	Participatory Rural Appraisal
REDD	Reduced Emissions from Deforestation and Degradation
QA/QC	Quality Assurance / Quality Control
RGC	Royal Government of Cambodia
t CO_2e	Ton of Carbon Dioxide equivalent
TGC	Terra Global Capital
UNFCCC	United Nations Framework Convention on Climate Change