INTERNATIONAL TROPICAL TIMBER ORGANIZATION

Distr.
GENERAL

ITTC-JC(XLVII)/3
25 September 2013

Original: ENGLISH ONLY

FORTY-NINTH SESSION
25 – 30 November 2013
Libreville, Gabon

Technical Guidance for the Quantification of Carbon Benefits in ITTO Projects

[Developed under RED-PA 069/11 REV.1 (F): QUANTIFYING CARBON BENEFITS OF ITTO PROJECTS]

Prepared for ITTO
by
Dr. Carmenza Robledo
ECOEXISTENCE and Helvetas Swiss Intercooperation

The views expressed in this report do not necessarily reflect those of ITTO or its country members. The author expresses her gratitude to Joachim Sell, Patricia Tobon, and Thelma Krug, as well as FAO experts Susane Braatz, Serena Fortuna, Eduardo Mansur, Mette Loyche-Wilkie, Marco Piazza, Leslie Lipper and Simmone Rose; Moriz Vohrer from The Gold Standard and Summer Montacute from the CVS Association. The author also expresses her gratitude to Caitlin Connelly for her support in editing the final document.

CONTENT

TECHNICAL GUIDANCE FOR THE QUANTIFICATION OF CARBON BENEFITS AND ASSURING CO-BENEFITS IN THE DESIGN AND IMPLEMENTATION OF ITTO PROJECTS

Project Name:	Quantifying the carbon benefits of ITTO projects		
Project's information in the ITTO files	Thematic Programme: Reducing Deforestation and Forest Degradation and Enhancing Environmental Services (REDDES)		
	SERIAL NUMBER: *RED-PA 069/11 Rev.1 (F)*		
	ITTO COMMITTEE: REFORESTATION AND FOREST MANAGEMENT		
	SUBMITTED BY: ITTO Secretariat		
Output:	**Output 2** Technical guidance for the quantification of carbon benefits and assuring co-benefits in the design and implementation of ITTO projects		
Author(s):	Dr. Carmenza Robledo Abad Althaus		
Version:	1		
File name:	ITTO Carbon benefits guidance- Final version_edited		
Date:	20 November 2013	Template Version:	1

Table of changes

No	Date	Version	Place	Description	Editor
1	22.07.2012	1	CH	Draft structure	CR
2	29.11.2012	1	Jp	Comments from ITTO Secretariat	Hwan Ma, Steve Johnson Gerhard Breulmann
2	29.11.2012	1	Gy	Expert comments to the draft structure	Pradeepa Bholanath
3	13.06.2013	2	Rom	Meeting with FAO team (Susane Braatz, Serena Fortuna, Mette Loyche-Wilkye, Marco Piazza and Simmone Rose). Presentation and discussion. Powerpoint	CR
4	June, 2013	3	CH	Document draft: Outline improved for: - accommodating voluntary markets and UNFCCC framework (definitions, mechanisms, methods, standards, etc). - proposing a step-wise approach for forest managers - highlighting the added value vis-à-vis other existing guidance/guidelines	CR
5	31.07.2013	5		Completed draft for review (experts review, ITTO country members)	
6	18.09.2013		Intl.	Comments from experts (Patricia Tobon, Joachim Sell, Susane Braatz, Serena Fortuna, Eduardo Mansur, Mette Loyche-Wilkie, Marco Piazza, Leslie Lipper and Simmone Rose; Moriz Vohrer from The Gold Standard and Summer Montacute	

				from the CVS Association and Hwan Ma .	
7	25.09. 2013	Final_V 1	CH	All comments addressed, final version for the professional editor	CR
8	18.10.2013	Final_ edits	FR	Comments by editor	Caitlin Connely
9	29.10.2013	Final version edited	CH	All edits reviewed	CR
10					

ABBREVIATIONS

AGB	Above ground biomass
AFOLU	Agriculture, Forestry and Other Land Use
Annex I	Annex to the United Nations Framework Convention (UNFCCC) listing industrialized and transitional economy countries
Annex II	Annex to the UNFCCC, listing mostly OECD countries, which have commitments to assist developing countries with funding and technology transfer
AR4	IPCC Fourth Assessment Report
A/R	Afforestation and reforestation
ARWG	Afforestation/Reforestation Working Group
ARD	Afforestation, reforestation, deforestation (as a requirement for Annex I countries in the KP)
AWG-KP	Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol
AWG-LCA	Ad Hoc Working Group on Long-term Cooperative Action under the Convention
BAP	Bali Action Plan
BGB	Below ground biomass
CCBA	Climate, Community and Biodiversity Alliance
CCBS	Climate, Community and Biodiversity Standards
CDM	Clean Development Mechanism
CDM A/R	Afforestation and Reforestation project activities under the CDM
CER	Certified emission reductions
tCER	temporary CER
lCER	long-term CER
CFRT	Community Forest Retention Trust Account
CH4	Methane
CO_2	Carbon dioxide
COP	Conference of the Parties
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (also known as COP/MOP)
CPF	Collaborative Partnership on Forests; The 14 members of the CPF are the Center for International Forestry Research (CIFOR), UN Food and Agriculture Organization (FAO), International Tropical Timber Organization (ITTO), International Union of Forestry Research Organizations (IUFRO), CBD Secretariat, Secretariat of the Global Environment Facility (GEF), UNCCD Secretariat, UNFCCC Secretariat, United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), World Agroforestry Centre (ICRAF), World Bank, and World Conservation Union (IUCN). The UNFF Secretariat supports the work of the CPF.
DD	Deforestation and forest degradation
EB	Executive Board of the CDM
ENCOFOR	Environment and Community-based Framework for Designing Afforestation, Reforestation and Revegetation Projects in the CDM
EU ETS	European Union Emission Trading System
FAO	United Nations Food and Agriculture Organization
FCPF	Forest Carbon Partnership Facility
FMU	Forest Management Unit
GEF	Global Environment Facility
GFP	Global Forest Partnership
GHG	Greenhouse gas
GPG	Good Practice Guidance
Ha	Hectare
HFC	Hydrofluorocarbons
HWP	Harvested wood products
IFRT	International Forest Retention Fund
IPCC	Intergovernmental Panel on Climate Change

ITTA	International Tropical Timber Agreement
ITTC	International Tropical Timber Council
ITTO	International Tropical Timber Organization
JI	Joint Implementation
KP	Kyoto Protocol
LCA	Life Cycle Analysis
LULUCF	Land Use, Land Use Change and Forestry
MAI	Mean annual increment
MRV	Measureable, reportable and verifiable
N_2O	Nitrous Oxide
NAI	Non-Annex I Parties (see above), mostly developing countries
NFP	National Forest Program
NLBI	Non-legally binding instruments
NTFP	Non-timber forest products
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
PES	Payment for Environmental Services
PDD	Project Design Document
PFC	Perfluorocarbons
REDD	Reducing Emissions from Deforestation and Forest Degradation
REDD+	Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
SBSTA	Subsidiary Body for Scientific and Technological Advice
sCreen	fast track estimation of carbon benefits from forestry activities (methodology and tool)
SFM	Sustainable Forest Management
TARAM	Tool for Afforestation and Reforestation Approved Methodologies
UNDP	United Nations Development Program
UNEP	United National Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
UNFF	UN Forum on Forests
VCS	Verified Carbon Standards
WG I	Working Group I (of the IPCC, see above), assesses the literature on the physical science basis of climate change
WG II	Working Group II (of the IPCC, see above), assesses the literature on the impacts, vulnerability and adaptation to climate change
WG III	Working Group III (of the IPCC, see above), assesses the literature on the mitigation of climate change, i.e. reducing GHG emissions
WMO	World Meteorological Organization

1 INTRODUCTION

This technical guidance is the second output of the project proposal RED-PA 069/11 Rev.1 (F), called "Quantifying carbon benefits of ITTO projects" which was financed by the REDDES Thematic Program in 2011[1]. The technical guidance is a response to the increasing need to support forest managers[2] in:

a) increasing their knowledge regarding scientific, technical and social aspects for climate change mitigation and forestry
b) their efforts to include climate change mitigation a management objective
c) understanding the possibilities to get carbon finance for forestry activities
d) monitoring and reporting carbon benefits from ITTO co-funded activities

The technical guidance is structured as follows:
→ Chapter 2 clarifies the objective, scope and target population of this guidance;
→ Chapter 3 presents the main concepts regarding estimation, measuring and monitoring carbon benefits from forestry activities. This section includes an explanation of ex-ante estimation and ex-post quantification of carbon benefits as well as clarification on stratification, permanence, leakages, uncertainties and data availability;
→ Chapter 4 present a taxonomy of the mitigation frameworks, including the UNFCCC, other regulated markets and the so called "voluntary market" in a general manner
→ Chapter 5 presents a roadmap of steps to be taken at the level of forest management unit (FMU) when you want/need to include carbon benefits and climate change mitigation in your project activities. The section is organized following ***a step-wise approach*** including definition of project boundaries, identification of institutional framework, definition of management priorities at the FMU level, identification of potential risks, screening of carbon potentials, a road map for identifying the proper mitigation framework for your FMU, detailed guidance for monitoring carbon benefits in ITTO projects, considerations about legal aspects and an analysis of opportunities and challenges for monitoring carbon benefits from Sustainable Forest Managements.
In this chapter you will find the general requirements from each mitigation framework at the FMU level, as well as a compilation of the approved carbon accounting methodologies by each mitigation framework and carbon standard.
→Chapter 6 presents the efforts made by other multilateral organizations towards integrating carbon accountability into their projects.
At the end the guidance include several annexes including i.a. a description of available tools per mitigation framework and a format for reporting carbon benefits from ITTO co-funded projects. This guidance should be understood as a living document and as such it should be regularly updated according to the developments within the UNFCCC as well as in the voluntary markets.

2 SCOPE OF THE GUIDANCE

There are already many publications that provide guidance on monitoring carbon benefits from forestry activities, including (Baker et al., 2010; Diaz and Delaney, 2011; FAO, 2013; GOFC-GOLD, 2011; Harris et al., 2012; Herold and Skutsch, 2011; Hodgman et al., 2012; MacDicken, 1997; Martin Herold and Tracy Johns, 2007; Muraya and Baraka, 2010; Pearson et al., 2012, 2007; T. Pearson et al., 2005b; T. R. H. Pearson et al., 2005; Petrokofsky et al., 2012; Ravindranath and Ostwald, 2007; Rombold, 2003; UN-REDD Programme, 2013a; Walker et al., 2012; Watson, 2009; Zhang et al., 2012)[3].

[1] REDDES Thematic Programmme is the ITTO thematic programme on **RE**ducing **D**eforestation and forest degradation and enhancing **E**nvironmental **S**ervices in tropical forest.
[2] Forest managers in the context of this guidance are persons or organizations that can decide about the management activities at a specific site and who are also involved in the implementation of these activities.
[3] There are other guidelines for evaluating social impacts of forestry activities aimed at mitigating climate change (e.g. by Forest Trends, or CCBA or Rainforest Alliance). These are mentioned in more detailed in chapter 5. However, the main focus of this guidance is on the technical aspects.

The IPCC guidebook "*Good Practice Guidance for Land Use, Land-Use Change and Forestry"* (GPG-LULUCF), published in 2003, which provides direction on carbon accountability at the national and project level, as well as a series of default regional formulas and default values regions[4]. The IPCC put out additional guidance in Volume four of the "*2006 Guidelines for National Greenhouse Gas Inventories*", which deals with the quantification of greenhouse gases emissions and sinks from Agriculture, Forestry and Other Land Uses (AFOLU)[5].

There are numerous other organizations that have prepared guidelines for quantifying carbon benefits, such as the Global Environment Facility (GEF), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP) and UNEP Risoe Center, UN-REDD Programme and FAO. The 2005 UNDP and GEF joint guidelines for "Integrating carbon benefits estimates into GEF projects" provide detailed guidance on the quantification of carbon benefits, and can be used in any ongoing forestry project.[6].Furthermore, in 2007 the GEF and other multilateral organizations, including UNDP and the World Bank, started an over US$ 10 million dollar project aimed at providing a cost-effective, user-friendly, and scientifically rigorous methodology for modeling, measuring and monitoring carbon and greenhouse gas mitigation benefits projects dealing with natural resources in all climate zones and land use systems. Other organizations, like FAO or UNEP offer guidelines on climate change mitigation looking at opportunities and challenges from forestry activities (see Chapter 6).

The current guidance considers and builds upon the existing body of work and aims to simplify decisions for using climate mitigation mechanisms, either within the UNFCCC or in the voluntary markets. It targets forest managers at the FMU level who want to I) calculate their potential carbon benefits, ii) determine which existing mechanism to use and iii) learn about of the specific requirements and challenges of the different mechanisms and methodologies. Further, the guidance clarifies how to monitor and report carbon benefits from ITTO projects.

The guidance seek to address a range of important questions:

- How to find out the size of the potential carbon benefit of my intervention? Is this potential significant?
- If this potential is significant, what are the possible climate mitigation frameworks available?
- Which one is the climate mitigation framework that fits best to my circumstances?: Should I go to the voluntary market? To the CDM market? Is REDD+ an option?
- How do I select a methodology that fits to my circumstances?
- What are the implications in terms of data collection?
- What are the available methods and tools for monitoring carbon benefits according to the different mitigation frameworks
- Who owns the carbon benefits?
- How to identify major risks and corresponding strategies?
- How can I monitor and report carbon benefits to the ITTO, even if my project is not participating in any mitigation framework?

Thus the current guidance provides an added value to existing technical guidelines for accounting carbon benefits. It is not an assessment of the mechanisms, methods or procedures defined at the national or international levels, but rather a tool to help better understand the options for a given activity at the FMU level. The objective is to enable forest managers to select the best option according to the specific circumstances.

---

[4] The IPCC (Good Practice Guidance for Land Use, Land-Use Change and Forestry" (GPG-LULUCF) ara available at http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html The report is available in Arabic, Chinese, English, French, Russian and Spanish.

[5] Volume 4 of the IPCC Guidelines for National Greenhouse Gas Inventories is available at http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html The chapter is available in Arabic, Chinese, English, French, Russian and Spanish.

[6] The GEF guideline on „Integrating carbon benefits estimates into GEF projects" can be downloaded from www.winrock.org/ecosystems/files/GEF_Guidebook.pdf

3 CARBON BENEFITS FROM FOREST ACTIVITIES: AN OVERVIEW

Tropical forests are landscapes in change. On one side there are major social and economical drivers behind degradation, conversion to agriculture or other land uses; while on the other side there is increasing awareness about the importance of securing sustainable provision of forest goods and services (e.g. timber and non-timber are forest products while conservation of biological diversity and scenic view or regulation of the hydrological cycle are some services). Forest managers are called upon to use the forest in a sustainable manner and to provide sufficient economic return and environmental benefits. The mechanisms aimed at mitigating climate change can serve as tools to help achieve this balance

In order to use forest ecosystems to mitigate climate change the level of carbon stocks present in the ecosystem must either remain steady, or, if possible, increase Climate change mitigation is not necessarily the unique forest management objective, thus carbon benefits should be seen as complementary to other management objectives.

This chapter presents the basic elements needed for estimating carbon benefits during the planning and implementation phases of a given forestry activity. Section 3.1 explains the potential carbon benefits from specific forestry activities and section 3.2 explains the main concepts regarding how to account these benefits.

3.1 FORESTRY ACTIVITIES: POTENTIAL CARBON BENEFITS

There are three main ways through which forestry activities can contribute to mitigate climate change;

- Carbon substitution: Producing forest products – inputs – as substitutes for emissions-intensive materials (e.g. substitution of steel through wood in building);
- Carbon sequestration or enhancement: Promoting/enhancing carbon sequestration through forest growth or increasing forest density;
- Greenhouse gas emission reduction: Reducing greenhouse gas emissions e.g. from deforestation and forest degradation.

As a general principle, the use of forestry activities as means for mitigating climate change should depend upon the development priorities in a given country. For the purpose of this guidance, the three main categories are seen as potential “carbon benefits” of forestry management activities in the tropics.

Carbon substitution: Carbon substitution takes place when a carbon intensive material is replaced through a less carbon-intensive material, for example, using harvested wood products in replacement of steel or replacing fossil fuels through so-called biofuels (including wood or fuels from non-timber forest products). Quantifying carbon substitution is challenging for three reasons:

1) the total substitution effect can only be quantified only if the carbon accounting from both materials is available (in order to answer the question; what has been replaced and how much were the emissions from this material?).
2) there are many uncertainties related to life span of the replacement material (how long will the substitution effect last?).
3) quantification of GHG emissions related to some substitution (e.g. biofuel) are highly contested due to the emissions in the production phase as well as to potential indirect emissions (e.g. through indirect forest conversion for biofuel plantations).

Promoting sequestration and/or enhancing existing carbon stocks: Carbon sequestration and carbon enhancement result from promoting or increasing the absorption of carbon (C) in the vegetation through photosynthesis. It happens when extending forest area or increasing forest density through management practices like plantations and agroforestry, silvo-pastoral systems,

forest restoration or rehabilitation of secondary forest. Because trees have a much longer lifespan than agricultural crops, they act as long-term reservoirs, which lock up the carbon for decades, even centuries, in the trees and soil. Therefore, enhancing carbon sinks through activities like restoration or plantations can contribute substantially to mitigate climate change.
Sequestration potential in the tropics seems to be significant, but challenging to achieve (Hodgman et al., 2012). Results on the potential sequestration of forestry activities (mainly through plantations and agroforestry) show huge variation[7] (Sathaye et al., 2006). Further, the actual availability of land, water and vegetal material as well as socio-economic conditions and lack of clarity in land and carbon tenure are among the challenges that need to be faced when using carbons sequestration in the tropics.

Greenhouse gas emission reductions[8]: Burning fossil fuels is the most important source of greenhouse gases (GHG) emissions worldwide (IPCC, 2007). The second most important source of GHG emissions is the land use sector, primarily tropical deforestation, forest degradation and forest fires (ibid). Besides its impacts on the climate system, deforestation and ecosystem degradation belong to the most critical environmental problems facing developing countries today in terms of its long-term negative impact on biodiversity, loss of economic opportunities and increased social disparity. There are basically three greenhouse gases that can be emitted from forest ecosystems; carbon dioxide (CO_2); methane (CH_4) and nitrox dioxide (N_2O) and to lesser extent carbon monoxide. Forestry activities aimed at reducing or avoiding deforestation of forest degradation can then have a potential carbon benefit if they result in a reduction in greenhouse gas emissions. Minor changes in management can further reduce GHG emissions, e.g. reduction of fertilizers.

Table 1 summarizes the main forest management activities and their relation to the carbon benefits. It also includes the mitigation activities as presented in the Fourth Assessment Report of the IPCC (IPCC, 2007). Minor changes in forest management at the FMU level can have important impacts on carbon stocks as well. For example, extending the rotation period, reducing the damage in the forest through reduced impact logging (RIL) or managing forest fires can provide carbon benefits as well.

Forestry Activity	Mitigation activity (according to IPCC, 2007)	Carbon Benefit (according to decisions and ongoing discussion in the UNFCCC)	Relation to land use change if no project takes place (relation to "baseline")
Conservation, Sustainable Forest Management – SFM - (Avoided deforestation/reducing deforestation)	Maintain a forest area and long term carbon density in areas under pressure	GHG emission reduction	Avoiding change from forest to non-forest Avoiding degradation
afforestation or reforestation	Increase in forest area and carbon stocks	C Sequestration/C enhancement	Non-forest to forest
Restoration	Increase site-level C-density		Forest to forest
Agroforestry and silvo-pastoral	Increase landscape scale C stocks		Non-forest to forest
Biofuel plantations (timber, wood and NTFP)	Increase input for bio-energy production and substitution through harvested wood products, when biofuel production does not increase GHG forest emissions	Creating a potential for substitution	Non-forest to forest

[7] According to Sathaye et al the potential can vary between 18 to 94 Mt CO2e (Sathaye et al., 2006)
[8] Some authors refer to „carbon conservation" when discussiing forestry options for reducing GHG emissions

Table 1: Potential impact on carbon stocks, from different forestry activities.
Source: IPCC, 2007, adapted (IPCC, 2007)

In order to understand the potential size of carbon benefits from forestry activities it is useful assess the current carbon stocks in the tropical forests. Tropical forests worldwide contain approximately 540 Pg carbon, the major part of it in living plants (340 Pg), and the rest mainly in soil. In comparison, the amount of carbon found in boreal forests contain is around 338 Pg, and is found underground (see figures 1 and 2).[9] This indicates broad differences in carbon dynamics between biomes (Price et al., 2012)

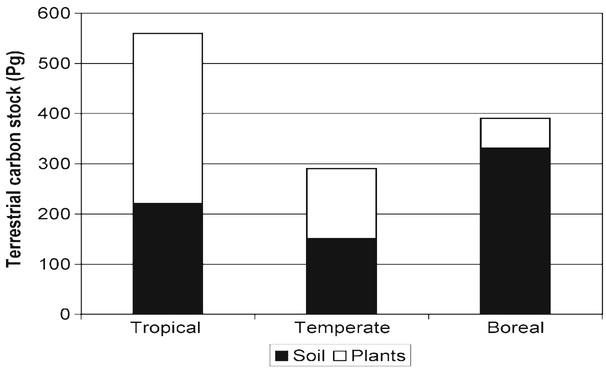


Figure 1: Distribution of world forest carbon stocks by biome
Source: (Price et al., 2012)

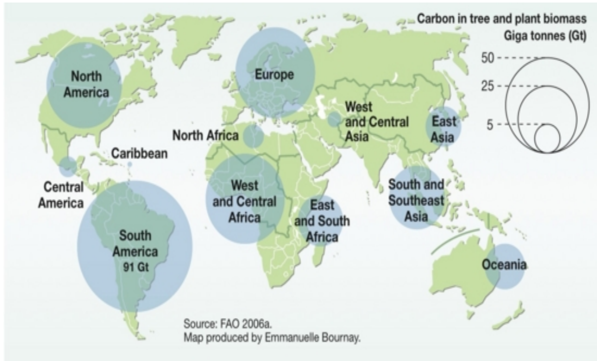


Figure 2: Distribution of carbon in tree and plant biomass
[10]Source: http://www.grida.no/graphicslib/detail/forest-carbon-stock-per-region_1760 Included with permission

Within the tropics there are important variations in carbon stocks among and within regions (see Table 2 and Figure 2). On a local scale various factors including soil fertility, precipitation levels, and disturbance regimes can influence the amount of biomass and carbon (Cid-Liccardi et al., 2012; Gibbs et al., 2007; Olander et al., 2008).

Type of forest	Region	MtC/ha
Rain forest	Neotropics (Central and South America)	120 - 400
	African	130 - 510
	Asia-Pacific	120 - 680*
Montane forest	Neotropics (Central and South America)	60 - 230
	Africa	40 - 190
	Asia-Pacific	50 - 360
Seasonal forest	Neotropics (Central and South America)	210
	Africa	140
	Asia-Pacific	130

* Carbon peat swamps in the Asia-Pacific region > 1,000MtC/ha

Table 2: Carbon stock ranges in tropical forests
Sources: (Cid-Liccardi et al., 2012; deFries et al., 2002; Eggleston and Intergovernmental Panel on Climate Change. National Greenhouse Gas Inventories Programme, 2006; Houghton, 2005, 2003)

Summary:
There are three major options for getting carbon benefits from forestry activities; reducing greenhouse gas emissions, sequestering carbon/promoting carbon enhancement and carbon

[9] 1Petagram (Pg) = 1 Gigatonne (Gt)
[10] Graphic designed by : Rekacewicz, Philippe with Marin, C., Stienne, A., Frigieri, G., Pravettoni, R., Marguerritte, L. and Lecoquierre, M. Uploaded 25.02.2012 by Grid-Arendal

substitution. There are various forest management activities that provide such carbon benefits, including i.a. conservation, sustainable forest management, plantations, agroforestry, silvo-pastoral systems, restoration or rehabilitation of secondary forests. Further, forest products such as wood or non-timber forest products (NTFP) can be used as bioenergy resource. Changes in the management practices (e.g. extending rotation periods) can provide a carbon benefit too. Tropical forests have meaningful carbon stocks that could be maintained and increased. This can provide major carbon benefits as well as other environmental and social positive impacts.

3.2 CARBON ACCOUNTING: WHAT IS TO BE ESTIMATED, MEASURED AND MONITORED?

There are three types of carbon benefits; reduction of greenhouse gas emissions, carbon sequestration or enhancement and carbon substitution (see Section 3.1). Reduction of greenhouse gas (GHG) emissions in the forest sector includes reductions in emissions of methane (CH_4), nitrox oxide (N_2O) and/or carbon dioxide (CO_2). In order to keep consistency in the estimations and measurements of carbon benefits it is necessary to convert these GHG into a common unit called CO_2equivalent (commonly written CO_{2Eq} or CO_{2e}). How to do that?

Methane, carbon dioxide and nitrous oxide have different warming potentials, i.e. they interact in different manners with the atmosphere and thus have different impacts on climate change over time. Conversion from these greenhouse gases into CO_{2e} is done through the use of default values for the Global Warming Potential (GWP) and using the formula:

$$\text{mass CO2e} = (\text{mass of GHG}) * (\text{GWP})$$

GWP values are provided in the table below. Normally the value used is the one for 100 years as reported in the IPCC, 1996 (values marked in red)[11]

GHG	Lifetime	GWP time horizon			Source
		20 years	100 years	500 years	
Carbon dioxide (CO2)	Complex	1	1	1	IPCC, 2007
		1	1	1	IPCC, 2001
		1	**1**	1	IPCC, 1996
Nitrous Oxide (N2O)	114	289	298	153	IPCC, 2007
	114	275	296	156	IPCC, 2001
	120	280	**310**	170	IPCC, 1996
Methane (CH4)	12	72	25	7.6	IPCC, 2007
	12	62	23	7	IPCC, 2001
	14	56	**21**	6.5	IPCC, 1996

Table 3: default values for Global Warming Potential of forestry relevant GHG

Sources: IPCC, 2007 (Fourth Assessment Report, Working Group I, Chapter 2)
IPCC, 2001 (Third Assessment Report, Working Group I, Chapter 6)
IPCC, 1996 (Second Assessment Report, Working Group I, Chapter 2)

Further, conversion from C into CO_{2e} is done using the following formula

$(\text{mass})\ CO_{2e} = (\text{mass})\ C * 44/12$
Note: $44/12 = 3.6666666\ (\approx 3.67)$

Example: $55.05\ TCO_{2e} = 15TC * 3.67$

[11] The Conference of the Parties of the United Nations Framework Convention on Cliamte Change has agreed to use these values. However future agreements can ask for an adjustment.

Summary:
There are three main GHG that need to be considered when accounting for carbon benefits in the forest sector, carbon dioxide (CO_2), nitrous oxide (N_20) and methane (CH_4). These GHGs need to be converted into CO_{2e}.
Data on carbon benefits is given either in mass C (e.g. TC) or mass CO_2 (e.g. TCO_2). It is necessary to be consistent and be sure that all data is converted into CO_{2e}
There are specific formulas and default values for making these conversions

3.2.1 Carbon pools, harvested wood products and bioenergy resources

This section looks at the question «where» the carbon benefits take place. It explains the potential carbon benefits inside the forest (forest carbon pools), and then potential carbon benefits outside the forest.

3.2.1.1 Carbon benefits within the forest

The IPCC defines five carbon pools (or reservoirs) within the forest. Changes in carbon stocks in the forest take place through increase or decrease of in these pools (see figure 3 and table 4).[12]

As far as possible all carbon pools should be included in the calculations. The guidance by IPCC and UNFCCC is that a pool can only be excluded "whenever the carbon stock changes in the pool are not significant". Approved methodologies include different pools according to the specific applicability conditions (more information about specific methodologies in Chapter 5).

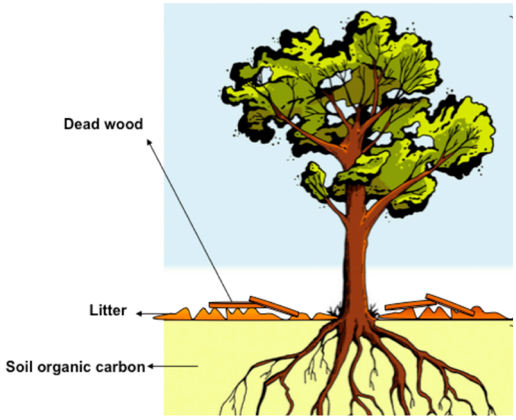


Figure 3: Forest carbon pools
Source: (Robledo and Blaser, 2008)

Pool		
Biomass	Above-ground biomass (AGB)	All biomass of living vegetation, both woody and herbaceous, above the soil including stems, stumps, branches, bark, seeds, and foliage. Note: In cases where forest understory is a relatively small component of the above-ground biomass carbon pool, it is acceptable for the methodologies and associated data used in some tiers to exclude it, provided the tiers are used in a consistent manner throughout the
	Below-ground biomass (BGB)	All biomass of live roots. Fine roots of less than (suggested) 2mm diameter are often excluded because these often cannot be distinguished empirically from soil organic matter or litter.
Dead organic matter	Dead wood	Includes all non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots, and stumps, larger than or equal to 10 cm in diameter (or the diameter specified by the country).

[12] The GEF Guidelines for integrating carbon benefits estimates refer to seven pools and differ from this guidance in two main ways: 1/they include harvesting wood products, and 2/they divide above-ground biomass into two pools: above-ground trees and above-ground non-trees.

	Litter	Includes all non-living biomass with a size greater than the limit for soil organic matter (suggested 2 mm) and less than the minimum diameter chosen for dead wood (e.g. 10 cm), lying dead, in various states of decomposition above or within the mineral or organic soil. This includes the litter layer as usually defined in soil typologies. Live fine roots above the mineral or organic soil (of less than the minimum diameter limit chosen for below-ground biomass) are included in litter where they cannot be distinguished from it empirically.
Soils	Soil organic matter (SOC)[1]	Includes organic carbon in mineral soils to a specified depth chosen by the country and applied consistently through the time series[2]. Live and dead fine roots and DOM within the soil, that are less than the minimum diameter limit (suggested 2 mm) for roots and DOM, are included with soil organic matter where they cannot be distinguished from it empirically. The default for soil depth is 30

[1] Includes organic material (living and non-living) within the soil matrix, operationally defined as a specific size fraction (e.g., all matter passing through a 2 mm sieve). Soil C stock estimates may also include soil inorganic C if using a Tier 3 method. CO_2 emissions from liming and urea applications to soils are estimated as fluxes using Tier 1 or Tier 2 method.

[2] Carbon stocks in organic soils are not explicitly computed using Tier 1 or Tier 2 method, (which estimate only annual C flux from organic soils), but C stocks in organic soils can be estimated in a Tier 3 method. Definition of organic soils for classification purposes is provided in Chapter 3.

Table 4: Definitions of carbon pools
For clarifications on tiers see box 1 below
Source: Table 1.1 *«Definitions for carbon pools used in AFOLU for each land-use category»* in IPCC Guidelines for National Greenhouse Gas Inventories - Vol. 4 Agriculture, Forestry and Other Land Use (IPCC, 2006)

Besides stock changes in these five forest carbon pools other potential emissions can become important in the forest sector, especially emissions from fossil fuel consumption from transportation and machinery.

3.2.1.2 Carbon benefits outside the forest

Harvesting wood products: Timber products are removed from the forest after harvesting and therefore reduce carbon stocks in the forest's living biomass. This loss is accounted for as a reduction of the potential carbon benefit *in situ*. At the same time, the wood harvested is often used for building, etc. and can be seen as a long-term carbon sink or can be used for substituting other materials with higher carbon intensity. Regarding the first option (wood as long term carbon sink) the IPCC defines Harvested Wood Products (HWP) "*all wood material (including bark) that leaves harvest sites*" Regarding the first option (wood as long term carbon sink) the IPCC defines Harvested Wood Products (HWP) "*all wood material (including bark) that leaves harvest sites*" (Eggleston and Intergovernmental Panel on Climate Change. National Greenhouse Gas Inventories Programme, 2006, Chapter 12). HWP constitute then a carbon pool (or reservoir) outside the forest. The potential use of HWP in the different climate frameworks and corresponding methods is discussed in Chapters 4 and 5.

Forest products as bioenergy source: Further, timber and non-timber forest products can be used as bioenergy resources. Potential bioenergy resources from forestry include forestry residues and outputs from bioenergy plantations or dedicated tree/forest crops (e.g. palm oil or jatropha). The carbon benefit associated with bioenergy use is carbon substitution. Quantification of carbon benefits resulting from substitution needs to consider the greenhouse gas emissions and sinks from both the substitute and the substituted material. For example, if jatropha replaces a fossil fuel the carbon benefit would be the difference between the respective greenhouse gas emissions (fossil fuels and biofuels).

> Note: The production of biofuels can be energy-intensive, therefore bioenergy cannot be considered not entirely carbon neutral, but rather based in a renewable material. Further, when using forest products as a bioenergy source there are sustainability aspects, including impacts on food production or land competition at the local level, to consider. Otherwise the carbon benefits through the use of bioenergy can be reverted due to displacement of activities (i.e. leakages).

Summary:
Carbon benefits result when carbon stock changes in forest carbon pools increases or is maintained. There are five carbon pools in the forest: above-ground biomass, below-ground biomass, deadwood, litter and soil organic matter. Timber production means a reduction of carbon stocks in the forest and will be discounted. However, as harvested wood products (HWP) can become long-term sinks, HWP is also recognized as a carbon pool (reservoir), but outside the forest. There are not yet agreed methods for its quantification in developing countries. Finally forestry activities can produce inputs for bioenergy, having a potential carbon benefit. Quantification of this carbon benefits needs to consider GHG emissions and sinks in the bioenergy production as well as in the replaced energy system (e.g. fossil fuels)

3.2.2 Ex-ante estimation of expected carbon benefits

Ex-ante estimation of expected carbon benefits is expected difference between the CO_{2e} impact of your intervention and what would happen without intervention. You normally make a ex-ante estimation during the planning phase of your project. It can be calculated comparing either the expected carbon stocks or the GHG emissions (see figures 4-6). The scenario (projection over time) showing what would have happened without intervention is commonly called «business as usual»

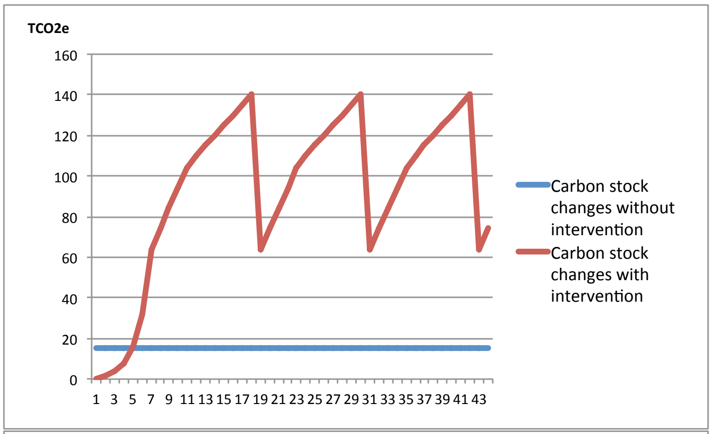


Figure 4: Carbon sequestration/carbon enhancement.
This graphic shows a typical curve of the expected *changes in carbon stocks* from activities aimed at promoting sequestration or enhancing carbon stocks (e.g. through plantations).
Typically the carbon stocks without intervention are less than the carbon stocks with intervention

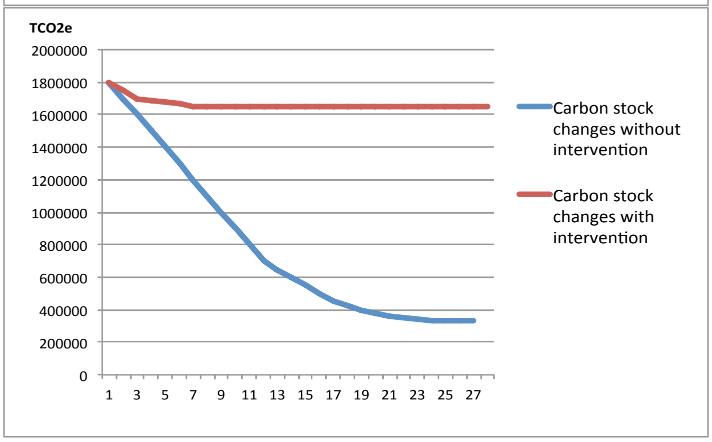


Figure 5: Emission reductions (Option 1)
This figure shows the expected *changes in carbon stocks* from activities aimed at reducing GHG emissions (e.g. through conservation). In this case carbon stocks will be dramatically reduced without intervention (e.g. due to deforestation or forest degradation). Carbon stocks are then higher in the intervention scenario

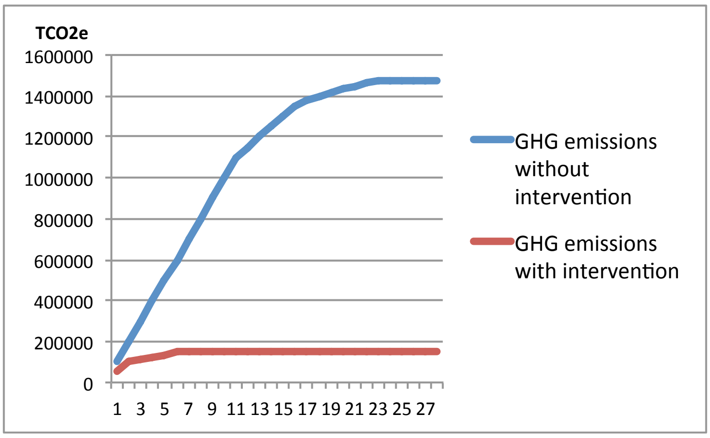


Figure 6: Emission reductions (Option 2)
This figure shows the *difference in GHG emissions* between scenarios with and without intervention.
Typically one expects to have less GHG emissions with an intervention (e.g. conservation) than without any intervention (e.g. continuation of deforestation)

Preparing an ex-ante estimation requires a robust understanding of past and future land use trends in the associated area as well as on the proposed management activities of your project. Historical trends can be extrapolated only when no new developments are expected i.e. when the context remains similar as in the past. If the context conditions are expected to change in a significant manner, e.g. through a new forest policy, this will affect the future changes in carbon stocks or in GHG emissions, even without intervention. These future changes need to be reflected in the ex-ante estimation of carbon benefits.

Regulation of the modalities, procedures and methods available for conducting the ex-ante estimation depend upon the specific mitigation framework. For projects under the Clean Development Mechanism (CDM) the ex-ante estimation is called "baseline" while under REDD+ the ex-ante estimation is either the "Reference Emission Level" (REL) or the Reference Level (RL) (for clarification of the mitigation frameworks and mechanisms see chapter 4; for clarification of specific modalities and procedures, go to chapter 5 and for a summary of approved tools see the corresponding annexes).

3.2.3 Measuring and monitoring changes in carbon stocks

Monitoring changes in carbon stocks refers to the measurement of progress in accumulating carbon in the carbon pools or in reducing GHG emissions over the length of a project or forestry activity. Regular monitoring facilitates an accurate account of progress and can help to identify potential difficulties or options for increasing benefits. In this sense monitoring progress is not only aimed at ongoing quantification of carbon benefits but also at facilitating management adjustments.

There are four categories of methods for measuring forest biomass and estimating carbon which are currently in use: i) forest inventory (biomass) and corresponding algometric equations; ii) remote sensing (relationship between biomass and land cover); iii) eddy covariance (direct measurement of CO2 release and uptake); and iv) the inverse method (relationship among biomass, CO_2 flux and CO_2 atmospheric transport). These methods all vary in their level of accuracy and the resolution at which data can be obtained. Each technique has its own advantages and disadvantages and there are appropriate circumstances for using each one in measuring CO_2 flux and carbon storage for different temporal and spatial scales of evaluation and measurement. (Zhang et al., 2012). A combination between forest inventories and remote sensing is common for measuring changes in carbon stocks in activities in developing countries over time. A combination of the first two approaches – forest inventories and remote sensing – is most commonly used to measure changes in carbon stocks in activities in developing countries over time. Eddy covariance and the inverse method are not frequently used by developing countries for a variety of reasons: the eddy covariance is advanced in terms of accuracy and resolution it is normally used for measurement in small areas (hectare-plus) and it has some systematic restrictions; and the inverse methods are used at continental or global scales (Ibid, 2012). A major challenge when using these methods is to get high confidence intervals.

3.2.4 Stratification

The IPCC defines stratification as the division of an area into sub-populations (or strata) according to specific criteria, so that each strata can be taken as a relatively homogenous unit (IPCC, 2003).

Stratification of the (project) area can increase the accuracy and precision of the measurement and monitoring in a cost-effective manner. The size and spatial distribution of a project does not influence this step – one large contiguous block of land or many small parcels are considered the population of interest and are stratified in the same manner. In general, stratification decreases the costs of measuring and monitoring because it is expected to diminish the sampling effort necessary to achieve a given level of confidence caused by smaller variance in each stratum than in the project area itself. The stratification should be carried out using criteria that are directly related to the variables to be estimated, measured and monitored, e.g., the change in carbon stocks in carbon pools in the forest.

The following criteria are commonly used for undertaking the stratification: land use, type of vegetation, age, slope and topography, drainage o proximity to roads or settlements (IPCC, 2003; T. R. H. Pearson et al., 2005).

According to the IPCC there is a trade-off between the number of strata defined and the required sampling intensity. The goal is to balance the number of strata identified against the total number of plots needed to adequately sample each stratum (Ibid, 2003).

3.2.5 Permanence, leakage and conservativeness

This section discusses two major challenges in estimating, measuring and monitoring carbon benefits – permanence and leakage – and conservativeness as an approach for reducing overestimations of carbon benefits.

Permanence relates to the period of time that carbon remains in the biosphere. Due to different risks, including fires or pests, carbon can be released into the atmosphere, reversing mitigation benefits. Carbon stocks in the forest pools can then be emitted at any time, making emission reductions and or sequestration effects non-permanent. The IPCC has clarified that a short-term reduction in emissions or sink effect has a positive short-term impact in mitigating climate change. However, it is important to promote an effect on the atmosphere that is as permanent as possible.

Leakage and emissions displacement are concepts looking at the emissions caused by your intervention, but outside of the area of your intervention. In the CDM leakage has been defined as *the increase in GHG emissions by sources that occurs outside the boundary of a given area (in A/R CDM in the project area) which is measurable and attributable to the particular activities envisaged* (UNFCCC Decision 5/CMP.1). A great difficulty for dealing with this concept is that it refers to emissions outside your intervention area but not does provide specific guidance on how to define "outside". Thus it becomes very challenging to create consistent and coherent rules for attributing emissions outside your intervention area to your forest activities when "outside" is not a limited geographic area.

Conservativeness is seen as a good practice for reducing overestimation of carbon benefits. Where accounting relies on assumptions, values and procedures with high uncertainty, the most conservative option in the biological range should be chosen so as not overestimate sinks or underestimate sources of GHGs. Conservative carbon estimates can also be achieved through the omission of carbon pools, as long as these pools are not net-emitters (Watson, 2009)

3.2.6 Availability of data

Estimations and measurements of carbon stock changes in the forest pools is data intensive. To the extent possible both data and algorithms should be based on measurements in the area of intervention. However this information is not always available. IPCC has developed a three-tier system for data in order to facilitate comparable carbon accounting (see Box 1). As a good practice it is encouraged to combine the use of activity data (area assessment) with emission factors and carbon stock numbers.

Tier 1 – Global default data: The Tier 1 approach employs the basic method provided in the *IPCC Guidelines* (Workbook) and the default emission factors provided in the *IPCC Guidelines* (Workbook and Reference Manual)

Tier 2 – Country/Region data: It can use the same methodological approach as Tier 1 but applies emission factors and activity data, which are defined by the country for the most important land uses/activities. Tier 2 can also apply stock change methodologies based on country-specific data. Country-defined emission factors/activity data are more appropriate for the climatic regions and land use systems in that country. Higher resolution activity data are typically used in Tier 2 to correspond with country-defined coefficients for specific regions and specialised land-use categories.

Tier 3 – Project data, In this case higher order methods are used including models and inventory measurement systems tailored to address national circumstances, repeated over time, and driven by high-resolution activity data and disaggregated at sub-national to fine grid scales. These higher order methods provide estimates of greater certainty than lower tiers and have a closer link between biomass and soil dynamics. Such systems may be GIS-based combinations of age, class/production data systems with connections to soil modules, integrating several types of monitoring. Pieces of land where a land-use change occurs can be tracked over time. In most cases these systems have a climate dependency, and thus provide source estimates with inter-annual variability. Models should undergo quality checks, audits, and validations.

Box 1: IPCC tiers for data availability
Source: (IPCC, 2003)

3.2.7 Uncertainty

The IPCC GPG-LULUCF includes two definitions of uncertainties relevant for the forest sector:

> ***Statistical definition:*** *"An uncertainty is a parameter, associated with the result of a measurement that characterizes the dispersion of the value that could be reasonably attributed to the measured quantity (e.g. the sample variance or coefficient of variation"* (page G.21)
> ***Inventory definition:*** *"A general and imprecise term, which refers to the lack of certainty (in inventory components) resulting from any causal factor such as unidentified sources of sinks, lack of transparency, etc.)"* (page G.21)

For Petrokofsky et all. there are four sources of uncertainty associated with biomass estimates of tropical forests (Petrokofsky et al., 2012):

- inaccurate measurements of variables, including instrument and calibration errors
- wrong algometric models;
- sampling uncertainty (related to the size of the study sample area and the sampling design); and
- poor representativeness of the sampling network

As a result, the estimation of carbon benefits has uncertainties associated with land/activity area and emissions/sinks factors. The IPCC GPG proposes two possibilities for estimating uncertainties, either through simple propagation of errors or through Monte Carlo analysis (IPCC, 2003, Chapter 5).

4 POSSIBLE MITIGATION FRAMEWORKS

This section presents a taxonomy of existing mitigation frameworks that deliver regulations, modalities and procedures. This guidance differentiates between three mitigation frameworks: i) UNFCCC; ii) regulated markets; iii) voluntary market.

This chapter introduces the UNFCCC framework, the other regulated markets and the voluntary market, while chapter 5 presents the specific regulations and methods available in each framework and for specific forest activities. Further, chapter 6 presents the progress made by some multilateral organizations in their efforts to mainstream quantification of carbon benefits into their regular programs and projects.

4.1 UNFCCC

The United Nations Framework Convention on Climate Change (UNFCC) considers carbon benefits from forest ecosystems into three mechanisms; REDD+, A/R CDM and NAMAS (see figure 7). In the following subsections you can find an update of the status of the negotiations and the options offered to forestry projects.

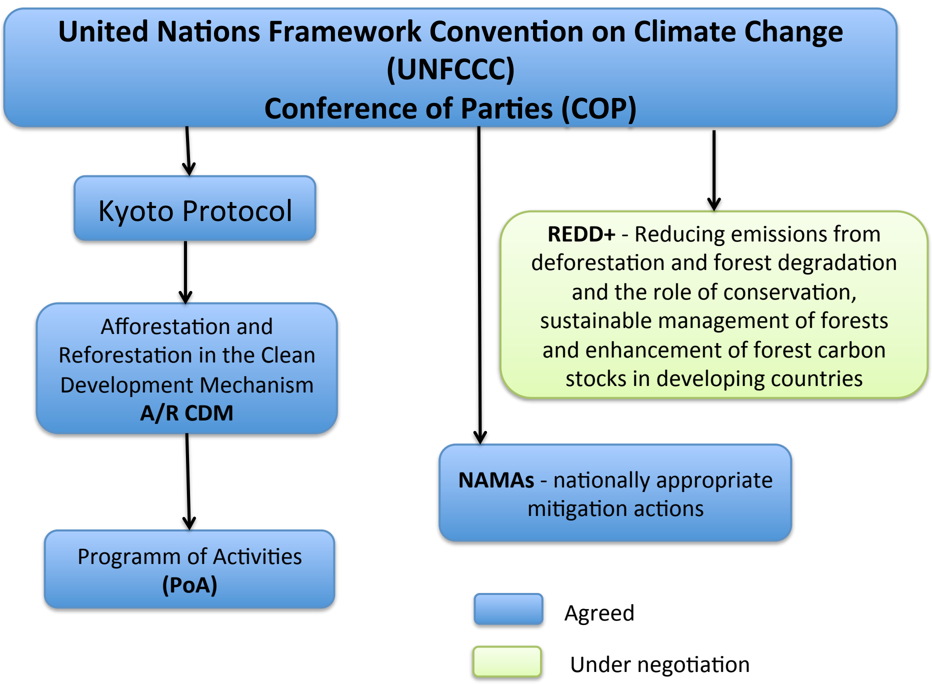


Figure 7: Structure of the UNFCCC mechanisms that consider carbon benefits from forestry activities

4.1.1 REDD+

REDD+ refers to a negotiation item within the UNFCCC as well as to a series of ongoing processes, programs and initiatives looking at climate change mitigation options in the forest sector. At present, there is neither a binding agreement nor agreement on a complete set of rules and requirements to govern this subject within the UNFCCC. As such, many aspects of the mechanism, e.g. what is possible or not, required or not, necessary or not, are left open to interpretation. This situation provides the opportunity to explore useful approaches and mechanisms for forestry activities as means for mitigating climate change and promoting sustainable development.

"*Reducing emissions from deforestation in developing countries and approaches to stimulate action*" was first introduced into the UNFCCC discussions at the eleventh session of the Conference of the Parties (COP 11) in Montreal (December 2005). Since then there has been a remarkable development not only in the international discussions but also in the efforts to facilitate pilot activities in developing countries. Today, the term REDD+ refers to *"Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests* *and enhancement of forest carbon stocks in developing countries".* Initially the discussion on REDD+ considered the possibility of including project level activities. However, during the course of negotiations it was agreed that the REDD+ mechanism from the UNFCCC will operate at the national level and subnational activities are considered interim (Dec. 1/CP.16).

There are three main areas in the discussion of REDD+; carbon accountability, co-benefits and safeguards, and financial issues. **Carbon accounting** refers to methodological guidance for the ex-ante estimation and ongoing quantification of climate change mitigation benefits achieved through human induced activities in forests ecosystems. In REDD+ terms related to this ex-ante estimation are "Reference Level" (RE), "Reference Emission Level" (REL).

Ongoing **quantification** refers to the actual measurement and monitoring of mitigation benefits. This should be done regularly during the implementation of activities with the aim to gain REDD+ benefits. The ex-post quantification includes methods and procedures clarifying how to monitor progress; how to report this progress; and how, when and by whom a verification of the mitigation gains should be done. Methods and experiences in the ex-post quantification in REDD+ are covered under "Measurement, Reporting and Verification" or "Monitoring, Reporting and Verification" (both using the abbreviation MRV).[13]

How to **secure long-term finance of REDD+** is another key issue. This includes the discussion around different questions including: How much can cost to reduce deforestation and forest degradation? How much is necessary for planning, conducting and monitoring activities? Who should receive this money? Who pays for it? What are appropriated sharing mechanisms? How to avoid double accounting (e.g. in more than one mitigation framework)? These questions are important for Parties to the UNFCCC as well as for the civil society and the private sector. Financing issues in REDD+ includes *i.a.* pertinence of market and non-market mechanisms, monetary and non-monetary incentives, sharing mechanisms or discussion on what costs are to be covered by a future REDD+ mechanism. All actors mentioned above have been active in discussing and testing options for securing long-term and equitable distributed financing of REDD+ through pilot activities[14].

Although REDD+ started as a climate change mitigation option, the international community realized very soon that REDD+ could have positive or negative impacts on living conditions for various social groups and on biodiversity at various scales (from local to global). This is reflected in the inclusion of **safeguards for REDD+ and the consideration of gender** as well as the preoccupation for promoting **co-benefits of REDD+** as key elements in the decisions taken by the COP 16 (2010) and 17 (2011).

Appendix I of the UNFCCC Dec. 1/CP16 established that the following safeguards should be promoted and supported:

a) Complementarity to national forest programs and relevant international agreements
b) Transparent and effective national forest governance structures, considering national legislation and sovereignty
c) Respect knowledge and rights of indigenous peoples and local communities (considering national and international agreements and legislation)
d) Consistency with conservation of natural forest and biological diversity. REDD+ actions should enhance other social and environmental benefits.

One year later, in 2011 Decision 2/CP. 17 established guidance on a) systems for providing information on progress on safeguards implementation and; b) modalities regarding forest reference emission levels (REL) and forest reference levels (RL).

[13] For more detailed information see http://unfccc.int/methods_science/redd/methodological_guidance/items/4123.php
[14] For more detailed information see http://unfccc.int/methods_science/redd/redd_finance/items/7376.php

These activities are known as "early actions" and include a very heterogeneous group of activities worldwide. There are many early actions, including activities funded by multilateral or bilateral agencies or by the private sector.

At present, the early actions are neither coordinated nor regulated by a central body. Funding agencies or companies involved in the actions can provide a normative framework for the specific actions, but they have not the mandate to deliver a overall REDD+ regulation, beyond the requirements and procedures as established by the COP. For example, the multilateral funds working on REDD+ (e.g. UN-REDD or FCPF) can include some specific measuring, reporting and verification (MRV) requirements, but that does not mean that a future agreement on REDD+ will include the same requirements.

Tables 5 and 6 present the major funds currently financing early activities and the donors providing financial means for REDD+.

Fund	**Amount in USD millions**	**% of total amount**
Amazon Fund	1,033	24.1
Australia's International Forest Carbon Initiative	216	5.0
Congo Basin Forest Fund (CBFF)	165	3.9
Forest Carbon Partnership Facility - Carbon Fund (FCPF-CF)	219	5.1
Forest Carbon Partnership Facility - Readiness Fund (FCPF-RF)	240	5.6
Forest Investment Program (FIP)	611	14.3
Indonesia Climate Change Trust Fund (ICCTF)	21	0.5
Norway's International Climate and Forest Initiative	1,608	37.5
UN-REDD	171	4.0
Total pledges	4,283	100.0

Table 5: REDD+ funds Source: (Nakhooda et al., 2011; Schalatek et al., 2012)

In 2009, Parties agreed to establish a new fund – the Green Climate Fund (GCF) – at COP-15 in Copenhagen, which will include REDD+ activities. The GCF is not yet operational and is therefore not included in Table 5.

The amounts noted in Tables 1 and 2 represent pledges and not actual deposits by donors; actual deposits are far lower than pledges (Nakhooda et al., 2011; Schalatek et al., 2012).

REDD+ financing grew rapidly between 2007 and 2011. However, the current trend in financing activities in climate change shows a shift in donor interest towards activities aimed at adaptation and technology transfer.

The UNFCCC negotiations are at a pivotal stage: binding agreement on all negotiation items, including REDD+, are expected by the end of 2015. The importance of REDD+ in this agreement remains unclear; therefore, it is difficult to predict the future of REDD+ financing.

The FCPF and the UN-REDD (two multilateral funds) are financing activities in many developing countries and are developing a set of methodologies and tools for accounting carbon in REDD+ (see Section 5.6.1.1 for a more detailed information).

Country	**Amount in USD millions**	**%**
Australia	295.4	6.9
Brazil	4.5	0.1
Canada	46.4	1.1
Denmark	23.9	0.6
Finland	14.7	0.3
France	15.3	0.4
Germany	137.0	3.2
Italy	5.0	0.1
Japan	82.1	1.9
Luxembourg	2.7	0.1
Netherlands	20.3	0.5
Norway	3068.7	71.6
Regional - Europe and Central Asia	26.0	0.6
Spain	22.0	0.5
Sweden	15.3	0.4
Switzerland	19.0	0.4
United Kingdom	289.1	6.7
United States	191.0	4.5
Unknown	5.0	0.1
Total pledges	***4283.2***	***100.0***

Table 6: Donors support to REDD+ by end 2012 Source: (Nakhooda et al., 2011; Schalatek et al., 2012)

4.1.2 A/R CDM and the programmatic CDM

The Clean Development Mechanism (CDM) is a flexible mechanism included in the Kyoto Protocol. It has a two-fold objective, first to support industrialized countries in achieving their mitigation commitments and second to promote sustainable development in developing countries. Under the Clean Development Mechanism, emission-reduction projects in developing countries can earn certified emission reduction credits. These credits can be sold on the carbon market for use by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol. A/R CDM refers to projects activities on afforestation and reforestation (A/R)[15] that can be included in the CDM.

By April 2013, A/R CDM counted with 10 approved methodologies for large scale projects, 7 methodologies for small scale projects and 3 consolidated methodologies (UNFCCC, 2012). Further, the CDM Board has developed 13 tools for facilitating the different steps in the process of A/R CDM Project (Section 5 presents the methods and tools in the A/R CDM). By the end of June 2013, the UNFCCC reported that 7 A/R CDM projects had issued certificates totaling 7,302,123CO_2e.[16,17]

Within the CDM, there is also the possibility of having a programmatic approach, with a specific "program of activity" in a given sector. According to the UNFCCC Secretariat, under a Programme of Activities (PoA) it is possible to register the coordinated implementation of a policy, measure or goal

---

[15] Specific definitions of the terms "afforestation" and „reforestation" unde the A/R CDM are provided in the glossary

[16] Excel file on Issued CERs/tCERs as per 30 June 2013 from http://cdm.unfccc.int/Registry/index.html downloaded at 31.07.2013

[17] This corresponds to 0.53% of the CDM certificates

that leads to emission reduction. Once a PoA is registered, an unlimited number of component project activities (CPAs) can be added without undergoing the complete CDM project cycle. Compared to regular CDM project activities, this programmatic approach has many benefits, particularly for less developed countries or regions[18].

The main benefits of PoA are i.a. reduction of transaction costs and investment risks at the project level, increase in approval speed, access to smaller projects (that wouldn't make it a s stand-alone projects). As at April 2013 there were no registered PoAs on forestry.

4.1.3 Forestry NAMAs[19]

The Conference of Parties (COP), at its sixteenth session, decided to set up a registry to record nationally appropriate mitigation actions (NAMAs) seeking international support, to facilitate the matching of finance, technology and capacity-building support with these actions, and to recognize other NAMAs. Developing countries can include the forestry sector in a NAMA or can also have a NAMA solely for this sector. By April 2013 there were three NAMAs considering forestry activities as follows:

Chile: This NAMA aims to advance the implementation of the country's Platform for the Generation and Trading of Forest Carbon Credits (PBCCh). It includes the development of pilot sites that will be established in different types of forests and lands suitable to forestation. These pilot units will be the first to generate units for trading under the PBCCh. They will include improvements in land titling processes, the identification and implementation of more appropriate forest management techniques, the generation of sub-national reference levels and MRV systems, among others issues related to forestry carbon projects.

Mali: This NAMA is aimed at reducing of GHG emissions by 12,000,000 tCO2 per year through afforestation and reforestation. The Government of Mali is currently in the face of seeking financing for its NAMA

Dominica: This NAMA supports the implementation of the Low Carbon Climate Resilient Development Strategy in the sectors of agriculture, buildings, energy supply, forestry, industry, waste and transport. The NAMA was submitted to the UNFCCC Secretariat in 2012 and is still in the planning phase

4.2 OTHER REGULATED MARKETS

In order to compensate for the lack of national CO_2 regulation in the United States, several states have established their own regulations alone or in conjunction with others. Although the majority of these schemes look for reductions in GHG emissions in the energy sector some include forestry activities. There are two US schemes which are increasingly gaining importance for forestry activities in ITTO Producer Members: The California Climate Action Registry (CCAR) and the Climate Action Reserve (CAR). CCAR is part of the State of California's effort to address climate change in advance of Federal action in the United States.

Another regulated marked, the Chicago Climate Exchange (CCX) closed activities in 2010. The CCX was the first cap-and-trade system for GHG that was launched in the United States in 2003. CCX Members made a voluntary but legally binding commitment to meet annual GHG emission reduction targets. Although the CCX closed in December 2010 its sister institutions, the European climate Exchange and the Chicago Climate Futures Exchange were committed to continue its activities.

The possibilities for using CAR and CCAR at the FMU are explained in Chapter 5.

[18] see http://cdm.unfccc.int/ProgrammeOfActivities/index.html
[19] This section is taken from the UNFCCC website for NAMAs: https://unfccc.int/cooperation_support/nama/items/7476.php

4.3 THE VOLUNTARY MARKET

Besides the UNFCCC and the other regulated markets, there are several transactions of carbon certificates in what is amply called the "voluntary market". The voluntary market is not a market place itself, but the sum of transactions "over the counter". There are several standards active in the voluntary market, including the Verified Carbon Standard (VCS), the American Carbon Registry, The Gold Standards or Plan Vivo. There are also standards looking at certifying the co-benefits from forestry activities participating in carbon markets: The Climate, Community and Biodiversity Standards (CCBS) or the REDD+ Social and Environmental Standards – REDD+-SES

Chapter 5 describes the different standards and their requirements and methods at the FMU level.

5 FMU LEVEL

This chapter is aimed supporting decisions at the FMU level. Expected users of this chapter are forest managers, forest users or decision-makers at the FMU level. The chapter should help to answer the following questions:

- What type of forest management makes sense from the carbon perspective? Is it inline with other management priorities?
- How high are the potential carbon benefits from the activities in my management plan?
- If the potential carbon benefits seem significant, which framework fits best for my situation?
- If the potential carbon benefits do not seem significant, how can I adjust my management plan to get better/more carbon benefits?
- How to account carbon benefits if I do not participate in any specific mitigation framework?
- Besides carbon accounting, what else is important if I want to maximize carbon benefits over the implementation phase of my management plan?

This guidance proposes a step-wise approach (see Figure 8) for addressing these questions. By each step the guidance clarifies three questions.

- Why is this step necessary?
- How to do I undertake this step?
- What to do if there is a significant change?

It is important to note that in the majority of cases, obtaining carbon benefits is not the only management objective at the FMU level. Thus it is a good practice to include maximization of carbon benefits as a one objective and to balance it vis-a-vis other management objectives including *inter alia* timber production, production of NTFP or maintenance of ecosystem services (e.g. regulation of water cycle or conservation of biodiversity).

Considerations of carbon benefits should be included during the planning phase and progress need to be regularly monitored during the implementation of a management plan. When a forestry activity has already started and adjustment for maximizing carbon benefits is not possible anymore, forest managers should focus on monitoring carbon benefits.

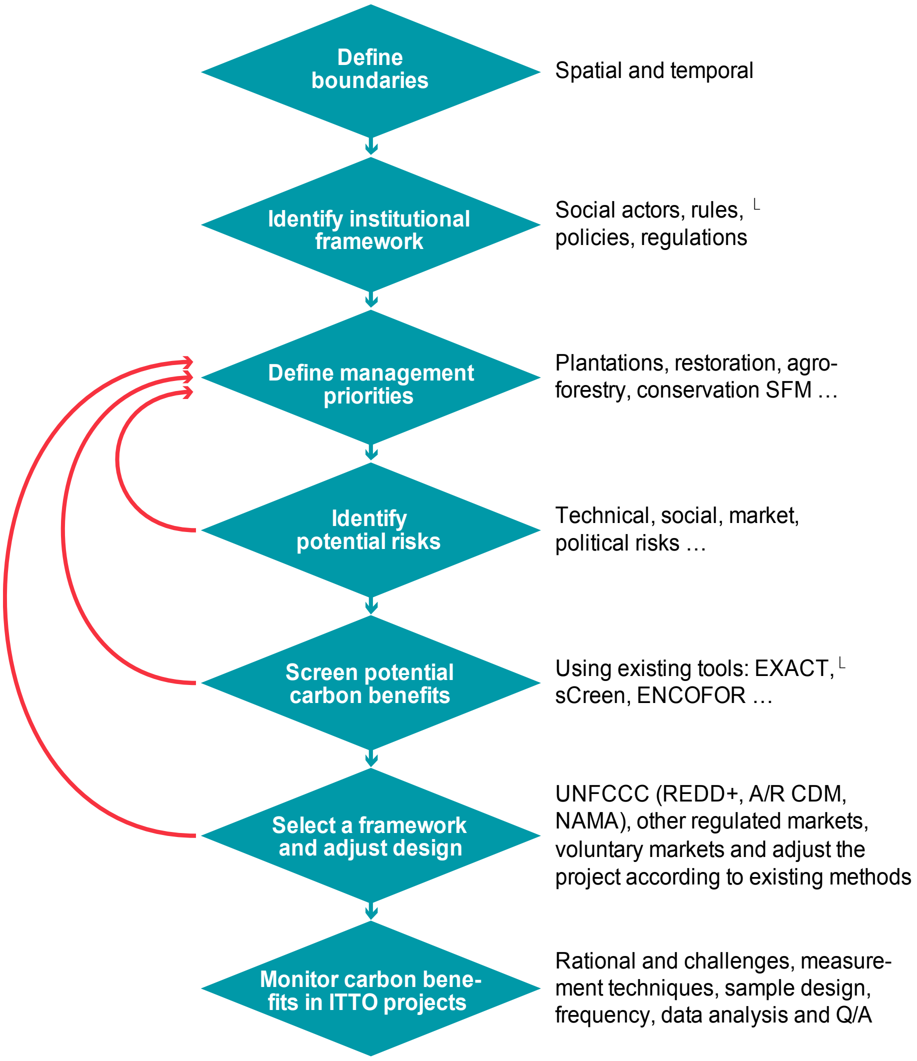


Figure 8: Step-wise approach from activity design to monitoring carbon benefits
Note: Rhombus indicate the steps, text on the right side is a short clarification of each step, blue lines indicate step-process, red lines show possible feed-backs

5.1 DEFINE BOUNDARIES

Why it is important to define boundaries?
Spatial boundaries: Total carbon benefits are dependent of the benefits per hectare as well as of the number of hectares where forest systems are established and the specific silvicultural treatment. A unique set of silvicultural practices needs to be tailored to the biophysical and social characteristics of each site to effectively manage forests for carbon, (Cid-Liccardi et al., 2012). For this reason the clear definition of the projects/activity boundaries is extremely important.

Temporal boundaries: For some mitigation frameworks it is necessary to secure that carbon benefits will be quantified over a certain period of time. The length of this period depends of the specific framework. Therefore it is important to clarify for how long the current forest managers will retain responsibility over land management.

How to define boundaries?
Spatial boundaries: There are several tools that can be used to set boundaries. These include maps, aero-photographs or coordinates obtained with a global positioning system (satellite imaginary and geographic information systems). In some cases it will be necessary to show legal status of land ownership. For this reason it is important to consider legal status as well as biophysical conditions when setting the boundaries. The more accurate the definition of boundaries, the more accurate the estimation monitoring carbon benefits (Gregory P Asner, 2009) (see Section 5.7).

Temporal boundaries: Forest managers determine temporal boundaries after clarifying how long they can assure the management of the specific forest/land. Some standards or certification procedures include provisions for a minimum project length. It is good practice to consider adjustments in the temporal boundaries after the selection a specific framework for securing carbon benefits (see Section 5.6). Note that donors have different requirements with respect to project length and activity length in order to get carbon benefits. It is thus a good practice to identify potential challenges in securing a long-term management of forests as required by most climate change mitigation frameworks.

What to do if there is a significant change in the boundaries?
If boundaries change over time, the ex-ante estimation and monitoring are impacted. If the size increases, new strata and monitoring plots may be required.

In some mitigation frameworks boundary change is not permitted once the activity has started. It is important to strike a balance when defining the size of your intervention area. If the area is too large, it can be difficult to monitor and it could take a long period of time to see full results. If the area is too small, potential carbon benefits might be lost "outside" of the area.

5.2 IDENTIFY THE INSTITUTIONAL FRAMEWORK

Institutional framework in the context of this guidance is understood as the rules and regulations between different social actors that are relevant for the current and future management of a given forest/land. It includes the rules and regulations between the public sector, the private sector and the civil society as well as policies, laws, investment plans, crediting systems, traditional use and indigenous rights.

Why it is important to identify the institutional framework?
Social actors include forest users as well as regulatory bodies and investment organizations. The interaction between them has a great influence on how a forest/land is used. For instance deforestation drivers are highly determined by this interaction. Another example is the impact on plantations as a consequence of tax reductions for timber producers or

How to identify the institutional framework?
There are two factors which must be included when identifying the institutional framework. First, it is important to characterize the social actors (who, [add other) and characterize the institutional agreements and regulations.

5.2.1 Characterization of the social actors[20]

Table 7 provides a template to help characterize relevant social actions. This table is completed by defining relevant roles for your forestry activity in the axis x and attributing them to all social actors for the given area (axis y). It is a good practice to use participative methods for completing the matrix [21].

Social actors belong to all sectors of the society: public sector, private sector and civil society. Actors in the private sector and in the civil society can be clustered in social groups according to specific variables (e.g. occupation, income level, land tenure, education level), or by combining such variables (Madlener et al., 2006)

Table 7 below provides an example of a social actors' matrix. One can include as many social actors as present in each of the three sectors. A given social actor or social group can be assigned to more than one role. Both the social actors (vertical axis) and the roles (horizontal axis) need to be completed according to the circumstances in the specific case.

[20] This section comes from the contribution by Dr. Carmenza Robledo to the section 3 of the FORECA-Toolbox, with permission by the author. See: http://www.theredddesk.org/fr/node/8515

[21] According to the country and region, specific participatory methods will be available. It is beyond the scope of this toolbox to present such methods

→ Role ↓ Social actors	Regulator	Enforce-ment	Informal /illegal user	Concessio-naire	Other formal user	Traditional owner	Owner according to the national regulation
Public sector							
Local authorities							
Regional authorities							
National authorities							
Private sector							
Company XY							
Bank XY							
Cooperative of users							
Civil society							
Church							
Research institutions and universities							
NGOs							

Table 7: Example of the social agent matrix. The list of actors and roles will be specific in each case.

Source: Robledo, C. 2011. Chapter 3, FORECA-Toolbox. See: http://www.theredddesk.org/fr/node/8515

5.2.2 Characterization of institutional agreements

Identify the regulatory framework that sets the agreements and norms for the use of the forest and surrounding land today and in the future. This regulatory framework includes policies, laws and any type of regulation, formal or informal, at the national, regional and local levels. One has to include customary rights, when identifying the regulatory framework.

Regulatory frameworks beyond the forest sector, such as laws, norms and regulations from other sectors like agriculture, mining, energy and any other sector, can constitute a driver for deforestation and forest degradation and have to be considered.

Analyze the regulatory framework considering:

- What can facilitate/promote a driver for deforestation or forest degradation?
- Where are the duplications and/other contradictions between different sector regulatory frameworks?
- Land tenure distribution (among social actors)
- Land use distribution (among social actors)
- Degree of enforcement of the regulatory framework
- Queries from different social actors (e.g. due to lack of clarity on land tenure or land use rights).

It is considered a good practice to base the analysis on the following criteria:

- State of decentralization of the public administration of the natural resources
- Degree of participative approaches for planning the use of natural resources

- State of REDD+ authorities: existence and enforcement of a REDD+ legal and administrative framework in the public sector
- Extent to which land tenure has been clarified.

What to do if there is a significant change in the institutional framework?
If major changes take place in the institutional framework (either changes in social actors or in institutional agreements) analyze the impact that those changes can have on your management activity and if necessary consider adjusting your activities. If you are participating in any market scheme, check if institutional changes have an impact on your contracts.

5.3 DEFINE YOUR MANAGEMENT PRIORITIES

Why it is important to define your management priorities?
Your management priorities are the basis for your management plan. If your most important priority is to maximize carbon benefits your planting/harvesting will respond to it. However other management priorities can suffer from this decision. It is consider a good practice to balance management priorities as a means for promoting sustainable management.

How to define your management priorities?
There are innumerable sets of guidance for planning forestry activities. Over the years ITTO has developed a set of guidelines that help to getting a balance between management priorities when planning forestry activities. Table 8 presents the list of these guidelines

ITTO/IUCN guidelines for the conservation and sustainable use of biodiversity in tropical timber production forests
Revised ITTO criteria and indicators for the sustainable management of tropical forests
ATO/ITTO principles, criteria and indicators for the sustainable management of African natural tropical forests
ITTO guidelines for the restoration, management and rehabilitation of degraded and secondary tropical forests
ITTO guidelines on fire management in tropical forests
ITTO guidelines for the establishment and sustainable management of planted tropical forests
Revised SFM Guidelines (expected to be approved by ITTC 49 in November 2013)

Table 8: ITTO guidelines.
Note: available for download from http://www.itto.int/policypapers_guidelines/

What to do if there is a significant change in your management priorities over time?
Significant changes in management priorities will have changes in carbon benefits. Consequently if these changes take place you will need to:

a) document and report changes in management priorities
b) clarify corresponding changes in management practices
c) estimate changes in carbon stocks due to the (new) management practices
d) monitor and report changes in carbon stocks using the formats required by the specific mitigation framework (see Section 5.6)

5.4 IDENTIFY POTENTIAL RISKS

Why it is important to identify potential risks?
Identifying risks gives you relevant information about the feasibility of your management practices today and in the future. If you are liable for the carbon benefits from your FMU you are responsible for securing these benefits.

How to identify potential risks?
There are different potential risks for forestry activities including political and regulatory risks, social risks, economic and financial risks, natural disturbance and hazards ad non-permanence

Potential risk	Current risk (high, medium, low)	Future risk (high, medium, low)
Political and regulatory risks		
- Approval of adverse policies		
- Non-clarity about land tenure and/or carbon tenure		
- Political instability		
- Other political risks…		
Social risks		
- Lack of technology, capacity or skills during the implementation of the management plan		
- Risk of social instability		
- Risk of social conflict or other type of violence		
- Other social risks…		
Economic and financial risks		
- Lack of credit		
- Financial failure		
- Price breakdown		
- Lack of long-term funding		
- Other economic or financial risks		
Natural disturbance and hazards		
- Risk of fire		
- Risk of pest		
- Risk of flooding		
- Risk of drought		
- Risk of severe erosion or desertification		
- Risk of landslides		

Table 9: Potential risks
Source: (Foreca-Toolbox, 2011; CCBA, 2011; Forest Carbon Partnership Facility - FCPF, 2012; Harvey and Pilgrim, 2011; Pitman, 2011; REDD+ SES Initiative, 2012a; Richards, 2011)

Risks can have an impact on the permanence of carbon benefits and therefore the forest manager risks to loose these benefits (see Section 3.2.5 about permanence). That is what is called the non-permanence risk.

What to do if there are significant risks today and/or if these appear in future?
When a significant risk is identified, for today or future, it is a good practice to consider the following steps:

1. Adjust your management plan to minimize the risk (feedback to step on defining management priorities section 5.3)
2. Design risk management strategies for minimizing the risk and monitor the implementation of these strategies during the length of your management practices
3. Monitor the evolution of the risks over time

5.5 SCREEN POTENTIAL CARBON BENEFITS

Screening potential carbon benefits is aimed at getting a preliminary estimation of potential carbon benefits of forestry activities. It should be doable with the information from the management plan and using existing default values for estimating carbon benefits.

Why it is important to screen potential carbon benefits?
Establishing a detailed ex-ante estimation of carbon benefits can be a costly as well as time consuming and data intensive. If the potential carbon benefits are not considerable there is little reason to undertake a detailed ex-ante estimation. A list of existing carbon screening tools is provided in Section 5.5.3. However, before starting the actual screening you need to undertake some preparatory steps.

How to screen potential carbon benefits?
Three steps are recommended for screening potential carbon benefits: select main pools; define strata; select screening tool.

5.5.1 Select main pools
You should include all living biomass, i.e. above and belowground biomass. If any other pool is a significant greenhouse gas emitter you should include this pool. This is particularly important in the case of emissions from organic soils. Forest conversion on peat soil can produce high greenhouse gas emissions. If a pool is a zero net emitter it can be a conservative approach and a cost-effective decision to omit this pool from your estimations.

5.5.2 Define strata
Stratification is the process of dividing a non-homogeneous project area into sub-populations (or strata) that share important characteristic and are therefor more or totally homogeneous (Diaz and Delaney, 2011; IPCC, 2003). Stratification can increase accuracy and precision in the measurements and reduce monitoring costs. The criteria used for stratification can include the following (IPCC, 2003; T. Pearson et al., 2005b; T. R. H. Pearson et al., 2005):

- Type of vegetation
- Tree species
- Age class
- Slope
- Proximity to settlements, roads or other relevant infrastructure
- Type of soil

It is possible that the stratum prior to the project will be different from the stratum/strata after implementation of the project. Furthermore, within one project it is possible to seek objectives that result in varying stratum. For example, your stratum pre-project is a homogenous non-managed pasture in a plain area. Within the framework of your project you want to install a fast growing plantation in one half of the area and an agroforestry system in the other half. This would mean result in different strata.

5.5.3 Select an existing screening tool
Currently there are several tools and simplified methods that allow screening potential carbon benefits of forestry activities (see table 9)

sCreen	
Short description	sCreen (fast track estimation of carbon benefits from forestry activities) is a set of methods for estimating carbon benefits from any forestry activity including sustainable forest management, forest conservation, forest rehabilitation/restoration, forest plantations or agroforestry. A excel based tool has been developed for operationalizing the methods. sCreen has been developed by the ITTO
Pools considered	Aboveground biomass and belowground biomass
Available at	Upon decision of the ITTC in November 2013
ENCOFOR	
Short description	ENCOFOR ("ENvironment and COmmunity based framework for designing afFORestation, reforestation and revegetation projects in the CDM: methodology development and case studies") aims at maximizing synergies between the sequestration of carbon and the creation of benefits for the local environment and local stakeholders. ENCOFOR developed several tools including a carbon accounting model for the pre-feasibility stage. The Carbon Accounting Module integrates the quantitative analyses that are necessary to prepare a Project Idea Note. These include relatively simple assessments of the baseline and with-project scenarios.
Pools considered	Aboveground biomass, belowground biomass, litter, deadwood, soil and harvested wood products This tool focuses on plantations, agroforestry or silvopastoral systems.
Available at	http://www.joanneum.at/encofor/tools/tool_demonstration/prefeasibility.htm

Ex-Act	
Short description	EX-ACT (*Ex Ante* Appraisal Carbon-balance Tool) is aimed at providing *ex-ante* estimations of the impact of agriculture and forestry development projects on GHG emissions and carbon sequestration, indicating its effects on the carbon balance. EX-ACT has been tested more specifically on agricultural development projects and investment programs. Ongoing tests on forestry projects are in progress, as well as value chains analysis.
Pools considered	Aboveground biomass, belowground biomass, litter, dead wood and soil
Available at	http://www.fao.org/tc/exact/en/
REDD+ feasibility tool	
Short description	The excel based tool was developed for use by project developers in order to help quickly and accurately assess a proposed site/region's potential for REDD+ development, including a detailed financial feasibility breakdown.
Pools considered	Aboveground biomass and belowground biomass
Available at	http://www.conservation.org/global/carbon_fund/publications/pages/publications.aspx

Table 9: List of some existing carbon screening tools (in no specific order)

Tools aimed at producing detailed ex-ante quantification of potential carbon benefits are also available by the different mitigation frameworks. However the use of these tools require a higher investment in time, data and capacities (see Annex 2 for a list of some of these tools).

Screening tools should help you to clarify whether your mitigation potential is big enough to make a further investment.

What to do if there is a significant carbon potential?
If your potential carbon benefits are significant, then it is worth considering the inclusion of your project into a mitigation framework. Section 5.6 explains how to select the adequate framework for your circumstances. Please bear in mind that using any of the mitigation frameworks included in this section will cause costs to your project. These costs are related to getting information, fulfilling requirements for acceptance (validation and whenever required registration) monitoring, verifications and in some cases certification. Costs vary profoundly from framework to framework and from standard to standard. Thus it is a good practice to undertake a cost-benefit assessment of your potential carbon benefits.

If your potential carbon benefits are low to very low, it is worth considering if an adjustment in your management priorities is possible. Then you can screen your potential again and again. The idea of having simple carbon screening tools is so that the forest manager can maximize the different benefits of your forestry practices toward a more sustainable management of the resources.

5.6 Select the mitigation framework and Adjust design

Why it is important to select the mitigation framework and to adjust the project design?
There are several reasons for selecting the mitigation framework that is appropriate for your circumstances:

- There are differences about what activities are eligible
- Some frameworks have specific approved methodologies for the ex-ante estimation as well as for monitoring and quantification of the ex-post benefits
- Some frameworks have specific regulations about third party validation, verification and/or certification
- Requirements for carbon tenure can be different from framework to framework
- Benefits and compensations schemes as well as corresponding conditions can be different between frameworks (e.g. not all mitigation frameworks offer direct payments)
- Requirements for documentation of processes and changes can be different
- Formats can be different
- Country contact point and countries requirements can be different

How to define select the mitigation framework?
First you need to clarify the purpose of your intention for accounting carbon benefits (see Figure 9)

Figure 9: Decision tree 1: Purpose of your carbon accounting

If you are interested in participating in any of the mitigation frameworks presented in Chapter 4, you need to select which one is the most appropriate for your specific circumstances. Decision tree 2 will help you to make this decision (see Figure 10).

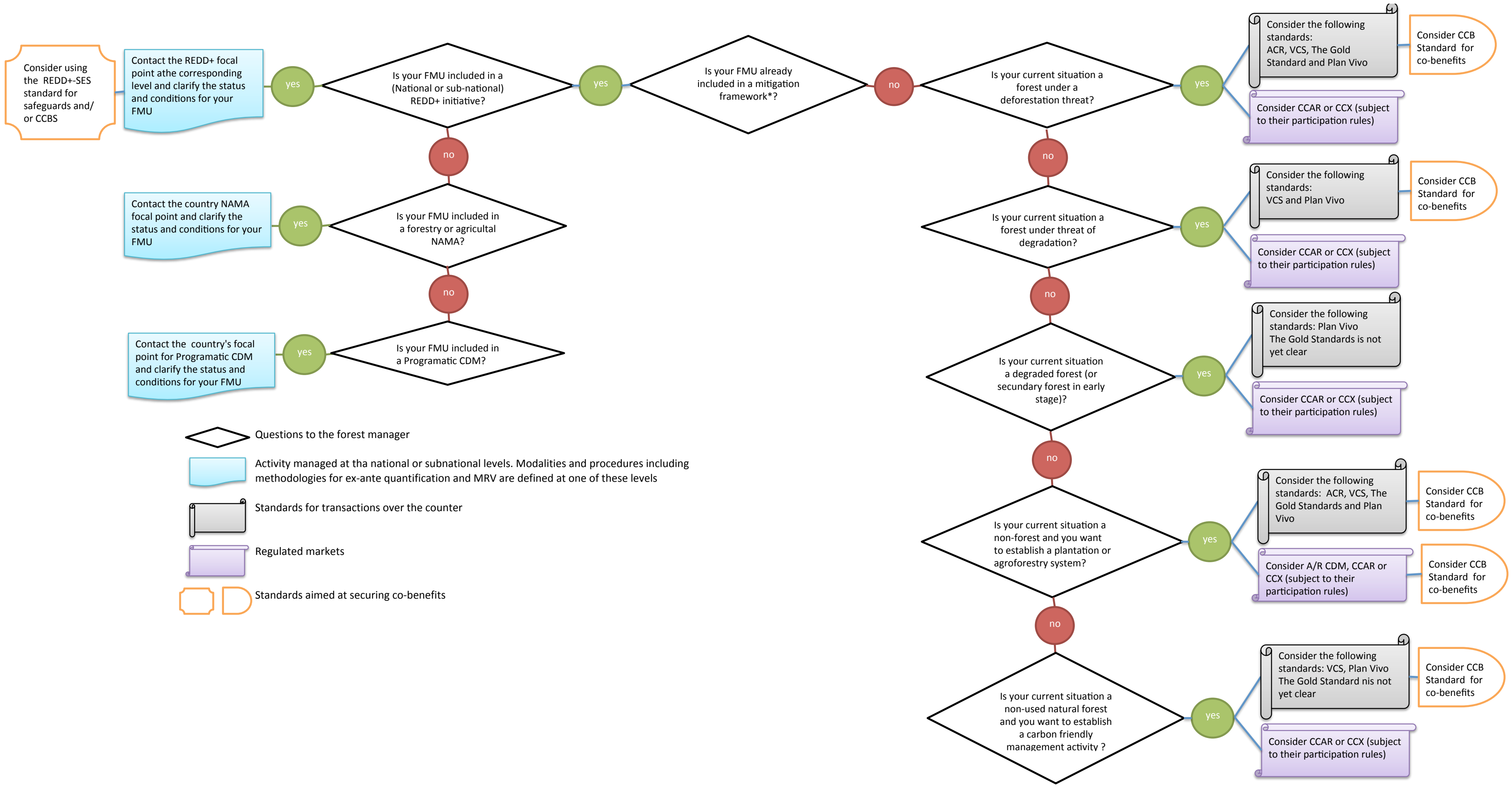


Figure 10: Decision tree 2: Selecting a mitigation framework at the FMU level

Sections 5.6.1 – 5.6.3 present a summary of the requirements and approved methodologies for each mitigation framework and Annex 2 presents the existing tools by these mitigation frameworks[22]

5.6.1 UNFCCC

5.6.1.1 REDD+

As explained before the REDD+ mechanism is still under negotiation in the UNFCCC. Currently a series of pilot activities are ongoing as so called “early actions”. Several developing countries, multilateral organizations and other stakeholders are participating in these initiatives aimed at gaining experience and knowledge in REDD+ related issues.

According to decision 1/CP16 of the UNFCCC, REDD+ will be based on a national level and, if appropriate, as an interim measure a subnational level can be used. Developing countries have been asked to define a REDD+ strategy as a basis for their activities. **For this reason if a forest manager at the FMU level wants to participate in the REDD+ mechanism under the UNFCCC, he/she needs to contact the corresponding focal point at the national level. Guidance on methodologies, modalities and procedures for integrating the FMU level into the REDD+ mechanisms are defined at the country level.**

The following sections present experiences in ongoing initiatives on REDD+ for defining three main elements: Reference level/reference emission level (RL/REL); Monitoring, Reporting and Verification (MRV) and Safeguards according to the reports by multilateral organizations and other stakeholders[23].

5.6.1.1.1 Forest Carbon Partnership Facility - FCPF

The Forest Carbon Partnership Facility of the Word Bank is a global partnership of governments, businesses, civil society, and Indigenous Peoples focused on reducing emissions from deforestation and forest degradation, forest carbon stock conservation, the sustainable management of forests, and the enhancement of forest carbon stocks in developing countries (activities commonly referred to as REDD+). The Forest Carbon Partnership Facility assists developing countries in their efforts to plan and implement "REDD+ strategies” by providing value to standing forests[24.25]
A compilation of strategic guidance to emerging best practices in the field was developed together with Forest Trends and other partners.[26] It is comprised of nine volumes including:

1. Step by step overview
2. REDD Guidance: Technical Project Design
3. AR Guidance: Technical Project Design
4. Carbon Stock Assessment Guidance: Inventory and Monitoring Procedures
5. Community Engagement Guidance: Good Practice for Forest Carbon Projects
6. Legal Guidance: Legal and Contractual Aspects of Forest Carbon Projects
7. Business Guidance: Forest Carbon Marketing and Finance
8. Social Impacts Guidance: Key Assessment Issues for Forest Carbon Projects
9. Biodiversity Impacts Guidance: Key Assessment Issues for Forest Carbon Projects

---

[22] Information as per end of July 2013.
[23] Information in these subsections is based on the experiences reported by countries, NGOs and research organisations to the REDD+ Platform oft he UNFCCC (http://unfccc.int/methods/redd/redd_web_platform/items/4531.php) as well as on information from the mentioned multilateral funds (as documented)
[24] for more information on the FCPF see: http://www.forestcarbonpartnership.org/
[25] By end of July 2013 the following countries have the status as Participants in the FCPF: Argentina, Bolivia, Cameroon, Cambodia, Central African Republic, Chile, Colombia, Democratic Republic of Congo, Republic of Congo, Costa Rica, El Salvador, Ethiopia, Gabon, Ghana, Guatemala, Guyana, Honduras, Indonesia, Kenya, Lao People’s Democratic Republic, Liberia, Madagascar, Mexico, Mozambique, Nepal, Nicaragua, Panama, Papua New Guinea, Paraguay, Peru, Suriname. Tanzania, Thailand, Uganda, Vanuatu and Vietnam
[26] see_ http://www.forestcarbonpartnership.org/building-forest-carbon-projects-new-set-guidance-documents-forest-trends

The volume on "*Carbon Stock Assessment Guidance Inventory and Monitoring Procedures*" [27] (Diaz and Delaney, 2011), deals with forest inventories and carbon accounting in the field and is therefore relevant to the worked discussed in the this report. The FCPF also has guidance on safeguards called "Common approach to environmental and social safeguards for multiple delivery partners". This document clarifies its requests to developing countries participating in the fund financing schemes with regard to REDD+ safeguards (Forest Carbon Partnership Facility - FCPF, 2012).

5.6.1.1.2 UN-REDD Programme

The UN-REDD Programme is the United Nations collaborative initiative on Reducing Emissions from Deforestation and forest Degradation (REDD) in developing countries. The program was launched in 2008 and builds on the convening role and technical expertise of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). UN-REDD supports the nationally led REDD+ processes and promotes the informed and meaningful involvement of all stakeholders. In particular, they support the involvement of indigenous peoples and other forest-dependent communities in national and international REDD+ implementation (from the UN-REDD programme webpage, June, 2013 [28]). Figure 11 shows countries where UN-REDD is active.

Figure 11: Countries in the UN-REDD Programme (source: http://www.un-redd.org/)

For the UN-REDD monitoring systems that allow for credible measurement, reporting and verification of REDD+ activities are among the most critical elements for the successful implementation of any REDD+ mechanism. Consequently the UN-REDD Programme is supporting countries to develop cost-effective, robust and compatible national monitoring and MRV systems, providing tools, methodologies, training and knowledge sharing that help countries to strengthen their technical and institutional capacity for effective MRV systems. Its activities in MRV include:

- **MRV of carbon:** The focus of the work is GHG emissions monitoring, Reference Emissions Levels (RELs), forest inventories and remote sensing;
- **Monitoring safeguards** The UN-REDD Programme supports countries on how to build systems for providing information on safeguards and how safeguards can be implemented and respected throughout the implementation of REDD+; and
- **Governance** Monitoring of governance focuses on the performance of a country's capacity and governance.

[27] see: http://www.forest-trends.org/publication_details.php?publicationID=2862
[28] see: http://www.un-redd.org/Events/tabid/104448/Default.aspx

- **Multiple Benefits and potential risks** Monitoring of multiple benefits identifies the additional benefits that REDD+ can harness, in addition to carbon (including *i.a.* livelihood improvement or protection of biodiversity and watersheds).

The UN-Programme recently produced a guidance document on Monitoring and Measurement, Reporting and Verification (M & MRV) in the context of REDD+ Activities (UN-REDD Programme, 2013a). This document focuses on reporting needs and options at the national level of national forest monitoring systems. The UN-REDD Programme also supports developing countries in developing their country level approaches for fulfilling requirements on REDD+ safeguards and their corresponding information systems (Peskett and Todd, 2013). This work is inline with the "Social and Environmental Principles and Criteria" (SEPC) which includes the following principles (UN-REDD Programme, 2012)[29]:

1. Apply norms of democratic governance, as reflected in national commitments and Multilateral Agreements
2. Respect and protect stakeholder rights in accordance with international obligations
3. Promote sustainable livelihoods and poverty reduction
4. Contribute to low-carbon, climate-resilient sustainable development policy, consistent with national development strategies, national forest programs, and commitments under international conventions and agreements
5. Protect natural forest from degradation and/or conversion
6. Maintain and enhance multiple functions of forest including conservation of biodiversity and provision of ecosystem services
7. Avoid or minimize adverse impacts on non-forest ecosystem services and biodiversity

UN-REDD Programme has design a corresponding tool for assessing social and environmental risks. More information about this tool is included in annex 2 of this guidance.

5.6.1.2 Clean Development Mechanism and Programmatic CDM

The following conditions and information are relevant for all A/R methodologies and are applicable in addition to the conditions listed in the methodology summaries (UNFCCC, 2012):

- Vegetation cover on the land eligible for project activities must have been below the forest threshold – as determined by the developing country - on 31 December 1989. This needs to be proven (e.g. using satellite image or participatory rural appraisal (PRA));
- No tree vegetation is expected to emerge without human intervention to for a forest on the project land;
- Project start date must be January 1st, 2000 or later,
- In absence of the project activity, carbon stocks in the carbon pools not considered in the project activity are expected to decrease or increase less relative to the project scenario.

A/R CDM project activities result in t-CERs and l-CERs.

5.6.1.2.1 CHECK FOR SPECIFIC COUNTRY REGULATION

Project managers shall check the requirements for an A/R CDM project activity in their specific country. Each developing country involved in the A/R CDM (i.e. host country) has a focal point called Designated National Authority (DNA). This authority is responsible for setting the forest definition for A/R CDM in the given country as well as for setting he approval requirements (see annex 10.1.1 for the list of DNAs of the ITTO Producer Countries).

5.6.1.2.2 SELECT A METHODOLOGY

The A/R CDM distinguishes between three different types of methodologies:

[29] The document includes definitions and/or clarifications of several relevant terms (e.g. degradation, conservation...)

- Compiled methodologies;
- Methodologies for large scale projects; and
- Methodologies for small-scale projects.

5.6.1.2.2.1 Compiled methodologies

There are three A/R CDM compiled methodologies (see table 11)

Number	A/R CDM Compiled methodology
AR-AMC0001:	Afforestation and reforestation of degraded land. See more under: https://cdm.unfccc.int/methodologies/DB/X4VOLW3Y7IJCH9WXSBXBC2Q0JKG9UZ
AR-ACM0002:	Afforestation or reforestation of degraded land without displacement of pre-project activities. See more under: https://cdm.unfccc.int/methodologies/DB/OOH5AKLQDUYW6N3STD3LDH7EL9THD1
AR-ACM0003:	Afforestation and reforestation of lands except wetlands. See more under: https://cdm.unfccc.int/methodologies/DB/WB63WYT7LKF8N6V0A3YXXXI8GCP2J3

Table 11: A/R CDM compiled methodologies.
Source: UNFCCC Secretariat https://cdm.unfccc.int/methodologies/index.html

5.6.1.2.2.2 Methodologies for large scale projects

This section of the annex lists all approved methodologies for large-scale A/R CDM projects (see Table 12). The web page presenting the specific methodology includes also all needed tools. Take into account that many of these methodologies have been replaced by consolidated methodologies (as clarified by each methodology. The consolidated methodologies are included in annex 10.1.3.1

Number	A/R CDM methodology for large scale projects
AR-AM0002	Restoration of degraded lands through afforestation/reforestation. This methodology has been replaced by the consolidated methodology AR-ACM0003
AR-AM0004	Reforestation or afforestation of land currently under agricultural use. This methodology has been replaced by the consolidated methodology AR-ACM0003
AR_AM0005	Afforestation and reforestation project activities implemented for industrial and/or commercial uses. This methodology has been replaced by the consolidated methodology AR-ACM0003
AR-AM0007	Afforestation and reforestation of land currently under agricultural or pastoral use. This methodology has been replaced by the consolidated methodology AR-ACM0003
AR-AM0009	Afforestation or reforestation on degraded land allowing for silvopastoral activities. This methodology has been replaced by the consolidated methodology AR-ACM0003
AR-AM0010	Afforestation and reforestation project activities implemented on unmanaged grassland in reserve/protected areas. This methodology has been replaced by the consolidated methodology AR-ACM0003
AR-AM0011	Afforestation and reforestation of land subject to polyculture farming. This methodology has been replaced by the consolidated methodology AR-ACM0003
AR-AM 0012	Afforestation or reforestation of degraded or abandoned agricultural lands. This methodology has been replaced by the consolidated methodology AR-ACM0003
AR-AM0013	Afforestation and reforestation of lands other than wetlands. This methodology has been replaced by the consolidated methodology AR-ACM0003
AR-AM0014	Afforestation and reforestation of degraded mangrove habitats. See more under: https://cdm.unfccc.int/methodologies/DB/MYKQ6SF4NBIOQ77A5V7RFZ602N39GQ

Table 12: A/R CDM methodologies for large-scale projects.
Source: UNFCCC Secretariat https://cdm.unfccc.int/methodologies/index.html

5.6.1.2.2.3 Methodologies for small-scale A/R CDM project activities

There are seven approved methodologies for small-scale A/R CDM projects (see table 13)

Number	A/R CDM methodology for small-scale projects
AR-AMS0001	Small-scale A/R CDM project activities implemented on grasslands or croplands with limited displacement of pre-project activities[30]. This methodology is not active anymore. It has been incorporated into AR-AMS0007
AR-AMS0002	Small-scale afforestation and reforestation project activities under the CDM implemented on settlements[31]. This methodology is not active anymore. It has been incorporated into AR-AMS0007 AR-AMS0003: Small-scale A/R CDM project activities implemented on wetlands. See more under: https://cdm.unfccc.int/methodologies/DB/8LLTGVPG1SMMB1AMGSU0ZEYVO9P45P
AR-AMS0004	Small-scale agroforestry - afforestation and reforestation project activities under the CDM[32]. This methodology is not active anymore. It has been incorporated into AR-AMS0007
AR-AMS0005	Small-scale afforestation and reforestation project activities under the CDM implemented on land having low inherent potential to support living biomass[33]. This methodology is not active anymore. It has been incorporated into AR-AMS0007
AR-AMS0006	Small-scale silvopastoral – afforestation and reforestation project activities under the CDM[34]. This methodology is not active anymore. It has been incorporated into AR-AMS0007
AR-AMS0007	Small-scale A/R CDM project activities implemented on lands other than wetlands. See more under: https://cdm.unfccc.int/methodologies/DB/M9KFJT0OMGFD2M07PGAA3E7XIGSI7T

Table 13: A/R CDM methodologies for small-scale projects.
Source: UNFCCC Secretariat https://cdm.unfccc.int/methodologies/index.html

5.6.2 Other regulated markets

5.6.2.1 California Climate Action Registry (CCAR) and the Climate Action Reserve (CAR)

The California Climate Action Registry (CCAR) is part of the State of California's effort to address climate change in advance of Federal action in the United States. One aspect of the land use focus of the CCAR is forests within California and forests controlled by California entities (Haskett, 2011). The California Registry's parent organization[35], the Climate Action Reserve, operates the premier carbon offset registry for the North American carbon market. The Reserve built upon the California Registry's knowledge and expertise in GHG accounting and developed a regulatory-quality program to quantify GHG emissions reductions from offset projects[36].

The CCAR includes a forest project reporting level (FMU) level for three types of activities;

---

30 The CDM Board, at ist 68th meeting revised the methodology AR-AMS0007, which incorporates the methodology AR-AM001, and agreed to withdraw AR-AMS0001 with 20 March 2013 as the effective date for withdrawal
31 The CDM Board, at ist 68th meeting revised the methodology AR-AMS0007, which incorporates the methodology AR-AM001, and agreed to withdraw AR-AMS0002 with 20 March 2013 as the effective date for withdrawal
32 The CDM Board, at ist 68th meeting revised the methodology AR-AMS0007, which incorporates the methodology AR-AM001, and agreed to withdraw AR-AMS0004 with 20 March 2013 as the effective date for withdrawal
33 The CDM Board, at ist 68th meeting revised the methodology AR-AMS0007, which incorporates the methodology AR-AM001, and agreed to withdraw AR-AMS0005 with 20 March 2013 as the effective date for withdrawal
34 The CDM Board, at ist 68th meeting revised the methodology AR-AMS0007, which incorporates the methodology AR-AM001, and agreed to withdraw AR-AMS0006 with 20 March 2013 as the effective date for withdrawal
35 The California Climate Action Registry, a program of the Climate Action Reserve, closed in December 2010. It served as a voluntary greenhouse gas (GHG) registry to protect and promote early actions to reduce GHG emissions by organizations. California Registry provided leadership on climate change by developing credible, accurate, and consistent GHG reporting standards and building tools for organizations to measure, monitor, third-party verify and reduce their GHG emissions consistently across industry sectors and geographical borders (see http://www.climateregistry.org/)
36 see http://www.climateactionreserve.org/

- Conservation-based forest management;
- Reforestation projects and
- Conservation projects

In its forest protocol CAR presents the eligibility rules and requirements, the rules for assessment of GHG emissions, quantification approach and strategy for ensuring permanence as well as the modalities for monitoring and the verification procedure (Climate Action Reserve, 2012a). Further, the CAR has prepared detailed guidelines for carbon quantification including algorithms and default data(Climate Action Reserve, 2012b). Participants in the CAR should use this guidance.

5.6.3 Voluntary Standards

5.6.3.1 American Carbon Registry[37]

The American Carbon Registry® (ACR) is a non-profit U.S. carbon market standard and registry As the first private voluntary greenhouse gas registry in the U.S.. ACR has issued over 37 million carbon offsets. ACR has three standards, the American Carbon Registry Standard, the Forest Carbon Project Standard and the ACR nested REDD+ standard (see Table 14 for ACR methodologies)

The American Carbon Registry (ACR) provides a electronic registry system for Members to transparently register offset projects as well as transfer and retire serialized project-based verified emission reductions (VERs), branded as Emission Reduction Tons ("ERTs").

Name	Short description
Afforestation and reforestation of degraded lands	The methodology was initially developed from Clean Development Mechanism (CDM) approved consolidated afforestation and reforestation baseline and monitoring methodology AR-ACM0001 Version 5.0.0. Guidance on accounting for harvested wood products drawn from a methodology for Improved Forest Management through Extension of Rotation Age, developed by Winrock International, was incorporated by TREES Forest Carbon Consulting, reviewed and approved by ACR's independent Agriculture, Forestry and Other Land Use (AFOLU) Technical Committee and published in March 2011. Available at: http://americancarbonregistry.org/carbon-accounting/carbon-accounting/afforestation-and-reforestation-of-degraded-lands
ACR Methodology for Reducing Emissions from Deforestation and Degradation (REDD) – Avoiding Planned Deforestation	Reducing Emissions from Deforestation and Degradation (REDD) is an eligible project activity under the ACR Forest Carbon Project Standard, defined as the reduction in GHG emissions from the avoided conversion of forest to non-forest use or avoided degradation of forests remaining as forests. This REDD-APD methodology is applicable only to the REDD sub-category Avoiding Planned Deforestation (APD). Separate ACR methodologies address other types of REDD such as avoiding unplanned deforestation and avoiding forest degradation through fuelwood and charcoal production. The methodology references a separate ACR Tool for Estimation of Stocks in Carbon Pools and Emissions from Emissions Sources ("CPES Tool"). Projects using this methodology must comply with all requirements of the ACR Forest Carbon Project Standard; submit a GHG Project Plan for certification by ACR; and secure independent validation of the GHG Project Plan, and verification of GHG assertions, by an ACR-approved third-party verifier. Available at: http://americancarbonregistry.org/carbon-accounting/carbon-accounting/redd-2013-avoiding-planned-deforestation

[37] Information on the American Carbon Regitry was taken from http://americancarbonregistry.org/aboutus

REDD Methodology Modules	The REDD Modules are applicable to projects reducing emissions from planned deforestation, unplanned deforestation, and degradation through non-renewable fuelwood collection and charcoal production. The modular approach is an effort to streamline methodology development and use. The REDD modules may be used on their own for project-level REDD activities, or alternately combined with ACR's forthcoming Nested REDD+ Requirements to register project-level activities nested within a jurisdictional accounting framework. A framework module, REDD-MF, establishes the overall functionality of the methodology, Included underneath REDD-MF are: 1) Three baseline modules a. •BL-PL "Estimation of baseline carbon stock changes and GHGemissions from planned deforestation"• b. BL-UP "Estimation of baseline carbon stock changes and GHGemissions from unplanned deforestation"• c. BL-DFW "Estimation of baseline emission from forest degradation caused by extraction of wood for fuel" 2) Four leakage modules: a. LK-ASP "Estimation of emissions from activity shifting for avoided planned deforestation" b. LK-ASU "Estimation of emissions from activity shifting for avoided unplanned deforestation" c. LK-ME "Estimation of emissions from market effects" d. LK-DFW "Estimation of emissions from displacement of fuelwood extraction" 3) M-MON "Methods for monitoring of greenhouse gas emissions and removals" 4) Two miscellaneous modules:• X -STR "Methods for stratification of the project area"• X-UNC "Estimation of uncertainty for REDD project activities" Available at: http://americancarbonregistry.org/carbon-accounting/carbon-accounting/redd-methodology-modules-1 Further the methodology includes four tools (see Annex 2)

Table 14: Methods available at the American Carbon Registry
Source: http://americancarbonregistry.org/aboutus

5.6.3.2 Climate, Community and Biodiversity Standards –CCBS[38]

The Climate, Community and Biodiversity Standards (CCB Standards) are aimed at evaluating land-based carbon mitigation projects from the early stages of development through implementation. CCB Standards don't look at accounting carbon benefits but foster look for the integration of best-practice and multiple-benefit approaches into project design and implementation. The CCB Standards look at:

- identifying projects that simultaneously address climate change, support local communities and conserve biodiversity;
- promoting excellence and innovation in project design and implementation; and
- mitigating risk for investors and offset buyers and increase funding opportunities for project developers.

The CCB Standards can be applied to any land-based carbon projects including activities that reduce emissions from deforestation and forest degradation (REDD) and contribute to conservation, sustainable management of forests and enhancement of forest carbon stocks (REDD+), agricultural land management and avoided degradation of non-forest ecosystems. The CCB Standards used alone do not lead to delivery of quantified emissions reductions certificates so they should be used in combination with a carbon accounting standard (e.g. CDM, VCS). Consequently, the CCBS don't provide a set of methodologies for ex-ante carbon estimation or for ex-post carbon quantification.

[38] For more detailed information about the CCBA Standards go to http://www.climate-standards.org/

The carbon accounting is done according to the provisions for the specific mitigation framework selected (e.g. A/R CDM or VCS). Relevant information for the CCB Standards is then included in the project design document (PDD). If you want to combine CCB Standards with the Verified Carbon Standard (VCS) there are specific templates and guidance available [39]

The CCB Standards must be used through a two-step process including a validation and a verification step. If at the FMU level you are interested in certifying social and biodiversity co-benefits of those forestry activities aimed at getting carbon benefits you can consider using the CCB Standards (CCBA, 2010, 2008). The CCB Standards look that projects fulfill a series of criteria. By July 2013 the CCB Standards are under revision. Table 15 includes the CCB criteria as included in the new version (currently under public scrutiny).

GENERAL SECTION	
G1. Project goals, design, and long term viability	The project has clear objectives to generate climate, community and biodiversity benefits and is designed to meet these objectives. Risks are identified and managed to generate and maintain project benefits within and beyond the life of the project.
G.2 Without project land use scenario and additionality	The without-project land use scenario describes expected land use changes in the Project Zone in the absence of project activities. The project impacts for climate, communities and biodiversity are measured against the expected conditions for total GHG emissions, for Communities and for biodiversity associated with this without-project land use scenario (described in CL1, CM1, B1). Project benefits must be 'additional', such that they would not have occurred without the project.
G.3 Stakeholder engagement	All Communities and Other Stakeholders have adequate information for full and effective participation, that includes effective consultations with all relevant stakeholders and participation, as appropriate, of those that want to be involved. Feedback and grievance redress mechanisms are established and functional. Best practices are adopted for worker relations and safety.
G.4 Management capacity	The project has adequate human and financial resources for effective implementation.
G.5 Legal status and property rights	The project respects rights to lands, territories and resources, including the statutory and customary rights of Indigenous Peoples and others within Communities and Other Stakeholders. Project activities have the free, prior and informed consent of relevant rights holders and do not lead to involuntary relocation of people or activities important for the livelihoods and culture of Communities. The project is based on a solid legal framework, complies with relevant regulatory and customary requirements and has necessary approvals from the appropriate authorities.
CLIMATE SECTION	
CL. 1 Without project climate scenario	Estimates of total GHG emissions in the project area under the without-project land use scenario are described.
CL. 2 Net positive climate impacts	The project reduces GHG emissions over the project lifetime from project activities within the project area.

[39] Fort he VCS+CCB project description template or the project development process guidance go to: http://www.climate-standards.org/documents/

CL. 3 Offsite climate impacts ("leakage")	The increased GHG emissions that occur beyond the project area that are caused by project activities (commonly referred to as 'leakage') are assessed and mitigated.
CL. 4 Climate impact monitoring	Climate impact monitoring assesses changes (within and outside the Project Area) in project-related carbon pools, project emissions, and non-CO2 GHG emissions if appropriate, resulting from project activities.
GL. 1 Climate change adaptation benefits (optional)	The project provides significant support to assist Communities and/or biodiversity in adapting to the impacts of climate change. Anticipated local climate change and climate variability within the project zone that could potentially affect Communities and biodiversity are assessed. Strategies to help local communities and biodiversity adapt to climate change are identified and implemented.
COMMUNITY SECTION	
CM.1 Without- project scenario for communities	Original well-being conditions for Communities and expected changes under the without-project scenario are described
CM.2 Net positive community impacts	The project generates net positive impacts on the well-being of Communities over the project lifetime. The project maintains or enhances the High Conservation Values in the project zone that are of importance to the well-being of Communities
CM.3 Other stakeholder impacts	Project activities at least 'do no harm' to the well-being of Other Stakeholders.
CM.4 Community impact monitoring	Community impact monitoring assesses changes in well-being resulting from the project activities for Community Groups and Other Stakeholders.
GL2. Community- and smallholder-led equitable benefits (optional)	Smallholder- and Community-led projects are projects in which Smallholders/Community Members are actively involved in design and implementation of project activities and have rights to benefits from the project. Risks related to aggregating Smallholders/Community Members at scale are effectively addressed through appropriate institutional and governance arrangements that enable effective participation in decision-making, including women and marginalized and/or vulnerable groups. Benefits are shared equitably with and among the Smallholders/Community Members, ensuring that equitable benefits also flow to more marginalized and/or vulnerable households and individuals within them
B1. Biodiversity without project scenario	Original biodiversity conditions in the Project Zone and expected changes under the Without-project Scenario are described.
B.2 Net positive biodiversity impacts	The project generates net positive impacts on biodiversity within the Project Zone over the project lifetime. The project maintains or enhances any High Conservation Values present in the Project Zone that are of importance in conserving biodiversity. Native species are used unless otherwise justified and invasive species and genetically modified organisms (GMOs) are not used.
B.3 Offsite biodiversity impacts	Negative impacts on biodiversity outside the Project Zone resulting from project activities are evaluated and mitigated.
B.4 Biodiversity impact monitoring	Biodiversity impact monitoring assesses the changes in biodiversity resulting from project activities within and outside the Project Zone

GL.3 Exceptional biodiversity benefits	Projects conserve biodiversity at sites of global significance for biodiversity conservation based on the Key Biodiversity Area (KBA) framework of vulnerability and irreplaceability

Table 15: Criteria for CCB Standards as included in (CCBA, 2013)

Further, the CCBS has produced a manual for assessing social and biodiversity impacts from REDD+ projects (CCBA, 2011). The manual has three main components:

i) Core guidance for project proponents, that explains the rational and theory of change behind the assessment approach as well as the seven stages for their application (CCBA, 2011);
ii) Social impact assessment toolbox (see Annex 2)(Richards, 2011); and
iii) Biodiversity impact assessment toolbox (see Annex 2) (Pitman, 2011)

5.6.3.3 Plan Vivo[40][41]

The Plan Vivo Standard is a certification framework for projects supporting rural smallholders and community groups with improved natural resource management, using payments for environmental services (PES). Quantifying and monitoring climate services, in tones CO2e, enables projects to generate "Plan Vivo Certificates" which can be used to generate funding for project activities and payments for ecosystem services, for example through the voluntary carbon market or other ecosystem service markets. The Plan Vivo Standard can also be used in other funding schemes e.g. through bilateral cooperation projects (The Plan Vivo Foundation, 2012a).

Project interventions may include any improved land- management activities that can generate quantifiable climate services, and benefit the livelihoods of participants and local level ecosystems. Eligible activities for generating Plan Vivo certificates are afforestation and agroforestry, forest conservation, restoration and avoided deforestation. Activities are undertaken by smallholders and community groups on their own land and designed with full participation of local communities. The projects follow the "whole landscape" approach. The standard includes requirements regarding *i.a.* eligibility of projects, coordination and management, participatory design, quantification and monitoring of climate services, risk management (Ibid, 2012). Projects can be small or large in scale, and can scale-up over time. Procedures are designed to facilitate a "program of activities" model of expansion (The Plan Vivo Foundation, 2012a)

The following principles guide the Plan Vivo Standard (Ibid, 2012a):

i) Project interventions directly benefit smallholders and community groups
ii) Projects generate climate services through interventions that also benefit local livelihoods and ecosystems
iii) Good project governance, stakeholder engagement and compliance with the law
iv) Smallholders and community groups participate meaningfully in project design and develop *plan vivos* (management plans) that support their livelihoods needs
v) Credible, conservative quantification and monitoring of climate services
vi) Effective risk management throughout project design and implementation
vii) Performance-based incentives and equitable benefit sharing through a transparent PES mechanism
viii) Integrated design of project activities to ensure livelihood and ecosystem benefits

Plan Vivo includes corresponding detailed requirements to each of these principles (The Plan Vivo Foundation, 2012a, 2012b). Plan Vivo counts with a checklist for eligibility that facilitates clarifying if your FMU activity fits into the standard (see annex 2 for the tools from plan vivo).

---

[40] For more information on the Plan Vivo Standard see: http://www.planvivo.org/governance-of-the-standard/

[41] In 2012 the Plan Vivo Standard undertook a review process. Currently the final version of the new Plan Vivo Standard has been submitted to the Board of Trustees for consideration and approval. For updating see: http://www.planvivo.org/governance-of-the-standard/

Plan Vivo projects need to be designed with a so-called "approved approach". An approved approach is a protocol, methodology or tool that has been approved by the Plan Vivo Foundation to assess or quantify elements of Plan Vivo projects (The Plan Vivo Foundation, 2012b). These tools/methods are aimed to measuring carbon pools and emission sources, quantifying climate services, assessing and monitoring leakage and assessing risks/identifying appropriate buffer levels. Table 16 presents the approved approach by Plan Vivo as per end of July 2013. Other tools from Plan Vivo are included in annex 2

Baseline/carbon modelling methodologies			
Title	**Location**	**Developer**	**Date of approval**
Assessment of Net Carbon Benefit for Emiti Nibwo Bulora project	Tanzania	Vi Agroforestry	Approved May 2010
Assessment of Net Carbon Benefit of CHDI Malawi Land USe Activities	Malawi	Clinton Hunter Development Initiative	Approved Dec 2011
Afforestation/reforestation			
Title	**Location**	**Developer**	**Date of approval**
Reforesting traditional home gardens using the analog forestry concept in tropical wet zones	Sri Lanka	Conservation Carbon Company and Rainforest Rescue International	Under review Submit comment
Woodlots (mixed native)	Tanzania	Vi Agroforestry	Approved May 2010
Woodlots (mixed Miombo species)	Mozambique	Envirotrade	Approved
Woodlots (mixed native/naturalised species)	Malawi	Clinton Hunter Development Initiative	Approved Dec 2011
Homestead planting (mixed fruit and non-fruit)	Mozambique	Envirotrade	Approved
Sole species woodlots (Maesopsis emini)	Uganda	ECOTRUST	Approved 2007
Mixed native species woodlots	Uganda	ECOTRUST	Approved 2007
Mixed native species plantation	Nicaragua	Taking Root	Approved March 2011
Agroforestry			
Title	Location	Developer	Status
Dispersed interplanting	Tanzania	Vi Agroforestry	Approved May 2010
Fruit orchard, mixed (mango, lemon, avocado, jackfruit)	Tanzania	Vi Agroforestry	Approved May 2010
Boundary planting	Tanzania	Vi Agroforestry	Approved May 2010
Dispersed systematic interplanting	Malawi	Clinton Hunter Development Initiative	Approved Dec 2011

Citrus orchard	Malawi		Approved Dec 2011
Boundary planting	Malawi		Approved Dec 2011
Mango orchard	Malawi		Approved Dec 2011
Fruit orchard, Mango (Mangifera Indica)	Mozambique	Envirotrade	Approved
Dispersed-interplanting, (*Faidherbia albida*)	Mozambique	Envirotrade	Approved
Boundary planting	Mozambique	Envirotrade	Approved
Fruit orchard, cashew (Anacardium occidentale)	Mozambique	Envirotrade	Approved
Sub-tropical improved fallow (pine oak)	Mexico	AMBIO	Approved 2007
Sub-tropical live fence	Mexico	AMBIO	Approved 2007
Tropical shade coffee	Mexico	AMBIO	Approved 2007
Tropical improved fallow	Mexico	AMBIO	Approved 2007
Tropical live fence	Mexico	AMBIO	Approved 2007
Tropical taungya system	Mexico	AMBIO	Approved
Forest restoration, conservation, avoided deforestation			
Title	**Location**	**Developer**	**Status**
Forest management and conservation (tropical lowland humid forest)	Mexico	AMBIO	Approved 2007
Sub-tropical forest restoration	Mexico	AMBIO	Approved 2007
Conservation of Miombo Woodland in Mozambique	Mozambique	Envirotrade	Review underway

Table 16: Plan Vivo approved approaches and methodologies (as per Plan Vivo website) [42]

5.6.3.4 The Gold Standard[43]

The Gold Standard is a only 'compliance grade' standard also operating in the voluntary market. Their credits can only be assessed by UN accredited auditors and unlike any other standard, The Gold Standard also conducts additional in-house reviews of audit reports. This double-checking process is aimed at ensuring that carbon reductions are real, measurable, additional and permanent and that sustainable development benefits are assured. Gold Standard credits are numbered and transparently listed in one central registry that allows direct access to all project and audit documentation.

The Gold Standard Foundation has recently expanded its scope to include the Land Use and Forests sectors. Regarding forestry the Gold Standard will initially focus on Afforestation/Reforestation (A/R) and Improved Forest Management (IFM). By end of July 2013, when this guidance is being written, the Gold Standard Land Use & Forestry Framework and the A/R Requirements are under final revision. The information provided here is based on the last public version available (The Gold

[42] The methodologies can be downloaded under http://www.planvivo.org/tools-and-resources/plan-vivo-technical-library/

[43] Information taken from The Gold Standard website and related documents (cited). See: http://www.cdmgoldstandard.org/our-activities/land-use-forests

Standard, 2013a, 2013b) The IFM requirements are in preparation, and final IFM requirements are expected by the end 2014.

The following principles are mandatory for The Gold Standard (The Gold Standard, 2013a):

1. The project shall do no harm, complying with the UNDP Millennium Development Goals (MDG) Carbon Safeguard Principles;
2. The project shall enhance sustainable development;
3. The project shall involve all relevant stakeholders;
4. Greenhouse gas emission reductions and carbon sequestration shall be real;
5. The project shall be compliant with all relevant laws and Gold Standards Principles;
6. The project shall be transparent; and
7. The project's compliance and progress shall be monitored, reported and independently verified throughout the entire crediting period

The Gold Standard foresees 8 stages process that includes a pre-feasibility assessment.

The Gold Standard and FSC are partnering, thus it will be possible for projects to obtain a dual certification. The A/R requirements include, beside information requirements, the following topics: sustainability, additionality, methodology for accounting carbon benefits, carbon performance, a description of the project cycle and provisions for non-compliance. Section 5 – methodology – includes allgorithms, default values and procedures for calculating GHG emissions from the forest carbon pools as well as other emissions (e.g. from combustion of fossil fuel for transportation). It indicates how to estimate the baseline, including how to calculate potential leakage.

The Gold Standards accept other approved methodologies and tools as those from the A/R CDM (see Section 5.6.1.2. and Annex 2 for these methodologies and tools)

5.6.3.5 REDD+ Social and Environmental Standards – REDD+SES[44]

These standards are related to the REDD+ safeguards, which are mandatory under the UNFCCC. Recognizing growing awareness at both international and national levels of the need for effective social and environmental safeguards, the REDD+ Social & Environmental Standards initiative aims to define and build support for a higher level of social and environmental performance from REDD+ programs.

These standards are designed for government-led programs of policies and measures implemented at national or state, provincial, or other level and are relevant for all forms of fund-based or market-based financing.

A primary role for REDD+ SES is to provide a mechanism for country-led, multi-stakeholder assessment of REDD+ program design, implementation and outcomes to enable countries to show how internationally- and nationally-defined safeguards are being addressed and respected. A country can use REDD+ SES to support monitoring and reporting on safeguards throughout implementation of the REDD+ program and to develop a safeguards information system that can respond to UNFCCC guidelines and donor or other reporting needs (ProForest, 2010).

According to the new version of the Standards REDD+ SES can be used by governments, NGOs, financing agencies and other stakeholders to support the design and implementation of REDD+ programs that respect the rights of indigenous peoples and local communities and generate significant social and environmental benefits (REDD+ SES Initiative, 2012a). By April 2013 the State of Acre in Brazil, the Province of Central Kalimantan in Indonesia, Ecuador and Nepal were using the REDD+SES in their three core elements: governance, interpretation and assessment. Other

[44] At the moment of preparing this guidance (July 2013) the REDD+SES Standards were under revision. The information presented here is taken from the REDD+ SES website and related documents (cited). See: http://www.redd-standards.org/

countries/provinces that were starting the use of REDD+-SES were Guatemala, Mexico, San Martin Region in Peru, Amazonas State in Brazil, Liberia and Tanzania.

The standards are aimed at facilitating the implementation of REDD+ safeguards as agreed in international processes (ibid). REDD+ SES provides support for the development of a (required) safeguard information system. Although the Standards can be used at various levels its application requires a clear definition of the REDD+ program and are not foreseen for application of stand-alone projects.

The REDD+ SES Standards are based on the following principles (REDD+ SES Initiative, 2012a)[45]:

1. The REDD+ program recognizes and respect rights to lands, territories and resources;
2. The benefits of the REDD+ program are share equitably among all relevant rights-holders and stakeholders;
3. The REDD+ program improves long-term livelihood security and well-being of indigenous peoples and local communities with special attention to women and the most marginalized and/or vulnerable people;
4. The REDD+ program contributes to good governance to broader sustainable development and to social justice;
5. The REDD+ program maintains and enhances biodiversity and ecosystem services
6. All relevant right-holders and stakeholders participate fully and effectively in the REDD+ program; and
7. The REDD+ program complies with applicable local and national laws and international treaties, conventions and other instruments.

A set of criteria and indicators is provided for the above mentioned principles (REDD+ SES Initiative, 2012a). The standards foresee a ten process around three core elements (see table 17).

Core element	Step
	1. Awareness raising / capacity building
Governance	2. Establish facilitation team
	3. Create the Standards Committee
Interpretation	4. Develop plan for the REDD+ SES process
	5. Develop draft country-specific indicators
	6. Organize consultations on indicators
Assessment	7. Prepare monitoring and assessment plans
	8. Collect and assess monitoring information
	9. Organize stakeholder review of draft assessment report
	10. Publish the assessment report

Table 17: REDD+ SES core elements and steps.
Source: (REDD+ SES Initiative, 2012b).

The REDD+ SES standards do not provide methodologies for carbon accounting and/or carbon monitoring.

5.6.3.6 Verified Carbon Standard – VCS[46]

The Verified Carbon Standard (VCS) is an Association that operates a GHG crediting program in the voluntary carbon market. A VCS Program is the mechanism to certify emission reductions and/or carbon sequestration. The VCS relies on four basic quality assurance elements including integration of best practices, robust GHG accounting methodologies, independent auditing of all projects and a transparent registry.

[45] Definitions of most terms are included in the REDD+ SES Standards (REDD+ SES Initiative, 2012a)
[46] See: http://www.v-c-s.org/methodologies/what-methodology The whole information regarding VCS methodologies was directly from VCS.

The VCS issues credits to project developers using their own methodologies (Shoch et al., 2013). By August 2013 VCS had over 70 registered projects in AFOLU and around 15 in REDD+.

By **end of September 2013** VCS counted with 13 approved methodologies for AFOLU, 10 of them the FMU level (see Table 18). Three (3) of these methodologies were under review when preparing this guidance. Further, four (4) new methodologies were under development (see table 18). For information about VCS tools and modules, see Annex 2. VCS developed the Jurisdictional and Nested REDD+ (JNR) framework for accounting and crediting REDD+ programs, whether implemented at the national or subnational scale. The resulting framework also establishes a clear pathway for existing and new subnational jurisdictional activities and projects to be integrated (or "nested") within broader (higher-level) jurisdictional REDD+ programs[47].

[47] For more information please see: http://www.v-c-s.org/JNRI

	APPROVED VCS METHODOLOGIES	
VM0003	Methodology for Improved Forest Management through Extension of Rotation Age, v1.1	This methodology quantifies the GHG emission reductions and removals generated from improving forest management practices to increase the carbon stock on land by extending the rotation age of a forest or patch of forest before harvesting. By extending the age at which trees are cut, projects increase the average carbon stock on the land and remove more emissions from the atmosphere. This methodology is applicable to managed forests where clear cutting or patch cutting practices are implemented in the baseline. http://www.v-c-s.org/methodologies/VM0003
VM0004*	Methodology for Conservation Projects that Avoid Planned Land Use Conversion in Peat Swamp Forests, v1.0	This methodology quantifies the GHG emission reductions and removals generated by preventing land-use change of tropical peat forests. The methodology accounts for a reduction in GHG emissions by avoiding deforestation and peat drainage as well as an increase in carbon stock. This methodology is applicable to undrained tropical peat forest in Southeast Asia. In the absence of a project, the land would have been completely deforested by a corporate or government entity. http://www.v-c-s.org/methodologies/VM0004
VM0005	Methodology for Conversion of Low-productive Forest to High-productive Forest, v1.1	This methodology quantifies the GHG emission reductions and removals generated by avoiding re-logging and/or the rehabilitation of previously logged forest. Rehabilitation is achieved by implementing silvicultural techniques to increase forest density, such as cutting climbers and vines, liberation thinning, or enrichment planting. This methodology is applicable to logged or degraded natural evergreen tropical rainforest. This methodology was updated to version 1.1 on 24 August 2011. http://www.v-c-s.org/methodologies/VM0005
VM0006*	Methodology for Carbon Accounting in Project Activities that Reduce Emissions from Mosaic Deforestation and Degradation, v1.0	This methodology quantifies the GHG emission reductions and removals generated by avoiding unplanned deforestation and forest degradation in a mosaic configuration. Deforestation and degradation can be reduced by strengthening land-tenure status, developing sustainable forest and land use management plans, protecting forest through patrolling of forests and forest boundaries, capacity building, preventing fire and introducing fuel-efficient wood-stoves and mosquito nets for livestock. This methodology is applicable to forest that would be deforested in the absence of the project activity. Deforestation and degradation in the baseline would be caused by 1) conversion of forest to crop-land or grazing land for small-scale farming, 2) conversion of forest land to settlements, 3) logging of timber for commercial sale, 4) logging of timber for local and domestic use, 5) fuel-wood collection of charcoal production or 6) forest fires. http://www.v-c-s.org/methodologies/VM0006

VM0007	REDD Methodology Modules (REDD-MF), v1.4	This methodology provides a set of modules for various components of a methodology for reducing emissions from deforestation and forest degradation (REDD). The modules, when used together, quantify GHG emission reductions and removals from avoiding unplanned and planned deforestation and forest degradation. This methodology is applicable to forest lands that would be deforested or degraded in the absence of the project activity. The methodology includes a module for activities to reduce emissions from forest degradation caused by extraction of wood for fuel. No modules are included for activities to reduce emissions from forest degradation caused by illegal harvesting of trees for timber; such a module may be included in the future.
		http://www.v-c-s.org/methodologies/VM0007
VM0009	Methodology for Avoided Deforestation, v2.1	This methodology pioneered by Wildlife Works presents a robust, all-encompassing methodology for broad applicability to REDD projects throughout the world's tropics and beyond. Version 2.1 can model five different baseline scenarios including planned deforestation and unplanned deforestation in the mosaic and frontier configurations. These models utilize primary and secondary deforestation agents in order to fully describe the intricate nature of deforestation trends within these scenarios
		http://www.v-c-s.org/methodologies/VM0009
VM0010	Methodology for Improved Forest Management: Conversion from Logged to Protected Forest, v1.2	This methodology quantifies the GHG removals generated from preventing logging of an unlogged tropical forest. The baseline scenario the forest management regime includes selected timber harvest practices. The quantification of GHG emission removals is determined based on a change in land use practice and an increase in carbon sequestration. This methodology is applicable to unlogged tropical forests.
		http://www.v-c-s.org/methodologies/VM0010
VM0011	Methodology for Calculating GHG Benefits from Preventing Planned Degradation, v1.0	This methodology quantifies the GHG emission reductions generated from improving forest management and preventing the planned degradation of a forest by stopping selective logging. This methodology accounts for a reduction in GHG emissions by stopping logging as well as an increase in carbon stock growth. This methodology is applicable to previously logged or intact tropical forests where selective logging would have occurred in the absence of carbon finance.
		http://www.v-c-s.org/methodologies/VM0011

VM0012*	Improved Forest Management in Temperate and Boreal Forests (LtPF), v1.1	This methodology quantifies the GHG emission reductions generated by improving forest management and preventing logging in temperate and boreal forests. Specifically, the methodology quantifies GHG emission reductions from Logged to Protected Forest (LtPF) activities, or activities that protect logged or degraded forests from further logging or that protect unlogged forests from future logging. The methodology was revised on 4 May 2012 to be applicable on publicly owned lands in addition to privately owned (fee simple) forest properties.
		http://www.v-c-s.org/methodologies/VM0012
VM0015	Methodology for Avoided Unplanned Deforestation, v1.1 REDD - AUD	This methodology estimates greenhouse gas emissions from areas where unplanned deforestation is taking place and quantifies the emission reductions achieved by curbing deforestation. The methodology provides a comprehensive set of tools for analyzing both frontier and mosaic deforestation patterns to establish the baseline deforestation rate, monitor emission reductions and assess leakage.
		http://www.v-c-s.org/methodologies/VM0015

Table XXX: Approved VCS Methodologies. Source http://v-c-s.org/
* Status of the methodology is "Revision pending". Updates about this status are provided in the websites given in the table

VCS METHODOLOGIES UNDER DEVELOPMENT	
Improved Forest Management on Lands Subject to Unextiguished Indigenous Rights and Title (LtPF)	The methodology quantifies the GHG emission reductions generated from improving forest management and preventing planned logging. This methodology accounts for a reduction in GHG emissions by stopping logging and includes methods to estimate carbon stock enhancement of forests. This methodology is applicable to forest lands managed for wood products on state lands subject to unextinguished indigenous rights and title where the state and the indigenous peoples have negotiated and reached land use planning agreements which lead to improved forest practices.
	http://www.v-c-s.org/methodologies/improved-forest-management-lands-subject-unextiguished-indigenous-rights-and-title

Baseline and Monitoring Methodology for the Rewetting of Drained Peatlands used for Peat Extraction, Forestry or Agriculture	This methodology outlines procedures for estimating the reduction of net greenhouse gas (GHG) emissions resulting from project activities that rewet drained peatlands in temperate climatic regions. It allows for the estimation of GHG emissions from drained and rewetted peatlands and also accounts for changes in carbon stocks in selected non-peat carbon pools. The scope of this methodology is essentially limited to project activities designed to rewet peatlands that have been drained for forestry, peat extraction or agriculture, but where these activities are not or are no longer profitable. Post-rewetting activities are limited to forestry, agriculture, nature conservation/recreation or activities that aim to reduce GHG emissions, or any combination of all these. This methodology uses ground vegetation composition and water level as proxies for peatland GHG emissions, known as the Greenhouse Gas Emission Site Type, or GEST, approach.	http://www.v-c-s.org/rewetting_drained_peatlands_GEST
Avoiding Planned Deforestation of Undrained Peat Swamp Forests	This methodology quantifies the GHG emission reductions and removals generated by activities that avoid planned deforestation and forest degradation of peat swamp forest. The methodology also quantifies the GHG emission reductions and removals from activities that avoid peat conversion and considers the GHG benefit from assisted natural regeneration. This methodology is applicable to tropical forests on peat swamp that are designated for production purposes.	http://www.v-c-s.org/methodologies/avoiding-planned-deforestation-undrained-peat-swamp-forests
Methodology for Carbon Accounting of Grouped Mosaic and Landscape-scale REDD Projects	This methodology quantifies GHG emission reductions and removals from activities that reduce unplanned anthropogenic deforestation and forest degradation of the mosaic type. Baseline emissions in the project area are calculated based on historical deforestation or forest degradation rates in a reference region that is similar to the project area. This methodology can be combined with Improved Forest Management (IFM), Agricultural Land Management (ALM) and Afforestation, Reforestation and Revegetation (ARR) methodologies to achieve a landscape-scale REDD project that holistically addresses land and resource needs of communities. For example, while the reduced pressure on native forest areas through the increased supply of fuelwood is covered in the current methodology the increase in woody biomass through the creation of woodlots and agroforestry activities can be part of an ARR methodology. This methodology is applicable to grouped projects, in which discrete project parcels are added after the start of the project and without a full validation, provided the additionality of the project is not impacted. The mechanism to group projects allows discrete project area parcels that are not yet under control at the time of validation, but become under control during the crediting period, to be included.	http://www.v-c-s.org/methodologies/methodology-carbon-accounting-grouped-mosaic-and-landscape-scale-redd-projects

Rewetting of Drained Tropical Peatlands in Southeast Asia	This methodology applies to project types that reduce greenhouse gas (GHG) emissions from peat oxidation by rewetting previously drained tropical peatlands using technical means (eg, the establishment of dams in drainage canals). This kind of project will have the following effects on greenhouse gas emissions: • A reduction in carbon dioxide (CO_2) emissions due to decreased oxidation of soil organic material; • A reduction in nitrous oxide (N_2O) emissions in nutrient-rich peatlands (not accounted for by this methodology); and • A possible increase in methane (CH_4) emissions (unlikely in the tropics) if the water level after rewetting is maintained near the surface • A possible net positive carbon accumulation in peat (not accounted for by this methodology).
	http://www.v-c-s.org/rewetting_drained_tropical_peatlands_southeast_Asia

Table 18: VCS Methodologies under development. Source http://v-c-s.org/

5.6.4 Options for adjusting the project/activity design

Including your FMU activities into a mitigation framework can imply a series of changes in your management plan. It is important to keep a good balance between different management priorities and according to the specific circumstances of your FMU/country. Table 19 presents possible adjustments that you will need to consider.

Possible adjustments strategies	**Additional considerations**
Consider adjusting the management plan at the level of management activities and for increasing your carbon benefits	▪ Estimate costs and benefits of the new selected activities and compare. Are the new activities still competitive? ▪ Do you have enough human and technological skills for the new activities or do you need to increase capacities?
Consider adjusting your management priorities fir increasing your carbon benefits	▪ Estimate costs and benefits of the new selected activities and compare. Are the new activities still competitive? ▪ Do you have enough human and technological skills for another management priority or do you need to increase capacities? ▪ Are the new management priorities inline with the forest policy and legislation? ▪ Do other social actors (forest users, traders of forest products) agree with the new management priorities
Consider using another mitigation framework	▪ Check the eligibility criteria and other requirements *Note:* This option might be not possible if your FMU is part of an initiative in a given mitigation framework that is agreed at a higher administrative level than the FMU (e.g. REDD+)
Consider not to apply for any of the mitigation frameworks presented in the previous section	If the existing mitigation frameworks are not satisfactory for the plans for your FMU or if the carbon benefits are not significant you might decide not include your project in any of these frameworks. However it is considered a good practice to monitor changes in carbon stocks over time (see section5.7 for monitoring carbon benefits in ITTO projects) *Note:* This option might be not possible if your FMU is part of an initiative in a given mitigation framework that is agreed at a higher administrative level than the FMU (e.g. REDD+)

Table 19: Possible adjustment strategies

5.7 GUIDANCE FOR MONITORING CARBON BENEFITS IN ITTO PROJECTS

Why it is important to monitor carbon benefits?

Monitoring carbon benefits is aimed at quantifying the real and measurable changes in carbon stocks and GHG emissions from other sources over time. Changes in carbon stocks are those changes in the five carbon pools; GHG emissions can include, for example, emissions from transportation related to your FMU. Monitoring allows you to quantify your carbon benefits over time.

Monitoring carbon benefits is necessary for:

- Generating a ex-post quantification of carbon benefits;
- Making management adjustments over time in order to maximize potential carbon benefits; and
- Report carbon benefits to investors, project stakeholders or funding organizations

All mitigation frameworks discussed above have their specific requirements for monitoring carbon benefits. However, it is possible that you still need to report carbon benefits of your management, even if you are not participating in any mitigation framework.

As addressing climate change is increasingly important in the context of sustainable development some multilateral agencies are promoting monitoring carbon benefits as a regular activity in bilateral and multilateral funded projects.

There are several documents that provide guidance for monitoring carbon benefits from forestry activities (Baker et al., 2010; Diaz and Delaney, 2011; FAO, 2013; GOFC-GOLD, 2011; Harris et al., 2012; Herold and Skutsch, 2011; Hodgman et al., 2012; MacDicken, 1997; Martin Herold and Tracy Johns, 2007; Muraya and Baraka, 2010; Pearson et al., 2012, 2007; T. Pearson et al., 2005b; T. R. H. Pearson et al., 2005; Petrokofsky et al., 2012; Ravindranath and Ostwald, 2007; Rombold, 2003; UN-REDD Programme, 2013a; Walker et al., 2012; Watson, 2009; Zhang et al., 2012).

The purpose of this section is, based on the existing material, to clarify the steps that ITTO project managers need to take for monitoring their carbon benefits when no mitigation framework has been used. If the ITTO project participates in any of the mitigation frameworks, carbon benefits can be reported on the bases of the monitoring requirements already used in these frameworks.

Sections 5.7.1. to 5.7.5 explain "how" to do this monitoring and "who" is responsible for it. If the results of the regular monitoring protocols indicate a carbon benefit significantly below what was expected in the ex-ante screening (e.g. as those estimated with sCreen) you can:

a) Check if the default values used in the estimation correspond to the measured values during the monitoring. Report significant difference to the source of the default values and correct your estimations;
b) Check for management corrections for improving activity performance; and
c) Check if area per activity in the implementation corresponds to area planed. If there are significant differences clarify why and pursue an improvement in performance

5.7.1 Rationale

Many ITTO projects include monitoring activities related to the specific management priorities at a given FMU level. If that is the case in your FMU monitoring carbon benefits should be planned as complementary to other monitoring activities in your FMU and not as purely additional and separated activities.

The IPCC Good Practice Guidelines for Land Use, Land Use Change and Forestry monitoring carbon benefits as a function of land or activity area and emission factors per activity. Clarification of the land/activity area responds to the question "where do GHG emissions or sinks happen?" and clarification of emission factors responds to the question "what GHG emissions or sinks happen in a given area/activity?" (IPCC, 2003 chapters 2 and 3; UN-REDD Programme, 2013a) (see Figure 12).

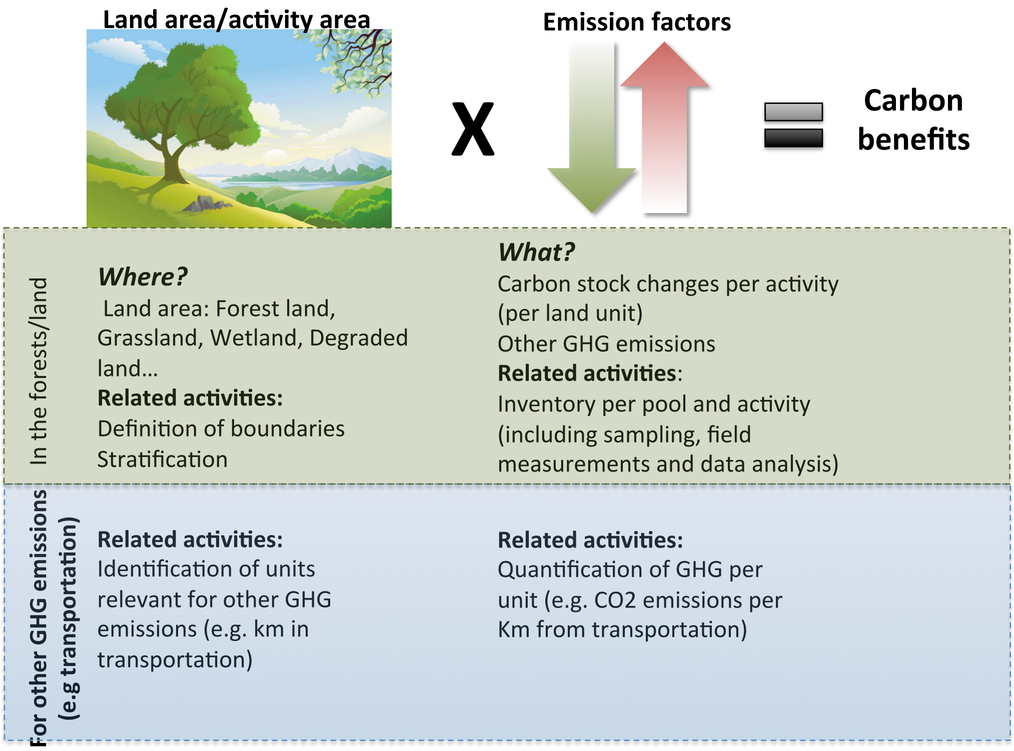


Figure 12: Monitoring's rational. Source: Based on (UN-REDD Programme, 2013a), adjusted by the author. Landscape graphic from www.resourcegraphics.com

The IPCC defines three approaches for establishing the land area/activity area as follows (IPCC, 2003):

- **Approach 1 – *Basic land use data***: Represent the total land use area within an administrative border. In case of an ITTO project it refers to the land/activity area as per regular statistics in the project region. The geographical specification is not known (see Table 20). Whenever required, sub-division of data for approach can be undertaken for increasing accuracy.

- **Approach 2 - *Survey of land use and land use change***: This approach includes information on land use changes and it can account for all land-use transitions, but without geographic specification. It "*includes more information on changes between categories. The final result of this approach can be presented as a non-spatially explicit land use matrix* (Ibid p. 2.9 -2.12) (see Table 21)

- **Approach 3 - *Geographically explicit land use data***: "*requires spatially explicit observations of land and land-use change. The data may be obtained either by sampling or geographically located points, a complete tally (wall-to-wall mapping), or a combination of the two (*ibid p. 2.12*)*" When using approach 3 you obtain detailed maps indicating land/activity types into special units as grid cells or small polygons and on time series. The final result is a spatially explicit land-use change matrix

Time 1			Time 2			Land-Use Change between Time 1 and Time 2		
F	=	18	F	=	19	Forest	=	+1
G	=	84	G	=	82	Grassland	=	-2
C	=	31	C	=	29	Cropland	=	-2
W	=	0	W	=	0	Wetlands	=	0
S	=	5	S	=	8	Settlements	=	+3
O	=	2	O	=	2	Other land	=	0

Sum = 140	Sum = 140	Sum = 0
Note: F = Forest land, G = Grassland, C = Cropland, W = Wetlands, S = Settlements, O = Other land. Numbers represent area units (Mha in this example).		

Table 20: Example of Approach 1: available land-use data with complete territorial coverage.
Source: Table 2.3.1 (IPCC, 2003)

Final \ Initial	Forest land (Unmanaged)	Forest land (Managed)	Grassland (Rough grazing)	Grassland (Improved)	Cropland	Wet lands	Settlements	Other land	Final area
Forest land (Unmanaged)	5								5
Forest land (Managed)		10	1	2	1				14
Grassland (Rough grazing)		2	56						58
Grassland (Improved)			2	22					24
Cropland					29				29
Wetlands						0			0
Settlements		1	1		1		5		8
Other land								2	2
Initial area	5	1	60	24	31	0	5	2	140
NET change	0	+1	-2	0	-2	0	+3	0	0

Note: Column and row totals show net changes in land use as presented in Table 2.3.2 but subdivided into national subcategories as in Table 2.3.3. "Initial" indicates the category at a time previous to the date for which the assessment is made and "Final" the category at the date of assessment. Net changes (bottom row) are the final area minus the initial area for each of the (sub) categories shown at the head of the corresponding column. Blank entry indicates no land-use change for this transition.

Table 21: Illustrative example of approach 2 data in a LUC matrix with category subdivisions.
Source: Table 2.3.4 (IPCC, 2003)

IPCC proposes three different tiers for getting the data related to the emission factors per activity (see Box 1 in Section 3.2.6). The higher the approach and tier, the more accurate will be your calculation.

The following sections propose guidance on how to establish the land/activity area and the emission factors in ITTO projects, when no other mitigation framework is used in the project. The guidance includes a procedure for assessing leakage, and when appropriate, undertaking the corresponding discounting from the carbon benefits.

This guidance takes into account that it will be difficult for some ITTO project activities to fulfill all data requirements both for Approach 3 and tier 3 as explained above.

5.7.2 Establishing land/activity area

Thus for the purpose of monitoring carbon benefits in ITTO projects we recommend to creating maps either using Approach 2 or 3 for determining land/activity area. To create these maps you need to undertake two steps (using one of the approaches mentioned before).

- Establish the FMU boundaries
- Stratify the FMU area

5.7.2.1 FMU boundaries

As indicated in Section 5.1

5.7.2.2 Stratification

As indicated in Section 5.5.2 and for the strata relevant for the activities in your FMU plan
As a result of the definition of boundaries and the stratification, you should have detailed geographic information about the size and location of the activity areas. This information can be represented in maps, geographic coordinates and/or any data in a geographic information system (Gregory P Asner, 2009).

5.7.2.3 Establishing units for other sources of GHG emissions

Besides the carbon pools in the forest, there are other sources of potential GHG emission in your projects, including:

- Transportation;
- Operation of equipment; and
- Buildings construction and operation.

If you think that any of these sources could become significant in your project, you should establish a measurement unit for the greenhouse gas emissions (e.g. number of kilometers for transportation).
If you feel that none of these sources will become significant in your project you need to document these as non-relevant sources in your reporting for ITTO.

5.7.3 Establishing emission/sink factors

5.7.3.1 Carbon pools

General guidance on deciding which carbon pools are relevant for your project was given in section 5.5.1. The table below (Table 22) shows the recommended pools to be monitored in ITTO projects per forestry activity.

Project type	**Carbon**					
	Living biomass			**Dead Organic**		**Soil Organic Carbon**
	Aboveground :	***Aboveground :***	***Below-groun***	***Litter***	***Dead wood***	
Afforestation/reforestation	Y	M	Y	M	M	M
Forest management	Y	M	Y	M	Y	M
Conservation	Y	M	Y	M	Y	M
Restoration	Y	M	Y	M	M	M
Re-vegetation	M	Y	M	M	M	M

Letters in the above table refer to the need for measuring and monitoring the carbon pools:

Y= Yes – the change in this pool is likely to be large and should be measured.

N = No – the change is likely to be small to none and thus it is not necessary to measure this pool.

M = Maybe – the change in this pool may need to be measured depending upon the forest type and/or management intensity of the project.

Table 22: Recommended carbon pools to be measured and monitored. Source: (Table 4.3.1 IPCC, 2003; T. R. H. Pearson et al., 2005, adjusted by the author)

5.7.3.2 Sampling design

Regarding sampling design you need to:

1. Determine the type of plots
2. Determine the form of plots
3. Determine the number of plots
4. Determine the location of plots

There are temporal and permanent plots. Both have advantages and disadvantages (see Box 23). Permanent plots can be used for monitoring tree carbon pools (living biomass). Temporal plot must be used for the other three pools (litter, dead wood and soil organic carbon) because measuring the sample destroys that specific sample (so called “destructive sampling”).

Type of plots:	**Advantages**	**Disadvantages**
Temporal	Can not be treated differently and cannot be destroyed by disturbances	Less precise in the estimation of changes in carbon stocks. This can be partially solved through a higher number of plots, but this increases costs
Permanent	Seen as statistically more efficient in estimating changes in carbon stocks, because there is a highly covariance between observations at successive sampling events	As the location is known (and marked) treatment can be different as for the rest of the land/activity area Can be destroyed by disturbances

Table 23: Advantages and disadvantages between temporal and permanent plots

According to Pearson et all. “*the size and shape of the sample plots is a trade-off between accuracy, precision, time and cost for measurement*”(T. Pearson et al., 2005a). One can use single or nested plots depending of the type of activity in the FMU (plantation, forest management, conservation or restoration). This decision has an impact on the required size of the sample i.e. if you use single plots these tend to be bigger than if you use nested plots.

Estimating the number of plots is a function of various factors including the confidence interval, the variance of each carbon pool and the number of strata. There are some available tools for estimating the number of plots (see Box 2).

In order to secure statistical rigor plot locations need to be located without introducing bias. All strata in the project need to be sampled. That can be done randomly or using a fixed grid that covers the whole area.

How to proceed?

1- Clarify if there are specific guidance for sampling design in your country or region
2- If there is not specific guidance in your country/region you can select any of the guidelines included in box 2, according to appropriateness to your specific circumstances (including *i.a.* available/achievable information, available budget and other monitoring priorities)
3- Document the following information:
    a. Assumptions
    b. Methods selected and criteria for decision
    c. Tools used

Detailed guidelines for sampling design are included in several publications including:

- Diaz, D., Delaney, M. (Eds.), 2011. Building Forest Carbon Projects: Carbon Stock Assessment Guidance Inventory and Monitoring Procedures. Available at http://www.forest-trends.org/publication_details.php?publicationID=2555
- Ravindranath, N.H., Ostwald, M., 2007. Carbon Inventory Methods: Handbook for Greenhouse Gas Inventory, Carbon Mitigation and Roundwood Production Projects. Springer.
- Pearson, T., Brown, S., Birsey, R., 2007. Measurement guidelines for the sequestration of forest carbon available at: http://www.nrs.fs.fed.us/pubs/3292
- A/R Methodological Tool - “Calculation of the number of sample plots for measurements within A/R CDM project activities” (Version 02). See annex 2 for more details and : http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-03-v2.1.0.pdf/history_view
- Pearson, T., Brown, S., Walker, S., 2005. Sourcebook for Land use, Land-use change and Forestry projects. Available at http://www.winrock.org/ecosystems/tools.asp
- Winrock Sampling Calculator. Available at: http://www.winrock.org/ecosystems/tools.asp
- Pearson, T.R.H., Brown, S., Ravindranath, N.H., 2005. Integrating Carbon Benefit Estimates

into GEF Projects. UNDP and GEF. Available at: http://www.winrock.org/ecosystems/tools.asp
- GOFC-GOLD, 2011. A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals caused by deforestation, gains and losses of carbon stocks in forests remaining forests, and forestation. Global Observation of Forest and Land Cover Dynamics.
- IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. IPCC/OECD/IEA/IGES, Hayama, Japan. Available at: http://www.gofcgold.wur.nl/

Box 2: Detailed guidelines for sampling design

5.7.3.3 Field measurements

Field measures depend upon a) the carbon pools you have selected (see 5.7.3.1) and b) if there is a default equation (or default value) that relates your measured pool with other pools. For example, there are default values for relating AGB and BGB. In this case the use of these default values can reduce the need for BGB sampling.

For aboveground biomass (AGB) measurements: In theory you would need to measure all AGB components, including tree branches and leaves, because all components have sequestered carbon and could emit it back to the atmosphere. However, this would result in a very expensive inventory. The solution here is to measure trees at dbh and use "biomass expansion factors" (BEF) (sources of BEFs are e.g. the GPG-LULUCF IPCC, 2003). If you are going to use BEFs you will need to make measurements only of trees (including palms and lianas) and non-tree vegetation.

You can make measurements of AGB either through a forest inventory and/or using emerging techniques like LiDAR remote sensing (Hudak et al., 2012; Kronseder et al., 2012; Sierra et al., 2007). If you have access to this or related techniques in your FMU, you should consider its use for quantifying AGB.

Belowground biomass includes roots and fine roots. Either you use default values for relating AGB and BGB or you use regression equations for estimating BGB or you might undertake with destructive sampling. The last option has impacts on your sampling design as you will need temporal plots for measuring BGB.

For the deadwood pool you will need to sample standing dead trees, (coarse) dead wood > 10 cm of diameter. In the case of litter you need to collect all material including dead leaves, twigs, dead grasses, small branches and wood < 10 cm of diameter.

According to Ravindranath and Ostwald (2007) there are several methods available and in use for estimating soil organic carbon (SOC), ranging from simple laboratory estimations to diffuse reflectance spectroscopy, being the wet digestion or titrimetric determination method the most used in the field.

Field measurements need to be planned in advance in a very detailed manner, including Standard Operation Proceedings for your specific area. That allows to reduce costs and to increase accuracy and transparency of the measurements

How to proceed?

1. Clarify the pools that you need to measure (see Section 5.7.3.6)
2. Identify the data requirements from the selected equations for specific pools (are these equations based on default values
3. Select specific field measure techniques using box 3 below
4. Prepare the Standards Operation Procedures for your FMU
5. Check availability of equipment and qualified team

Detailed guidelines or specific experience for field measurement can be found in the following publications/websites:

- Walker, S.M., Pearson, T., Casarim, F.M., Harris, N., Petrova, S., Grais, A., Swails, E., Netzer, M., Goslee, K., Brown, S., 2012. Standard Operating Procedures for Terrestrial

Carbon Measurement: Version 2012. Available at: http://www.winrock.org/ecosystems/tools.asp

- Hudak, A.T., Strand, E.K., Vierling, L.A., Byrne, J.C., Eitel, J.U.H., Martinuzzi, S., Falkowski, M.J., 2012. Quantifying aboveground forest carbon pools and fluxes from repeat LiDAR surveys. Remote Sensing of Environment 123, 25–40.
- Kronseder, K., Ballhorn, U., Böhm, V., Siegert, F., 2012. Above ground biomass estimation across forest types at different degradation levels in Central Kalimantan using LiDAR data. International Journal of Applied Earth Observation and Geoinformation 18, 37–48.
- Diaz, D., Delaney, M. (Eds.), 2011. Building Forest Carbon Projects: Carbon Stock Assessment Guidance Inventory and Monitoring Procedures. Available at http://www.forest-trends.org/publication_details.php?publicationID=2555
- Ravindranath, N.H., Ostwald, M., 2007. Carbon Inventory Methods: Handbook for Greenhouse Gas Inventory, Carbon Mitigation and Roundwood Production Projects. Springer.
- Pearson, T., Brown, S., Birsey, R., 2007. Measurement guidelines for the sequestration of forest carbon available at: http://www.nrs.fs.fed.us/pubs/3292
- Pearson, T., Brown, S., Walker, S., 2005. Sourcebook for Land use, Land-use change and Forestry projects. Available at http://www.winrock.org/ecosystems/tools.asp
- Pearson, T.R.H., Brown, S., Ravindranath, N.H., 2005. Integrating Carbon Benefit Estimates into GEF Projects. UNDP and GEF. Available at: http://www.winrock.org/ecosystems/tools.asp
- GOFC-GOLD, 2011. A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals caused by deforestation, gains and losses of carbon stocks in forests remaining forests, and forestation. Global Observation of Forest and Land Cover Dynamics. http://www.gofcgold.wur.nl/
- IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. IPCC/OECD/IEA/IGES, Hayama, Japan. Available at:

Box 3: Available guidance for field measurements

5.7.3.4 *Frequency of the measurements*

Person et all (2005) proposes a very straight forward approach for determining the frequency of the measurement events. This is related to the carbon accumulations in the pools and the type of forestry activity (T. Pearson et al., 2005a). This means a frequency of 5 years for all carbon pools with the exception of SOC and measurements of SOC every 10 or even 20 years (Ibid, 2005a)

However, as the purpose of this section is to deliver guidance for reporting carbon benefits in the ITTO project cycle we propose to have two field measurement events:

- in the last year of implementation of the ITTO project
- during the year of the ex-post evaluation (same season as above)

The reason for this frequency is to facilitate reporting on carbon benefits to the ITTO (see 5.7.6)

5.7.3.5 *Emission factors from other sources*

For GHG emissions from other sources relevant in your FMU (see Section 5.7.2.3) you will need either to make measurements in your site or to use default values. As making measurements can become very expensive we recommend using default values as appropriated for your FMU site (see Box 4)[48].

If your project involves significant building construction that will be attributed to the FMU activities (e.g. if you build up a fabric) that can have an important impact on your carbon balance.

There are several data bases either at the national or international levels. You can look at the factors used in e.g.:

- The National GHG Inventories of your country http://unfccc.int/ghg_data/items/3962.php ,
- The UNFCCC data inventory (http://unfccc.int/ghg_data/items/3800.php) or
- International accepted data bases and data resources (e.g ecoinvent, Althaus H.-J., Lehmann M. (2010). Ökologische Baustoffliste (v2.2e), Empa Abteilung Technologie

48

und Gesellschaft, Dübendorf, 2010 available at http://www.empa.ch/baustoffliste/)

Box 4: Sources of default values for emission factors from other sources

5.7.3.6 Data analysis

In this step you use your measurement for calculating two things a) the changes in carbon stocks in the carbon pools selected in your project and b) the emissions from other sources.

$$\text{Total } MC_{tx} = \Sigma(MC_{ptx} * A_{sa...j}) + \Sigma(MC_{otx} * U_{oa...j})$$

Where;

Total MC_{tx} = Total monitored carbon in your FMU at time x for each strata (given in CO_{2e})

MC_{ptx} = Total monitored carbon stocks in the selected pools by time x (given in CO_{2e}) → see 5.7.3.1-4

$A_{s1...j}$ = Corresponding total land/activity area per strata a…j → see 5.7.2

MC_{etx} = Total monitored emissions from each other sources by time x (given in CO_{2e}) → see 5.7.3.5

$U_{oa...j}$) = Total units of other sources per each source (e.g. number of litter petrol) → see 5.7.2.3

How to calculate the total changes in carbon stocks in the selected pools?

There are established equations for calculating each carbon pool, especially for AGB (Brown et al., 1991, 1989; Chave et al., 2005; IPCC, 2003; Kronseder et al., 2012; Lü et al., 2010; Ngo et al., 2013; T. Pearson et al., 2005a; Petrokofsky et al., 2012; Ravindranath and Ostwald, 2007; Sierra et al., 2007; Vieilledent et al., 2012).

You should first select that equations set best appropriated for your specific situation. You should do that for each selected pool and following the IPCC tier approach as presented in Box 1. That means: look first for equations from your region/site (Anwar Siregar, 2011; Sierra et al., 2007). If there is no equation available for your region/site, use equations for your country. If country level data are not available use default equations as per IPCC, 2003 or Pearson et al., 2005. Box 5 provides a list of publications that include such equations. You also have the possibility to develop your own equations, however that is a time and resource intensive activity.

Please bear in mind, that you need to include emissions from non-CO2 gases in your calculations. This refers to emissions coming from the use of fertilizers, draining, fires or the use of some species (e.g. leguminous). The IPCC 2003 GPG-LULUCF provides methods for estimating these emissions.

List of references providing detailed steps for data analysis including equations

- Anwar Siregar, C., 2011. Develop forest carbon standard and carbon accounting system for small-scale plantation based on local experiences.
- Berry, N., 2008b. Carbon modelling for afforestation and reforestation projects.
- Brown, S., Gillespie, A.J.R., Lugo, A.E., 1989. Biomass Estimation Methods for Tropical Forests with Applications to Forest Inventory Data. Forest Science 35, 881–902.
- Brown, S., Gillespie, A.J.R., Lugo, A.E., 1991. Biomass of tropical forests of south and southeast Asia. Canadian Journal of Forest Research 21, 111–117.
- Chave, J., Andalo, C., Brown, S., Cairns, M.A., Chambers, J.Q., Eamus, D., Fölster, H., Fromard, F., Higuchi, N., Kira, T., Lescure, J.-P., Nelson, B.W., Ogawa, H., Puig, H., Riéra, B., Yamakura, T., 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. Oecologia 145, 87–99.
- GOFC-GOLD, 2011. A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals caused by deforestation, gains and losses of carbon stocks in forests remaining forests, and forestation. Global Observation of Forest and Land Cover Dynamics.
- IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. IPCC/OECD/IEA/IGES, Hayama, Japan.
- Lü, X.-T., Yin, J.-X., Jepsen, M.R., Tang, J.-W., 2010. Ecosystem carbon storage and partitioning in a tropical seasonal forest in Southwestern China. Forest Ecology and

Management 260, 1798–1803.
- Muraya, P., Baraka, P., 2010. Supporting Data Management System; How to set up a structured Data Management System (DMS).
- Ngo, K.M., Turner, B.L., Muller-Landau, H.C., Davies, S.J., Larjavaara, M., Nik Hassan, N.F. bin, Lum, S., 2013. Carbon stocks in primary and secondary tropical forests in Singapore. Forest Ecology and Management 296, 81–89.
- Pearson, T., Brown, S., Ravindranath, N.H., 2005a. Integrating carbon benefit estimates into GEF projects.
- Pearson, T., Brown, S., Walker, S., 2005b. Sourcebook for Land use, Land-use change and Forestry projects.
- Ravindranath, N.H., Ostwald, M., 2007. Carbon Inventory Methods: Handbook for Greenhouse Gas Inventory, Carbon Mitigation and Roundwood Production Projects. Springer.
- Sierra, C.A., del Valle, J.I., Orrego, S.A., Moreno, F.H., Harmon, M.E., Zapata, M., Colorado, G.J., Herrera, M.A., Lara, W., Restrepo, D.E., Berrouet, L.M., Loaiza, L.M., Benjumea, J.F., 2007. Total carbon stocks in a tropical forest landscape of the Porce region, Colombia. Forest Ecology and Management 243, 299–309.
- Vieilledent, G., Vaudry, R., Andriamanohisoa, S.F.D., Rakotonarivo, O.S., Randrianasolo, H.Z., Razafindrabe, H.N., Rakotoarivony, C.B., Ebeling, J., Rasamoelina, M., 2012. A universal approach to estimate biomass and carbon stock in tropical forests using generic allometric models. Ecol Appl 22, 572–583.

Box 5: Available guidance for data analysis

5.7.4 Uncertainty

According to the GPG-LULUCF, IPCC 2003 "*estimates of uncertainty need to be developed for all categories in an inventory and for the inventory as a whole*".(IPCC, 2003 p.5.7) Further, the GPG includes a section discussing the key types of and provides specific information on how to apply guidance for good practices in the treatment of uncertainties. Thus for the purpose of this guidance you should follow the indications as presented in Chapter 5 of the GPG-LULCF, IPCC 2003.

5.7.5 Assessment of leakage

For assessing the leakage we propose to use the same approach as in the methodology for sCreen, as follows[49]:

The term leakage was defined within the discussions on modalities and procedures for the Kyoto Protocol[50]. Within the context of REDD+ the text in the UNFCCC decisions include the terms "leakage" and "displacement of emissions" without giving a specific definition. For the purpose of the estimation of carbon benefits of ITTO projects, this guidance considers leakage as potential greenhouse gas emissions a project selected carbon pool that was displaced from the project area to an area outside the project. For instance, in a case where a project wants to reduce degradation due to illegal logging. If the social groups involved in illegal logging are not included in the management activity, they probably will move to other forests and continue their illegal activities. In that case the greenhouse gas emissions due to degradation will continue outside the (ITTO) project area.

A simplified assessment of the potential leakages can be done undertaking the following procedure:

1. Identify activities that cause GHG emissions in the baseline (e.g. deforestation)
2. Identify the social groups involved

[49] See Robledo, 2012. Methodology for fast track estimation of climate change mitigation contribution from forestry activities- sCreen. This methodology has been prepared in parallel to this guidance and as an output of the same REDDES project *RED-PA 069/11 Rev.1 (F)*

[50] In this context **Leakage** was been defined as the increase in greenhouse gas emissions by sources, which occurs outside the boundary of an afforestation or reforestation project activity under the CDM which is measurable and attributable to the afforestation or reforestation project activity.

3. Clarify if or to which extent these social groups were involved in the implementation of the management activity
4. If the majority or all social groups involved in activities emitting GHG in the baseline were also involved in the implementation of the management activity go for Option 1
5. If some social groups involved in activities emitting GHG in the baseline were also involved in the implementation of the project go for Option 2
6. If no social group was involved in activities emitting GHG in the baseline was involved in management activities go for Option 3

Option 1: No or non-significant leakage is expected. In this case there is no need for a reduction (0%)

Option 2: Reduce 30- 50% of the potential carbon benefit as estimated using the methodologies presented above and argue the size of the reduction according to the social groups involved

Option 3: Reduce of 100% of the potential carbon benefit as estimated using the methodologies presented above

5.7.6 Reporting carbon benefits to ITTO

ITTO projects should regularly report on their progress in addressing carbon benefits; there is a minimum requirement of two reporting moments: when finalizing the ITTO project, and during the ex-post evaluation. If the ITTO project has more than one phase then you should report at the end of the first phase and at the beginning and end of the successive phases. For those projects that continue implementation after finalizing ITTO financing (e.g. if you have established a plantation) you should report progress on carbon benefits every five years.

There are two possible procedures:

a) If your project is using any of the mitigation frameworks explained in Section 5.6, then report using the monitoring and reporting protocols of the given mitigation framework. If the monitoring and reporting dates do not coincide with the end of the ITTO project and the date of the ex-post evaluation use the closest monitoring and reporting events of the selected mitigation framework in your project and use this information for reporting to ITTO.

b) If you are following the procedures as indicated in Sections 5.7.1-5 follow the reporting procedure indicated below:

First you need to calculate the total carbon benefits of your project using;

$$CB_{tx} = MC_{tx} - EC_{tx} - L$$

CB_{tx} = Carbon benefits by year x
MC_{tx} = Monitored changes in carbon stocks and emissions from other sources by year x → as per section 5.7.3.6
EC_{tx}= carbon stock changes expected without intervention by year x → (estimated with a simplified tool e.g. with sCreen)
L= Leakage→ see 5.7.5

Once you have this calculation you can proceed to fulfill the ITTO format for reporting carbon benefits as included in annex 4.

5.7.7 Stakeholder participation in monitoring activities

This guidance recommends involving local stakeholders in the monitoring activities. Integrating local stakeholders can help to increase acceptance and transparency of the project and thus support permanence of carbon benefits.

Participation schemes and methods are known in ITTO country members and don't need to be repeated in this guidance. However it is worth highlighting that specific guidance on stakeholders involvement in monitoring projects are arising, especially for projects aimed at achieving climate change mitigation (Blomly and Richards, 2011; Larrazábal et al., 2012; Madlener et al., 2006; Verplanke and Zahabu, 2009).

In order to promote participation of local stakeholders this guidance recommends the following steps:

1. Identify specific monitoring activities that suit to a participatory approach
2. Identify local capacities for the above
3. Establish capacity building demands/needs for a participative monitoring
4. Conduct capacity building of local stakeholders in advance of any monitoring activity
5. Establish roles, responsibilities and benefits with the stakeholders that are going to participate in any monitoring activity
6. Document the above mentioned agreements

5.7.8 Inventory Quality Assurance / Quality control and Documentation

The IPCC GPG-LULUCF states "*it is a good practice to implement quality control checks and external expert review of inventory estimates and data. Specific attention should be paid attention to country-specific estimates of stock change factors and emission factors to ensure that they are based on high quality and verifiable expert opinion*" (IPCC, 2003 p. 3.149)

Further, this guidance recommends keeping close documentation of all decisions done when undertaking the different steps included in Sections 5.7.2 -7 and the criteria used in these decisions. Such documentation increases transparency and credibility in the monitoring and reporting process.

5.8 Opportunities and challenges when monitoring carbon benefits from Sustainable Forest Management

The potential carbon benefits from expanding sustainable forest management in the tropics seems to be very relevant. Studies give a range between 0.16 $GtCyr^{-1}$ (from improving timber practices, calculations with a very conservative approach, see Figure 13) and 0,26 $GtCyr^{-1}$ (all possible management activities) (Putz et al., 2008; Robledo and Blaser, 2008). Both studies used the same basic assumption of 350 mio hectare of tropical forest designated as production forest. This potential is equal to at least 10% of the potential emission reductions from deforestation in developing countries.

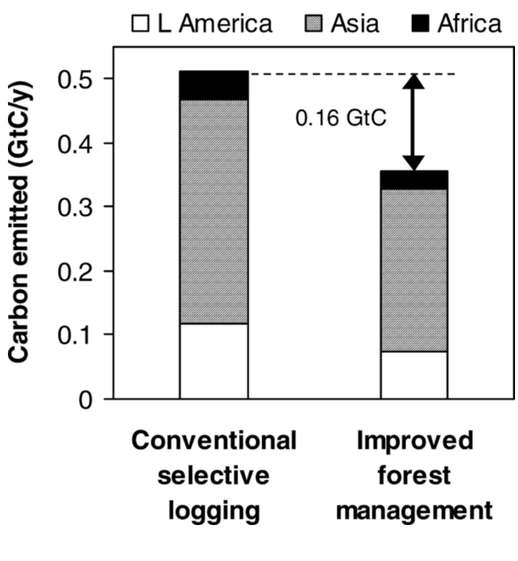


Figure 13: Annual reductions in global carbon emissions that would result from the adoption of improved tropical forest management practices

Source: (Putz et al., 2008, Figure 2)

According to Langner et all. (2012) "*in contrast to clear logging, reduced-impact logging (RIL) mitigates the physical impacts on the ground, to the remaining standing trees, and ecosystem as a whole by using a combination of pre-harvest census, controlled felling, lowered allowable cut, and regulated machinery use. In combination with longer cutting cycles as applied under next-generation sustainable forest management (SFM) RIL also helps to preserve carbon*" (Langner et al., 2012). If a payment or compensation mechanism is used carbon benefits can help to leverage economic feasibility of sustainable forest management, creating a "win-win" situation. This can become a relevant alternative towards sustainability in many non-protected forests in the tropics

What makes then SFM challenging in the context of climate change mitigation? One reason among many is that monitoring carbon benefits from SFM presents poses challenges both for defining the land/activity area and for estimating/monitoring the emissions and sinks factors (see Table 24).

Estimating AGB is one of the main challenges. Tropical forests are characterized by a high number of species per hectare. As AGB calculations are based on the definition of the growth curves of the main vegetation, an accurate estimation would require basic equations of many species. Although there are equations available for groups of species, the literature is inconsistent and scarce (IPCC, 2006, 2003; T. Pearson et al., 2005a)

Challenges for monitoring carbon benefits from SFM	Strategies currently used	Remaining challenges
Clarifying forest status (e.g. stage of degradation) → necessary for defining boundaries and strata	Remote sensing offers a good option for differentiating forest from non-forest, but is less useful for determining state of degradation (1, 2,7)	Estimate state of degradation → necessary for an accurate stratification (3)
Getting appropriate AGB equations/quantification for different sites ***Estimating stage of degradation***	Use of radar or optical remote sensing technology (1)	Radar remote sensing can acquire data irrespective of haze and the persistently cloudy weather conditions in the humid tropics (4), but the signal of all available radar sensors tends to saturate at a lower value than the actual AGB volumes of tropical rain forests (3) and there are increasingly errors in mountain areas (5)
	Use light detection and ranging (LiDAR) sensors for overcoming sensor saturation	Large scale applications are not feasible due to narrows swath and high costs (3)
Estimating AGB growth after harvesting (with different techniques)	There are ongoing research projects aimed at developing the necessary models and testing the above mentioned techniques combined with field inventories (8, 9, 10, 11)	
Quantification of carbon benefits in other pools additional to AGB	Field inventories and ongoing research (8, 9, 10, 11, 12, 13, 14, 15, 16)	Costs of field inventories for non-AGB pools (in remote areas)

Table 24: Summary of main challenges for monitoring carbon benefits in SFM
Sources: 1: (Saatchi et al., 2011); 2:(Ramankutty et al., 2007); 3:(Langner et al., 2012); 4: (Gregory P Asner, 2009), 5:(Gibbs et al., 2007), 6 (Hudak et al., 2012), 7:(DeFries et al., 2007), 8: (Hall et al.,), 9: (Le Toan et al., 2011), 10: (Mitchard et al., 2011), 11 (Baker et al., 2010), 12: (Ravindranath and Ostwald, 2007), 13: (Batjes, 2011), 14: (Coles et al., 2010), 15: (Eliasson et al., 2013), 16: (Price et al., 2012)

Although there is relevant progress in methods for quantifying carbon and monitoring carbon benefits there are still major challenges to solve. An option is combining existing technologies and procedures, e.g. LiDAR as an alternative for calibration of satellite data instead of field inventory is a promising option, especially for remote forest areas (Gregory P Asner, 2009). Nevertheless increasing costs of monitoring can become a great difficulty especially at the project level.

Besides research projects and national monitoring initiatives, reporting carbon benefits from the FMU level remains important a) for getting an approximation of real and measurable carbon benefits at the field, b) testing new technologies under the reality of forest managers and c) identifying research gaps. In order to fulfill these needs a stepwise approach for improving monitoring carbon benefits from SFM is then needed at the FMU level. Such an approach should encourage forest managers in their attempts for monitoring carbon benefits without creating financing burdens for SFM activities. Further, such an approach should facilitate permanent improvement in the monitoring procedures. This means that on one side forest managers should have flexible monitoring guidance that allow them to use the best techniques and equations as available for their specific sites. On the other side the forest managers should report on methods and measurement techniques used in their monitoring activities in an accurate and transparent manner. The monitoring guidance for ITTO projects presented in this chapter is based on these principles.

5.9 Legal and contractual considerations

If you promote carbon benefits in your FMU, it is important to clarify who owns these benefits. Clarification of carbon benefit's ownership is a requirement when you want to sale carbon certificates (as in the A/R CDM, in the other regulated markets and for most standards active in the voluntary market). The question of ownership of the carbon benefits is increasingly important in the REDD+ negotiations too (Carol J. Pierce, 2011; Corbera and Schroeder, 2011; Ezzine-de-Blas et al., 2011; Hawkins, 2011; Kanowski et al., 2011; Markus, 2011; McDermott, 2012).

Clarification of ownership of carbon benefits needs to be inline with the land tenure and use regulations in your country as well as considering customary rights and –whenever appropriate – existing land tenure and use claims (see Box 6).

For detailed procedures regarding clarification of legal and contractual issues in your FMU:

- Certified Emission Reductions Sale and Purchase Agreement (open source). Guidelines and contract template. Available at http://www.cerspa.com
- Hawkins, S., 2011. Legal Guidance. Legal and contractual aspects of forest carbon projects. Available at: http://www.forest-trends.org/publication_details.php?publicationID=2867

Box 6: Available guidelines for clarifying legal and contractual issues

6 GUIDANCE FOR CARBON ACCOUNTING IN MULTILATERAL ORGANIZATIONS

6.1 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE – IPCC -

In 2000 the IPCC launched the first special report on issues related to forestry and climate change mitigation, the Special Report on Land Use, Land Use Change and Forestry[51] (IPCC, 2000). This special report shown the importance of forestry in mitigating climate change, however questions related to methods for accounting for carbon benefits remained unanswered. Over the last decade the IPCC has produced two main documents regarding carbon accountability. The first document is the "*Good Practice Guidance for Land Use, Land-Use Change and Forestry*"[52] (IPCC, 2003). Chapter 4 of this guidance deals with quantification of carbon benefits in projects (i.e. FMU level). The second document is the "2006 IPCC Guidelines for National Greenhouse Gas Inventories" (Eggleston and Intergovernmental Panel on Climate Change. National Greenhouse Gas Inventories Programme, 2006). The volume forth of these guidelines deals with Agriculture, Forestry and Other Land Uses (AFOLU) (IPCC, 2006).

Although there are still knowledge gaps the IPCC guidance and special reports provide a robust basis for accounting mitigation benefits of forestry activities. The documents include guidelines at the project level (GPG-LULUCF) as well as for national inventories (2006 Guidance). This material is very often used as basis for specific methodologies in all previously mentioned frameworks.

6.2 GLOBAL ENVIRONMENTAL FACILITY[53]

The GEF finances a wide range of activities on sustainable landscape management (SLM) in developing countries from reforestation and agroforestry projects to projects that protect wetlands or foster sustainable farming methods. The carbon benefits of these and other non GEF SLM projects are likely to be considerable. However, it has been difficult to compare the carbon benefits of different land management interventions as a range of different methods are used to measure them. Equally, it has been difficult for SLM activities in developing countries to gain the financial rewards they deserve from emerging carbon markets.

Aware of this situation the GEF launched in 2009 the GEF-Carbon Benefit Project (CBP). The Carbon Benefits Project (CBP), implemented by the United Nations Environment Programme (UNEP) in cooperation with six organizations is a new solution to a persistent problem: how to measure terrestrial carbon, particularly on complex landscapes. It is thus an effort to address the need to quantify and predict the carbon contents and dynamics of landscapes in the context of global climate change. The product of the effort is a modular, web-based system that allows the user to collate, store, analyze, report and project carbon and total GHG benefits in a standard and comprehensive manner (see Annex 2). The test phase for the tools began in April 2013, and the tool launch is expected by end of 2013.

6.3 UNDP, UNEP AND UNEP- RISOE CENTRE

As part of their efforts for improving capacities in the Sub-Saharan Africa UNDP, UNEP and the UNEP Risoe Centre prepared a set of principles for accounting forest carbon (Watson, 2009). In the corresponding report three forms of carbon accounting are included; stock accounting, emissions accounting and emissions reductions accounting. It is aimed to providing understanding of the forest carbon accounting process. The report presents main principles, practices and challenges for carbon accounting in the forestry sector (see figure 14). The detailed structure of the report is included in Annex 10.4

---

[51] see http://www.ipcc.ch/ipccreports/sres/land_use/index.php?idp=0
[52] See http://www.ipcc-nggip.iges.or.jp/public/gp/english/
[53] Information from the GEF website and corresponding documents. See: http://www.unep.org/climatechange/carbon-benefits/ ;

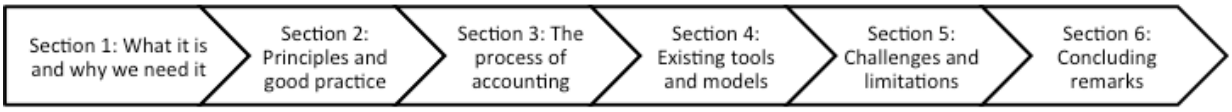


Figure 14: Structure of the Overview and principles for carbon accounting as presented by UNDP, UNEP and UNEP-Risoe Centre (Watson, 2009)

6.4 UN FOOD AND AGRICULTURE ORGANIZATION (FAO)

In 2010 FAO prepared forest and climate change guidelines for the national level. These guidelines were aimed at supporting *policy makers* in their attempts to integrate climate change mitigation and adaptation into the forest policies and programs at the national level (FAO, 2011).

In 2013, FAO launched a second and complementary set of guidelines aimed at supporting *forest managers* in their attempts to integrate climate change mitigation and adaptation into (sustainable) forest management (FAO, 2013). In the 2013 guidelines, climate change is seen as one of the many factors that forest managers need to consider when planning and implementing management activities. The 2013 guidelines for forest managers seek to be useful for all managers (individuals, groups, private companies or state) and for all management objectives (Ibid, 2013).

The 2013 guidelines for forest managers introduce the twofold relationship between climate change and forests, including impacts and vulnerabilities as well as the concepts of mitigation, carbon sinks and carbon sources. The understanding of potential climate impacts forest productivity; biodiversity; water availability and quality; fire; pests and diseases; extreme weather events; sea-level rise; and economic, social and institutional considerations sets the basis for looking at the potential of adaptive management in the context of sustainable forest management as a means for adaptation. The 2013 guidelines further look at the potential mitigation effects of the forest management activities considered and on cost and benefits analysis. The 2013 guidelines for forest managers presents an interactive approach between climate adaptation and mitigation and (sustainable) forest management (see Figure 15)

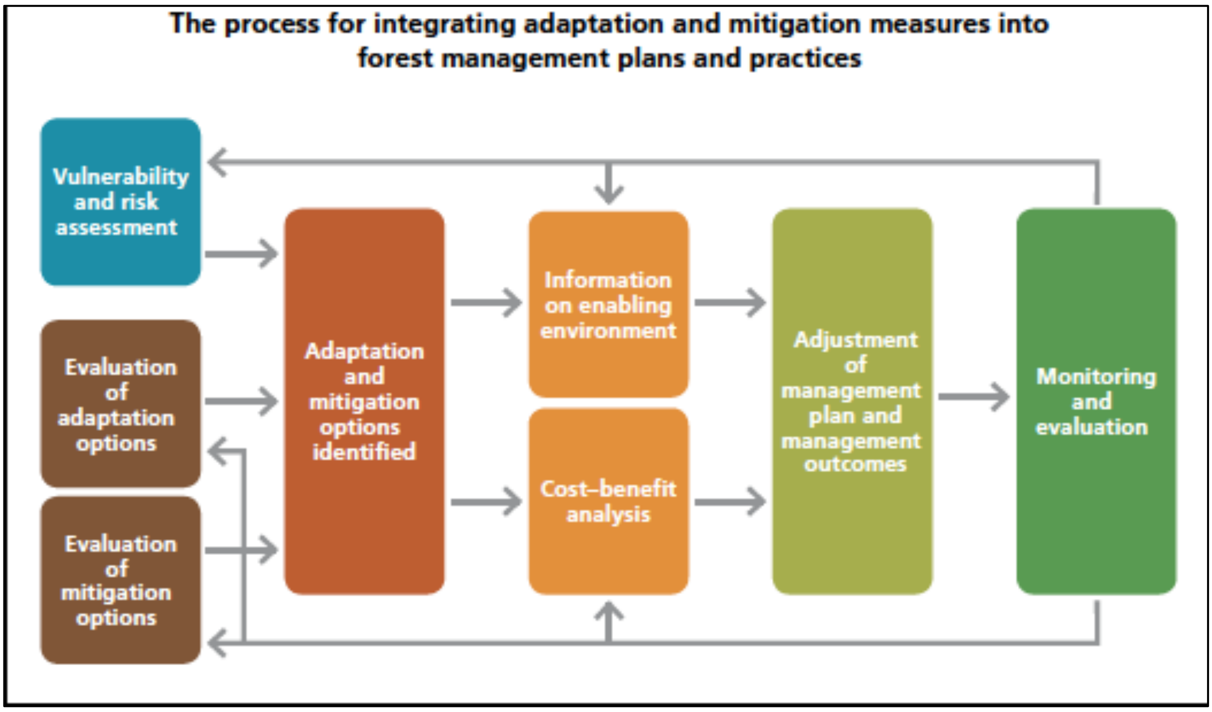


Figure 15: The process of integrating adaptation and mitigation measures into forest management plans. Source (FAO, 2013), page 20.

7 REFERENCES

Anwar Siregar, C., 2011. Develop forest carbon standard and carbon accounting system for small-scale plantation based on local experiences.

Baker, D.J., Richards, G., Grainger, A., Gonzalez, P., Brown, S., DeFries, R., Held, A., Kellndorfer, J., Ndunda, P., Ojima, D., Skrovseth, P.-E., Souza Jr., C., Stolle, F., 2010. Achieving forest carbon information with higher certainty: A five-part plan. Environmental Science & Policy 13, 249–260.

Batjes, N.H., 2011. Soil organic carbon stocks under native vegetation - Revised estimates for use with the simple assessment option of the Carbon Benefits Project system. Agriculture, Ecosystems & Environment 142, 365–373.

Berry, N., 2008a. Baseline survey for agroforestry projects - Protocol.

Berry, N., 2008b. Carbon modelling for afforestation and reforestation projects.

Blomly, T., Richards, M., 2011. Community Engagement Guidance. Good practice for forest carbon projects.

Brown, S., Gillespie, A.J.R., Lugo, A.E., 1989. Biomass Estimation Methods for Tropical Forests with Applications to Forest Inventory Data. Forest Science 35, 881–902.

Brown, S., Gillespie, A.J.R., Lugo, A.E., 1991. Biomass of tropical forests of south and southeast Asia. Canadian Journal of Forest Research 21, 111–117.

Carol J. Pierce, C., 2011. Marginalized Forest Peoples' Perceptions of the Legitimacy of Governance: An Exploration. World Development 39, 2147–2164.

CCBA, 2008. Climate, Community and Biodiversity Project Desing Standards - Second edition.

CCBA, 2010. CCB Standards. Rules for the use of the Climate, Community and Biodiversity Standards.

CCBA, 2011. Social and Biodiversity Impact Assessment Manual. Climate, Community & Biodiversity Alliance.

CCBA, 2013. Climate, Community and Biodiversity Standards. Draft Third Edition of the CCB Standards for Public comment.

CCX, 2009. Chicago Climate Exchange Offset Project Protocol - Forestry Carbon Sequestration Projects.

Chave, J., Andalo, C., Brown, S., Cairns, M.A., Chambers, J.Q., Eamus, D., Fölster, H., Fromard, F., Higuchi, N., Kira, T., Lescure, J.-P., Nelson, B.W., Ogawa, H., Puig, H., Riéra, B., Yamakura, T., 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. Oecologia 145, 87–99.

Cid-Liccardi, C.D., Kramer, T., Ashton, M.S., Griscom, B., 2012. Managing Carbon Sequestration in Tropical Forests, in: Ashton, M.S., Tyrrell, M.L., Spalding, D., Gentry, B. (Eds.), Managing Forest Carbon in a Changing Climate. Springer Netherlands, pp. 183–204.

Climate Action Reserve, 2012a. Forest Project Protocol. Version 3.3.

Climate Action Reserve, 2012b. Quantification guidance for use with forest carbon projects.

Coles, A.J.C., Lewis, K.A., Sims, R.E.H., 2010. Observing novel soil conditioners for carbon emissions mitigation. International Journal of Climate Change Strategies and Management 2, 48–67.

Corbera, E., Schroeder, H., 2011. Governing and implementing REDD+. Environmental Science & Policy 14, 89–99.

DeFries, R., Achard, F., Brown, S., Herold, M., Murdiyarso, D., Schlamadinger, B., de Souza Jr., C., 2007. Earth observations for estimating greenhouse gas emissions from deforestation in developing countries. Environmental Science & Policy 10, 385–394.

deFries, R.S., Houghton, R.A., Hansen, M.C., Field, C.B., Skole, D., Townshend, J., 2002. Carbon emissions from tropical deforestation and regrowth based on satellite observations for the 1980s and 1990s. Proceedings of the National Academy of Sciences 99, 14256–14261.

Diaz, D., Delaney, M. (Eds.), 2011. Building Forest Carbon Projects: Carbon Stock Assessment Guidance Inventory and Monitoring Procedures.

Eggleston, H.S., Intergovernmental Panel on Climate Change. National Greenhouse Gas Inventories Programme, 2006. 2006 IPCC guidelines for national greenhouse gas inventories. Institute for Global Environmental Strategies, Hayama, Japan.

Eliasson, P., Svensson, M., Olsson, M., Ågren, G.I., 2013. Forest carbon balances at the landscape scale investigated with the Q model and the CoupModel - Responses to intensified harvests. Forest Ecology and Management 290, 67–78.

Ezzine-de-Blas, D., Börner, J., Violato-Espada, A.-L., Nascimento, N., Piketty, M.-G., 2011. Forest loss and management in land reform settlements: Implications for REDD governance in the Brazilian Amazon. Environmental Science & Policy 14, 188–200.

FAO, 2011. Climate change for forest policy-makers. An approach for integrating climate change into national forest programmes in support of sustainable forest management.

FAO, 2013. Climate change guidelines for forest managers. Final draft. FAO forestry paper 172.

Forest Carbon Partnership Facility - FCPF, 2012. Common Approach to Environmental and Social Safeguards for Multiple Delivery Patrners.

Gibbs, H.K., Brown, S., Niles, J.O., Foley, J.A., 2007. Monitoring and estimating tropical forest carbon stocks: making REDD a reality. Environmental Research Letters 2, 045023.

GOFC-GOLD, 2011. A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals caused by deforestation, gains and losses of carbon stocks in forests remaining forests, and forestation. Global Observation of Forest and Land Cover Dynamics.

Gregory P Asner, 2009. Tropical forest carbon assessment: integrating satellite and airborne mapping approaches. Environmental Research Letters 4, 034009.

Hall, F.G., Bergen, K., Blair, J.B., Dubayah, R., Houghton, R., Hurtt, G., Kellndorfer, J., Lefsky, M., Ranson, J., Saatchi, S., Shugart, H.H., Wickland, D., 2011. Characterizing 3D vegetation structure from space: Mission requirements. Remote Sensing of Environment 115, 2753–2775.

Harris, N.L., Pearson, T., Brown, S., Andrasko, K., Kapp, G., 2012. Decision support tool for developing Reference Levels for REDD+.

Harvey, M., Pilgrim, S., 2011. The new competition for land: Food, energy, and climate change. Food Policy 36, Supplement 1, S40–S51.

Haskett, J., 2011. Interfacing the Carbon Benefits Project with Existing Carbon Standards. A Manual.

Hawkins, S., 2011. Legal Guidance. Legal and contractual aspects of forest carbon projects.

Herold, M., Skutsch, M., 2011. Monitoring, reporting and verification for national REDD+ programmes: two proposals. Environmental Research Letters 6, 014002.

Hodgman, T., Munger, J., Hall, J.S., Ashton, M.S., 2012. Managing Afforestation and Reforestation for Carbon Sequestration: Considerations for Land Managers and Policy Makers, in: Ashton, M.S., Tyrrell, M.L., Spalding, D., Gentry, B. (Eds.), Managing Forest Carbon in a Changing Climate. Springer Netherlands, pp. 227–255.

Houghton, R.A., 2003. Revised estimates of the annual net flux of carbon to the atmosphere from changes in land use and land management 1850 - 2000. Tellus 55B, 378–390.

Houghton, R.A., 2005. Tropical deforestation as a source of GHG emissions, in: Moutinho, P., Schwartzman, S. (Eds.), Tropical Deforestation and Climate Change. Amazon Institute of Environmental Research and Environmental Defense, Belém, Brazil, pp. 13–22.

Hudak, A.T., Strand, E.K., Vierling, L.A., Byrne, J.C., Eitel, J.U.H., Martinuzzi, S., Falkowski, M.J., 2012. Quantifying aboveground forest carbon pools and fluxes from repeat LiDAR surveys. Remote Sensing of Environment 123, 25–40.

IPCC, 2000. Special Report on Land use, Land Use Change and Forestry. Cambridge University Press.

IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. IPCC/OECD/IEA/IGES, Hayama, Japan.

IPCC, 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories - Vol. 4 Agriculture, Forestry and Other Land Use. Intergovernmental Panel on Climate Change.

IPCC, 2007. Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report. Intergovernmental Panel on Climate Change.

Jaung, W., Bae, J.S., 2012. Evaluating socio-economic equity of REDD+ in a rights-based approach: Rapid equity appraisal matrix. Environmental Science & Policy 22, 1–12.

Kanowski, P.J., McDermott, C.L., Cashore, B.W., 2011. Implementing REDD+: lessons from analysis of forest governance. Environmental Science & Policy 14, 111–117.

Kronseder, K., Ballhorn, U., Böhm, V., Siegert, F., 2012. Above ground biomass estimation across forest types at different degradation levels in Central Kalimantan using LiDAR data. International Journal of Applied Earth Observation and Geoinformation 18, 37–48.

Langner, A., Samejima, H., Ong, R.C., Titin, J., Kitayama, K., 2012. Integration of carbon conservation into sustainable forest management using high resolution satellite imagery: A case study in

Sabah, Malaysian Borneo. International Journal of Applied Earth Observation and Geoinformation 18, 305–312.

Larrazábal, A., McCall, M.K., Mwampamba, T.H., Skutsch, M., 2012. The role of community carbon monitoring for REDD+: a review of experiences. Current Opinion in Environmental Sustainability 4, 707–716.

Le Toan, T., Quegan, S., Davidson, M.W.J., Balzter, H., Paillou, P., Papathanassiou, K., Plummer, S., Rocca, F., Saatchi, S., Shugart, H., Ulander, L., 2011. The BIOMASS mission: Mapping global forest biomass to better understand the terrestrial carbon cycle. Remote Sensing of Environment 115, 2850–2860.

Lü, X.-T., Yin, J.-X., Jepsen, M.R., Tang, J.-W., 2010. Ecosystem carbon storage and partitioning in a tropical seasonal forest in Southwestern China. Forest Ecology and Management 260, 1798–1803.

MacDicken, K.G., 1997. A guide to monitoring carbon storage in forestry and agroforestry projects.

Madlener, R., Robledo, C., Muys, B., Freja, J.T.B., 2006. A Sustainability Framework for Enhancing the Long-Term Success of Lulucf Projects. Climatic Change 75, 241–271.

Markus, L., 2011. From CDM to REDD+ — What do we know for setting up effective and legitimate carbon governance? Ecological Economics 70, 1900–1907.

Martin Herold and Tracy Johns, 2007. Linking requirements with capabilities for deforestation monitoring in the context of the UNFCCC-REDD process. Environmental Research Letters 2, 045025.

McDermott, C.L., 2012. REDDuced: From sustainability to legality to units of carbon—The search for common interests in international forest governance. Environmental Science & Policy.

Mitchard, E.T.A., Saatchi, S.S., Lewis, S.L., Feldpausch, T.R., Woodhouse, I.H., Sonké, B., Rowland, C., Meir, P., 2011. Measuring biomass changes due to woody encroachment and deforestation/degradation in a forest–savanna boundary region of central Africa using multi-temporal L-band radar backscatter. Remote Sensing of Environment 115, 2861–2873.

Muraya, P., Baraka, P., 2010. Supporting Data Management System; How to set up a structured Data Management System (DMS).

Nakhooda, S., Caravani, A., Schalatek, L., 2011. Climate Finance Fundamentals. Brief 5.

Ngo, K.M., Turner, B.L., Muller-Landau, H.C., Davies, S.J., Larjavaara, M., Nik Hassan, N.F. bin, Lum, S., 2013. Carbon stocks in primary and secondary tropical forests in Singapore. Forest Ecology and Management 296, 81–89.

Olander, L.P., Gibbs, H.K., Steininger, M., Swenson, J.J., Murray, B.C., 2008. Reference scenarios for deforestation and forest degradation in support of REDD: a review of data and methods. Environmental Research Letters 11 pp.

Pearson, T., Brown, S., Birsey, R., 2007. Measurement guidelines for the sequestration of forest carbon.

Pearson, T., Brown, S., Ravindranath, N.H., 2005a. Integrating carbon benefit estimates into GEF projects.

Pearson, T., Brown, S., Walker, S., 2005b. Sourcebook for Land use, Land-use change and Forestry projects.

Pearson, T., Swails, E., Brown, S., 2012. Wood product accounting and climate change mitigation projects involving tropical timber.

Pearson, T.R.H., Brown, S., Ravindranath, N.H., 2005. Integrating Carbon Benefit Estimates into GEF Projects. UNDP and GEF.

Peskett, L., Todd, K., 2013. Putting REDD+ Safeguards and Safeguard Information Systems into practice. Policy Brief 3. UN-REDD Programme. Newsletter Nr. 35.

Petrokofsky, G., Kanamaru, H., Achard, F., Goetz, S., Joosten, H., Holmgren, P., Lehtonen, A., Menton, M., Pullin, A., Wattenbach, M., 2012. Comparison of methods for measuring and assessing carbon stocks and carbon stock changes in terrestrial carbon pools. How do the accuracy and precision of current methods compare? A systematic review protocol. Environmental Evidence 1, 6.

Pitman, N., 2011. Social and Biodiversity Impact Assessment Manual for REDD+ Projects: Part 3 – Biodiversity Impact Assessment Toolbox.

Price, S.P., Bradford, M.A., Ashton, M.S., 2012. Characterizing Organic Carbon Stocks and Flows in Forest Soils, in: Ashton, M.S., Tyrrell, M.L., Spalding, D., Gentry, B. (Eds.), Managing Forest Carbon in a Changing Climate. Springer Netherlands, pp. 7–30.

ProForest, 2010. REDD+ SE Standards - Briefing on complementarities with other REDD+ social and environmental safeguard mechanisms.

Putz, F.E., Zuidema, P.A., Pinard, M.A., Boot, R.G.A., Sayer, J.A., Sheil, D., Sist, P., Elias, Vanclay, J.K., 2008. Improved Tropical Forest Management for Carbon Retention. PLoS Biol 6, e166.

Ramankutty, N., Gibbs, H.K., Achard, F., Defries, R., Foley, J.A., Houghton, R.A., 2007. Challenges to estimating carbon emissions from tropical deforestation. Global Change Biology 13, 51–66.

Ravindranath, N.H., Ostwald, M., 2007. Carbon Inventory Methods: Handbook for Greenhouse Gas Inventory, Carbon Mitigation and Roundwood Production Projects. Springer.

REDD+ SES Initiative, 2012a. REDD+ Social & Environmental Standards.

REDD+ SES Initiative, 2012b. Guidelines for the use of REDD+ Social & Environmental Standards at country level.

Richards, M., 2011. Social and Biodiversity Impact Assessment (SBIA) Manual for REDD+ Projects: Part 2 – Social Impact Assessment Toolbox.

Robledo, C., Blaser, J., 2008. The Bali Road Map. Key issues under negotiation, in: UNDP (Ed.), Key Issues on Land Use, Land Use Change and Forestry (LULUCF) with an Emphasis on Developing Country Perspectives. United Nations Development Programme, Bureau for Development Policy, Environment and Energy Group, New York, NY.

Rombold, J., 2003. A bibliography on carbon sequestration and biomass estimation.

Saatchi, S.S., Harris, N.L., Brown, S., Lefsky, M., Mitchard, E.T.A., Salas, W., Zutta, B.R., Buermann, W., Lewis, S.L., Hagen, S., Petrova, S., White, L., Silman, M., Morel, A., 2011. Benchmark map of forest carbon stocks in tropical regions across three continents. Proceedings of the National Academy of Sciences 108, 9899–9904.

Sathaye, J., Makundi, W., Dale, L., Chan, P., Andrasko, K., 2006. GHG Mitigation Potential, Costs and Benefits in Global Forests: A Dynamic Partial Equilibrium Approach. Energy Journal 47, 127–172.

Schalatek, L., Caravani, A., Nakhooda, S., Watson, C., 2012. Climate Finance Thematic Briefing: REDD+ Finance. Climate Finance Fundamentals Nr. 5.

Shoch, D., Eaton, J., Settelmyer, S., 2013. Project Developer's Guidebook to VCS REDD Methodologies. Conservation International.

Sierra, C.A., del Valle, J.I., Orrego, S.A., Moreno, F.H., Harmon, M.E., Zapata, M., Colorado, G.J., Herrera, M.A., Lara, W., Restrepo, D.E., Berrouet, L.M., Loaiza, L.M., Benjumea, J.F., 2007. Total carbon stocks in a tropical forest landscape of the Porce region, Colombia. Forest Ecology and Management 243, 299–309.

The Gold Standard, 2013a. The Gold Standard Land Use & Forest Framework. Final draft for public comment.

The Gold Standard, 2013b. The Gold Standard Afforestation/Reforestation (A/R) requirements. Final draft for public comment.

The Plan Vivo Foundation, 2012a. The Plan Vivo Standard for Community Payments for Ecosystem Services Programmes - Consultation draft.

The Plan Vivo Foundation, 2012b. Plan Vivo Procedures Manual for the registration and oversight of Plan Vivo projects and issuance of PlanVivo Certificates. 2012 draft for consultation.

UN-REDD Programme, 2012. UN-REDD Programme Social and Environmental Principles and Criteria.

UN-REDD Programme, 2013a. National Forest Monitoring Systems: Monitoring and Measurement, Reporting and Verification (M & MRV) in the context of REDD+ Activities.

UN-REDD Programme, 2013b. Draft Social and Environmental Proncíples and Criteria - Benefits and Risks Tool (SEPC - BeRT).

UNFCCC, 2012. Methodologies for Afforestation and Reforestation (A/R) CDM Project Activities, in: CDM Methodology Booklet (Chapter IV).

Verplanke, J.J., Zahabu, E. (Eds.), 2009. A field guide for assessing and monitoring reduced forest degradation and carbon sequestration by local communities.

Vieilledent, G., Vaudry, R., Andriamanohisoa, S.F.D., Rakotonarivo, O.S., Randrianasolo, H.Z., Razafindrabe, H.N., Rakotoarivony, C.B., Ebeling, J., Rasamoelina, M., 2012. A universal approach to estimate biomass and carbon stock in tropical forests using generic allometric models. Ecol Appl 22, 572–583.

Walker, S.M., Pearson, T., Casarim, F.M., Harris, N., Petrova, S., Grais, A., Swails, E., Netzer, M., Goslee, K., Brown, S., 2012. Standard Operating Procedures for Terrestrial Carbon Measurement: Version 2012.

Watson, C., 2009. Forest Carbon Accounting: Overview and Principles.

Zhang, X., Zhao, Y., Ashton, M.S., Lee, X., 2012. Measuring Carbon in Forests, in: Ashton, M.S., Tyrrell, M.L., Spalding, D., Gentry, B. (Eds.), Managing Forest Carbon in a Changing Climate. Springer Netherlands, pp. 139–164.

ANNEX 1: GLOSSARY

Source of the glossary: (IPCC, 2007)

Abrupt climate change
The nonlinearity of the climate system may lead to abrupt climate change, sometimes called rapid climate change, abrupt events or even surprises. The term abrupt often refers to time scales faster than the typical time scale of the responsible forcing. However, not all abrupt climate changes need be externally forced. Some possible abrupt events that have been proposed include a dramatic reorganisation of the thermohaline circulation, rapid deglaciation and massive melting of permafrost or increases in soil respiration leading to fast changes in the carbon cycle. Others may betruly unexpected, resulting from a strong, rapidly changing, forcing of anon-linear system.

Adaptation
Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Various types of adaptation exist, e.g. anticipatory and reactive, private and public, and autonomous and planned. Examples are raising river or coastal dikes, the substitution of more temperature-shock resistant plants for sensitive ones, etc.

Adaptive capacity
The whole of capabilities, resources and institutions of a country or region to implement effective adaptation measures.

Afforestation
Planting of new forests on lands that historically have not contained forests (for at least 50 years). For a discussion of the term forest and related terms such as afforestation, reforestation, and deforestation see the IPCC Report on Land Use, Land-Use Change and Forestry (IPCC, 2000). See also the Report on Definitions and Methodological Options to Inventory Emissions from Direct Human-induced Degradation of Forests and Devegetation of Other Vegetation Types (IPCC, 2003).

Afforestation (for the A/R CDM, definition of the Marrakesh Accords)
The direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources.

Annex I countries
The group of countries included in Annex I (as amended in 1998) to the United Nations Framework Convention on Climate Change (UNFCCC), including all the OECD countries in the year 1990 and countries with economies in transition. Under Articles 4.2 (a) and 4.2 (b) of the Convention, Annex I countries committed themselves specifically to the aim of returning individually or jointly to their 1990 levels of greenhouse gas emissions by the year 2000. By default, the other countries are referred to as Non-Annex I countries. For a list of Annex I countries, see http://unfccc.int.

Annex II countries
The group of countries included in Annex II to the United Nations Framework Convention on Climate Change (UNFCCC), including all OECD countries in the year 1990. Under Article 4.2 (g) of the Convention, these countries are expected to provide financial resources to assist developing countries to comply with their obligations, such as preparing national reports. Annex II countries are also expected to promote the transfer of environmentally sound technologies to developing countries. For a list of Annex II countries, see http://unfccc.int.

Anthropogenic
Resulting from or produced by human beings. Anthropogenic emissions Emissions of greenhouse gases, greenhouse gas precursors, and aerosols associated with human activities, including the burning of fossil fuels, deforestation, land-use changes, livestock, fertilisation, etc.

Barrier
Any obstacle to reaching a goal, adaptation or mitigation potential that can be overcome or attenuated by a policy, programme, or measure. Barrier removal includes correcting market failures directly or reducing the transactions costs in the public and private sectors by e.g. improving institutional capacity, reducing risk and uncertainty, facilitating market transactions, and enforcing regulatory policies.

Baseline
Reference for measurable quantities from which an alternative outcome can be measured, e.g. a non-intervention scenario used as a reference in the analysis of intervention scenarios.

Biofuel
A fuel produced from organic matter or combustible oils produced by plants. Examples of biofuel include alcohol, black liquor from the paper-manufacturing process, wood, and soybean oil.

Biomass
The total mass of living organisms in a given area or volume; recently dead plant material is often included as dead biomass. The quantity of biomass is expressed as a dry weight or as the energy, carbon, or nitrogen content.

Biome
A major and distinct regional element of the biosphere, typically consisting of several ecosystems (e.g. forests, rivers, ponds, swamps within a region of similar climate). Biomes are characterised by typical communities of plants and animals.

Carbon (Dioxide) Capture and Storage (CCS)
A process consisting of separation of carbon dioxide from industrial and energy-related sources, transport to a storage location, and long-term isolation from the atmosphere.

Carbon cycle
The term used to describe the flow of carbon (in various forms, e.g. as carbon dioxide) through the atmosphere, ocean, terrestrial biosphere and lithosphere.

Carbon dioxide (CO2)
A naturally occurring gas, also a by-product of burning fossil fuels from fossil carbon deposits, such as oil, gas and coal, of burning biomass and of land use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the Earth's radiative balance. It is the reference gas against which other greenhouse gases are measured and therefore has a Global Warming Potential of 1.

Carbon dioxide (CO2) fertilisation
The enhancement of the growth of plants as a result of increased atmospheric carbon dioxide (CO2) concentration. Depending on their mechanism of photosynthesis, certain types of plants are more sensitive to changes in atmospheric CO2 concentration.

Carbon intensity
The amount of emission of carbon dioxide per unit of Gross Domestic Product.

Carbon leakage
The part of emissions reductions in Annex B countries that may be offset by an increase of the emissions in the non-constrained countries above their baseline levels. This can occur through (1) relocation of energy-intensive production in non-constrained regions; (2) increased consumption of fossil fuels in these regions through decline in the international price of oil and gas triggered by lower demand for these energies; and (3) changes in incomes (thus in energy demand) because of better terms of trade.

Carbon sequestration
See Uptake

Climate change
Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the United Nations Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as: 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'. The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes. See also Climate variability; Detection and Attribution.

Deforestation
Conversion of forest to non-forest. For a discussion of the term forest and related terms such as afforestation, reforestation, and deforestation see the IPCC Report on Land Use, Land-Use Change and Forestry (IPCC, 2000). See also the Report on Definitions and Methodological Options to Inventory Emissions from Direct Human-induced Degradation of Forests and Devegetation of Other Vegetation Types (IPCC, 2003).

Ecosystem
A system of living organisms interacting with each other and their physical environment. The boundaries of what could be called an ecosystem are somewhat arbitrary, depending on the focus of interest or study. Thus, the extent of an ecosystem may range from very small spatial scales to, ultimately, the entire Earth.

Emission factor
An emission factor is the rate of emission per unit of activity, output or input. E.g. a particular fossil fuel power plant has a CO2 emission factor of 0.765 kg/kWh generated.

Environmental effectiveness
The extent to which a measure, policy or instrument produces a decided, decisive or desired environmental effect.

Forest
Defined under the Kyoto Protocol as a minimum area of land of 0.05-1.0 ha with tree-crown cover (or equivalent stocking level) of more than 10-30 % with trees with the potential to reach a minimum height of 2-5 m at maturity in situ. A forest may consist either of closed forest formations where trees of various storey and undergrowth cover a high proportion of the ground or of open forest. Young natural stands and all plantations that have yet to reach a crown density of 10-30 % or tree height of 2-5 m are included under forest, as are areas normally forming part of the forest area that are temporarily un-stocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest.

Global warming
Global warming refers to the gradual increase, observed or projected, in global surface temperature, as one of the consequences of radiative forcing caused by anthropogenic emissions.

Global Warming Potentials (GWPs)
An index, based upon radiative properties of well mixed greenhouse gases, measuring the radiative forcing of a unit mass of a given well mixed greenhouse gas in today's atmosphere integrated over a chosen time horizon, relative to that of CO2. The GWP represents the combined effect of the differing lengths of time that these gases remain in the atmosphere and their relative effectiveness in

absorbing outgoing infrared radiation. The Kyoto Protocol is based on GWPs from pulse emissions over a 100-year timeframe.
Carbon dioxide (CO2) was chosen by the IPCC as this reference gas and its GWP is set equal to one (1). GWP values are applied to units of mass (e.g., kilograms, pounds, metric tons, etc.) not to units of volume (e.g., cubic meters, cubic feet, liters).

Greenhouse effect
Greenhouse gases effectively absorb infrared radiation, emitted by the Earth's surface, by the atmosphere itself due to the same gases and by clouds. Atmospheric radiation is emitted to all sides, including downward to the Earth's surface. Thus, greenhouse gases trap heat within the surface-troposphere system. This is called the greenhouse effect. Thermal infrared radiation in the troposphere is strongly coupled to the temperature at the altitude at which it is emitted. In the troposphere, the temperature generally decreases with height. Effectively, infrared radiation emitted to space originates from an altitude with a temperature of, on average, –19°C, in balance with the net incoming solar radiation, whereas the Earth's surface is kept at a much higher temperature of, on average, +14°C.
An increase in the concentration of greenhouse gases leads to an increased infrared opacity of the atmosphere and therefore to an effective radiation into space from a higher altitude at a lower temperature. This causes a radiative forcing that leads to an enhancement of the greenhouse effect, the so-called enhance greenhouse effect.

Greenhouse gases (GHGs)
Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds. This property causes the greenhouse effect. Water vapour (H2O), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4) and ozone (O3) are the primary greenhouse gases in the earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorineand bromine-containing substances, dealt with under the Montreal Protocol. Besides carbon dioxide, nitrous oxide and methane, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride, hydrofluorocarbons, and perfluorocarbons.

Kyoto Mechanisms (also called Flexibility Mechanisms)
Economic mechanisms based on market principles that parties to the Kyoto Protocol can use in an attempt to lessen the potential economic impacts of greenhouse gas emission-reduction requirements. They include Joint Implementation (Article 6), Clean Development Mechanism (Article 12), and Emissions trading (Article 17).

Kyoto Protocol
The Kyoto Protocol to the UNFCCC was adopted at the Third Session of the Conference of the Parties (COP) in 1997 in Kyoto. It contains legally binding commitments, in addition to those included in the FCCC. Annex B countries agreed to reduce their anthropogenic GHG emissions (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride) by at least 5% below 1990 levels in the commitment period 2008-2012. The Kyoto Protocol came into force on 16 February 2005.

Land-use
The total of arrangements, activities and inputs undertaken in a certain land-cover type (a set of human actions). The social and economic purposes for which land is managed (e.g., grazing, timber extraction, and conservation). Land-use change occurs when, e.g., forest is converted to agricultural land or to urban areas.

Radiative forcing
Radiative forcing is the change in the net vertical irradiance (expressed in Watts per square metre: W/m2) at the tropopause due to an internal change or a change in the external forcing of the climate system, such as, for example, a change in the concentration of CO2 or in the output of the sun.

Reforestation (for the A/R CDM) i
Direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities

Reservoir
A component of the climate system, other than the atmosphere, which has the capacity to store, accumulate or release a substance of concern, e.g., carbon, a greenhouse gas or a precursor. Oceans, soils, and forests are examples of reservoirs of carbon. Stock is the absolute quantity of substance of concerns, held within a reservoir at a specified time. See also Carbon pool.

Sequestration
Carbon storage in terrestrial or marine reservoirs. Biological sequestration includes direct removal of CO2 from the atmosphere through land-use change, afforestation, reforestation, carbon storage in landfills and practices that enhance soil carbon in agriculture

ANNEX 2: TOOLS AND MODULES

SEPC- BeRT from the UN-REDD Programme[54]

The Social and Environmental Principles and Criteria – Benefits and Risks tool (SEPC – BeRT) were designed for serving two purposes, addressing social and environmental issues in UN-REDD National programs as well as supporting countries in developing national approaches for REDD+ safeguards inline with the UNFCCC.

This excel based tools guides the user through a series of questions on criteria and indicators following the principles defined by the UN-Programme (UN-REDD Programme, 2012). According to the SEPC – BeRt document a completed BeRT is *expected to document the process of assessing potential risks and opportunities from these programs and initiatives, and is intended for use by national program teams* (Ibid, 2012).

A draft version of the tool can be downloaded at
http://www.unredd.net/index.php?option=com_docman&task=doc_details&gid=6352&Itemid=53

A/R CDM

Tools for A/R CDM project activities[55]

1. Tool for the demonstration and assessment of additionality	
	This tool provides a step-wise approach to demonstrate and assess the additionality of a A/R CDM project activity, including: Step 0→ Preliminary screening based on the starting date of the A/R CDM project activity Step 1 → Identification of alternative land use scenarios; Step 2 → Investment analysis; Step 3 → Barrier analysis; and Step 4 → Common practice analysis This tool is not applicable to small-scale project activities See more: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-01-v2.pdf/history_view
2. Combined tool to identify the baseline scenario and demonstrate additionality	
	This tool provides a step-wise approach to identify the baseline scenario and simultaneously demonstrate additionality, including: Step 0→ Preliminary screening based on the starting date of the A/R CDM project activity Step 1 → Identification of alternative land use scenarios; Step 2 → Barrier analysis; Step 3 → Investment analysis (if needed); Step 4 → Identification of the baseline scenario; and Step 4 → Common practice analysis This tool is not applicable to small-scale project activities See more: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-02-v1.pdf/history_view
3. Calculation of the number of sample plots for measurements	
	This tool can be used for calculation of number of sample plots required for estimation of biomass stocks from sampling based measurements in the baseline and project scenarios of an A/R CDM project activity. The tool calculates the number of required sample plots on the basis of the specified targeted precision for biomass stocks to be estimated. It is based on specific assumptions regarding area of each stratum and variance of biomass stocks See more: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-03-v2.1.0.pdf/history_view
4. Tool for testing significance of GHG emissions	
	This tool facilitates the determination of significance for GHG emissions by sources, decreases in

54 Information on the SPEC – BeRT tool was taken from (UN-REDD Programme, 2013b) and the web draft version of the tool http://www.unredd.net/index.php?option=com_docman&task=doc_details&gid=6352&Itemid=53

55 This section is fully based on the CDM-Methodology Booklet (UNFCCC, 2012)

	carbon pools, or leakage emissions. It is used to determine if emissions from a given pool or from other sources are insignificant so that these can be neglected See more: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-04-v1.pdf/history_view
5. Procedure to determine when accounting of the soil organic carbon pool may be conservatively neglected	
	This tool provides guidelines and criteria to determine when accounting of the soil organic carbon pool may be conservatively neglected in A/R CDM project activities. Where availability of evidence on change in the soil organic carbon pool under land use or land-use change remains limited, a conservative approach has been adopted. There are specific conditions for the land area for which this tool can be applied. See more: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-06-v1.pdf/history_view
6. Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity	
	This tool can be used for estimation of non-CO2 GHG emissions resulting from all accurrence of fire within the project boundary, i.e. burning of biomass when fire is used for site preparation and/or to clear the land of harvest residue prior to replanting of the land , or when a forest fire occurs within the project boundary See more: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-08-v4.0.0.pdf/history_view
7. Estimation of carbon stocks and change in carbon stocks in dead wood and litter	
	This tool can be used for ex post estimation of carbon stocks and change in carbon stocks in dead wood and/or litter in the baseline and project scenarios of an A/R CDM project activity. This tool has no internal applicability conditions. See more: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-12-v1.1.0.pdf/history_view
8. Tool for the identification of degraded or degrading land for consideration in implementing A/R CDM project activities	
	It provides a procedure for the identification of degraded or degrading lands (based on the documented evidence of degradation) for the purpose of application of A/R CDM methodologies. See more: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-13-v1.pdf/history_view
9. Estimation of carbon stocks and change in carbon stocks of threes and shrubs	
	This tool can be used for estimation of carbon stocks and change in carbon stocks of trees and shrubs in the baseline and project scenarios of an A/R CDM project activity. This tool has no specific internal applicability conditions See more: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-14-v2.1.0.pdf/history_view
10. Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities	
	This tool is applicable for estimating the increase of GHG emissions attributable to the displacement of pre-project agricultural activities due to implementation of an A/R CDM project activity, which can not be considered insignificant according to the most recent: (i) “Guidelines on conditions under which increase in GHG emissions attributable to displacement of pre-project crop cultivation activities in A/R CDM project activity in insignificant”, (ii) “Guidelines on conditions under which increase in GHG emissions related to displacement of pre-project grazing activities in A/R CDM project is insignificant”. Specific definitions on following terms are included: agricultural activities, crop cultivation activities, grazing activities and displacement of agricultural activities. See more : http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-15-v1.pdf/history_view
11. Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities	
	This tool estimates the change, occurring in a given year, un soil organic carbon (SOC) stocks of land within the boundary of an A/R CDM project activity, To tool is only applicable if litter remains on site during the A/R CDM project activity and soil disturbance is limited: It is not applicable on land containing organic soils or wetlands, and if specific land management practices with inputs are applied. Specific management practice limitations are listed in the tool for each temperature/moisture regime. See more: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-16-v1.1.0.pdf/history_view
12. Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass	
	This tool allows demonstration whether a volume table or volume equation, in combination with selected biomass expansion factors (BEFs) and basic wood density, is appropriate for estimation of aboveground tree biomass in an A/R CDM project activity. It provides criteria for direct applicability

	of an equation for ex-post calculations, and –if these criteria are not met – describes the process required for verification of a volume equation. This tool has no internal applicability conditions. See more: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-17-v1.pdf/history_view
13. Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass	
	This tool allows demonstration whether an allometric equation is appropriate for estimation of aboveground tree biomass in an A/R CDM project activity. It provides criteria. See more: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-17-v1.pdf/history_view

AMERICAN CARBON REGISTER

T-ADD: "ACR Tool for Determining the Baseline and Assessing Additionality in REDD Project Activities"	Project Proponents shall use this tool to demonstrate additionality, and as applicable determine the baseline scenario, in REDD project activities. The tool is consistent with and amplifies the "threeprong" additionality guidance in the ACR Standard and ACR Forest Carbon Project Standard. The tool provides a step-by-step approach to identify credible alternative land use scenarios, evaluate both the alternatives and the proposed project scenario, and demonstrate the additionality of the project scenario. In verifying the application of this tool, the ACR-approved verifier shall assess credibility of data, rationales, assumptions, justifications and documentation provided by the Proponent to support the selection of the baseline and demonstration of additionality. Available at: http://americancarbonregistry.org/carbon-accounting/carbon-accounting/redd-methodology-modules-1
T-BAR "Tool for AFOLU non-permanence risk analysis and buffer determination"	In development
CPES "ACR Tool for the Estimation of Stocks in Carbon Pools and Emissions from Emission Sources"	This tool provides procedures for the estimation of carbon stocks and GHG emissions, for those pools and emission sources identified as significant and selected for inclusion in the GHG assessment boundary of forest carbon project activities. It includes procedures for all the carbon pools and emission sources required for ACR Reducing Emissions from Deforestation and Forest Degradation (REDD) methodologies, including Avoiding Planned Deforestation (APD), Avoiding Unplanned Deforestation and Degradation (AUDD), and Avoiding Degradation through Fuelwood and Charcoal Production. In the future the tool may be referenced and/or modified for use in other ACR forest carbon project methodologies. Available at: http://americancarbonregistry.org/carbon-accounting/carbon-accounting/redd-methodology-modules-1

Source: American Carbon Registry http://americancarbonregistry.org/carbon-accounting/tools-templates

CLIMATE, COMMUNITY & BIODIVERSITY STANDARDS – CCBS[56]

Social and Biodiversity impact assessment manual for REDD+ Projects (SBIA)
Social Impact Assessment Toolbox:* *http://www.climate-standards.org/documents/
The toolbox introduces a range of Social Impact Assessment (SIA) methods useful in the context of a forestry activity aimed at gaining carbon benefits. Further, it relates these to the seven stages in the SBIA. Project proponents will need to decide which one fits the best for assessing social impacts of the given project and in the given context. It includes the following methods: Stakeholder analysis, Scenario Analysis, The Sustainable Livelihoods Framework, The Social Carbon Methodology, Participatory Impact Assessment (PIA), The Basic Necessities Survey (BNS), Social Indicator Checklist
Biodiversity Impact Assessment Toolbox:* *http://www.climate-standards.org/documents/
This toolbox seeks to provide guidance on each of the biodiversity-related criteria required for certification under the CCB Standards. The toolbox is organized in four sections: • A survey of typical biodiversity impacts of land-based carbon projects, both positive and negative; • Guidance for describing initial biodiversity conditions, identifying risks to that biodiversity, and projecting a 'without-project' scenario for biodiversity; • Guidance for designing project activities and estimating their biodiversity impacts; and • Guidance for monitoring biodiversity impacts.

Sources: (Pitman, 2011; Richards, 2011)

PLAN VIVO[57]

Basic eligibility checklist The checklist includes the following items: i) Start date ii) Project participants iii) Project coordinators iv) Land tenure/use rights v) Project activities vi) Project landscape vii) Expansion ambitions Using the checklist is simple and it provides a clear idea if the Plan Vivo Standard matches with a project idea/activity
Developing baselines (Afforestation, reforestation, agroforestry) • ECCM Protocol: Baseline survey for agroforestry projects. • *Winrock Sourcebook for Land Use, Land-Use Change and Forestry*. (T. Pearson et al., 2005b) • *Bibliography for Carbon Sequestration and Biomass Estimation. (Rombold, 2003)* • Approved small-scale CDM afforestation/reforestation methodologies
Carbon modelling tools • ECCM Protocol: Estimating tree growth (Berry, 2008a) • ECCM Protocol: Carbon modelling for afforestation and reforestation projects (Berry, 2008b) • CO2FIX http://www.efi.int/projects/casfor/models.htm CO2FIX is a tool that can be used to quantify the carbon stocks and fluxes in forest biomass, soil organic matter and the wood products chain. Included are also a bioenergy module, a financial module and a carbon accounting module. The model is applicable to afforestation projects and agroforestry systems, and this provides a useful tool for Plan Vivo projects. The model is freely available from the web, together with examples and guidance documents.
Monitoring performance • MacDicken (1997) *A Guide to Monitoring Carbon Storage in Forestry and Agroforestry Projects* (MacDicken, 1997)

56 see: http://www.climate-standards.org/documents/
57 see: http://www.planvivo.org/tools-and-resources/

- Verplanke, J.J. and E. Zahabu, Eds. 2009: *A Field Guide for Assessing and Monitoring Reduced Forest Degradation and Carbon Sequestration by Local Communities* (Verplanke and Zahabu, 2009)

REDD

- Ecometrica Protocol: Above-ground biomass survey for projects that aim to reduce greenhouse gas emissions from deforestation and forest degradation. 2009. Download
- BioCarbon Fund Methodology for Estimating Reductions of GHG Emissions from Mosaic Deforestation. Download.
- Coming soon: Plan Vivo REDD+ methodology

Source http://www.planvivo.org/tools-and-resources/ All tools can be downloaded from this website

VERIFIED CARBON STANDARD - VCS[58]

Including tools for projects and/or modules

APPROVED VCS TOOLS	
Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, v3.0	The tool provides a step-wise approach to demonstrate and assess additionality for AFOLU project activities. New and revised VCS methodologies may reference and required the use of the tool to demonstrate additionality of AFOLU project activities. This tool is adapted from the CDM Tool for the demonstration and assessment of additionality in A/R CDM project activities. http://www.v-c-s.org/methodologies/VT0001
Tool for the Demonstration and Assessment of Additionality in IFM Project Activities, v1.0	The tool provides a step-wise approach demonstrate and assess additionality for IFM project activities. New and revised VCS methodologies may reference and required the use of the tool to demonstrate additionality of IFM project activities. This tool is applicable to VCS IFM project activities. http://www.v-c-s.org/methodologies/VT0002
Tool for the Estimation of Uncertainty for IFM Project Activities, v1.0	The tool provides a step-wise approach to estimate uncertainty in the estimation of emissions and removals in IFM project activities. The tool focuses on uncertainty associated with the estimation of stocks in carbon pools and changes in carbon stocks and on uncertainty in the assessment of project emissions This tool is applicable for use under VM0005 Converting from Low to High Productive Forests. http://www.v-c-s.org/methodologies/VT0003
Tools/modules for the REDD Methodology Modules (REDD-MF), v.1.4	- Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools (CP-AB), v.1.0 - Estimation of carbon stocks in the dead-wood pool (CP-C), v 1.0 - Estimation of carbon stocks in the litter pool (CP-L), v1.0 - Estimation of carbon pools in the soil organic carbon pool (CP-S) v1.0 - Estimation of carbon stocks in the long-term wood products pool (CP-W) v.1.1 - Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation and planned degradation (BL-PL) v. 1.2 - Estimation of baseline carbon stock changes and greenhouse gas emissions from unplanned deforestation (BL-UP), v3.2 See: http://www.v-c-s.org/methodologies/VM0007
VCS TOOLS UNDER DEVELOPMENT	

58 See: http://www.v-c-s.org/methodologies/what-methodology The whole information regarding VCS methodologies was taken directly from VCS by end July 2013

Tool for the Estimation of Jurisdictional Leakage in VCS JNR Programs	This tool provides a step-by-step approach to estimate leakage for Jurisdictional and Nested REDD+ (JNR) programs applying a VCS Scenario 2 or Scenario 3 approach where full accounting takes place at the jurisdictional level. Through the use of two supporting modules, JNR programs may apply the tool to determine activity shifting leakage, market leakage and/or deforestation-to-degradation leakage. The tool is applicable for subnational JNR programs without nation-wide monitoring and reporting of emissions. Public comments will help determine whether to provide both global commodity leakage modules for optional use by jurisdictions or to eliminate one of the modules. http://www.v-c-s.org/methodologies/tool-estimation-jurisdictional-leakage-vcs-jnr-programs
Global Commodity Leakage Module: Production Approach	This module and the associated calculation tool provide a framework to determine the global commodity leakage that may result from a Jurisdictional and Nested REDD+ (JNR) program applying a Scenario 2 or Scenario 3 approach. The module assesses jurisdictional market leakage associated with the production of agricultural, livestock and forest commodities.The module estimates a global commodity leakage value through a step-by-step approach based on the volume of commodities required to maintain international market demand. International market demand for these commodities is determined by assessing the baseline level of production and applying econometric factors to estimate demand for lost production. This approach conservatively assumes that commodity production will be distributed based on the international market share of the host country's top commodities. Commodity production is assumed to be distributed evenly across forest and agricultural land. http://www.v-c-s.org/methodologies/global-commodity-leakage-module-production-approach
Global Commodity Leakage Module: Effective Area Approach	This module provides a calculation framework to determine the global commodity leakage that may result from a Jurisdictional and Nested REDD+ (JNR) program applying a Scenario 2 or Scenario 3 approach. The module assesses jurisdictional market leakage associated with the production of agricultural, livestock and forest commodities. The module estimates a global commodity leakage value through a step-by-step approach based on the area of land required to maintain production levels within the jurisdiction. This effective area is determined by analyzing a jurisdictional production baseline, using data on the area of production and commodity yields, and comparing that baseline to the observed production. This approach conservatively assumes an area equal to the entire effective area will be deforested outside the jurisdiction based on the host country's international share of deforestation or at-risk forest carbon stocks. http://www.v-c-s.org/methodologies/global-commodity-leakage-module-effective-area-approach
Tool for the Demonstration and Assessment of Additionality in VCS IFM Project Activities on Lands Subject to Unextinguished Indigenous Rights and Title	The tool provides a step-wise approach to demonstrate and assess additionality for VCS IFM project activities on lands subject to unextinguished indigenous rights and title. This tool is adapted from the VCS VT0001 Tool for the Demonstration and Assessment of Additionality in VCS AFOLU Project Activities. http://www.v-c-s.org/methodologies/tool-demonstration-and-assessment-additionality-vcs-ifm-project-activities-lands
Tool for Calculating Deforestation Rates Using	This tool calculates historical deforestation rates using incomplete remote sensing imagery when complete scenes are not available. A remote sensing image may be incomplete due to (a) atmospheric conditions such as cloud and shadow cover, dust or

Incomplete Remote Sensing Images	smoke and/or (b) sensor-related errors such as anomalous speckles, data saturation, spatial offsets or missing data. This tool is intended to be used in regions where limited archival imagery exists such as regions that have persistent cloud cover or where existing complete archival imagery is too expensive.This tool assumes that project proponents have already conducted a classification of the incomplete remote sensing images into appropriate land use/ land cover (LULC) categories using established procedures. The tool describes how a series of incomplete classified remote sensing images can be combined to calculate a robust estimate of historical deforestation and degradation rates and transition matrices. http://www.v-c-s.org/methodologies/tool-calculating-deforestation-rates-using-incomplete-remote-sensing-images

Clarification: Webpages in the table were available by September 15th 2013. The Jurisdictional Non-Permanence Risk Tool will be available from October onwards in the VCS website. By September 2013 the jurisdictional tools are undergoing final review and final versions will be available on the website in early October 2013.

GOFC-GOLD[59]

Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD) is a coordinated international effort working to provide ongoing space-based and in-situ observations of forests and other vegetation cover, for the sustainable management of terrestrial resources and to obtain an accurate, reliable, quantitative understanding of the terrestrial carbon budget.

GOFC-GOLD is working to accomplish its objectives by:
- Providing a forum for users of satellite data to discuss their needs and for producers to respond through improvements to their programs;
- Providing regional and global datasets containing information on:
- Location of different forest types;
- Major changes in forest cover;
- Biological functioning of forests (this will help quantify the contribution forests make as absorbers and emitters of greenhouse gases).
- Promoting globally consistent data processing and interpretation methods;
- Promoting international networks for data access, data sharing, and international collaboration; and
- Stimulating the production of improved products.

Potential users of GOFC-GOLD products include global change researchers, international agencies, national governments, non-governmental organizations, and international treaties and conventions (such as the Framework Convention on Climate Change). One of the most important challenges facing GOFC-GOLD is to develop methods and implement systems that provide both research and operational information on a regular sustained basis.
There are two teams, the land cover and the fire teams

The Land Cover Characteristics and Change theme promotes the use and refinement of land cover data and information products for resource managers, policy makers, and scientists studying the global carbon cycle and biodiversity loss (see more information under: http://www.fao.org/gtos/gofc-gold/land.html).The GOFC-GOLD-Fire Mapping and Monitoring Theme is aimed at refining and articulating the international requirements for fire related observations and making the best possible use of fire products from the existing and future satellite observing systems, for fire management, policy decision-making and global change research (see more information under: http://www.fao.org/gtos/gofc-gold/f_fire.html). Further, GOCF-GOLD maintains various regional networks. The regional networks provide a forum for users and researchers operating in (or with an interest in) a common geographic area, and represent a link between national agencies and user groups and the global user/producer community. (more information on the regional networks. Under: http://www.fao.org/gtos/gofc-gold/networks.html)

GOCF-GOLD has produced a sourcebook of methods and procedures for monitoring measuring and reporting GHG emissions from deforestation and forest degradation (GOFC-GOLD, 2011). Based on the current status of negotiations and UNFCCC approved methodologies, this sourcebook aims to provide additional explanation, clarification, and methodologies to support REDD early actions and readiness mechanisms for building national REDD monitoring systems. The book emphasizes the role of satellite remote sensing as an important tool for monitoring changes in forest cover, and provides clarification on the IPCC Guidelines for reporting changes in forest carbon stocks at the national level. It is the outcome of an ad-hoc REDD working group of GOFC-GOLD that has been active since the initiation of the UNFCCC REDD process in 2005. It provides a consensus perspective from the global community of earth observation and carbon experts on methodological issues relating to quantifying carbon impacts of implementation activities to reduce emissions from deforestation and degradation in developing countries (REDD).

[59] Information on GOFC-GOLD has being taken in full from its web site: http://www.fao.org/gtos/gofc-gold/index.html

CIFOR AND ICRAF

Two research centers from the CGIAR[60] system are conducting programs related to accountability of carbon benefits in the forest sector; namely the Center for International Forestry Research – CIFOR – and the World Agroforestry Centre – ICRAF. Jointly they developed a toolbox for forest and climate change – including mitigation and adaptation [61]. The toolbox is aimed at building understanding and technical proficiency on issues of climate change and forests including mitigation, adaptation, carbon accounting and markets, and biofuels.

The toolbox is divided into 5 so called "topics". Topics 4 and 5 are dedicated to forest and mitigation to climate change. Topic 4 looks at accounting carbon while topic 5 mechanisms, markets and projects. Besides explanations on the importance and challenges of carbon accounting in forest, topic 4 includes a "Forest Carbon Calculator". The Forest Sector Carbon Calculator is a tool to help learn about how carbon works in the forest sector; that is the forest itself and the carbon that is harvested from the forest. It is a simulation and not a measurement tool. As such it can be used for estimating potential carbon benefits, but it doesn't replace the need to make periodic measurements of changes of carbon stock over time (monitoring)[62].

CARBON BENEFIT PROJECT (CBP) - GEF[63]

Structure of the Modeling or Measurement tools

- Simple Assessment: of the impact of a project on carbon stock and greenhouse gas emissions. Requires information on land use changes and/or livestock production in the project area. Suitable for a quick assessment at any stage including proposals. Uses standard information on greenhouse gas emission rates.
- Detailed Assessment: of the impact projects have on carbon stocks and greenhouse gas emissions. Requires information on land use changes and/or livestock production in the project area plus can utilize local and project specific field measurements and other local datasets. Suitable for detailed reporting in projects with a reasonable focus on climate change mitigation.
- Dynamic Modeling: utilizes the Century Model to assess soil and biomass carbon stock changes. For users with a scientific background who wish to model carbon stock changes in projects with a carbon focus.
- Direct Measuring: provides a general protocol and specific methodologies for field, laboratory and remote sensing measurements of carbon stocks and greenhouse gases. Requires extensive field measurements and remote sensing analysis to measure carbon stocks in soil and biomass and monitor their changes over time in the project area. Displays project spatial information in an online information system to manage measurement data in carbon and greenhouse gas projects. Project indicators display a results framework of social, biodiversity and environmental indicators of carbon and greenhouse gas benefits in the project area. The data derived from measurements can be used directly for reporting changes in the carbon and greenhouse gas balance or the measurement data may be used as inputs for CBP modeling assessments.
- Project Planning Tools: provide supporting information for project managers during the development phase of landscape carbon and other sustainable land management projects. The information provided is useful for making decisions on which trees to plant based on a large database of agroforestry trees, to estimate the economic benefits that can be expected from participating in the carbon markets by planting trees and support in setting up project boundaries using available maps.

Additional to these tools the CBP offers a socio-economic component- It serves to capture human-biophysical interactions relating to a project's carbon and greenhouse gas balance. It aids the

---

[60] The Consultative Group on International Agricultural Research – CGIAR – is a global partnership that unites organizations engaged in research for a food secure future. For more information see http://www.cgiar.org/

[61] CIFOR, World Agroforestry Centre and USAID 2009 Forest and climate change toolbox [PowerPoint presentation]. Available from http://www.cifor.cgiar.org/fctoolbox/

[62] Information taken from: http://landcarb.forestry.oregonstate.edu/default.aspx

[63] See: http://www.unep.org/ClimateChange/carbon-benefits/cbp_pim/# Information taken from the provisional webpage from CBP

project in understanding a land user's socio-economic rationale for adopting certain land management practices and not others by identifying the underlying drivers and barriers of adoption. It also helps to determine the tradeoffs that land users make in adopting carbon- and greenhouse gas-friendly practices. This facilitates 'no regrets' decision making when balancing development and carbon sequestration objectives, helping to assess the sustainability of carbon and greenhouse gas benefits.

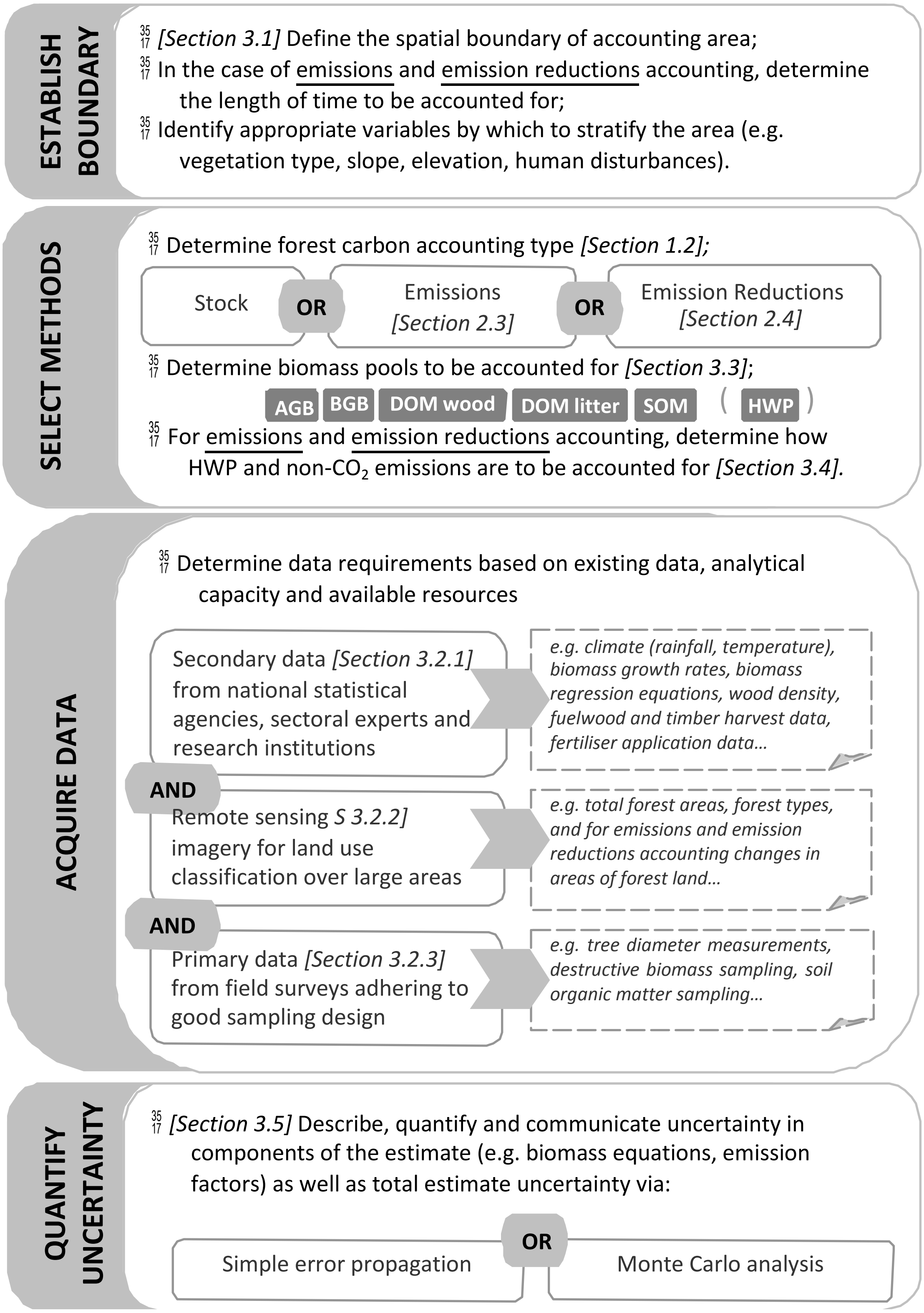
The table below summarizes the structure of the tools provided by the CBP

Analysis tools	Simple Assessment	It includes guidance for undertaking three steps as follows: 1. Define project boundaries 2. Review supporting spatial data 3. Define project land use area
	Detailed Assessment	It provides a tool for undertaking clarification of: - Initial Land use, - Baseline Scenario and - Project Scenario It includes the following land use categories: selecting among forest land, grassland, settlements, wetlands, annual crops, agroforestry and livestock categories
	Dynamic Modelling	The Dynamic Modelling tool assesses carbon stock change associated with a multiple, complex land use or land management changes on large areas with several combinations of soil and climate. Emphasis is on changes in soil carbon. This tool is suitable for users with a soil carbon inventory background. Methods used are based on the GEFSOC modelling system.
	Socio-economic tools	Including two tools: 1. Driver-Impact Response Analysis (DPSIR): a qualitative analysis identifying the main drivers and barriers for the adoption of specific land management practices and possible responses to overcome them 2. Cost-Benefit Analysis is a quantitative tool determining the economic impact and labor barrier of a land use activity
Direct Measuring		Which directs to the GEF Guidelines on Integrating Carbon Benefit Estimates into GEF Projects
Project planning tools		It includes the following tools: 1. Agroforestree Database 2. Useful tree species for Africa 3. Multi-criteria tree species selection tool 4. Project boundary tool 5. Stratification tool 6. Data management tool 7. Community participation manual 8. Training the trainers manual 9. Manual on CBP and other carbon Standards
Carbon MRV tool		This toolbox supports an organization's needs for developing, managing and reporting carbon projects at the national or project level. It provides an enterprise-wide solution of on-line tools for planning and implementing national forest inventory for carbon, development and management of carbon projects across all of your organization's offices and units, and enterprise training and capacity-building. The Toolbox supports planning, tasking and implementation, and its distributed web-enabled approach allows managers in one office to communicate and interact with field offices and other offices or cooperators across the organization. This structure and its secure login and workspace design allows verifiers and others to review the project data, providing a level of transparency and openness needed for most carbon projects today. See: http://www.carbon2markets.org/content.cfm?id=52&m=52&mm=0

Source: Carbon Benefit Source, preliminary website.

UNDP, UNEP AND UNEP- RISOE CENTRE

The figure below shows the structure of the UNDP, UNEP and UNEP-RISOE Centre guidelines. It shows where in this guideline can you find specific information



Source: (Watson, 2009)

OTHER TOOLS

TARAM: Tool for Afforestation and Reforestation Approved Methodologies	
Short description	The purpose of this spreadsheet tool is to facilitate the application of the following CDM approved methodologies: AR-AM0001, AR-AM0002, AR-AM0003, AR-AM0004, AR-AM0005, AR-AM0006, AR-AM0007, AR-AM0008, AR-AM0009, and AR-AM0010
Available at: http://www.forestcarbonportal.com/resource/tool-afforestation-and-reforestation-approved-methodologies-taram-v-13	
CVal: Assess the economics of participating in carbon markets	
Short description	CVal is a spreadsheet tool that will help foresters, managers, and project developers work with private forest landowners to assess the economic profitability of participating in carbon markets. CVal provides a discounted cash flow analysis based on a full accounting of variables, including tract size, carbon sequestration rate, carbon price, and enrollment and trading costs. Automated financial break-even analyses in the macros version quickly assess threshold values of key variables for profitable projects, and the program readily performs "what if" calculations after storing starting values. CVal was designed to evaluate managed forest and afforestation projects traded on the Chicago Climate Exchange, but its methodology could be adapted for other trading mechanisms and agricultural sequestration projects. Available at http://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr180.html

Additional tools for REDD+

Training kit on participatory spatial information manamgement and comunication	The Training Kit has been developed with the objective "to support the spread of 'good practice' in generating, managing, analysing and communicating community spatial information. The training kit counts with 15 modules that can be downloaded from: http://pgis-tk-en.cta.int/
MRV tool for forest carbon management and mitigation	Details about this tool are included in section 10.8. http://www.carbon2markets.org/content.cfm?m=52&id=52&startRow=1&mm=0
REDD Integrity	Schemes aimed at Reducing Emissions from Deforestation and Forest Degradation (REDD) are at risk from corruption. Learn about the types of risk involved and potential anti-corruption approaches. More information: http://www.u4.no/themes/redd-integrity/
REDD+ Database	The purpose of the IGES REDD+ Online database is to make information on REDD+ negotiations, readiness activities and projects available in a succinct manner for discussion, learning and analysis. It provides REDD+ Project Profiles, a REDD+ Project matrix, National REDD+ Reports and International REDD+ Event Briefs. For more information: http://redd-database.iges.or.jp/redd/
Rapid Equity Appraisal Matrix - REAM	A methodology for evaluating the equity capacity of REDD+ projects and stakeholders. REAM consists of three axes: a REDD+ project axis, a stakeholder axis, and an indicator axis. A systematic literature review was employed to establish ten indicators as minimum requirements for REDD+ projects to achieve socio-economic equity (Jaung and Bae, 2012).
REDD Financial Feasibility Assessment Tool	The SOCIALCARBON, together with CCBA, have developed a tool for evaluating the financial feasibility of REDD projects. This tool is not a requirement of the Standards, but is intended to help project developers to design projects that are likely to be financially viable. Se more under: http://www.socialcarbon.org/documents/redd-financial-feasibility-assessment-tool/

ANNEX 3: ADDITIONAL INFORMATION

A/R CDM

List of Designated National Authorities in ITTO Producer Members under ITTA, 2006

Update: 24.04.2013

Africa	
Benin	n.a.
Cameroon	n.a.
Congo	n.a.
Côte d'Ivoire	National Agency for Environment (ANDE) 08 BP 09 ABIDJAN 08 Riviéra Attoban Rue I 32 En face du Groupe Scolaire Jules FERRY Ms. Rachel Boti-Douayoua (rbdouayoua@gmail.com, botirach@yahoo.fr) CDM-DNA Coordinator Phone: +225 22 43 23 10 / +225 01 03 28 95 Fax: +225 22 43 19 57
Democratic Republic of the Congo	Ministère de l'Environnement, Conservation de la Nature et Tourisme B.P. 12348, Kinshasa 1 Republique Democratique du Congo Mr. Venan Mabiala Ma Mabiala (venanmabiala@gmail.com) Directeur de l'Autorité Nationale Désignée du Mécanisme pour un Développement Propre Phone: +243 99 99 89 917 Fax: +243 88 4 3675 (PNUD-RDC Ministère de l'Environnement, Conservation de la Nature et Tourisme B.P. 12348, Kinshasa 1 Republique Democratique du Congo Bavon N'Sa Mputu Elima (bavon_nsamputu2000@yahoo.fr) Minister Phone: +243 82 2992718 Fax: +243 88 4 3675 (PNUD-RDC)
Gabon	n.a.
Ghana	Environmental Protection Agency, Ministry of Environment, Science & Technology 91 Starlets Road, P. O. Box M326, Accra, GHANA Mr. Jonathan A. Allotey (jallotey@epaghana.org) Executive Director Phone: (233-21) 662 693 Fax: (233-221) 662 690 Ministry of Environment, Science and Technology P. O. Box M.232 Accra Ghana Mr. Peter Justice Dery (peterjdery@yahoo.com) National Climate Change Coordinator Phone: (+233) 0 302 267 3511 / 666 049 Mobile: (+233) 688 Fax: (+233) 688 913 / 662 533
Liberia	n.a.
Mali	Agence de l'Environnement et du Développement Durable (AEDD) BP 2357,

	Bamako Mali Monsieur Boubacar Sidiki Dembele (aedd@environnement.gov.ml, boubacarsdembele@gmail.com) Phone: (+223) 2023 1074 Fax: (+223) 2023 5867
Mozambique	Ministério para a Coordenação da Acção Ambiental (MICOA) Av. Acordos de Lusaka No. 2115 P.O. Box No. 2020 Maputo Mozambique Rosa Cesaltina Benedito (cesaltin@gmail.com) Phone: +258 21 46 5141 Fax: +258-21 46 6495
Togo	Direction de l'Environnement B.P. 4825 Lomé Togo M. Koffi Volley (denv_togo@yahoo.fr, koffivolley@yahoo.fr, koffivolley@gmail.com) Phone: (228) 2 221-3321/ -5197 Fax: (228) 2 221-0333
Asia & Pacific	
Cambodia	Ministry of Environment, Climate Change Office 48, Samdech Preah Sihanouk Blvd, Phnom Penh, Cambodia H.E. Thuk Kroeun Vutha (ETAP@online.com.kh, cceap@online.com.kh) Secretary of State, Cambodian Ministry of Environment Phone: (855-23)218-370 Fax: (855-23) 218 370
Fiji	n.a.
India	Ministry of Environment and Forests,Government of India Core IV B, 2nd floor, India Habitat Centre Lodhi Road, New Delhi India 110 003 Dr. A. Duraisamy (a.duraisamy19@gmail.com) Director & Member Secretary Phone: +91 11 2464 2176 Fax: +91 11 2464 2175
Indonesia	National Committee on Clean Development Mechanism BUMN Building, 18th floor, Jalan Merdeka Selatan 13, Jakarta 11110 Mr. Rachmat Witoelar (dna-cdm@dnpi.go.id) Chairperson of the National Committee on CDM of the Republic of Indonesia Phone: (62-21) 35 11 400 Fax: (62-21) 351 1403
Malaysia	Ministry of Natural Resources and Environment Level 6, Tower Block 4G3, Precinct 4, Environmental Management and Climate Change Division, Federal Government Administration Centre, 62574 Putrajaya, Malaysia Mr. Shahril Faizal Abdul Jani (faizal@nre.gov.my)

	Principal Assistant Secretary Phone: (603)8886 1137 Fax: (603)8888 4473 Ministry of Natural Resources and Environment Environmental Management and Climate Change Division Level 6, Tower Block 4G3, Precinct 4, Federal Government Administration Centre, 62574 Putrajaya, Malaysia Dr. Lian Kok Fe (drlian@nre.gov.my) Undersecretary Phone: (603)8886 1125 Fax: (603)8888 4473
Myanmar	Ministry of Forestry, Planning & Statistics Department Building No- 28, Nay Pyi Taw, Myanmar Mr. Sann Lwin (dgpsmof@mptmail.net.mm) Phone: (95-067)40 5009 Fax: (95-067)-40 5012
Papua New Guinea	n.a.
Philippines	Department of Environment and Natural Resources Environmental Management Bureau DENR Compound, Visayas Avenue Diliman, Quezon City 1116 The Philippines Mr. Juan Miguel T. Cuna (attymitchcuna@yahoo.com, emb@emb.gov.ph) Director, Environmental Management Bureau (DNA-TEC Chair) Phone: (+632) 920 2246, Fax: (+632) 928 3725, **Error! Hyperlink reference not valid.** Environmental Management Bureau DENR Compound, Visayas Avenue Diliman, Quezon City 1116 The Philippines Mr. Albert A. Magalang (albertmgg@yahoo.com) Head, Climate Change Office (DNA Forum Representative) Phone: (+632) 920 2251 Fax: (+632)928 4674
Latin America	
Colombia	Dirección de Cambio Climático, Ministerio de Ambiente y Desarrollo Sostenible Calle 37 No. 8-40 Bogota Colombia Dr. Diana Milena Rodriguez Velosa (dmrodriguez@minambiente.gov.co) Phone: (571) 332 3400 Ext: 2484, 2411 Fax: (571) 332 3607
Ecuador	Undersecretary of Climate Change of the Ministry of Environment 1159 Madrid y Andalucía Street Quito Ecuador Ms. Alexandra Buri Tene (aburi@ambiente.gob.ec) Phone: (+593) 2 3987-600 ext. 1314

Guatemala	Ministerio de Ambiente y Recursos Naturales Mr. Raúl Castañeda Illescas (ondl@marn.gob.gt) Coordinador de la Oficina Nacional de Desarrollo Limpio Phone: (502) 24 23 0500/24 23 0436 Ext.2311 Fax: (502-242) 30500 Ext. 1204 (Cell): (502) 55 899037
Guyana	n.a.
Honduras	Natural Resources and Environment Secretary (SERNA) Edificio Principal de la SERNA, 100 m al Sur del Estadio Nacional, Postal Adress: 1389 and 4710 Tegucigalpa, Honduras Dr. Rigoberto Cuellar (rigobertocuellar@hotmail.com) Phone: (504) 235 78 33 / 239 36 91 Fax: (504) 231 1918
Mexico	Comisión Intersecretarial de Cambio Climàtico Av. San Jerónimo 458, Piso 3, Col. Jardines del Pedregal, Delegación Álvaro Obregón, 01900 México, D.F. Sr. Luis Muñozcano Álvarez (luis.munozcano@semarnat.gob.mx) Coordinador del Comité Mexicano p. Proyectos de Reducción de Emisiones y Captura de Gases (COMEGEI) Phone: (52-55) 5490 2115
Panama	Autoridad Nacional del Ambiente Zona 0843 Balboa, Ancón República de Panamá Mr. Silvano Vergara (svergara@anam.gob.pa) Deputy Administrator General Phone: (507) 500 0823 Fax: (507) 500 0822 Ms. Elia Guerra (equijano@anam.gob.pa) Negotiator in International Environment Affairs Phone: (507) 500 0899 Fax: (507) 500 0822
Peru	Ministerio del Ambiente Av. Javier Prado 1440, San Isidro Lima 27 Perú Mr. Eduardo Durand López - Hurtado (edurand@minam.gob.pe, kmondonedo@minam.gob.pe) Director General de Cambio Climático, Desertificación y Recursos Hídricos Phone: (+511) 611-6000 ext. 1350 Fax: (+511) 611 6000 ext.1634
Trinidad and Tobago	Ministry of Planning, Housing and the Environment HDC Building, 2nd floor # 44 - 46 South Quay Port-of-Spain Trinidad Ms. Esmé Rawlins-Charles (Esme.Rawlins-Charles@phe.gov.tt) Permanent Secretary Phone: (868) 624 3378 Fax: (868) 625-2793

Forest definitions for the A/R CDM in ITTO Producer Members under ITTA, 2006

	Tree cover value between 10-30%	Land area value between 0,05 - 1.0 ha	Tree height value between 2-5 metres
Africa			
Benin	n.a.	n.a.	n.a.
Cameroon	n.a.	n.a.	n.a.
Congo	n.a.	n.a.	n.a.
Côte d'Ivoire	30	0,1	5
Democratic Republic of the Congo	30	0,5	3
Gabon	n.a.	n.a.	n.a.
Ghana	15	0,1	5
Liberia	n.a.	n.a.	n.a.
Mali	30	1	2
Mozambique	30	1	5
Togo	10	0,5	5
Asia & Pacific			
Cambodia	10	0,5	5
Fiji	n.a.	n.a.	n.a.
India	15	0,05	2
Indonesia	30	0,25	5
Malaysia	30	0,5	5
Myanmar	10	0,1	2
Papua New Guinea	n.a.	n.a.	n.a.
Philippines	10	0,5	5
Latin America			
Colombia	30	1	5
Ecuador	30	1	5
Guatemala	30	0,5	5
Guyana	n.a.	n.a.	n.a.
Honduras	30	1	5
Mexico	30	1	4
Panama	30	1	5
Peru	30	0,5	5
Trinidad and Tobago	10	0.4	3

ANNEX 4: PROPOSED FORMAT FOR REPORTING CARBON BENEFITS FROM ITTO PROJECTS

PROJECT IDENTIFICATION

TITLE:	
Thematic Programme (if any):	
SERIAL NUMBER:	
COMMITTEE:	
SUBMITTED BY:	
ORIGINAL:	
IMPLEMENTING AGENCY:	
COUNTRY	

SUMMARY REPORT ON CARBON BENEFITS

Reporting year	
Year of monitoring	
Year of the last monitoring (if first monitoring event, please indicate)	
Pools selected	
Total carbon benefits (in CO_{2e})	
Total changes in carbon as estimated without intervention (in CO_{2e})	
Total monitored carbon in your FMU (in CO_{2e})	
Total assumed leakage (in CO_{2e})	
Total area of the project (in ha)	
Person/entity responsible for monitoring and reporting	
Stakeholders involved in monitoring (indicating persons/groups and role in monitoring)	

BASIC INFORMATION

Land owner	
Land users	
Are there ownership or use claims	
Authorities responsible for regulating land use	
Main organizations	

INFORMATION REGARDING LAND/ACTIVITY

Total area	(number of ha)
Strata 1	(number of ha)
Strata 2	(number of ha)
Strata 3	(number of ha)
…. (for all strata)	(number of ha)

INFORMATION ABOUT EMISSION/SINK FACTORS

Carbon pools selected	
Above ground biomass (AGB)	

	Number of plots per strata	
	Sampling method	
	Frequency of measurements	
	Method/equations used in the data analysis	
Below ground biomass (BGB)		
	Number of plots per strata	
	Sampling method	
	Frequency of measurements	
	Method/equations used in the data analysis	
Dead wood		
	Number of plots per strata	
	Sampling method	
	Frequency of measurements	
	Method/equations used in the data analysis	
Litter		
	Number of plots per strata	
	Sampling method	
	Frequency of measurements	
	Method/equations used in the data analysis	
Soil organic carbon (SOC)		
	Number of plots per strata	
	Sampling method	
	Frequency of measurements	
	Method/equations used in the data analysis	

INFORMATION ABOUT LEAKAGE

Option selected (from the guidance)	
Reasons	
Documentation of the reasons	

INFORMATION ABOUT QUALITY CONTROL

Documentation available	
Where are these documents/information? (electronic data or hard copies)	

ANNEXES

Maps, users declarations, certificates, publications, ...