

LAO PDR FIP INVESTMENT PLAN

EMISSION REDUCTION CALCULATIONS

General considerations

The estimation of the changes in emissions of CO₂ resulting from the interventions by the three projects takes account of the following:

1. Reduced emissions from forest that would have been cleared without the project, but remains as forest as a result of the project interventions.
2. Reduced emissions from forest that would have been degraded, primarily caused by uncontrolled or illegal logging, as a result of the project intervention to improve protection,
3. Sequestration of CO₂ by the forest that would have been cleared or degraded without the project, through growth of the trees in the forest that now remains.
4. Sequestration of CO₂ in plantations established to restore forest cover and other purposes.
5. The type of forest that would have been cleared without the project, and the corresponding carbon stocks.

The amount by which emissions are reduced and the rate of sequestration is calculated based on the best available information on the forest types and conditions within the area that the project will influence. Data is available on average carbon stocks for the main natural forest types found in Lao PDR, that cover Evergreen, Mixed Deciduous, Dry Dipterocarp, Coniferous forest and secondary forest following shifting cultivation according to the number of years of re-growth. The carbon stock for the natural forest areas is based on about 47,000 temporary sample plots measured by SUFORD project Production Forest Areas covering the first four forest types plus plots established by the National Forest Inventory. This data shows that the average volume per ha declines very sharply with reducing crown closure and that most of the forest appears to be in the medium crown density class, while the areas classed as “potential forest” with <20% crown cover have very low volumes and hence carbon stocks and ~50% of the plots (although within Production forest) were bare. The plots have been stratified for each forest type into carbon stock density classes that correspond roughly with crown cover density, although no precise measurements have been made of the correlation between crown density and carbon stock.

	Mixed Deciduous Forest		Dry Dipterocarp		Dry Evergreen	
	Vpl/ha	No. plots	Vpl/ha	No. plots	Vpl/ha	No. plots
Crown closure >70%	208.0	3,504	178.0	174	171.7	275
Crown closure 40-70%	58.8	5,191	51.3	704	58.1	679
Crown closure 20-40%	18.9	3,307	18.6	614	20.4	356
Crown closure 10-20%	4.2	5,211	5.2	355	5.1	109
Bare		26,459		208		15
		43,672		2,055		1,434

The carbon stocks, and hence the emissions that would result from liquidating the forest are calculated from the timber volumes using the same conversion factors (timber volume to total volume to biomass to carbon to carbon dioxide) that are used in the national emission estimates.

For each of the projects it is assumed that project interventions would result in a slight decrease in the deforestation due to the project interventions aimed at the promotion of improved land management to increase agricultural productivity and farmer's income, small holder plantations that would have a similar outcome, and community based forest management and a decrease in forest degradation due to better protection of the forest areas with crown closure >20 %. The areas that would benefit from these interventions are calculated according to the available FIP budget, assuming that 60-80% of the budget would be used for investment in such activities (the balance being for capacity building and monitoring costs) using cost norms from current project activities. In addition it is assumed that small areas of "potential forest" would be restored by planting, with the area determined by the available budget and the labour capacity of the households that will be involved in the project. The sequestration by these plantations is based on growth models for slow growing indigenous species. The carbon stocks and carbon sequestration rates for secondary forest are based on research by the Japan Forest and Forest Industry Research Institute.

Project estimates

Project 1: Protecting Forests for Sustainable Ecosystem Services

The estimates of emission reductions are based on studies conducted during the BCC Project PPTA and assume that there will be significant investment in supporting alternative livelihoods such as rattan cultivation, agroforestry and home gardens with fruit and vegetables, that will result in local communities, that are mainly from "ethnic groups" gradually adopting agroforestry systems within the corridor area and hence reducing the area of secondary forest that they need to clear and burn each year. This will bring emission reductions from the area cleared and burnt annually as well as sequestration in the secondary forest from regrowth for a prolonged period without further cutting. In addition about 10% of the existing areas of forest within the corridor will be protected to reduce emissions from avoided encroachment and illegal logging and there will also be some sequestration by growth in the protected forest. About 1,700 ha of degraded forest will be restored and will sequester increasing amounts of CO₂ in the coming years. The restoration will be focused on areas within the corridor that improve connectivity between residual good forest patches as well as on steep slopes where soil and water conservation co-benefits will accrue.

Year	Secondary forest		Primary Natural forest				Total (tCO ₂)
	Emissions		Emissions avoided		CO ₂ sequestered		
	Avoided	Sequestered	Deforestation	Degradation	Growth	Restoration plantations	
2012	8,308	2,342	34,873	15,971	58,709	313	120,516
2013	16,615	3,712	38,044	17,423	58,709	1,428	135,931
2014	24,923	4,684	41,214	18,874	58,709	3,896	152,300
2015	33,230	5,438	44,384	20,326	58,709	8,279	170,367
2016	41,538	6,054	47,555	21,778	58,709	18,072	193,706
2017	49,845	6,575	50,725	23,230	58,709	34,908	223,992
2018	58,153	7,026	53,895	24,682	58,709	70,660	273,125
2019	66,460	7,424	57,066	26,134	58,709	147,480	363,273
2020	74,768	5,760	60,236	27,586	58,709	291,101	518,160
	373,840	41,966	427,922	196,004	528,381	576,137	2,144,240

The areas protected and restored are based on the feasible amount with about 60% of the FIP funds allocated to the project. It is assumed that the balance of the FIP funds will be used for capacity building and for monitoring. The estimated cost per ton of CO₂ emission reduction is about US\$3.1, which is significantly less than the current market price, suggesting that the investment is very cost effective.

Project 2: Smallholder Forestry Project.

Based on some Japanese research, the carbon stock of typical secondary forest that the farmers that will be engaged in the project, would have cleared for shifting cultivation (swidden) without the project, is around 30 tons/ha that would result in emissions of about 100 tons CO₂ if it is cut and burnt. If left to grow rather than being cleared it will continue to sequester about 5 tons CO₂ annually.

The establishment of, say, 7 ha of plantations by 1 farmer at 1 ha per annum will involve the initial clearance of the secondary forest = 100 tons CO₂ annually for 7 years, but his plantations will on average sequester about 20 tonnes per ha per an (less than the company plantations of about 25 tons) and so it will more or less replace the CO₂ emitted in five years and will then sequester an additional 40 tons over the next 2 years before it is harvested (assuming a 7 year cycle). But the harvested wood will not result in emissions immediately, and these will depend on the use to which the wood is put.

The company plantations will have a similar effect with the additional impact that the farmers who tend the plantations are allocated the land between the trees for crops and therefore cease to practice "swidden" and therefore there are additional emission reductions from the avoidance of the clearance of the land that the farmers would have used. Assuming that the company will plant about 2000 ha annually and the smallholders will collectively plant 100 ha in year 1 increasing to 500 ha after 7 years. This gives an order of magnitude of the net emission reductions that could be achieved, which is similar in magnitude to the other two projects.

Year	Company plantations (2,000ha/an)			Smallholder plantations			Total net reductions
	Emissions	Sequestration	Avoided	Area	Emissions	Sequestration	
1	-200,000	50,000	200,000	100	-10,000	2,000	42,000
2	-200,000	100,000	200,000	200	-20,000	6,000	86,000
3	-200,000	150,000	200,000	200	-20,000	10,000	140,000
4	-200,000	200,000	200,000	500	-50,000	20,000	170,000
5	-200,000	250,000	200,000	500	-50,000	30,000	230,000
6	-200,000	300,000	200,000	500	-50,000	40,000	290,000
7	-200,000	350,000	200,000	500	-50,000	50,000	350,000
	-1,400,000	1,400,000	1,400,000		-250,000	158,000	1,308,000

Project 3: Up-scaling Participatory Sustainable Forest Management

Using the 2010 study on baselines and RELs for Dong Sithouane PFA carried out by SUFORD a simple model has been constructed to estimate the reductions in emissions of CO₂ for the PFA and the surrounding area of 470,000 ha covered by the study. It is assumed that PSFM of the PFA will fully protect the existing forest and that carbon sequestration will take place due to growth (net of harvest) at a rate of 0.5% of the carbon stock. In addition it is assumed that about 10% of areas of good forest outside the PFA will be delineated with PLUP and established as village or community managed forest and will therefore reduce the emissions from the forest outside the PFA *pro rata* to the proportion of the area protected at the baseline emission level estimated by the study. In addition about 3,150 ha of degraded forest will be restored by planting over the coming 8 years and these will sequester carbon at a rate estimated from a yield model for slow growing hardwood species. The areas protected and restored are based on the feasible amount with about 60% of the FIP funds allocated to the project. It is assumed that the balance of the FIP funds will be used for capacity building and for monitoring. The estimated changes in carbon dioxide emissions and sequestration resulting from the project are given in Table 6 below. The estimated cost per ton of CO₂ emission reduction is about US\$3.1, which is significantly less than the current market price, suggesting that the investment is very cost effective.

Changes in CO ₂ emissions from forest protection & restoration				
	Outside PFA		PFA	Total net change in emissions
	Emissions avoided	Sequestration	Restoration plantations	
Base year	(tCO ₂)	(tCO ₂)	(tCO ₂)	(tCO ₂)
2012	121,553	215,596	349	337,497
2013	121,553	217,743	932	340,228
2014	121,553	219,891	1,801	343,244
2015	121,553	222,038	2,116	345,707
2016	121,553	224,186	3,299	349,038
2017	121,553	226,333	2,287	350,173
2018	121,553	228,480	2,930	352,963
2019	121,553	230,628	7,678	359,859
2020	121,553	232,775	4,914	359,242
	1,093,974	2,017,670	26,307	3,137,951