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Assessing the potential for generating carbon offsets in the Seima Biodiversity Conservation Area, Cambodia

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WINROCK INTERNATIONAL

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1.0 BACKGROUND

Seima Biodiversity Conservation Area (SBCA) covers 298,250 hectares in Mondulkiri Province in eastern Cambodia (Figure 1). It has globally outstanding biodiversity values by any measure. For example, it contains key landscapes from two of WWF's Global 200 Ecoregions (evergreen forests of the Greater Annamite mountain range and deciduous forests of the Lower Mekong Dry Forest Ecoregion). It also lies within the Indo-Burma biodiversity hotspot, two major Important Bird Areas as identified by BirdLife International, is part of a Priority 1 Tiger Conservation Landscape and overlaps several 'Last of the Wild' landscapes as assessed by WCS.

The landscape is interspersed with open grassland areas, permanent rivers, water sources and many mineral licks. This diversity of habitats, year round water and access to mineral licks has resulted in a highly productive landscape with the potential to hold very large populations of species of conservation concern. This mosaic of forest types contributes to the high species richness in the area. More than 40 species on the IUCN Red List are present, including at least four Critically Endangered bird species (Giant Ibis, White-shouldered Ibis, Red-headed Vulture and White-rumped Vulture) plus the restricted-range and Endangered Orange-necked Partridge. The area is home to 25 different species of carnivore, including Tiger and seven other species of wild cat. The SBCA is of international importance for the conservation of primates. It harbours eight species including possibly the largest populations in the world of Yellow-cheeked Crested Gibbon (at least 4,000 animals) and Black-shanked Douc (probably over 50,000 individuals). In addition the SBCA has regionally or globally important populations of Asian Elephant (recently estimated at about 115 animals), wild cattle, Germain's Peacock-pheasant and Green Peafowl, among others.

The SBCA was declared by Ministerial order in 2002 within a larger area of 471,490 ha that is under a 25-year concession agreement (signed in the mid-1990s) with the Malaysian logging company – Samling International. Samling selectively logged the southernmost Coupe in late 1998/9 but then suspended logging operations, complaining of high taxes and costs, and effectively withdrew their staff and equipment in 2003-4. The SBCA part of this landscape is currently managed by the Forestry Administration (FA) of the Ministry of Agriculture, Forestry and Fisheries (MAFF) in a long-term partnership with the Wildlife Conservation Society – Cambodia Program. The aim of this partnership is to establish effective management for SBCA and so to conserve the biodiversity values of the site whilst ensuring protection for the livelihoods of local people. There are many established local communities who are very poor and are heavily dependent upon the forest and surrounding habitat for their livelihoods. The key threat to biodiversity is clearance of forest and wetland habitats, much of which is driven by land speculation (since land is one of the easiest forms of wealth) and in-migration. As land is abundant and valuable there is little incentive for communities to intensify production on existing lands, or to deter in-migrants.

The entire forest area is formally classified as 'Production Forest' following the 2002 Forestry Law, overlain by the Ministerial declaration. It is not a formal Protected Area in the sense that term is used in Cambodia. The primary purpose of production forest is for the extraction of timber and NTFP resources, and the Forestry Law defines it as: "Forest area having the primary function for sustainable production of Timber and Non-Timber Forest Products. Production forest includes forest concession; forest permitted for harvesting, degraded forest, forest to be rehabilitated, reserved area for forest regeneration or forest plantation, reforested areas and forest areas under agreement between the Forestry Administration and the local community."

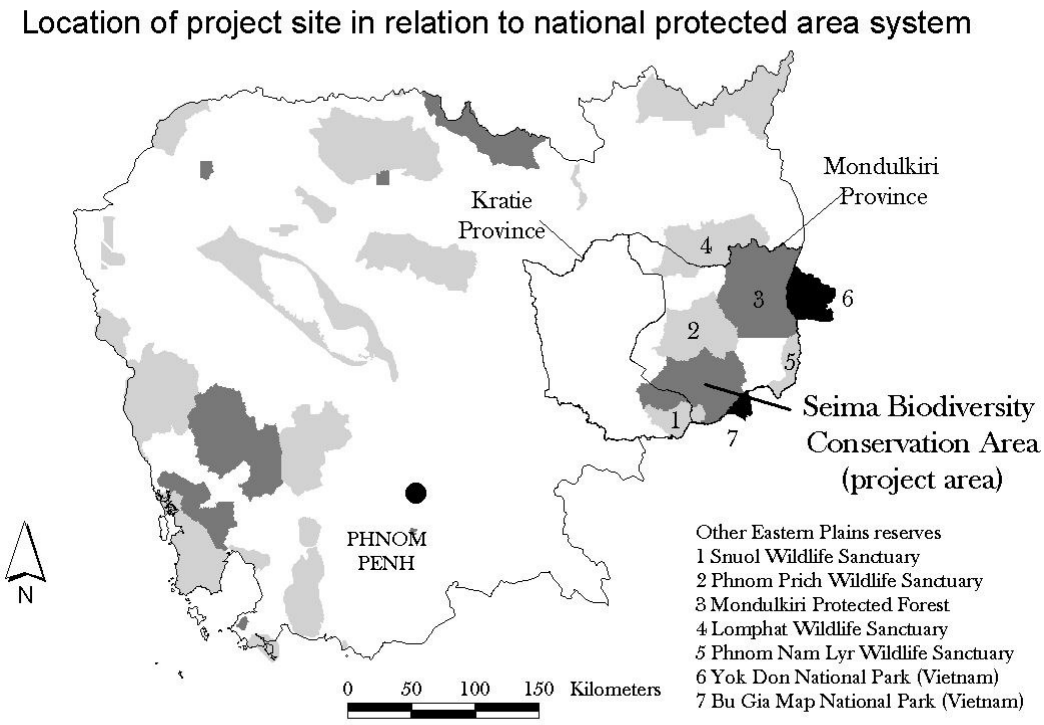


Figure 1 Mondulkiri Province with highlighted protection and production forest areas

Mondulkiri is one of the largest and most sparsely populated provinces in Cambodia. Nevertheless, it has experienced rapid population growth in recent years, which is partly due to in-migration associated with improvements in the road network. Province-wide the official population has grown from 32,400 in 1998 (McAndrew et al. 2003) to 39,943 in 2002 and 49,612 in late 2005 (Dept. of Planning data), representing growth of 24% in four years and 53% in seven years. 50% of people are under 18 years old (Dept. of Planning data). Overall population densities are still low (approx. 3.6/km^2).

The economy relies almost entirely on agriculture and forest products. In recent years, improved road access has increased the intensity of both agriculture and forest harvesting with matched increases in deforestation. Higher rates of deforestation are also driven by growing land pressure from existing inhabitants and migrants into the area. Beyond the small-scale illegal forest losses, government policies of allocating forest areas for long-term agro-industrial concessions are leading directly to broad swathes of deforestation around the SBCA and potentially within the SBCA in coming years.

WCS is interested in augmenting current conservation activities and guaranteeing the long term conservation of the SBCA through funding derived from carbon markets, based on the high level of threat currently from deforestation. The SBCA lies within a larger landscape of conservation areas, including three wildlife sanctuaries – Snoul, Phnom Prich and Phnom Nam Lyr (all managed by the Ministry of Environment, MoE) and the Mondulkiri Protected Forest (managed by the Forestry Administration, FA, of the Ministry of Agriculture,

Forestry and Fisheries, MAFF). Initiation of a successful REDD pilot in the SBCA would then serve as a demonstration for further projects within the larger landscape.

On a global scale, deforestation is responsible for as much as 20% of all greenhouse gases emitted to the atmosphere (IPCC 2007). As trees are composed of approximately 50% carbon, when trees are cut down and decompose, the carbon stored in the stem, branches, leaves and roots is released into the atmosphere. Because preventing deforestation or even selective tree harvesting prevents the emission of greenhouse gases into the atmosphere, these activities are eligible under most schemes for generating greenhouse gas offset credits.

In this feasibility study, Winrock presents an assessment of the potential of the forests in SBCA for generating greenhouse gas offsets. Throughout the report, projections are made five years into the future. Any projections made further into the future than this will be subject to excessive uncertainties.

2.0 CARBON STORAGE AND DEFORESTATION RATES

2.1 Current Carbon Storage

For any creditable carbon program, original carbon measurements will be necessary to estimate current standing carbon stocks. However, for the purpose of this feasibility study literature values were used as approximations for local carbon stocks.

Winrock has access to two forest inventories for Cambodia. The first was conducted by FAO and published in 1971. This first inventory focused on the lowlands, west of the Cardamom Mountains. The second (Rollet 1962) is a forest inventory east of the Mekong river. Geographically, the second inventory is more appropriate but this inventory is limited to just two forest types – Evergreen and Deciduous. In addition, two data sources exist from the SBCA itself. WCS has completed from nine 0.5 hectare plots in Evergreen and Semi-evergreen Forest where all trees > 20cm diameter have been measured. Secondly, Tani (2007) measured nine plots in the SBCA between 2003 and 2006, again in evergreen and semi-evergreen forest, as part of a Master's project.

Upon guidance from WCS, we focused on three forest types for the Mondulkiri region:

- Evergreen and Semi-Evergreen Forests (logged and unlogged); and
- Deciduous Forests

Grasslands and open woodlands were excluded from this feasibility analysis.

At a later stage, a more precise stratification should occur based on known carbon stocks but the forest type delineation given above will be the basis for this feasibility study.

Rollet (1962) gives total live tree aboveground biomass values of between 100 and 155 t/ha for evergreen forest depending on stocking, and 120 t /ha for deciduous forest. These values are low for tropical forests so for comparison we considered the limited volume inventory completed by WCS (see above). Using IPCC conversion factors the WCS inventory gave biomass numbers of 243 t/ha for evergreen/semi-evergreen forest. We therefore decided to use 243 t/ha of aboveground biomass for evergreen/semi-evergreen forest and 120 t/ha of biomass for deciduous (note that carbon stock is equal to biomass multiplied by 0.5).

In consultation with WCS it was decided to split the forests into 3 biomass classes: Unlogged evergreen / semi-evergreen forest, deciduous forest and evergreen / semi-evergreen logged by Samling in the late 1990s. A conservative arbitrary deduction of 2/3 is taken here from the unlogged forest values to give a biomass estimate for the logged forest. Including root using the IPCC default root-shoot ratio for moist-deciduous tropical rain forest and converting to carbon dioxide equivalents, the carbon stock data used in this feasibility study are as follows:

Evergreen / Semi-Evergreen (unlogged)	553 t CO_2e/ha
Evergreen / Semi-Evergreen (logged)	369 t CO_2e/ha
Deciduous	273 t CO_2e/ha

As the location of deforestation cannot be estimated precisely at this feasibility stage, carbon stock values were derived for the SBCA by area-weighting the carbon stock values of the three forest types according to the relative proportions of their areas . This gave an estimated area weighted carbon stock of:

403 t CO_2e/ha

For deforestation associated with the paving of the road through SBCA a higher carbon stock is warranted. WCS indicate that the road traverses unlogged evergreen forest. However, to be conservative here a number is adopted that represents a forest cover that is 50% logged and 50% unlogged giving a weighted carbon stock of:

461 t CO_2e/ha

This second carbon stock is to be applied solely to deforestation associated with the paving of the road through the SBCA.

Assuming that fire is used to clear land, additional emissions will result from the production of methane and nitrous oxide. Here we calculate this additional emission using equations and default factors from the IPCC Guidelines for National Inventories (2006). Per hectare deforested, these non-CO_2 greenhouse gases are responsible for emissions equal to:

11.98 t CO_2e.

The assumption made here is that forest types are consistent across the SBCA. Such variation is not within the scope of a feasibility evaluation but would have to be examined if a project went forward.

After deforestation, a loss in soil carbon stocks may also be expected. The IPCC (2006) indicates that the appropriate assumption is for no loss when conversion is to permanent agroforests or plantations, but a 52% loss over 20 years when conversion is to permanent agriculture. Batjes (1996) gives a mean value for soil carbon stocks in the region of 513 t CO_2e/ha, giving an annual loss over the 20 years after conversion of:

Annual soil carbon loss after conversion = 13 t CO_2e per ha per year (for 20 years)

This value will be used here for unplanned/illegal deforestation. For planned deforestation (government-issued concessions) we make the assumption here of no loss in soil carbon.

For permanent forest clearance, an additional benefit lies in the sequestration that would have occurred in the trees if they had not been cut down. IPCC (2006) gives a sequestration value of 2.2 tons of biomass per hectare per year for tropical rainforests that are more than 20 years old in continental Asia. Including roots this gives an annual sequestration equal to:

4.84 t CO_2e per ha per year (for 20 years).

When conversion is to permanent agriculture, it is reasonable to assume a post-clearance carbon stock in vegetation that approximates zero. However, when clearance is for plantations or agroforests in each year after clearance there will be sequestration that will decrease the net emission caused by the conversion. As an example, the IPCC lists the ultimate carbon stocks in broadleaf plantations in tropical forest regions of Asia as 403 t CO_2e/ha. Here therefore we take the assumption that net emissions benefit drops to zero over twenty years for deforestation for the purpose of new plantations. So that where forests are converted to plantations there is only a net increase in emissions for the first 20 years, after which the impact is neutral. Some concession may be for soya or cassava in which case such an argument will be incorrect but for conservativeness the assumption made here is that all plantations will be timber, rubber or palm oil.

2.2 Current and Projected Rates of Deforestation

This report represents a feasibility study. For an actual carbon project, a full analysis would be required that predicts both the rate of deforestation and the location of areas that would be deforested annually in the absence of project interventions.

For the feasibility study, we examined remote sensing data supplied to us by WCS to estimate approximately what areas might be deforested in a potential project baseline.

For this purpose, we used the landcover map for 2000 created by the Japan International Cooperation Agency (JICA) to define area covered by four natural habitat classes: Deciduous Dipterocarp (open) Forest, Evergreen Forest, Semi-evergreen/Mixed/Riverine/Bamboo Forest, and Woodland and grassland. According to this data, the total forest area within the SBCA area is 283,268 ha. This forest area was considered as the reference forest. Further deforestation on this forest area was determined using a landcover map for 2006 created by the Government of Cambodia. According to this analysis, the forest area in 2000 decreased by 2,596 ha per year between 2000 and 2006 (Table 1).

Table 1. Forest area and forest area loss across the entire SBCA

	2000	2006	Annual Loss
		ha	
Forest	268,668	253,095	2,596
Woodland and natural grassland	14,600	8,728	1,183
Total	283,268		

We also examined a different dataset to evaluate how rates of deforestation are changing within the SBCA. WCS has mapped the area of land cleared annually for parts of the SBCA region based on a supervised classification of ASTER, Landsat and LISS III/IV images (Evans et al 2008). These datasets have higher accuracy and are more suitable for determining deforestation trends than the national assessments. The

analysis presented below differs from the analysis of Evans et al (2008) in that a larger area is examined and changes in grassland and agricultural land are not considered.

The cleared land datasets for 2000/01, 2004/05 and 2006/07 have different spatial extents, so they were combined to define the area within the SBCA site that could be analysed. The analyzed area totalled 162,714 ha (including forest and non-forest). The annual deforestation rate for the SCBA area analyzed was estimated as 350 ha /yr.

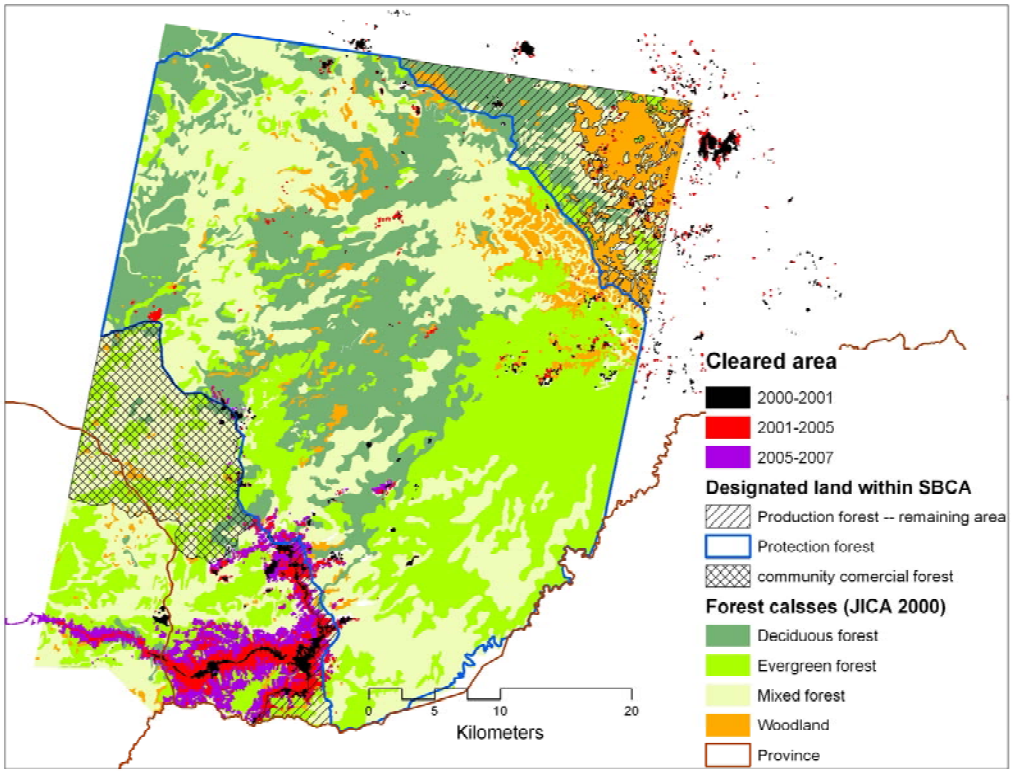


Figure 2. The area of the refined deforestation analysis

Rates of deforestation were calculated for the three time periods (2000 to 2001, 2001 to 2005, 2005 to 2007). These rates were then analysed with regression statistics to create a prediction line that could be used to estimate deforestation for future time periods (Figure 3).

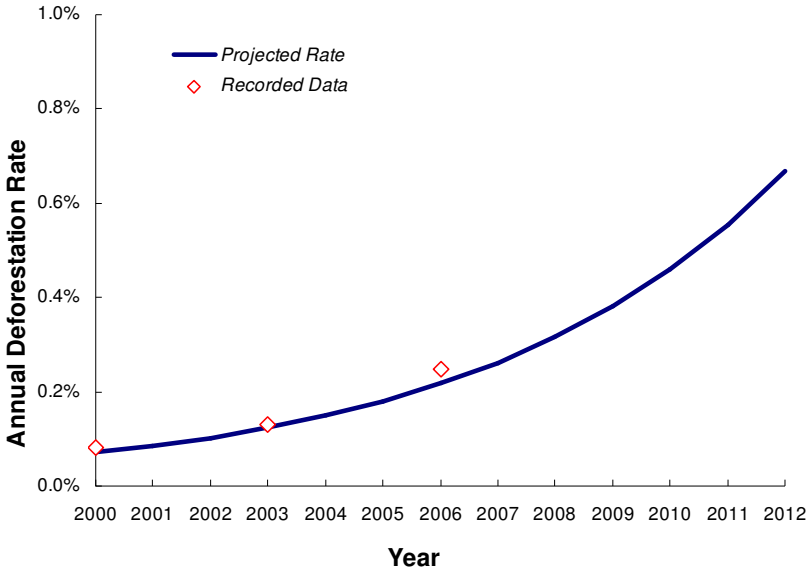


Figure 3. Regression analysis to predict future rates of deforestation from past rates (equation: y=0.0006e^0.1877x)

These deforestation rates were then applied to the total area to predict the area deforested over the next five years (Table 2).

Table 2. Estimates of the areas that will be deforested within the SBCA based on a continuation of the status quo

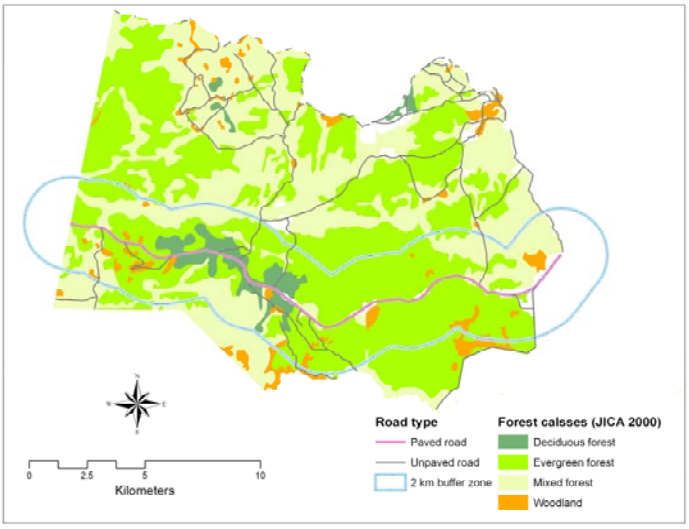
Year	Hectares of Estimated Unplanned Deforestation
2008	848
2009	1,023
2010	1,234
2011	1,489
2012	1,796

The prediction presented in Table 2 is an estimation of deforestation if the status quo continues. However, this is not a realistic scenario, because we already know that the major road though the SBCA will be paved imminently and that this paving will increase access to the forests, leading to higher profitability for people deciding to live and work on the land the forests currently occupy. It is therefore inevitable that paving the road will lead to increases in the rate of deforestation.

To estimate this increase in deforestation for the SBCA, we used the JICA 2000 land cover data, JICA road data and WCS annual area of cleared land for 2001-02, 2004-05 and 2006-07 to examine the deforestation trend along the improved road in the nearby Snoul Wildlife Sanctuary (Snoul WS). The main road through the Snoul WS has been repeatedly graded since 2003 greatly increasing access to the forests of Snoul WS relative to the SBCA. Consequently this area is used to conservatively estimate the impact of the paving of the road through

the SBCA. We make the assumption here that these deforestation rates can be extrapolated to rates that might be expected within the SBCA.

We analyzed an area of 19,787 ha within 2 km of the main road to determine the rate of deforestation between 2000 and 2007. During the six-year period the forest decreased by 26 % (5,015 ha) from the original forest area in 2000 (Figure 4).



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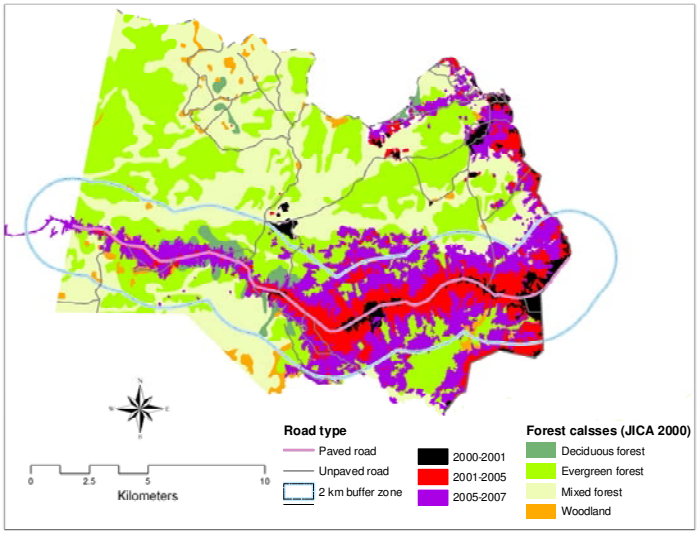

B

Figure 4. (A) – Section of analyzed buffer zone (2 km wide) around the paved road in the southeastern part of Snoul WS and location of forest classes according to JICA 2000 data; (B) – Location and extent of forest loss (2000–2007) within the analyzed buffer zone

The area within two kilometres of the road planned to be paved within SBCA was evaluated. It was shown to consist of 16,241 ha forest. The annual deforestation rates calculated from Snoul WS were applied to give the predicted deforestation rates in Table 3. The ongoing deforestation from the remaining area of SBCA was also included with the area of the buffer around the road removed in an attempt to avoid double counting.

Table 3. Area of unplanned deforestation predicted for the SBCA area considering the planned paving of the bisecting road

Year	Hectares of Estimated Unplanned Deforestation		
	Associated with Road	Remaining Area	Total
2008	698	796	1,494
2009	668	961	1,629
2010	640	1,159	1,799
2011	613	1,399	2,011
2012	587	1,687	2,274

As noted in the background discussion, not all deforestation in the region is unplanned. There is a significant and growing extent of planned deforestation for agro-industrial concessions. The Government has begun to de-gazette parts of Protected Areas to free up land for concessions. This has happened twice over the last two years. Approximately 550km^2 of the Mondulkiri Protected Forest (MPF) are in the process of being formally degazetted and have now apparently been parcelled out to a number of these concessions. Similarly a 12,756 ha region of Snoul Wildlife Sanctuary is also in the process of being degazetted, with the forested sections of this degazetted area apparently slated for rubber plantations. Forests in parts of SBCA are on good soils and would be attractive for this kind of development.

Documentation from WCS shows an annual area of allocated deforestation concessions of 36,426 ha per year between 2005 and 2008 (Figure 5). Conservatively we will assume this is the ongoing rate (2.7% of the remaining forest in the region per year). Thirty-six percent of the concessions were allocated to ungazetted forest, so the remaining 64% involved the removal of the gazetting of production and protection forests. Of the remaining production and protection forest in the region, 24% is located within the SBCA. Applying these proportions gives 5,646 ha of deforestation in new concessions annually (Table 4). However, even once a concession has been allocated it is likely that several years will be necessary before land clearance will occur. Conservatively therefore for this analysis an arbitrary one third of the 5,646 ha are considered as deforestation annually.

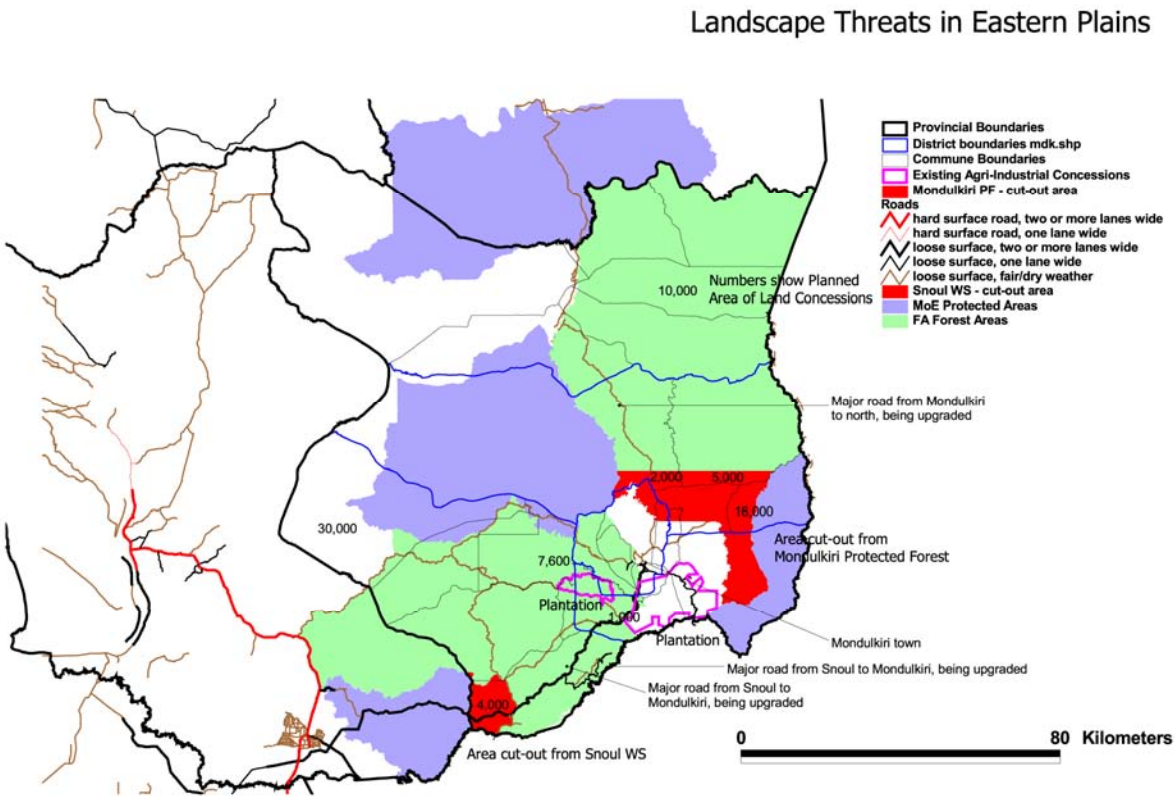

Figure 5. Areas of currently planned deforestation through Government concessions. Figure created by WCS

Table 4. Estimated future planned deforestation for the SBCA

Year	Hectares of Estimated Planned Deforestation
2009	5,646
2010	5,646
2011	5,646
2012	5,646

The estimate of deforestation for both planned and unplanned deforestation between 2008 and 2012 to be applied in this feasibility analysis is given in Table 5.

Table 5. Estimation of area that could be deforested when considering both planned and unplanned causes

Year	Hectares of Estimated Unplanned Deforestation		Hectares of Estimated Planned Deforestation	TOTAL
	Associated with Road	Remaining Area		
2008	698	716		1,413
2009	668	863	1,882	3,414
2010	640	1,042	1,882	3,563
2011	613	1,257	1,882	3,751
2012	587	1,516	1,882	3,985

Note that planned concessions for 2008 are already determined and so are not the subject of this analysis

3.0 CARBON PROJECT OVERVIEW

Trade in greenhouse gas reductions is a large and rapidly growing market, and participating in this market can potentially provide WCS with new resources and revenue to overcome their financial barriers. As presented in Section 2.0 above, forests within SBCA store significant amounts of carbon. However, the current carbon market in the land use and forestry sector deals with emissions or removals of atmospheric CO_2 – i.e., *changes* in carbon stocks rather than the standing stocks that are currently present on a landscape.

As WCS has expressed interest in investigating options for carbon sequestration and/or emissions reductions as a strategy for generating revenue to support interventions leading to avoided deforestation, including site management by the Forestry Administration and payments to local communities. We outline here the guiding principles of carbon projects that must be taken into consideration.

3.1 The Carbon Markets

The carbon project market is split between regulatory markets, where trading occurs to achieve mandatory caps in emissions, and voluntary markets, where participants may have more social, moral and public relation motivations.

3.1.1 The regulatory market

In the mandatory market, businesses, states and even whole countries are legislatively required to reduce their greenhouse gas emissions. This target may be met in part through the purchase of offsets from carbon projects. The mandatory market is dominated by the Clean Development Mechanism (CDM) of the Kyoto Protocol. Within the US, new regulatory markets are developing particularly in the Northeast and in California, but the requirements of these markets are undefined or the statement has been made that CDM credits may be applied for offset purposes.

Under the CDM, the only land-use projects that are allowed are afforestation (planting trees on lands that were never forested in the past) and reforestation (planting trees on lands that were previously forested but have been without forest since at least December 31st 1989).

CDM projects must apply methodologies already approved by the Executive Board. These methodologies define how to create the baseline and how to monitor project benefits, project emissions and project leakage. Third party organizations known as Designated Operating Entities (DOEs) verify that methodologies have been applied appropriately and that offsets are genuine.

3.1.2 The voluntary market

The voluntary market is in a state of development. In the early years, projects were created and traded with little in the way of standards or oversight. Now, buyers are beginning to demand more, and so standards and markets have been created in response to these demands.

Winrock believes that the Voluntary Carbon Standard (VCS) is likely to dominate as a worldwide standard for voluntary projects in the future. Like the CDM, it has a governing body that approves methodologies, third party verifiers that assure that offsets are genuine, and a buffer system to ensure fungibility of the credits. Offsets generated under the VCS will be recorded and traded. Under the VCS, several activities are allowed in the Agriculture, Forestry and Other Land Use (AFOLU) sector that result in carbon sequestration or avoided carbon emissions:

1. Afforestation, Reforestation and Revegetation (tree planting activities)
2. Agricultural Land Management
3. Improved Forest Management
4. Reduced Emissions from Deforestation

A second significant participant in the voluntary market is the Chicago Climate Exchange (CCX). Members join CCX voluntarily and agree to reduce emissions. Emissions targets may be met through trading among members and through offsets generated by projects and sold on the exchange. CCX is generally viewed as having lower standards than other sectors of the carbon market, and as such the offsets command lower prices. Eligible activities under CCX in land use are currently afforestation, forest conservation and sustainable forest management.

3.2 Key Requirements Under Each Carbon Market

There are different standards in the voluntary market to which the credits generated by projects are held accountable. However, all carbon projects have the same general underlying principles that must be followed. These are outlined below.

3.2.1 The baseline

Carbon projects are formulated based on the difference in carbon emissions or sequestration between a **baseline**, or business-as-usual, and **project** case. To calculate carbon project benefits, the baseline case is compared against the measured land use and carbon stocks on the project lands. Under both the CDM and the VCS, the baseline is the most likely land use and associated carbon stocks in the absence of the project.

After the start of a carbon sequestration project, project participants monitor the project's land use and carbon stocks through time by measuring the carbon that accumulates in the growing trees. A proxy area may be selected also to monitor the carbon accumulation through time of the baseline land use. The difference in carbon accumulation between the baseline land use (degraded or logged land) and the project land use (forest) essentially equals the carbon benefits (Figure 6).

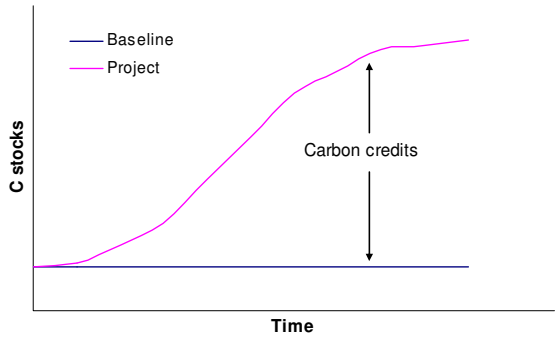

Figure 6. Baseline vs. project case for a carbon sequestration project.

For avoided emissions projects, carbon credits are calculated as difference in carbon *emissions* (rather than sequestration) between a baseline case, such as deforestation or logging, and the project case (Figure 7).

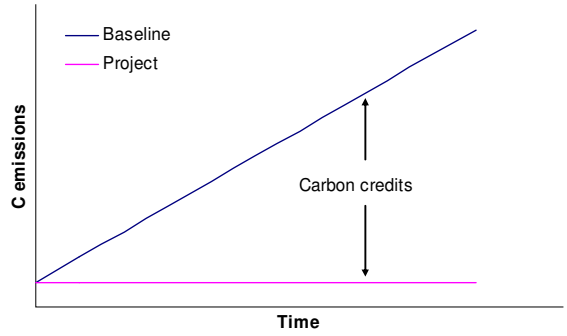

Figure 7. Baseline (cumulative emissions) vs. project case for an avoided emissions project.

Under the CDM, there is a process to go through (often tied to proof of additionality) to illustrate both the most likely land use and the carbon stock to be associated with the expected land use.

Under the VCS, criteria similar to those of the CDM are followed. However, the VCS permits avoided emission projects as well as sequestration projects. For avoided emission projects, formulating a baseline case can be more difficult because as soon as the project starts, what would have happened on the land (deforestation, degradation, logging, etc.) no longer occurs and a proxy area where this activity does occur may not be relevant to the project area or may not be measured easily.

Under the VCS baselines must be reassessed and validated at least every 10 years. The reason behind this is that deforestation is so uncertain when predicted into the future. Any prediction beyond 10 years would be meaningless.

For a VCS Avoided Deforestation project, establishing a project baseline requires project developers to develop baselines for three geographical areas: a Reference Region, a Project Area and a Leakage Belt. The Reference Region, which includes the Project Area and the Leakage Belt, is the analytic domain from which information about deforestation agents, drivers and rates is obtained, projected into the future and monitored. The Project Area is the geographical area delineated by the project's boundaries where the project participants will implement activities to reduce deforestation. The Leakage Belt is the land surrounding the project area where project activities influence deforestation and where leakage is most likely to occur. There must be a demonstrable deforestation threat within the project area over the time period of the expected emission reductions.

Deforestation in the region follows a "frontier" mode in which a deforestation frontier advances annually (contrasting with a "mosaic" form of deforestation). With a frontier mode an appropriate leakage reference area would be all the forest frontiers directly relevant to the forests of Mondulkiri. A full analysis would have to be done in a later phase to physically identify the zone into which leakage would be likely to occur.

CCX is different. For the majority of sectors (except avoided deforestation), there is no baseline. The project carbon stocks are compared directly with the carbon stock in the *base year* – the year prior to project implementation. The project can therefore take credit for any increases in carbon stocks that occur, but if the baseline case resulted in a decrease in carbon stocks (perhaps due to harvesting), no credit could be derived. For avoided deforestation projects under CCX, the current baseline standards allow the application of a deforestation rate that is pre-calculated for the state in which the project is located. Even if no risk of deforestation actually exists for the precise project location, crediting is still possible under CCX using the state's background rate as the baseline. It is important to note that for CCX, deforestation projects must be paired with afforestation projects and the credits for preventing deforestation may not exceed the credits for afforestation.

3.2.2 Carbon project requirements

Basic requirements of emissions reductions or removals are to create real, measurable and long-term benefits related to the mitigation of climate change. The credits should be additional to any that would occur in the absence of the project activity and usually must be verified and certified by an independent, third-party verifier. The estimation of carbon benefits must be conservative to prevent over-crediting that would result in a negative effect on the atmosphere. The credits generated by a carbon project must be able to be measured, monitored and tracked through time.

Real and Measurable

To be real and measurable, a project needs a detailed baseline that can be compared, using on-the-ground measurements, with the reality after a project is implemented. For land use carbon project baselines, two main components need to be assessed: the change in area and the change in carbon stocks. For avoided deforestation a detailed model predicting both the extent and location of deforestation in the absence of project activities would be required. This deforestation model would be paired with on-the-ground measurements of carbon stocks in both pre- and post-deforestation conditions. The non-CO_2 gases resulting from the process of deforestation could also be included.

As the standards of CCX are more relaxed, the requirements for project benefits to be real and measureable are more relaxed as well. For example, look-up tables may be used for afforestation projects within the US rather than on-the-ground measurements. As already stated, a state-average deforestation rate is used for avoided deforestation projects rather than a project-specific model of deforestation rates. Furthermore, a site visit by a third party verification is necessary only for very large projects (>12,500 t CO_2 per year).

Long-term

Credits generated from land use carbon projects have the potential to be reversed through time if a human or natural disturbance occurs.

Under the CDM, emission offsets are termed *Certified Emission Reductions* (CERs). The CDM's solution to permanence is the issuance of temporary, expiring credits (tCERs and lCERs). Temporary CERs (tCERs) are issued at each verification/certification period and expire at the next verification/certification period. Long-term CERs (lCERs) are issued at each verification/certification period but do not expire until the end of the crediting period. All CDM land use credits must ultimately be replaced with permanent credits from other (non-CDM forestry) sectors.

In the voluntary carbon market, companies and individuals buy *Verified Emissions Reductions* (VERs) to reduce their carbon footprint. The market for VERs is not regulated currently in the way that the CER market is. However, VERs from land use projects are interchangeable with VERs from a project in any other carbon sector (such as the energy sector). The Voluntary Carbon Standard (VCS) provides deductions and buffers for land use projects to account for the risk of non-permanence. Likewise, CCX maintains a 'reserve pool' that is fixed at 20% of project credits regardless of perceived risk. In addition, CCX requires contractual agreements guaranteeing the permanence of stocks.

Additional

Additionality, which is a key requirement of CDM and VCS projects, is the concept that all project activities that occur must be additional to the activities that would have occurred in the absence of carbon financing.

Proving additionality for CDM standards requires the use of the additionality tool developed by the United Nations Framework Convention on Climate Change (UNFCCC). The tool includes a barriers analysis, an investment analysis, or both. These tests must demonstrate conclusively that income from carbon crediting was essential for the project to go forward.

The Voluntary Carbon Standard has a similar step-wise approach towards proving additionality. The project proponent must demonstrate that the project is additional using one of three tests: the Project Test, the Performance Test or the Technology Test (Box 1).

BOX 1: The VCS Additionality Test

Test 1: The Project Test

Step 1. Regulatory surplus. The project shall not be mandated by any enforced law, statute or other regulatory framework.
Step 2. Implementation barriers. The project shall face one (or more) distinct barrier(s) compared with barriers faced by alternative projects. These can include investment barriers, technological barriers or institutional barriers.
Step 3. Common Practice. The project type shall not be common practice in sector/region, compared with projects that have received no carbon finance. If it is common practice, the project proponents shall identify barriers faced compared with existing projects.

Test 2: Performance Test

Step 1: Regulatory surplus. The project shall not be mandated by any enforced law, statute or other regulatory framework.
Step 2: Performance standard. The emissions generated per unit output by the project shall be below the level that has been approved by the VCS Program for the product, service, sector or industry, as the level defined to ensure that the project is not business-as-usual.

Test 3: Technology test

Step 1: Regulatory surplus. The project shall not be mandated by any enforced law, statute or other regulatory framework.
Step 2: Technology additionality. The project and its location are contained in the list of project types and applicable areas approved as being additional by the VCS Program. These project types are defined as those in which all projects would also be deemed additional using Additionality Test 1 and will be determined on a case by case basis.

A project within the SBCA would easily pass any additionality test. Additionality essentially is asking whether the carbon finance was necessary for the activity to go ahead. If WCS can demonstrate that it does not have the required finances to prevent business-as-usual deforestation but that with carbon payments increases in protection are possible then additionality is clear. Following the project test, protection is neither common practice nor required by law. A financial barrier exists against protection happening without a carbon finance incentive.

Under CCX, there is no requirement for proving financial additionality. It is possible under CCX to have carbon projects such as plantations that would have gone ahead even without carbon project finances. CCX (like the CDM and VCS) does require proof that the activity is not required by law (i.e., “regulatory surplus”).

Any activities requiring new financial resources that WCS undertakes to stop deforestation would be additional. Activities already undertaken as part of business as usual will not be additional. New activities further reducing deforestation would have to be undertaken due to the availability of carbon finances. However, the biggest issue for avoided deforestation is the baseline (which is paired to additionality in analyses). For VCS, the likely rate of deforestation and the locations where deforestation would occur within the park boundaries would have to be demonstrated. For CCX this would not be the case and offsets could be produced simply by applying the regional rate of deforestation. Note that deforestation projects under CCX currently must be paired with afforestation projects.

One key part of additionality for the SBCA will be convincing the Government to declare the area as Protected Forest (i.e. changing its current status as Production Forest). That can only happen through a sub-decree. It is one of the most effective mechanisms to reduce the threat of agro-industrial concessions, since these concessions cannot legally be declared in Protected Forest. The promise of carbon finance would be a significant incentive for the Government to revise the SBCA's status.

Conservative

Estimating the difference between baseline and project emissions should be conservative to prevent overcrediting. For avoided emissions projects, it is conservative to underestimate baseline emissions and overestimate project emissions. For sequestration projects, it is conservative to overestimate baseline carbon accumulation and underestimate project carbon accumulation.

4.0 CARBON STRATEGIES FOR THE SBCA

4.1 Baseline Scenarios

4.1.1 Description

Three baseline scenarios are presented here. These were developed in consultation with WCS. Scenario 2 predicts higher deforestation and is believed by WCS to be closer to reality but includes predictions of large-scale planned deforestation that may be hard to prove as a carbon project baseline if official documentation is not available for the plans. The CCX scenario illustrates that CCX allows projects to apply a national deforestation rate regardless of its applicability to the project site.

Baseline Scenario 1..Continued unplanned illegal deforestation

Easily demonstrable but lower potential project benefit

Samling's contract remains in place, but their management plan is not approved and costs/taxes remain too high for them to be interested in Cambodia. The Government does not plan to appoint another logging concessionaire, and does not declare any agro-industrial plantations. The forest remains technically classified as Production Forest, but with no formal operator. Small/medium-scale logging for commercial trade continues by local operators, and deforestation continues at historical rates. Deforestation is likely to increase as a consequence of the road upgrade through the site and greater pressure on the land from immigrants (a particular concern) and local population growth. This trend has already occurred in adjacent areas (e.g. Snoul). Snoul was the first area to be affected because it is closest to market centres and roads were upgraded longer ago. WCS continues to implement a relatively successful conservation program, but the possible range of conservation activities are restricted because the land is not formally protected. In addition, the lack of protected status deters further investment by funders in the SBCA in the mid- to long-term. Over time, the SBCA would become increasingly vulnerable to a Scenario 2 situation.

Baseline Scenario 2. Government issuance of new concessions for the SBCA

May be hard to demonstrate but higher potential project benefit

Large portions of SBCA will be removed from the permanent forest estate and issued as agro-industrial concessions, clear-felled and planted with cashew, rubber, acacia or other crops as appropriate, or issued as annual coupes for intensive logging and then conversion. This would lead to a rapid upsurge in deforestation rates (individual concessions are typically in the range 1,000-10,000 ha). There is a clear precedent for this happening elsewhere in the landscape. As SBCA does not have protected status, it is particularly vulnerable to these sorts of proposals. Therefore, the SBCA is likely to experience the same rates of land-use conversion to agro-industrial concessions as other sites in the landscape, and the current rate of declaration of land concessions in the landscape could be used as the baseline rate under the no-project scenario. In addition, small-scale deforestation by households and immigrants would also be expected to continue, particularly as planned road upgrades continue through the project site and planned new markets are created. The appropriate no-project deforestation rate would therefore start at the current level and increase over time to be similar to the deforestation rate in Snoul. Snoul is a suitable comparison area because roads and markets were upgraded earlier in Snoul.

CCX Scenario.

Under the CCX scenario a national rate calculated from FAO data (2.09% per year) is applied to the entire SBCA area.

The baseline scenarios could be reviewed and updated at any time to reflect increases in either planned or unplanned deforestation.

4.1.2 Calculation of Baseline Emissions

Baseline Scenario 1: Continued Unplanned Illegal Deforestation

Area:

Table 6. Estimated area of deforestation under baseline scenario 1

Year	Hectares of Estimated Unplanned Deforestation		
	Associated with Road	Remaining Area	Total
2008	700	800	1,490
2009	670	960	1,630
2010	640	1,160	1,800
2011	610	1,400	2,010
2012	590	1,690	2,270

Emissions:

Table 7. Estimated cumulative emissions under baseline scenario 1

Year	Cumulative Estimated Emissions from Unplanned Deforestation		
	Associated with Road	Remaining Area	Total
2008	331,600	332,700	664,300
2009	649,100	734,100	1,383,200
2010	953,100	1,218,400	2,171,500
2011	1,244,200	1,802,600	3,046,800
2012	1,522,900	2,507,500	4,030,400

Table 8. Estimated net cumulative emissions under baseline scenario 1 after 20 years

Year	Cumulative Estimated Emissions from Unplanned Deforestation		
	Associated with Road	Remaining Area	Total
2008	582,800	619,400	1,202,300
2009	1,140,900	1,366,800	2,507,700
2010	1,675,300	2,268,400	3,943,700
2011	2,186,900	3,356,300	5,543,200
2012	2,676,800	4,668,700	7,345,500

Reflects additional carbon emissions through losses in soil carbon

Baseline Scenario 2: Government issuance of new concessions for the SBCA

Area:

Table 9. Estimated area deforested under baseline scenario 2

Year	Hectares of Estimated Unplanned Deforestation		Hectares of Estimated Planned Deforestation	TOTAL
	Associated with Road	Remaining Area		
2008	700	720		1,410
2009	670	860	1,880	3,410

2010	640	1,040	1,880	3,560
2011	610	1,260	1,880	3,750
2012	590	1,520	1,880	3,980

Emissions:

Table 10. Estimated cumulative emissions under baseline scenario 2

Year	Cumulative Estimated Emissions from Unplanned Deforestation		Cumulative Estimated Emissions from Planned Deforestation	TOTAL
	Associated with Road	Remaining Area		
2008	331,600	298,900		630,500
2009	649,100	659,500	786,200	2,094,800
2010	953,100	1,094,600	1,572,400	3,620,100
2011	1,244,200	1,619,500	2,358,500	5,222,300
2012	1,522,900	2,252,800	3,144,700	6,920,500

Table 11. Estimated net cumulative emissions under baseline scenario 2 after 20 years

Year	Cumulative Estimated Emissions from Unplanned Deforestation		Cumulative Estimated Emissions from Planned Deforestation	TOTAL
	Associated with Road	Remaining Area		
2008	582,800	556,500		1,139,400
2009	1,140,900	1,228,000	0	2,368,900
2010	1,675,300	2,038,000	0	3,713,300
2011	2,186,900	3,015,300	0	5,202,300
2012	2,676,800	4,194,500	0	6,871,300

Reflects additional emissions through losses in soil carbon plus growth of trees in plantations in areas of planned concessions

CCX Baseline

The Chicago Climate Exchange allows the setting of baseline of deforestation based on regional or national rates. Here we take the rate reported by the UN FAO Forest Resources Assessment 2005. The FRA reported an area of forest of 11,541,000 ha in 2000 and 10,447,000 ha in 2005. This gives an annual rate of 2.09%.

Area:

Table 12. Estimated deforestation under a potential CCX deforestation scenario

Year	Hectares of Deforestation
2008	3,640
2009	3,560
2010	3,480
2011	3,410
2012	3,340

Emissions:

Table 13. Estimated cumulative emissions under a CCX baseline scenario

Year	Cumulative Emissions
2008	2,242,000
2009	4,438,000
2010	6,587,000
2011	8,692,000
2012	10,752,000

Table 14. Estimated net cumulative emissions under a CCX baseline scenario after 20 years

Year	Cumulative Emissions
2008	4,175,000
2009	8,263,000
2010	12,265,000
2011	16,183,000
2012	20,019,000

Reflects additional emissions through soil carbon losses

4.1.3 Potential Eligibility of Scenarios under Carbon Markets

Both scenarios 1 and 2 will potentially be eligible under the VCS or CCX. Clearly there is no eligibility under the CDM, which currently excludes all project types aside from afforestation and reforestation.

The burden for a carbon project is that the SBCA will be proving the baseline for the planned deforestation areas. A verifier will look for incontrovertible proof that an area was destined for deforestation. It is likely that such evidence would be a history of such deforestation (as we examined here) plus Government plans for specific areas of plans for new concessions.

The unplanned deforestation will be simpler to prove to a verifier but will be ultimately require a more complex baseline analysis to give a confident estimate of likely rate of deforestation for the next ten years and a prediction of the specific areas of forest likely to be deforested in the application of this rate.

The potential CCX-specific baseline provided above would clearly not be eligible under the VCS and would subject WCS to criticism from other environmental organizations and journalists that non-real emission reductions were being claimed within the SBCA.

4.2 Project Scenarios

4.2.1 Description of Project Scenarios

The only reasonably secure long-term protection against forest conversion is to gazette the site as a protected and multiple-use area by a Prime Ministerial subdecree. This is the highest form of decision-making over land designations in Cambodia, and has to be approved by the Council of Ministers. WCS is making the argument to the Government that gazetting the SBCA as a conservation area with multiple land uses, including ecotourism, reduced impact logging and payments for avoided deforestation, is a better model than logging. These multiple land uses include:

- Protection Forest. This is a second type of forest under the 2002 Forestry Law, defined as:

  "Forest area having the primary function for protecting the forest ecosystem including the water resources regulation; conservation of biodiversity, land, water, watershed and catchments areas; wildlife habitat, fishes, prevention of floods, erosions, sea water intrusion; soil fertility and valuable for cultural heritage which serve the public interests. Protection forest under this Law does not include the protected areas under the jurisdiction of Ministry of Environment pursuant to the Environmental Protection and Natural Resources Management Law." The proposed area of Protection Forest in the SBCA is 187,698ha. Acceptable land-uses would include tourism, payments for avoided deforestation, NTFP collection and small-scale agriculture by resident communities.
- Production Forest. This would be the remaining area of 110,552ha, including:
  - Community Commercial Forestry area, designated for Small-scale sustainable forest management. Area: 41,845ha. Acceptable land-uses would include reduced impact logging, tourism, payments for avoided deforestation, NTFP collection and small-scale agriculture by resident communities. Logging will follow RIL techniques, taking only 2 trees per hectare and working on around 1000 hectares per year.

- An area of grassland/scrub, which should be excluded. Area: 10,923ha.
- A remaining area of 57,784ha. Acceptable land-uses would include community logging for local purposes, NTFP collection, tourism and small-scale agriculture by resident communities.

Note: Enclave communities exist within each of these land types. Each community will be given title or tenure over portions of land for agriculture or residential purposes (c.5ha/household).

Land Designations:

Unit	Area (hectares)
SBCA – complete area	298,250 ha
Protection Forest	187,698 ha
Production Forest, of which -	110,552 ha
CCF area	41,845 ha
Excluded Grasslands/Scrub	10,923 ha
Remaining area	57,784 ha

Based on this the following project scenarios are proposed:

Scenario 1. Strict protection. The entire area is protected for avoided deforestation payments, assuming a 50% decrease in unplanned deforestation over the baseline. All the planned deforestation is halted. None of the area is logged.

Scenario 2. Strict protection with small-scale sustainable forest management in CCF. The entire area (including the buffer) is protected for avoided deforestation payments, with the exclusion of the CCF area which is managed for small-scale sustainable forest management, with around 1000 hectares explored each year. It is assumed that unplanned deforestation rates are decreased by 50% and planned deforestation is halted in Protection Forest and CCF areas (but not the remaining area).

Scenario 3. Strict protection of Protected Forest area, continued business-as-usual unplanned deforestation) in the remaining area. The protected forest area is eligible for avoided deforestation payments, assuming that unplanned deforestation rates are reduced by 50% and planned deforestation is halted in the Protection Forest. The remaining area remains a buffer and no attempt to reduce deforestation rates is made (although leakage is controlled). Logging is allowed, but only for community use (i.e. no commercial logging).

4.2.2 Estimation of Emission Reduction Benefits of Project Scenarios

Below results are given for immediate emission reductions, plus (in brackets) the net emission reduction after 20 years. In the years following deforestation additional emissions result from soil carbon losses plus the growth of forests that would be cut in the baseline can be credited but also the sequestration of carbon in potential plantations must be subtracted.

It is apparent that for baseline scenario 2 where planned deforestation is included the net emissions avoided and hence credits are lower than in the years immediately after deforestation. This is because of the growth of the plantations in these agroindustrial concession areas. The benefit of including the prevention of planned

deforestation is therefore not in the ultimate credits that may be received but in the timing of credits. Including these areas allows front-loading of carbon payments. Subsequently losses in credits result from the planned areas but these may be balanced by gradually increasing credits in the areas protected against unplanned deforestation.

Logging in the CCF area will result in emissions. However, these emissions will not equal the difference in stock between logged and unlogged forest as subsequent to logging substantial stocks remain sequestered in both dead wood in the forest and wood products extracted following processing of the timber at a mill. The emissions that will result from logging and therefore the emissions avoided through not logging would have to be evaluated during project development.

Scenario 1. Strict protection.

Net decrease in emissions (and therefore credits) after five years (in 2012):

Table 15. Project Scenario 1: Net decrease in emissions (and therefore credits) after five years and the net decrease for the same area after 20 years.

Baseline Scenario	Immediate	After 20 years
	t CO_2e	
1	2,015,000	3,673,000
2	5,033,000	3,436,000
CCX	8,864,000	16,584,000

Scenario 2. Strict protection with small-scale sustainable forest management in CCF.

Table 16. Project Scenario 2: Net decrease in emissions (and therefore credits) after five years and the net decrease for the same area after 20 years.

Baseline Scenario	Immediate	After 20 years
	t CO_2e	
1	1,816,000	3,301,000
2	4,099,000	3,064,000
CCX	7,931,000	16,212,000

Scenario 3. Strict protection of Protected Forest area, business-as-usual in the remaining area.

Table 17. Project Scenario 3: Net decrease in emissions (and therefore credits) after five years and the net decrease for the same area after 20 years.

Baseline Scenario	Immediate	After 20 years
	t CO_2e	
1	1,566,000	2,836,000

2	3,303,000	2,669,000
CCX	7,135,000	15,817,000

There is no calculation of avoided deforestation credits for the CCF area when logging is undertaken as a new calculation would be required of forest carbon stocks subsequent to sustainable forest management. More information is needed to make this determination and so conservatively under Scenario 3 potential credit is only calculated for the protection forest.

5.0 NEXT STEPS

5.1 Moving forward with carbon projects in Mondulkiri

The purpose of this feasibility study is not to provide an accurate accounting of carbon credits that might be expected by a potential project. Instead, the purpose was to determine the feasibility of a potential project plus an order of magnitude estimation of what credits could be expected if a project were to go forward.

This feasibility study, in Winrock's opinion, clearly shows that an avoided deforestation project would be highly feasible in the SBCA. If WCS were to decide to go forward, however, substantial data collection and additional analysis would be required to develop an accurate baseline and to complete the required paperwork for registration with the VCS.

This study estimates deforestation only five years into the future. This is due to the fact that uncertainty escalates as deforestation is projected out through time. In a project situation a more detailed analysis would allow ten year baselines.

5.1.1 Data collection / preparation required

Carbon Data

- a stratification of the SBCA into areas with similar carbon stocks
- measurements to calculate the carbon stocks in each of the strata

Deforestation Area Data

- socioeconomic data to derive predictive factors and drivers for deforestation in the SBCA
- determination of likely area of displacement for deforestation
- records from potential concessionaires to prove that the deforestation prevented in the SBCA has not just been displaced elsewhere

5.1.2 Documentation preparation

The Voluntary Carbon Standard is a new development in the voluntary carbon project arena (www.v-c-s.org). The purpose of its creation was to provide structure and accountability in voluntary offsets where currently there

is great uncertainty and no quality control. It is already achieving success in this regard and is being widely adopted worldwide.

The VCS process involves the registration of all projects with a central VCS Board (akin to the CDM's Executive Board). Registration occurs after successful 3rd Party Verification, and verification can occur only if the project is successful in applying one of the VCS's approved methodologies. The VCS decided to automatically accept all CDM methodologies as approved VCS methodologies.

Unfortunately, none of the carbon strategies currently considered for the SBCA can be defined as simple afforestation/reforestation projects and as such, none of the existing CDM methodologies could be directly applied. Therefore a new methodology would have to be created for any WCS carbon strategy. The VCS process for new methodologies is to have a double review by 3rd Party Verifier organizations. Two separate organizations, one chosen by the project, and one chosen by the VCS board would review the methodology and would have to accept it as appropriate in terms of rigor, reality, measurability and conservativeness. Instead, the avoided deforestation methodology developed by the World Bank would be adapted to favour the project before being submitted to the VCS for approval. Therefore the choices for WCS are to develop an entirely new methodology, adapt the World Bank methodology, or accept the World Bank methodology in its approved form. There are cost implications for each of the choices.

Once an approved methodology was available the VCS Project Description Document (PDD) would be completed and submitted for validation. Finally, after validation credits could start to be accumulated by the project.

The procedures for registering forestry projects under the Chicago Climate Exchange are as follows:

1. Submit project proposal and/or project questionnaire to CCX: CCX staff will provide project questionnaires and/or guidance on the proposal specifications. This proposal will be submitted to the CCX Committee on Offsets for review and preliminary approval and may be further referred to scientific technical advisory committees.

2. Obtain independent project verification: Upon project approval by the Committee on Offsets, a project owner or aggregator must obtain independent verification by a CCX-approved verifier. Verifiers use information provided by the project owner or aggregator, combined with possible site visits, to accurately assess a project's actual, annual greenhouse gas (GHG) sequestration or destruction. Verification reports are reviewed by CCX staff as well as the CCX provider of regulatory services, FINRA, for completeness and accuracy.

3. Register as a CCX Offset Provider or Offset Aggregator: Join CCX as an Offset Provider, or enroll the project through an existing Offset Aggregator. Project owners or aggregators may enroll an unlimited number of eligible projects for offset credit. Each distinct project within the portfolio must be registered independently; aggregated projects are registered on a combined basis.

4. Receive Carbon Financial Instrument® (CFI®) contracts for project offsets: Upon approval by the Committee on Offsets, CCX issues the Offset Provider or Aggregator CFI contracts in a quantity equal to the project's GHG sequestration or destruction (net CFI contracts withheld for a reserve pool if applicable). Offset Projects are issued CFI contracts on an annual basis, with the CFI Vintage applying to the program year in which GHG mitigation took place. For example, a methane capture and destruction offset project for methane destruction that occurred during calendar year 2005 would earn a given quantity of 2005 Vintage CFI contracts.

From CCX website

CCX has a rule book that provides guidance for each project type. Each project is reviewed by the Forestry Committee and the degree of departure of the project from the rule book will determine the level of scrutiny the project receives. Similar steps as detailed above under VCS would have to be followed for CCX though lower precision levels and therefore less measurement would be required. For the deforestation study, the methods for calculating the regional deforestation rate for Cambodia would need to be submitted and approved by the CCX Forestry Committee.

5.2 Advantages of a Larger Project in the Eastern Plains

Avoided deforestation carbon projects are being considered simultaneously not just in the SBCA but also in Phnom Prich Wildlife Sanctuary and the Mondulkiri Protected Forest, managed by MoE and MAFF with the support of WWF. A coordinated development of these three projects will lead to multiple savings. Examples of savings would include:

- A single spatial analysis to identify baseline deforestation rates and locations within each of the project boundaries and also along the region's deforestation frontiers in areas where leakage could occur
- A coordinated carbon stock assessment. A coordinated assessment would allow a larger team that could more efficiently conduct the assessment for the three areas
- Coordination in leakage avoidance programs. No avoided deforestation project will ultimately be successful without programs in place to avoid leakage. The more inclusive such programs are in terms of geographic area covered the lower the risk of activity displacement.

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