Afforestation and Reforestation Projects under the Clean Development Mechanism

A Reference Manual

A manual synthesizing the requirements in respect of the project cycle, project documentation, project validation and registration, and monitoring and verification of afforestation and reforestation project activities under the clean development mechanism of the Kyoto Protocol.

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A Reference Manual

UNFCCC Secretariat

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Contents

Abbreviations and acronyms

CME	coordinating and managing entity (of a PoA)
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CPA	component project activity (of a PoA)
CPA-DD	component project activity design document
DBH	diameter at breast height (of a tree)
DNA	designated national authority
DOE	designated operational entity
DOM	dead organic matter
FAO	Food and Agricultural Organisation (of the United Nations)
GHG	greenhouse gas
GIS	geographical information system
GPS	global positioning system
IPCC	Intergovernmental Panel on Climate Change
lCER	long-term certified emission reduction
LoA	letter of approval
ODA	overseas development assistance
PDD	project design document
PIN	project idea note
PoA	programme of activities
PoA-DD	programme of activities design document
QA	quality assurance
QC	quality control
SI	Sytème international (of units)
SOC	soil organic carbon
SSC A/R	small-scale afforestation and reforestation
tCER	temporary certified emission reduction
tCO_2	tonne carbon dioxide
tCO_2e	tonne carbon dioxide equivalent
UNFCCC	United Nations Framework Convention on Climate Change

Units of measurement

ft	foot
lb	pound
t	tonne (metric)
m	metre
ha	hectare

Chapter 1. Introduction

Summary. This chapter explains the organization and structure of the manual. It also describes the regulatory documents of the clean development mechanism (CDM) as they apply to afforestation and reforestation project activities. The user is also guided on how to access these documents on the official website of the CDM.

1.1 Structure of the manual

The manual consists of six chapters and three appendices. Following the present introductory chapter, Chapter 2 provides an overview of the clean development mechanism (CDM) and explains how afforestation and reforestation (A/R) projects under the CDM can be leveraged as an opportunity for conservation and sustainable management of forest and land resources in the developing countries. Chapter 3 explains the CDM project cycle that project participants and other stakeholders are expected to follow while undertaking CDM project activities. Chapter 4 describes the structure of the project design document (PDD) and explains how to develop and complete this key document while ensuring that the requirements contained in the CDM regulatory documents are consistently met. This is the most important chapter and constitutes a major part of this manual.

Chapter 5 explains the requirements to be followed in monitoring and verification of registered A/R CDM project activities. Monitoring and verification is the last stage in the CDM project cycle and it results in issuance of credits when successfully completed.

Chapter 6 explains the CDM programme of activity, how it situates with respect to individual project activities, and the requirements specific to it.

Appendices A, B and C provide specific information aimed at assisting the user in advancing his understanding of the features of an A/R CDM project activity. A full-length example illustrating design and development of the essential elements of a an A/R CDM project activity is provided in Appendix A. A study this example will be very helpful to the user interested in understanding and

applying the A/R CDM rules and regulations in the context of a real-life project. Appendix B provides a glossary containing the definitions of key CDM terms related to A/R CDM project activities. Appendix C provides a full list of the regulatory documents that should be of interest to developers of A/R CDM project activities. The reference numbers cited in the margin of the manual are the numbers contained in this appendix.

1.2 Source documents and how to access these

The regulatory documents from which requirements have been synthesized in this manual can be accessed online in the CDM section of the public website of the UNFCCC. A user visiting the CDM website will notice that presentation of documents is organised into different sections as described below.

Governance
Under this section are grouped the documents, meeting schedules, and other information related to the Executive Board of the CDM, its panels and working groups, the designated national authorities (DNAs) of the Parties to the Kyoto Protocol, and the accredited validators and verifiers of projects (called the designated operational entities or DOEs). The interested user will also find information on the terms of reference of the panels and working groups and list of currently serving members. The schedules of the forthcoming meetings and reports of the past meetings of the Board and the panels and working groups are also available in this section.

Rules and Reference
This section of the website contains the regulatory documents approved by the Board. The documents are further grouped by categories. This is the most important section for a prospective project developer. Major categories of documents are described below in some detail.

Standards
Standards are documents containing mandatory requirements that must be met by CDM projects. Standards can be further divided into sub-categories for facilitating their understanding:

Framework standards. These regulatory documents contain the requirements that must be met by all CDM project activities. The requirements which are mainly addressed at the project developers are contained in the *Clean Development*

Mechanism Project Standard, while those mainly addressed at the designated operational entities (DOEs) are contained in the *Clean Development Mechanism Validation and Verification Standard*.

Methodologies. These regulatory documents contain the requirements that must be met by the projects employing specific means to achieve greenhouse gas (GHG) emission reductions or removals. The provisions in the methodologies are mainly of scientific and technical nature although methodologies may further elaborate other requirements already contained in the *Project Standard*.

Example. The document "AR-AM0014 - Afforestation and reforestation of degraded mangrove habitats" is an A/R CDM methodology which contains requirements relating to A/R CDM projects implemented in degraded mangrove habitats.

Tools. These regulatory documents contain the requirements that must be met while applying a specific module, method, or routine contained in a methodology. Tools are extensions of the methodologies. It is possible that a given tool be used in several methodologies, whereas a methodology is often based in part on a number of tools.

Example. The document "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" is an A/R methodological tool that contains requirements for quantification of carbon stocks and changes in carbon stocks in the above-ground and below-ground carbon pools.

Procedures

Documents under this category contain process-related requirements that must be met by the project developers, the DOEs and other stakeholders. These are sometimes called procedural standards. The process-related requirements addressed mainly at the project developers and the DOEs are contained in the *Clean Development Mechanism Project Cycle Procedure*.

Example. The document "Development, revision and clarification of baseline and monitoring methodologies and methodological tools" is a procedure specifying procedural requirements be followed by stakeholders while requesting a revision of, or a clarification on, the requirements contained in a methodology or a tool.

Guidelines
Documents under this category contain supplemental information such as acceptable methods for satisfying requirements contained in standards or for filling out forms. Guidelines promote a uniform approach to compliance of requirements contained in the standards or procedures. Guidelines themselves are not a part of the mandatory requirements.

Example. The document "Guidelines on accounting of specified types of changes in A/R CDM project activities from the description in registered project design documents" provides supplemental information in respect of general requirements to be met in post-registration changes as contained in the *Project Standard*.

Clarifications
Documents under this category contain interpretations that remove ambiguities in understanding of the provisions contained in regulatory documents. Clarifications are transitory in nature and exist as stand-alone documents only until their content is incorporated into the revised version of the relevant regulatory documents.

Forms
Forms are documents with pre-defined fields to be filled in by project participants or DOEs in the process of putting together the data and information. Forms do not contain additional regulatory requirements in themselves but assist the stakeholders in consistently ensuring that the regulatory requirements applicable to their projects have been met.

Example. The document "F-CDM-PDD - Project Design Document form" is the form which should be used for preparing a project design document.

Methodologies
While the section "Rules and Reference" of the website contains the approved regulatory documents including all the approved methodologies, this section of the website contains both the approved methodologies and the methodologies that are in the process of being considered for approval by the Board. The user note that the same approved methodologies can be accessed under both the sections "Rules and Reference" and "Methodologies".

Project Cycle Search
This section contains a searchable database of registered CDM projects. Users interested in development of CDM projects may find it useful to download the project design documents (PDDs) of registered projects in order to obtain a better appreciation of content of the PDDs that have already been successfully registered.

CDM Registry
This section contains information on issuance of certified emission reductions (CERs) in favour of successful projects. The section includes a database of the CERs issued. Interested users may find information about how CREs are generated and used under the CDM.

Stakeholder Interaction
This section describes the processes of stakeholder interaction under the CDM. Specific channels for communication with the Board are described here. Information on workshops and other opportunities for participating in development of the rules and regulations of the CDM are also listed here.

1.3 How to use this manual

This manual synthesises the requirements relating to the CDM project cycle, preparation of a project design document (PDD) for A/R CDM project activities or programme of activities, and the monitoring requirements to be met by such project activities. The manual can be used as a reference, but the readers who are not familiar with the rules and regulations of the CDM will benefit most if they first reads the manual from start to end, and then focus on specific areas of their interest. The manual can also be used as resource material in training and capacity building activities.

While using this manual for development of actual projects, the reader should consult the latest versions of the regulatory documents which are referenced in this manual and a full list of which is provided in Appendix C.

Chapter 2. The Clean Development Mechanism and Forest Conservation

Summary. The clean development mechanism (CDM) presents a valuable opportunity for development and conservation of forest resources in the developing countries while contributing to the global cause of climate change mitigation. Afforestation and reforestation activities not only contribute to local, regional, and national economies but also generate local, national, and global environmental and social benefits. The recognition of the 'carbon services' provided by forests is an important milestone in recognition of the global values created by local resources. The CDM presents a valuable opportunity to the forest owners, the forest departments, and forest dependent communities in the developing countries for creating win-win partnerships while responding to the global challenge of climate change mitigation.

2.1 The Clean Development Mechanism

The clean development mechanism (CDM) is one of the three 'flexibility mechanisms' defined under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC). The CDM allows public and private entities from the industrialized countries (the Annex I Parties) to finance emission reduction activities in the developing countries (the non-Annex I Parties). The Annex I Parties, or the entities authorized by them, can purchase certified emission reductions and utilize these for meeting the emission reduction commitments of the Parties under the Kyoto Protocol. In the process, the developing countries get access to finance from the developed countries for steering their economic development on a less carbon intensive path while strengthening the elements of sustainability in their economic development.

The Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (the CMP) established the regulatory

framework for the CDM by agreeing to the 'modalities and procedures' of the CDM. These modalities and procedures were later on elaborated into detailed CDM rules and regulations by the Executive Board of the CDM (the Board).

The CDM is a project-based mechanism. An emission reduction project activity is defined as a set of interventions, or actions, to be implemented over a definite period of time. Project activities can be undertaken by private or public entities, including individuals and private businesses, called 'project participants'. A project may involve participation of entities from one or more Annex I Parties in addition to the entities from the non-Annex I Party hosting the project (the host Party).

A project activity under the CDM must demonstrate that it actually achieves GHG emission reductions or removals that are real, measurable, and verifiable. The project activity must also demonstrate that it requires additional effort, in terms of financial investment or other resources, in order to get implemented. The 'enablement' of the project activity must be attributable to the carbon revenue that the investor hopes to generate from the sale of the 'carbon credits'.

2.2 The CDM as an opportunity for reforestation of degraded forest lands

Afforestation and reforestation project activities contribute to climate change mitigation by capturing ('bio sequestering') the atmospheric carbon and locking it into the living and dead biomass in the ecosystem (e.g. tree biomass, soil organic carbon). Private and public entities in developing countries who own, manage or control land resources that do not have forests or have very low stocking of forests, can propose afforestation and reforestation (A/R) project activities under the CDM that would increase productivity of the forest and land resource and at the same time earn revenue from carbon credits in lieu of the global environmental service rendered by their resource.

In many developing countries in large areas of public lands are lying barren or being put under marginal use. These lands are legally classified as forest lands (i.e. the lands are reserved for forestry purposes), or are set aside as commons earmarked for providing ecological protection (e.g. protected watersheds, biodiversity or nature reserves) or community services (e.g. grazing

commons). Whatever may be the legal provisions that regulate land-use of such lands, the final objective, in law or policy, is to keep these lands under forest cover or some other form of perennial vegetation cover.

Figure 2.1 Restoration of tree-cover on steep slopes is critical for ensuring services provided by the watershed (e.g. provision of water resources, flood-control, and protection of soil)

In the developing countries which are Parties to the Kyoto Protocol, the degraded forest lands and other commons having vegetation below the national definition of forest under the CDM are eligible to be reforested under the CDM if these were already deforested on 31 December 1990.

Reforestation of these degraded forest lands and other commons is hindered by lack of availability of budgetary finance, low economic returns, and lack of entrepreneurial and managerial capacity at the level of the local communities and public service entities. Budgetary provisions for reforestation of lands, both in the national budgets and in the provincial or municipal budgets, are either absent or far inadequate. Private sector investment is not likely to be available for reforestation of these lands because private rights over public lands cannot be legally acquired or because the low productivity of these lands does not assure adequate return on investment. However, these lands can be reforested by the local communities, or local public service entities, if adequate support in

terms of capacity building and initial finance is provided to them. The CDM presents an opportunity for securing this additional financial support if the local public entities or local communities are encouraged to undertake reforestation of the commons.

Ownership and implementation of reforestation projects by local communities and local public service entities can have several add-on advantages (co-benefits). Direct flow of benefits of reforestation to the local entities would result in stronger engagement of the entities and would enhance the sustainability of forest resources resulting in long-term flow of carbon and non-carbon revenues. Benefits in terms of non-timber forest produce flowing at an early stage in a reforestation project would make the project more interesting to the communities whereas a commercial investor would only be interested in the final harvest.

Seen in this backdrop, the CDM is a valuable opportunity for the local communities as well as the host Party countries since it leverages the value of global environmental service (carbon service) for the purpose of overcoming the barriers faced by local communities. The CDM is not only a near-global instrument in its geographical coverage of the developing countries, it also has advantages over other sources of external finance such as overseas development assistance under the traditional development cooperation programmes (*see* Box 2.1).

Box 2.1: CDM vs. other opportunities for reforestation

A comparison of the financial incentive under the CDM with other financing opportunities available for reforestation of degraded forest lands, e.g. overseas development assistance (ODA) schemes, reveals that the CDM is more attractive than the alternative.

ODA	CDM
1. Opportunities of getting funds under ODA schemes are limited, as there is a great deal of competition for these funds.	1. The CDM being a market mechanism, there is no limit on amount of funds available, and everyone stands an equal chance of benefitting from this mechanism.
2. ODA schemes are negotiated at the level of governments and it is not realistic to expect that local communities influence decisions relating to ODA schemes.	2. A CDM project can be developed by any entity—private or public. The role of government is limited to confirming that the project furthers sustainable development objectives of the host country.
3. Funds are either a grant or a loan accepted by the national government. Funds are transferred to the local communities as grants, often with conditions originally determined by the donors.	3. The CDM revenues are not a grant; these are earned by the project participants for the environmental services provided by their projects. There are no conditions attached to utilization of the CDM revenues.
4. The role of local communities is limited to making a request and lobbying for getting a project in their region.	4. Communities can develop projects on their own. They need not depend upon anyone else.
5. Many ODA schemes provide only loan and this creates a long-term repayment liability for the host country, often leading to increased external debt.	5. Revenues from sale of CERs under the CDM are resources earned by the communities. Since there is no loan involved, there is no erosion of earnings because of interest liability. No long-term repayment liability is created for the host country.

2.3 A/R CDM projects registered under the CDM

Afforestation and reforestation projects under the CDM have already shown their feasibility. There were 88 A/R CDM project activities at various stages of the project cycle on 31 July 2013, out of which 45 were already registered. Of the registered project

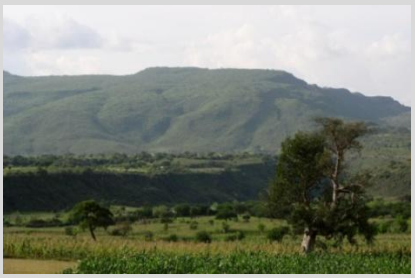
activities, eight had successfully secured their first issuances amounting to 6.7 million tCERs.

Box 2.2 Humbo Reforestation Project

Over-exploitation of forest resources and resulting deforestation in Humbo district in southern Ethiopia had brought a population of 65,000 to the brink of famine. Depletion of forest cover had resulted in scarcity of drinking water, rapid decline in agriculture productivity and high vulnerability to natural disasters. In response to this situation, the *Humbo Ethiopia Assisted Natural Regeneration Project* under the CDM (Project #2712, registered on 07 Dec 2009) was developed with the financial assistance of the BioCarbon Fund of the World Bank. Collaborative efforts involving newly established forest cooperatives of local communities, the Ethiopian Forestry Department and the humanitarian organization World Vision Ethiopia resulted in restoration of 2,700 ha of natural forests under the banner of the project. Successful verification and certification secured by the project resulted in issuance of 73,339 tCERs in favour of the local communities. Part of the tCERs generated under the project were agreed to be purchased by the BioCarbon Fund. It is estimated that over its crediting period of 30 years (from 01 Dec 2006 to 30 Nov 2036) the project will bring estimated carbon revenue of US$700,000 to the local communities. Further revenue will be generated from the sale of the remaining carbon credits not purchased by the World Bank and from the sale of timber products from the project. The co-benefits of the project include socioeconomic and environmental benefits of which the value is likely to be much larger than the monetized revenue. [Source: The *BioCarbon Fund* of the World Bank]

Before

After



Although sequestration of carbon in biological systems takes long time to achieve, these examples of successful projects demonstrate that bio-sequestration can achieve the twin objectives of climate change mitigation and sustainable development.

Chapter 3. The CDM Project Cycle

Summary. Project activities under the CDM must go through a transparent validation, registration, monitoring and verification process designed to ensure real, measurable and verifiable emission reductions. To this end, the regulatory framework of the CDM prescribes specific actions to be undertaken by specific stakeholders in the process of design and implementation of a CDM project activity. The CDM project cycle defines the roles and responsibilities of the stakeholders and lays down the time limits to be respected by the stakeholders and the governance actors. It is important for a project developer to be familiar with the procedural regulations underlying the CDM project cycle. This chapter provides a concise description of the CDM project cycle.

3.1 Initial project planning

At the initial planning stage the project developer should assess the feasibility of his project activity by documenting it in a project idea note (PIN). This part of the process cycle is not a formal requirement under the CDM, yet it is highly desirable to consider it so as to avoid committing significant resources to a project idea that at a later stage turns out to be infeasible or unsuitable for the CDM. The eligibility of the land to be afforested or reforested, the eligibility of the host Party to participate in the CDM, and the overall financing of the project are among the basic issues that should be considered at the initial planning stage. Consideration should also be given to how the project would increases net GHG removals and by what amount, how significant would be the impact of the potential carbon revenue on the project, and how the project would sustain itself in the long term. Issues of ownership of land and title to forests and carbon stocks in these lands should be clarified at this stage. The initial planning phase would also be very useful if the project developers intend to propose the project to a financer.

Box 3.1 The project idea note

Preparation of the project idea note (PIN) is not a formal requirement under the CDM rules, although other supporting entities may require a PIN. When required by such entities, the PIN should be prepared in the specific format prescribed if any. For example, the DNA of the host Party may issue a (preliminary) letter of approval (LoA) on the basis of a PIN which would be very useful since if the LoA is requested on the basis of a fully prepared project design document (PDD) and is denied, this can result in wasted resources. The financing institution or a purchasing entity may also require a PIN if an advance understanding or agreement is to be reached. The PIN is a concept note which describes how the proposed project activity meets, or expects to meet, the essential requirements of the CDM. Description or information on the following aspects of the proposed project activity are often provided in the PIN: eligibility of the host Party country for participating in the CDM, eligibility of the project activity, how the project intends to achieve net anthropogenic GHG removals by sinks, where is it located, who are the project participants, how is it going to be financed, how is the additionality of the project to be demonstrated, whether it qualifies as a small scale or a large scale CDM project, whether the project is proposed as a stand-alone project activity or forms part of a wider programme of activities, whether an approved CDM methodology will be applied or a new methodology is being proposed, what carbon benefits and non-carbon benefits are expected, who will be the main stakeholders, whether it could create positive or negative socioeconomic and environmental impacts and how the negative impacts might be contained or mitigated.

3.2 Preparation of the project design document (PDD)

The project design document (PDD) is the pivotal document on which development and operation of a CDM project activity is based. This document must be prepared in the prescribed format available on the CDM website. Preparing this document will require the project developer to collect all the necessary information relating to the project, and hence this can be the most time consuming and resource-intensive step in the project cycle. Detailed description of development of the PDD is provided in Chapter 4.

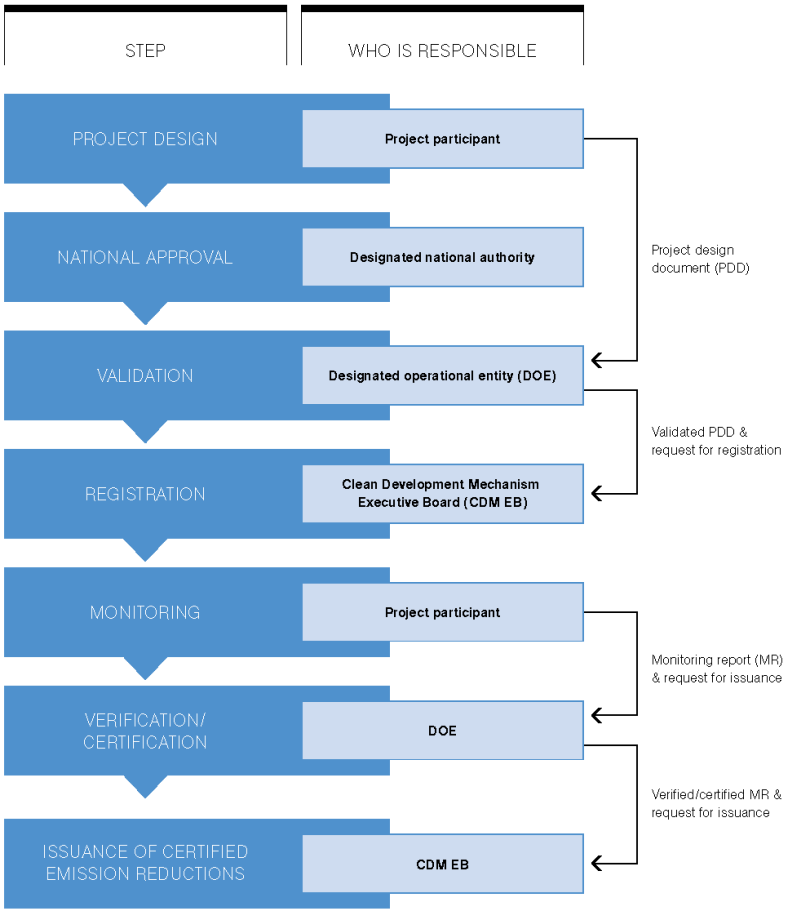


Figure 3.1 CDM project cycle

3.3 National approval

A written letter of approval, confirming voluntary participation, from the designated national authority (DNA) of each Party involved is a pre-requisite for registration of a CDM project activity. The same letter can concurrently authorize the respective entities to participate in the project activity. In case of the host Party, the letter should also confirm that the project contributes to sustainable development in the country.

Although this phase of the project cycle is short and should not require significant resources from the project developers, they should be aware that this phase is dependent upon the national arrangements within the organisation or the authority acting as the DNA.

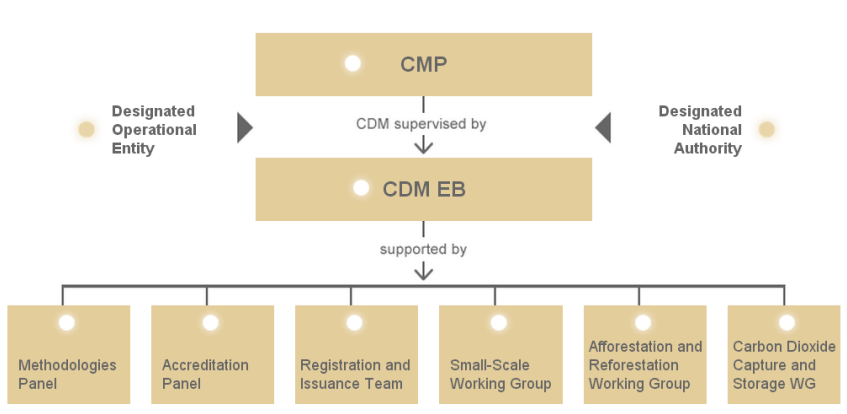
3.4 Project validation and registration

When the project design document has been completed in all respects it is submitted, along with the required letters of approval from the DNAs of the Parties involved, to a designated operational entity (DOE) for validation. The DOE assesses the documents against the CDM requirements and may ask for further information to satisfy itself that the contents of the PDD are adequate and are supported by justificatory evidence. The DOE then publishes the PDD by uploading it on the official website of the CDM and invites comments from stakeholders. This process of local stakeholder consultation lasts for four to six weeks. After the stipulated period of time has elapsed since uploading of the PDD, the project developer prepares a summary of the comments received, along with a report on how due account was taken of the comments, and furnishes the report to the DOE. This action may necessitate modification or revision of the PDD in order to address the concerns raised by the stakeholders.

Once the process of local stakeholder consultation is complete, the DOE forwards the PDD, along with the letters of approval and the report on the local stakeholder consultation, to the CDM Executive Board through the UNFCCC secretariat, recommending that the project be registered as a CDM project activity. The secretariat processes the request for registration according to the applicable procedures and makes the request for registration, along with all the documents, publicly available on the official website of the CDM. This qualifies as submission of the request for registration for consideration by the Board. The project activity is deemed to have been registered unless a request for review is received from the DNA of a Party involved in the project activity or at least three members of the Board within a period of 28 days from the date of making it public. The detailed requirements relating to submission of a PDD for registration, processing of the documents by the secretariat and consideration by the Board are laid down in the *Clean development mechanism project cycle procedure* (the PCP)

Box 3.2 CDM governance structure

The Executive Board of the CDM is responsible for supervising the CDM under the authority and guidance of *the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol* (the CMP). The Board develops and elaborates the rules and regulations governing the CDM and is the ultimate point of contact for CDM project participants for registration of projects and issuance of certified emission reductions. The Board is assisted in its functions by a support structure comprising of independent auditors and verifiers, known as the designated operational entities, (DOEs) and committees, teams, panels and working groups of experts. The Board is serviced by the UNFCCC secretariat.



3.5 Monitoring, verification and certification

Once a registered project has been implemented by the project participants and sufficient emission reduction or removal has been achieved, the project participants are required to prepare a monitoring report in accordance with the monitoring plan contained in the registered PDD. The monitoring report is based on actual data relating to the performance of the project. It provides evidence of the emission reductions or removals achieved by the project. The monitoring report is submitted to a DOE contracted by the project participants for the purpose of its verification and certification. The DOE makes the monitoring report publicly available on the official website of the CDM and undertakes a review and assessment of the monitoring report to ensure that the report is in accordance with the requirements contained in the registered PDD. The DOE conducts on-site inspections, as appropriate, and test-check the data underlying the monitoring report. Having satisfied itself of the

adequacy of the monitoring report as an evidence of the emission reductions or removals claimed by the project participants, the DOE prepares a verification and certification report which is made publicly available on the official website of the CDM.

Box 3.3 Validation, verification and certification

The terms validation, verification and certification have precise meanings under the CDM. These terms are defined in the high level documents called the CDM 'modalities and procedures'. Validation is the process of independent evaluation of a proposed project activity by a designated operational entity (DOE) against the CDM requirements on the basis of the design of the project. Verification is the periodic independent review and ex-post determination by the DOE of the emission reductions or removals achieved through implementation of the project activity. Certification is the written assurance by a DOE that a project activity achieved the emission reductions or removals, as verified.

Thus validation confirms that the design and specifications of a proposed project activity are fit for the purpose of the CDM. Verification confirms that the design and the specifications were actually followed in the implementation of the project activity. Certification confirms that the verification was actually carried out by the DOE under its own responsibility.

While validation of a CDM project activity largely concerns itself with the baseline of the project activity and takes an ex-ante view of the project activity itself, verification largely concerns itself with the implementation of the project activity and takes a counterfactual view of the baseline. The baseline is usually not subject to verification since it is no longer accessible after implementation of the project. At the time of verification, the baseline only serves as the datum with which to compare the actual emissions or removals realized under the project.

3.6 Issuance of tCERs or lCERs

The DOE, having verified and certified the emission reductions or removals achieved contained in the monitoring report, submits a request for issuance of CERs to the secretariat. The secretariat processes the request for issuance according to the applicable procedures and makes the request for issuance, along with the relevant documents, publicly available on the official website of the CDM. This qualifies as submission of the request for issuance for consideration by the Board. The request for issuance is deemed to have been agreed by the Board unless a request for review is received from the DNA of a Party involved in the project activity or at least three members of the Board within a period of 28 days from

the date of making it public. The detailed requirements relating to submission and processing of a request for issuance are laid down in the *Clean development mechanism project cycle procedure* (the PCP).

Chapter 4. Developing a project design document

Summary. The project design document (PDD) is the key document around which all actions and processes related to a CDM project revolve. The PDD defines the project activity and explains how it proposes to achieve the emission reductions or removals and by what estimated amount. It describes the project background, its objectives, and its benefits and impacts other than emission reduction benefits, particularly the socioeconomic and environmental benefits. It also explains how the project aims to contribute to the sustainable development objective of the host Party. Preparation of the PDD is the most important step in undertaking a CDM project activity. This chapter describes in a step-by-step manner the process of developing a PDD for an A/R CDM project activity.

4.1 Preliminary considerations

Before project developers commits further resources in preparation of an A/R CDM project design document, they should consider early on the two important requirements that any CDM project activity must meet: eligibility and additionality.

4.1.1 Eligibility of the project

Eligibility of a proposed project as a CDM project activity is an important consideration that should be examined at the feasibility stage of project development. Doing so will avoid commitment of further resources to a project that might later on be found ineligible as a CDM project. The rules of the CDM closely define the eligibility of a project as an A/R CDM project activity, as explained below.

Participation eligibility of the host Party

An afforestation and reforestation project activity is eligible as an A/R CDM project activity only if it is implemented in a non-Annex I Party to the Kyoto Protocol that has reported to the Executive Board of the CDM the minimum threshold values of land area, tree crown cover and tree height for defining forest for the purpose the CDM. The project developers may check the status of

this requirement for a party either by contacting the DNA of the Party or by consulting the official website of the CDM under the section *Governance: National Authorities*. By entering the name of the country in the appropriate search field on this page, the user will be able to access the necessary information.

Land eligibility

Only those lands are eligible for afforestation and reforestation project activities under the CDM which were already deforested on or before 31 December 1989. Land that was forested on 31 December 1989 but was deforested thereafter is not eligible for A/R CDM project activities. Assessment of eligibility on this criterion should be carried out by using the definition of forest adopted by the host Party for the purpose of the CDM. The A/R CDM methodological tool *Demonstration of the eligibility of lands for afforestation and reforestation CDM project activities* should be applied to check whether the land proposed to be afforested or reforested meets the requirements in this respect or not.

Activity eligibility

The proposed project activity must result in establishment of forest, or have the potential of establishing forest, as defined by the host Party. This eligibility is specific to the host Party. Thus, *for example*, a project activity of revegetation of river banks with perennial vegetation including trees having a potential of reaching a height of 3 meter at maturity might not be eligible as an A/R CDM project activity in one host Party but it might be eligible in another host Party. The activities of 'afforestation' and 'reforestation' have identical CDM requirements and the distinction between the two is not of material importance.

Eligibility in terms of the start date

A project activity under the CDM should meet requirements in respect of its start date. While implementation of a project activity normally starts after its registration, a project activity that started before its registration may also be eligible if the project developers can demonstrate that the CDM benefits were considered necessary in the decision leading up to starting of the project activity. Project developers should consider the relevant provisions of the *Clean development mechanism project standard* in order to assure themselves that their project responds to the requirements concerning 'prior consideration of the CDM', in cases of pre-dated projects.

Box 4.1 Forest, afforestation, reforestation and deforestation under the CDM

The CDM inherits the same definitions of forest-related terms that apply under other articles of the Kyoto Protocol. It is important to understand that a 'Kyoto forest' is not a forest in the usual 'functional' sense; it is defined purely on the basis of physical characteristics of the vegetation irrespective of its intended use. In usual sense of the word, a 'forest' is tree-dominated vegetation that serves specific functions (e.g. timber production, recreation, wildlife habitat), and therefore neither an orchard of fruit trees nor a road-side avenue of trees is understood as 'forest'. Under the CDM, however, each of the following examples of vegetation may or may not qualify as 'forest' depending upon the threshold values selected by the country in which the vegetation is located: (i) A rangeland or savannah consisting of grasses, shrubs and trees that are spaced far apart (e.g. 200 trees per hectare); (ii) A horticultural orchard; (iii) Perennial vegetation established for protecting river banks; (iv) A dwarf mangrove forest; (v) A road-side avenue of trees; (vi) A house garden; (vii) A farm with agroforestry. Further, under the CDM it is possible to 'reforest' a degraded forest area, which in the usual forest management terms can only be 'restored'. This is so because when the vegetation in a degraded forest area has gone below the threshold values for defining forest, the area is said to be 'deforested' in CDM terminology. Deforested land can only be reforested, not restored.

A mangrove forest, rich in carbon stocks, may not qualify as forest if the country in which it is located selects a tee height that is not reached by the particular species of mangrove trees.

4.1.2 Additionality of the project

An A/R project activity under the CDM must demonstrate that it results in *real* net anthropogenic GHG removals by sinks. Further, it must demonstrate that *additional* effort in terms of financial investment or other resources is necessary for the project activity to be implemented.

Project achieves real net GHG removals

The first requirement is that the project activity is not a 'null' activity; that is, it achieves real 'net anthropogenic GHG removals by sinks' relative to the 'business as usual' scenario (called the 'baseline scenario'). In the case of A/R CDM project activities with the baseline 'continuation of the pre-project land-use scenario' this requirement is automatically met for all eligible project activities, since raising tree crown cover from less than the threshold value to more than threshold value is expected to increase the carbon stocks in the above-ground biomass pool.

Project needs financial incentive under the CDM

The project activity must be in need of additional resources and it should be possible to cover this resource gap with the expected CDM revenue. That is, the financial incentives expected from carbon credits under the CDM must be demonstrated to be both necessary and sufficient for the project activity to be implemented. Thus the difference made by the financial incentives expected from carbon credits must be shown to be a decisive factor in enabling the project activity. Project developers may demonstrate this fact either by applying an approved A/R CDM methodology or by applying another approach of their choice in which case they must propose a new methodology along with their project proposal.

4.2 Completing the project design document form

Once the project developers have assured themselves that their planned project activity meets the essential criteria mentioned above, they should proceed with acquisition of the necessary data, evaluation of the data, and formulation of the project design document (PDD).

The PDD should be prepared by using the latest version of the officially approved PDD form which, in MS Word or PDF format, can be downloaded from the official website of the CDM. The PDD forms for large-scale and small-scale A/R CDM project activities are different and the form that is appropriate for the planned project activity should be used.

Box 4.2 Small-scale A/R CDM project activities

A/R CDM project activities that are expected to result in net anthropogenic GHG removals by sinks of less than 16,000 tCO_2 per year qualify as 'small-scale afforestation and reforestation (SSC A/R) project activities. The SSC A/R CDM project activities must be developed or implemented by 'low-income communities and individuals as determined by the host Party'. If an SSC A/R CDM project activity results in net anthropogenic GHG removals by sinks greater than 16,000 tCO_2 per year, the excess removals are not eligible for the issuance of tCERs or lCERs.

The requirements in respect of SSC A/R CDM project activities are less stringent than those for large-scale A/R CDM project activities in the following respects: (i) The same DOE who validates a project activity can also perform verification and certification; (ii) The baseline scenario is deemed to be the continuation of pre-project land-use scenario; (iii) Additionality can be demonstrated by showing that the project faces one or more barriers from a list of barriers contained in the appendix of the methodology; (iv) Several project activities may be bundled for the purpose of validation, although the size of the bundle must remain within the limit of 16,000 tCO_2 per year; (v) An overall monitoring plan may be proposed for a bundle of project activities; (vi) project activities attract reduced registration fee and share of proceeds to cover administrative expenses.

Local communities can propose small-scale A/R CDM project activity which can create employment, provide minor forest produce and ecological services, and improve environmental conditions.

The following sub-sections describe how the various fields in the PDD form should be filled and how the necessary requirements

should be demonstrated to have been met. Some sections of the PDD only require data or description. Other sections require analytical justification to demonstrate that the proposed project activity meets the requirement under that section. The level of details to be presented is indicated in what follows, but the project developers should also keep their specific project circumstances in view while completing these sections.

4.2.1 Description of the project activity

This section of the PDD form should provide a brief description of the overall objectives of the afforestation or reforestation project activity, including an overview of the location of the lands and the prevailing ecological conditions of those lands. It should explain how the project intends to achieve the objective of GHG removals. The project developer should fill in the information keeping in view the specific circumstances of the proposed project activity as well as the information that is required to form a reasonable view of the proposed project. The information in this section is divided into sub-sections described below.

Purpose and general description of the project activity

This sub-section should contain an overall introduction ('executive summary') of the project activity. It synthesizes what is presented in greater detail in the succeeding sub-sections. A brief description of the project activity and its purpose should be presented. A brief description of the present and past land-use activities and the baseline land-use scenario should also be provided. The estimated net anthropogenic GHG removals by sinks expected to be achieved over the crediting period of the proposed project activity should be mentioned. A brief description of how the project activity contributes to sustainable development in the host Party country should also be provided.

Location of the project activity

This sub-section should describe the location of the lands where the project activity it to be implemented, indicating the administrative unit in which the lands are situated as well as geo-referenced coordinates or other information that enables delineation of each discrete area of land included in the project boundary. A map showing at least the outer boundary of the project activity (e.g. an index map) should be included. Where relevant, additional background information and data can be included in an appendix. The fields under the sub-section should contain clear and unambiguous information as indicated below.

Host Party. Write the full official form of country name (English version) of the host Party.

Region/State/Province etc. Write the full name of the state or province, as appropriate. This could be the name of a district, county or circle where no other intermediate administrative units exist between the country and the town.

City/Town/Community etc. Write the name of the town, city or commune within the territorial jurisdiction of which the lands fall. If the project lands span across a number of jurisdictions, list all the jurisdictions.

Geographical location. Describe the location of the lands in terms of the geographical features (e.g. rivers, ridges, watersheds, roads, highways) that can serve as a reference for locating the lands.

Geographical boundaries. Describe the geo-referenced coordinates (e.g. latitudes and longitudes) of the corners of the polygons delineating discrete areas of land to be included within the project boundary. The geo-referenced coordinates can be derived from GPS handsets or by interpolation on gridded topographic maps. The objective of these coordinates is to delineate boundaries and identify the parcels of land and not to determine areas, in hectare, of the parcels, although the project developers can also determine the areas of parcels if the data used has the required precision. For mapping purposes alone, values of latitudes and longitudes with a precision of 15 seconds is adequate. In case this data is too voluminous to be conveniently presented in the PDD, the data can be presented in an appendix, and where it is too voluminous to be presented in an appendix, the data can be presented in an electronic file (e.g. a spread sheet, a collection of GIS files).

Environmental conditions

This sub-section should provide a description of the present environmental conditions in the project area, including climate, soils, terrain, hydrology, and ecosystem. The information on climate should include temperature (in degree Celsius, annual average, averages of daily maxima and minima); precipitation (in millimetre, annual average, monthly averages); extreme weather events (severity and frequency of storm, frost, drought, floods, fire). The description of hydrology of the area should provide information

on pattern of surface drainage, hydraulic soil erosion, and occurrence of flooding and water-logging. Ecosystem description should indicate the broad ecosystem type (e.g. terrestrial, upland, mountain, lowland, wetland, aquatic inland, marine, built-up or urban, agro-ecosystem) as well as specific features such as presence of endemic biodiversity or species richness, presence of rare and endangered species and their habitat, existing and past vegetation types and their condition; history of human activities in the ecosystem and use of ecosystem resources (e.g. timber harvesting, fuel-wood collection, grazing, controlled burning, cropping), disturbance or degradation of the ecosystem. The description of soils should include information on soil characteristics such as soil type (e.g. mineral or organic, the WRB reference soil group), soil fertility, soil depth, presence of soil erosion, contamination, salinity and acidity, and presence of desertification or waterlogging trends. Description of land use and management history should include information on intensity and frequency of ploughing, and type and level of nutrient inputs (e.g. return of crop residues, addition of manure, use of synthetic fertilisers).

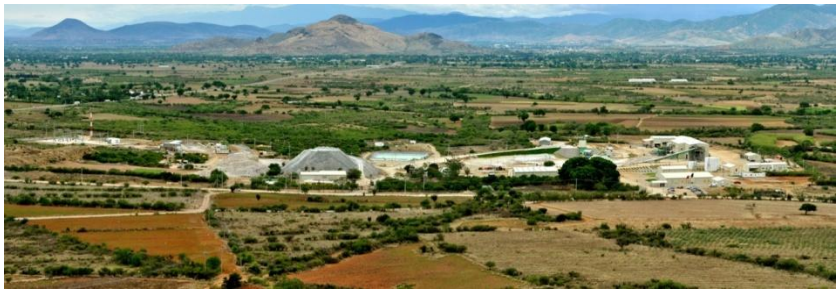


Figure 4.1 Land-use activities and ecosystem health are important determinants of terrestrial carbon stocks, particularly of the soil organic carbon of which cost-effective measurement is not feasible.

Technologies and measures

This sub-section should describe the technologies and measures (actions) that will be undertaken to afforest or reforest the lands (e.g. assisted natural regeneration, planting of seedlings, aerial sowing of seeds). Information on the species and varieties of trees to be planted, the nursery techniques and planting techniques to be employed and planting machines and equipment to be used should be provided. Silvicultural practices to be followed, including timing of silvicultural operations, should be described. If genetically improved breeds of trees are to be used, this should be mentioned while describing how any adverse ecological effects of these would be managed or contained. A brief description of where and how the technologies and know-how will be transferred to the host Party

entities from the participating Annex I Party entities, if any, should be provided.

Parties and project participants

This sub-section should provide information about the host Party, Annex I Parties participating in the project or supporting the project, and the private and public entities acting as project participants. The host Party does not necessarily have to be a project participant (and such is the case in majority of the registered A/R CDM projects) but may choose to become a project participant, if it wishes. Usually the role of the host Party is to grant the letter of approval whereas the role of the Annex I Party involved is to authorize private or public entity from this country to participate in the project as financer of the project or buyer of the credits. The table in this sub-section should contain only the names of the entities and Parties. Detailed information, such as addresses, names of contact persons etc. should be provided in appendix 1 of the PDD.

Legal title to the land and rights to tCERs/lCERs

This sub-section should provide information on the legal title to the lands to be afforested or reforested under the project activity (e.g. ownership, nature and type of tenurial rights). If the land is not owned by the project participants, they should provide documentary evidence that the legal right-holders of the land have authorized the project participants to undertake the project activity, to act on their behalf, and exercise rights as would be necessary for control of, and access to, the carbon pools in the lands for the purpose of monitoring of those pools. This section should also describe who will hold the rights to the carbon credits (tCER and lCER) to be issued under the project activity and how such rights are legally maintainable in the host Party.

Assessment of eligibility of the land

This sub-section should describe how each discrete area of land included in the project boundary is eligible for an A/R CDM project activity. The requirements for land eligibility are described Box 4.3 and are also contained in the applicable regulatory documents (i.e. the approved methodology applied and the relevant provisions in the *Clean development mechanism project standard*).

Box 4.3 Eligibility of land for A/R CDM project activity

Only those afforestation and reforestation activities are eligible under the CDM which take place in lands already deforested on or before 31 December 1989. This provision pre-dates the Marrakesh Accords (the politically agreed package on implementation of the CDM) and uses the words 'land that did not contain forest on 31 December 1989'. But combined with the definition of forest, this implies that the land did not contain forest any time between 31 December 1989 and the start date of the project activity. This is so because areas which are 'temporarily unstocked' but which are 'expected to revert to forest' continue to retain the status of 'forest' even if there were no trees in it for a period of time. Since the definition of 'forest' for the purposes of the CDM varies from country to country, the same areas that qualify as deforested in one country can qualify as forested areas in another country.

Young natural stands and plantations which have yet to reach the minimum threshold of crown cover and tree height are included under forest, provided they have the potential of reaching the threshold values.

Approach for addressing non-permanence

This sub-section should indicate the type of credits (i.e. tCER or lCER) that the project proponents are selecting. The validity period of the two types of the credits as well their associated monitoring requirements are different, and the project developer should keep this in mind while making this choice.

Public funding of the project activity

This sub-section should indicate whether the project activity is being financed with public fund sourced from an Annex I Party and if so, demonstrate that the financial support received is additional to, and not a diversion of, the official development assistance. It should also be shown that funding of the project is not counted towards the compliance of financial obligations of the Annex I Party under the convention or the Kyoto Protocol. An affirmation

obtained from the annex I Party to this effect should be attached in an appendix of the PDD.

Box 4.4 tCER versus lCER

Carbon credits earned from sink activities (sequestration credits) under the CDM are based on the quantity of carbon removed from the atmosphere and the period of time during which the carbon remains removed from the atmosphere. Thus these credits would ideally be quantified not in tonnes but in tonne-years. However, the CDM rules provide for a simplified accounting approach instead of the exact tonne-year approach. Since carbon stocks in a forest plantation change in quantity over time, these credits when expressed in terms of tonnes can be either time-sliced (tCERs, measured as different tonnage valid through fixed time-chunks) or tonne-sliced (lCERs, measured as fixed tonnage spanning across different periods). Thus, a tCERs is equal to the net anthropogenic GHG removals by sinks achieved by a project activity since the start of the project activity. An lCERs is equal to the net anthropogenic GHG removals by sinks achieved by the project activity since the previous certification of the project activity. Mathematically, the two approaches correspond to computing the same quantity of the area under the curve $y = f(x)$ which can be expressed either as $A = \int y\, dx$ or as $A = \int x\, dy$.

The accounting rules, expiration period, and residual liability for tCERs and lCERs are different. While tCERs expire at the end of the commitment period subsequent to the commitment period for which these are issued, lCERs expire at the end of the crediting period of the project activity. Both tCERs and lCERs carry their expiry date as an additional element in their serial number, and thus both are auto-expiring credits. However, the lCERs expire over much longer period of time than the tCERs, and therefore the lCERs carry a residual liability for periodic re-verification of the continued presence of the carbon stocks in the project area for which these were issued. In absence of the periodic re-verification, the lCERs have to be 'reversed' (i.e. cancelled). When tCERs and lCERs are used by an annex I Party for the purpose of meeting compliance of its commitment under the Kyoto Protocol, these are said to have been 'retired'. Retired tCERs and lCERs must be replaced with other valid credits (e.g. CERs) at the time of their expiry.

4.2.2 Application of approved methodology

This section should indicate which approved A/R CDM methodology is being selected in the project and how this methodology will be applied, including a justification that the choices made under the selected methodology and the methods of quantification of net anthropogenic GHG removals by sinks are consistent with, and appropriate to, the circumstances of the project activity.

Reference of methodology
This sub-section should indicate the reference number, the title, and the version of the approved A/R CDM methodology applied (e.g. AR-ACM0003 "Afforestation and reforestation of land except wetland" (Version 01.0)). List of approved A/R CDM methodologies and their current version can be found on the official website of the CDM.

Applicability of methodology
This sub-section should justify why the selected methodology is applicable to the proposed project activity, in particular by showing that the project activity meets the applicability conditions provided in the methodology.

Carbon pools and emission sources
This sub-section should indicate which carbon pools and greenhouse gases (GHGs) are to be included for accounting under the project activity and which carbon pools and GHGs are to be excluded from accounting. The appropriateness of the choice of carbon pools and GHGs for the purpose of accounting in the baseline and in the project should be explained.

Identification of strata
This sub-section should describe the stratification of land areas that has been followed in estimation of the pre-project carbon stocks and baseline net GHG removals. In most cases, some sort of stratification of areas may be necessary for efficient estimation of carbon stocks in the above-ground carbon pool. However, if the particular circumstances of the project activity do not necessitate stratification (e.g. when uniform vegetation conditions exist throughout the project area), the relevant justification for omission of stratification may be provided.

Stratification may also be helpful in *ex-ante* estimation of carbon stocks in the project scenario. In such a case, the stratification plan used for this purpose should be described. It should be noted that the stratification at the time of monitoring of the carbon stocks does not have to be (and rarely is) the same as the stratification in the *ex-ante* estimation of the carbon stocks, since the spatial distribution of carbon stocks rarely, if ever, can be predicted accurately.

Establishment and description of baseline scenario
This sub-section should explain how the baseline scenario is established for each stratum of the lands included in the project boundary, in accordance with the selected methodology.

Demonstration of additionality
This sub-section should describe how the additionality of the project activity is demonstrated in accordance with the selected methodology. The description should contain transparent and documented evidence for application of the relevant modules and steps from the methodology. The data and parameters used, the assumptions made, and the justification for the assumptions should be described.

If the start date of the project activity is prior to the registration of the project, evidence of prior consideration of the CDM should be provided in this sub-section in accordance with applicable provisions of the *Clean development mechanism project standard*.

GHG removals by sinks
This sub-section should describe how the *ex-ante* estimation of the net anthropogenic GHG removals expected to be achieved by the project activity is carried out.

Explanation of methodology. This sub-section should explain how the methodological steps contained in the selected methodology were applied for estimating the baseline net GHG removals by sinks, the actual net GHG removals by sinks, the leakage emissions, and the net anthropogenic GHG removals by sinks. Where the methodology allows alternative approaches or different default values, the choice made in this respect should be justified as appropriate to the project activity. In most cases, the *ex-ante* estimation is carried out by using some sort of tree growth modelling in combination with the data from planned timing and stocking of trees to be planted under the project activity.

Data and parameters fixed ex ante. This sub-section should provide information on the parameters used in *ex ante* estimation of the removals. The information should be furnished in the prescribed tabular format. The data and parameters may have been obtained from measurement, sampling, or may have been collected from published sources (e.g. values from official statistics, IPCC reports, other published literature). The data and parameters of under this sub-section are not subject to monitoring. These data are used for estimation of the baseline removals, pre-project carbon

stocks, or ex-ante estimation of project carbon stocks, which are not required to be monitored over the crediting period. The *ex-ante* estimation of actual net GHG removals under the project is presented only for the purpose of forecast and planning of the project, and is not used for crediting purposes. Crediting is based on *ex-post* estimation based on data obtained from field measurement at the time of monitoring.

The fields in the data description tables should contain clear and unambiguous information as indicated below.

Data / Parameter. Write the symbol used for representing the parameter or variable in the equations contained in the PDD. The symbols or variable names used in the PDD should be the same as those used in the selected methodology.

Unit. Write the unit of the parameter or variable (e.g. t m^{-3}). If a unit other than SI unit has been used in the source, then it must be demonstrated to be consistent in representing the same quantity in terms of SI units (e.g. if wood density value of 40.266 lb ft^{-3} is used from published literature, then this value should be mentioned as 0.645 t m^{-3} in the PDD while also indicating the value in the source units).

Description. Provide a description of the parameter or the variable (e.g. wood density of tree species *j*)

Source of data. Provide unambiguous and verifiable reference to the source from where the value of the parameter has been taken.

Value(s) applied. Provide the values applied in the calculations performed in the PDD. To include multiple values referring to the same parameter use a table (e.g. a table containing names of tree species and the respective wood density values). Voluminous data (e.g. obtained from census or sampling) may be provided in an electronic file and referred to in an appendix of the PDD.

Choice of data or measurement methods and procedures. Justify the choice of data source or the adequacy of the measurement method for the purpose for which the data is used. Where the values are based on measurement, include a description of the measurement methods, indicate the responsible persons, team or entity who undertook the measurement, also indicate the date of

measurement. More detailed information can be provided in an appendix if appropriate.

Purpose of data. Indicate whether the value of parameter has been used for the purpose of estimation of baseline net GHG removals by sinks or *ex ante* estimation of actual net GHG removals by sinks.

The data description tables should be replicated as many times as required so as to accommodate description of all the required data and parameters.

Ex-ante calculation of net anthropogenic GHG removals by sinks. This sub-section should explain how the ex-ante estimation of baseline net GHG removals by sinks, actual net GHG removals by sinks and leakage emissions have been carried out by combining the data values shown in the data description tables and the steps and equations applied from the selected methodology. The description should show how each equation is applied, in a manner that enables the reader to reproduce the calculations, including a sample calculation for each equation used, substituting the values used.

Summary of ex ante estimates of GHG removals by sinks. This sub-section should present the outcome of the estimation carried out in the above sub-sections in a summarised form for each year of the crediting period using the table in the prescribed format.

Monitoring plan

This sub-section should provide a description of the monitoring plan of the project activity and explain how the proposed monitoring plan meets the requirements stipulated in the selected methodology and the *Project Standard*.

Data and parameters to be monitored. This sub-section should provide description of the parameters that are to be used in monitoring of net anthropogenic GHG removals by sinks. The information should be provided in the prescribed tabular format. The data and parameters may have been, or are proposed to be, obtained from measurement, sampling, or remote sensing data.

The fields in the data description tables should contain clear and unambiguous information as indicated below.

Data / Parameter. Write the symbol used for representing the parameter or variable in the equations contained in the PDD. The symbols or variable names used in the PDD should be the same as those used in the selected methodology.

Unit. Write the unit of the parameter or variable (e.g. t m^{-3}). If a unit other than SI unit has been used in the source, then it must be demonstrated to be consistent in representing the same quantity in terms of SI units (e.g. if wood density value of 40.266 lb ft^{-3} is used from published literature, then this value should be mentioned as 0.645 t m^{-3} in the PDD while also indicating the value in the source units).

Description. Provide a description of the parameter or the variable (e.g. wood density of tree species *j*)

Source of data. Provide unambiguous and verifiable reference to the source from where the value of the parameter has been, or will be, taken. In case the data is to be obtained from measurement, provide description of the method of measurement and the resulting primary data which will be used in estimation of this parameter.

Value(s) applied. Describe the values that will be applied in the calculations to be performed in the monitoring report (e.g. measured values, estimated means, adjusted conservative means).

Measurement methods and procedures. Describe and justify the choice and adequacy of the measurement method for the purpose for which the data is used. In case of periodic measurements to determine a parameter, state the measurement interval.

Monitoring frequency. Indicate how frequently the parameter will be monitored (e.g. annually, or once at the time of verification).

QA/QC procedures. Describe what quality assurance system will be in place and what quality check will be applied to ensure integrity and quality of the data to be used in monitoring.

Purpose of data. Indicate the carbon pool, or the emission source, for which the value of the monitored parameter will be used.

The data description table should be replicated as many times as required so as to accommodate description of all the required data and parameters.

Sampling plan and stratification. This sub-section should describe the sampling plan proposed for conducting forest biomass inventory in accordance with the selected methodology. Stratification plan should describe how the geographic coordinates defining the strata boundaries and the location of the sample plots will be determined and documented. Actual boundaries of strata for the purpose of monitoring is not expected to be described in the monitoring plan since this will depend upon the actual spatial distribution of biomass at the time of monitoring. It might be useful to leave the options of the exact sampling method open, if the methodology allows alternative options of monitoring. For example, the monitoring plan may provide for either a sample-plot based inventory or a combination of sample-plot measurements and remote sensing data. The method that will be judged as more efficient at the time of monitoring, looking to the actual spatial distribution of carbon stocks, will get actually implemented.

Other elements of monitoring plan. This sub-section should provide other relevant information about the monitoring plan covering, at least, the following aspects of the monitoring plan: the management structure that will be in place for organising and conducting monitoring activities; the responsibilities and institutional arrangements for data collection and archiving; the quality management plan including the QA/QC procedures and systems that will be implemented; methods and standards for assessing and addressing uncertainties in data and parameters, including measurement uncertainty, calibration of equipment and control of calibration; measures that will be undertaken to minimize leakage emissions and procedures for monitoring of implementation of these measures.

Box 4.5 Quality assurance and quality control

The A/R CDM methodologies require that the monitoring plan of a project activity should include in it quality assurance and quality control (QA/QC) procedures. The objective of the QA/QC procedures is to ensure transparency, consistency, comparability, completeness, and confidence in the data and the underlying monitoring processes.

The QC system provides for regular and consistent checks on integrity and correctness of data and calculations. It also including addressing errors and omissions when these are detected, while documenting and archiving the data, the calculations and the record of all QC activities. Quality Assurance (QA) activities include a planned system of procedures and activities that would assure that a target level of quality is maintained. QA can include definition of procedures, rules and policies that govern acquisition and use of data. QA might also prescribe what percentage of data should be included in random test-check while conducting the QC procedure. While QA is proactive and prescriptive, QC is reactive and remedial. Outcome of QC should feed back into the QA to assess whether the QA procedure needs to be reviewed or modified for improved level of quality assurance in future.

The A/R CDM methodologies allow projects to select their own QA/QC procedures but these are required to be documented in the monitoring plan.

The dimensions of a tree need to be measured, converted into appropriate units, input into a model for conversion into tree biomass value, while following at each step the prescribed in quality assurance and quality control procedures procedures.

4.2.3 Duration and crediting period

This section should describe the duration over which the project will be operational and the period over which CERs will be issued.

Duration of the project activity

This sub-section should provide the period of time over which the project activity will be operational. The fields under the sub-section

should contain clear and unambiguous information as indicated below.

Start date of project activity. Write here the start date of the project activity, in the format of DD/MM/YY and describe how this date was determined. Evidence to substantiate this date should be provided if the start date predates registration of the PDD.

Expected operational lifetime of project activity. Provide here the expected operational lifetime of the project activity in years and months. The operational lifetime of the project activity may not be the same as the crediting period of the project activity. For example, if the project consists of reforestation of a watershed, the forest cover will be maintained in place permanently. However, the A/R CDM project activity is limited to maintenance of the carbon stocks and their monitoring, which is distinct from the activity of providing watershed protection services through maintenance of permanent forest cover. In this case, the operational lifetime of the project activity may be indefinite whereas the crediting period of the project may be limited to twenty, thirty or sixty years.

Box 4.6 Crediting period

The crediting period of an A/R CDM project activity is the period of time during which the removals achieved are eligible for issuance of credits. Actual process of issuance may lie outside this period, although monitoring must have been completed within the period. The removals that were achieved before registration of the project activity can also be credited, because a project is allowed to have its start date that precedes the date of registration under certain conditions. The start date of a project activity is also the start date of its crediting period. The crediting period ends after a fixed duration of time called the 'length of crediting period'. Project participants can select one of the two types of crediting period and its length: (i) A single fixed crediting period of up to thirty years; (ii) A renewable crediting period of up to twenty years which can be renewed twice. Thus the maximum length of the crediting period of an A/R CDM project activity, if successfully renewed both the times, can be sixty years.

Crediting period of the project activity
This sub-section should describe the period over which carbon credits will be claimed.

> **Type of crediting period**. State here whether a fixed crediting period or a renewable crediting period is being selected for the project activity. For a renewable crediting period, indicate the number of renewals foreseen.
>
> **Start date of crediting period.** State here the start date of the crediting period and, where applicable, the start date of the first crediting period.
>
> **Length of crediting period.** State the length of the crediting period of the project activity in years and months. In case of renewable crediting periods state the length of the renewable crediting period and the number of renewals proposed.

4.2.4 Environmental impacts

This section should describe the likely impacts of the project activity on natural and man-made environment in the area. The description should include both positive and negative impacts of the project activity.

Analysis of environmental impacts
This sub-section should provide a summary of the analysis of the environmental impacts, including impacts on biodiversity and natural ecosystems and impacts outside the project boundary.

Environmental impact assessment
This sub-section should state whether a formal and structured environmental impact assessment is required for the project activity under the relevant laws of the host Party, and if so, summarize the conclusions of the environmental impact assessment and provide reference to the related documentation. Relevant documentation may also be included as an appendix to the PDD.

4.2.5 Socio-economic impacts

This section should describe the socio-economic impacts that the project activity may have in the area. The description should include both positive and negative impacts of the project activity.

Analysis of socio-economic impacts
This sub-section should provide a summary of the analysis of the socio-economic impacts, including impacts on employment, livelihood and food security.

Socio-economic impact assessment
This sub-section should state whether a socio-economic impact assessment is required for the project activity under the relevant laws of the host Party, and if so, summarize the conclusions of the socio-economic impact assessment and provide reference to the related documentation. Relevant documentation may also be included as an appendix to the PDD.

4.2.6 Local stakeholders' consultation

This section should describe the process and outcome of the local stakeholder consultations carried out to assess any adverse impacts of the proposed project activity as well as to facilitate validation of local information provided in the PDD. Stakeholder consultation also facilitates validation of the environmental integrity of the proposed project activity.

Solicitation of comments from stakeholders
This sub-section should describe the process by which comments from stakeholders were invited.

Summary of the comments received
This sub-section should list the comments received from stakeholders and provide a compilation of these comments. If the comments received are too numerous or voluminous to be conveniently included in the body of the PDD, these may be compiled in an appendix, while providing a synthesis thereof in the body of the PDD.

Report on consideration of comments received
This sub-section should provide information demonstrating that all comments received from stakeholders have been considered and taken into account while finalising the PDD. If the comments received are too numerous or voluminous for including their responses in the body of the PDD, the responses to the comments may be compiled in an appendix, while providing a synthesis thereof in the body of the PDD.

4.2.7 Host Party approval and authorization

This section should provide information on host Party approval and authorization by other Parties where entities from Annex I Parties are involved in the project.

The letters of approval from the DNAs of the Parties involved should be included in an appendix to the PDD.

4.2.8 Appendices

The completed PDD may have appendices. Of the seven typical appendices mentioned below, only the first two are required in every PDD. For small-scale projects an additional appendix providing 'declaration on low-income communities' is also required. More appendices can be added if required.

Appendix 1. Contact information of project participants and letters of approval

In this appendix, the contact information for each project participant should be provided in the prescribed format. The letters of approval from the DNAs of the Parties concerned should be attached

Appendix 2. Affirmation regarding public funding

In this appendix, information or documentation relating to public funding of the project should be provided.

Appendix 3. Applicability of selected methodology (optional)

In this appendix, additional information confirming applicability of the methodology can be provided.

Appendix 4. Information on ex ante calculation of removals by sinks (optional)

In this appendix, additional information on models used or intermediate outcome of calculation steps can be provided.

Appendix 5. *Further background information on monitoring plan* (*optional*)

In this appendix, additional information on the proposed monitoring plan can be provided if the information does not fit into the body of the PDD.

Appendix 6. Geographic delineation of project boundary

In this appendix, list of geo-referenced coordinates delineating boundaries of discrete areas of land included within the project boundary can be provided. If the list is too long to be presented as

text, an electronic file containing the data may be attached and referenced in this appendix.

Appendix 7. Summary of post registration changes

This appendix should be left blank at the time of proposing the PDD for validation and registration. At the time of monitoring, this appendix should summarize the main changes made in the PDD at the time of monitoring, if any, with respect to the registered PDD.

Chapter 5. Monitoring and Verification

Summary. This chapter explains the process of monitoring of A/R CDM project activities. Monitoring of A/R CDM project activities centres around preparation of a biomass inventory of forest plantations raised under the project. Though the detailed inventory methods that can be applied are described in the respective methodological tools, a synthesis of the available approaches and their efficiency in a given context is presented here. Approaches for cost-effective planning and implementation of monitoring activities have been suggested.

5.1 Monitoring period and frequency

An A/R CDM project activity can choose to prepare its first monitoring report (for the 'initial verification and certification') at any time. In practical terms, however, the project participants would undertake the first inventory of their forest when the accumulated carbon stocks are large enough to justify the cost of monitoring. In a slow-growing forest the first monitoring may not be cost-effective before ten years of growth, whereas in a fast-growing plantation the first monitoring could be undertaken at five years from the date of planting. Apart from the rate growth and accumulation of carbon stocks, other factors such as the market price of carbon credits and timing of forest inventory required for other purposes than carbon management could play a decisive role in determining the timing of the first monitoring.

The first monitoring is also the occasion for firming up (freezing) the project boundary. In view of uncertainties and unforeseen circumstances, A/R CDM project activities have the flexibility of excluding some of the land areas that were proposed to be included within the project boundary at the time of registration. By the time of the first verification and certification, however, the project proponents must finalize the project boundary and the project boundary cannot be altered thereafter.

The CDM rules require that after the initial verification and certification of carbon stocks in the project boundary, verification and certification must be carried out every five years until the end

of the crediting period of the project activity. Therefore, the project participants have choice only in the timing the first verification and certification, not thereafter. However, verification and certification does not necessarily imply conducting a full forest inventory every five years. The methodology might allow alternative methods, other than a full forest inventory, for verification of carbon stocks or changes in carbon stocks since the previous verification and certification.

5.2 Estimating carbon pools

Monitoring of an A/R CDM project activity essentially involves monitoring of carbon stocks in the various carbon pools and changes in these carbon stocks over time. Estimation of carbon stock in a pool, which is represented by the biomass stock except in the case of the soil organic carbon (SOC) pool, is the main activity in monitoring.

The approved A/R methodologies provide several options for estimation of carbon stocks and changes in carbon stocks. The most common method is to conduct a biomass inventory for the above-ground tree and shrub biomass and to estimate the carbon stocks in the below-ground biomass by applying a root-shoot ratio. For the two carbon pools containing the dead organic matter, namely, the deadwood and litter pools, either independent concurrent inventory can be conducted or the carbon stocks in these pools can be accounted as a fixed percentage of the above-ground living tree biomass. For the soil organic carbon (SOC) pool, only the changes in carbon stocks are estimated since estimation of total carbon stocks in the SOC pool is neither feasible at a reasonable cost nor useful for the purpose of monitoring.

Box 5.1 A/R CDM methodological tools

The A/R CDM methodological standards consist of four methodologies and ten methodological tools. The tools can be divided into three categories: (i) Tools for estimation of carbon stocks and changes in carbon stocks in different carbon pools; (ii) Tools for estimation of project emissions and leakage emissions; (iii) Tools for demonstrating land eligibility and additionality. One of the tools, namely the tool for estimation of number sample plots, is an optional (best practice) tool and the project proponents may choose to apply other methods in lieu of this tool.

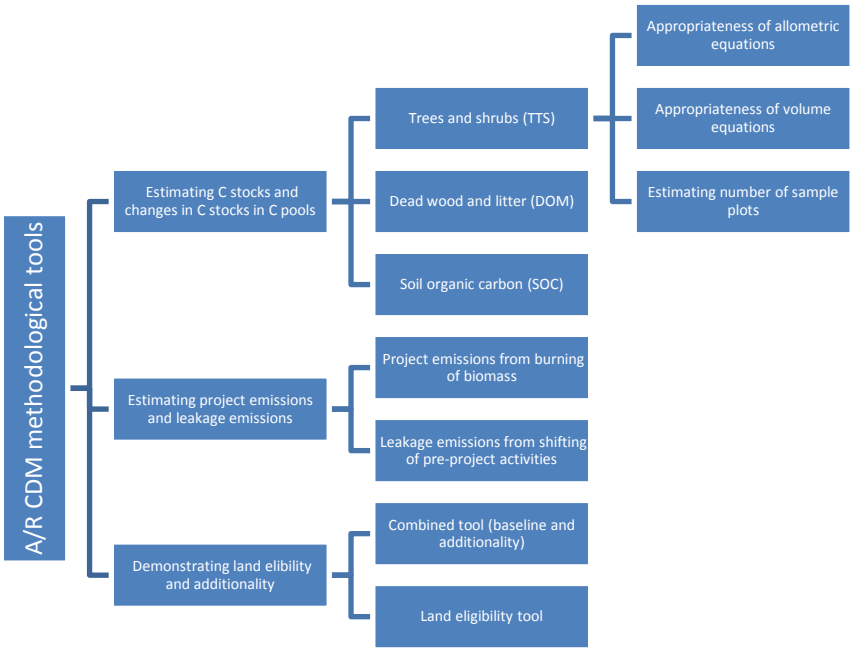


Figure 5.1 A/R CDM methodological tools

5.3 Monitoring project emissions

The approved A/R CDM methodologies require monitoring of project emissions only if field-burning of biomass is practiced under the project activity (e.g. for initial or inter-rotation site preparation). The relevant methodological tool provides a step-by-step method for estimating these emissions. Monitoring of these emissions must be done at the time of burning of biomass and not at the time of preparation of the monitoring report. The DOE may wish to inspect the field area where standing biomass was burnt and verify the area of land subjected to field-burning. The DOE may also wish to do a sample check on the amount of biomass per hectare present in the lands subjected to field-burning, and in this case, monitoring of the emissions must be planned and conducted accordingly.

Accounting of emissions resulting from burning of fossil fuels in operation of machinery and other activities is not required by the approved A/R CDM methodologies.

5.4 Monitoring leakage emissions

Leakage emissions can occur when pre-project agricultural activities, such as crop cultivation and animal grazing, are displaced from the project areas to areas outside the project boundary. The

relevant methodological tool provides a step-by-step method for estimating these emissions. Estimation of these emissions must be done at the time of displacement of the activity and not at the time of preparation of monitoring report. The DOE may wish to inspect the lands in which the displaced activity was received and verify the area affected. The DOE may also wish to do a sample check on the amount of biomass per hectare present in the lands where the activity was received. Monitoring of the leakage emissions must therefore be planned and conducted in view of these possibilities.

Box 5.2 Leakage in A/R CDM project activities

Leakage emissions resulting from A/R CDM project activities can either be very large or, as is the case with most registered project activities, absent. If an activity is shifted to a forest area, the emissions from clearance of the forest will be large and this may cancel most of the GHG removals expected to be achieved by the project activity. If an activity is shifted to an area of non-forested land that has not been used for a long time, the emissions from tillage of soils can be significantly high. If shrub clearance is necessary to accommodate the activity, further emissions may result from this. In view of its crucial role in ensuring environmental integrity of the project activity, the leakage tool takes a conservative approach by assuming that all emissions take place in the year of shifting of the activity because the shifted activity does not form part of the project activity and is not subject monitoring over the years.

5.5 Post-registration changes

One of the requirements of the monitoring report is that it must conform with the monitoring plan contained in the registered PDD. The implementation of the project activity must also be in conformity with the relevant provisions contained in the registered PDD. Therefore any change in implementation or monitoring of the project activity, with respect to the registered PDD, must be assessed by the DOE in view of their impact on the quantification of emission reductions or removals. These 'post-registration changes' can be categorised as 'temporary' or 'permanent'. These can be further categorised as those that require approval of the Board before a monitoring report can be accepted, and those that can be assessed by the DOE without prior approval by the Board. The latter types of changes also must be taken into account during preparation of the verification and certification report.

Forestry projects face a number of uncertainties, including local forestry practices and natural circumstances, and hence A/R CDM project activities may often require changes in the course of their implementation. In view of this, certain types of changes in implementation of the project activity and quantification of GHG removals have been agreed by the Board as minor. Changes of these types do not require prior approval of the Board. These changes are contained in the "Guidelines on accounting of specified types of changes in A/R CDM project activities from the description in registered project design documents". The project developers may find it useful to go through these guidelines to appreciate the flexibility they have in implementation and monitoring of A/R CDM project activities.

5.6 Verification and certification report

Once the necessary carbon inventories have been conducted and the monitoring report containing the outcomes of the inventories and monitoring of project emissions and leakage emissions has been prepared, the report is submitted to a DOE. The DOE conducts verification of the monitoring report in view of the requirements contained in the selected methodology and the requirements contained in the *Clean development mechanism validation and verification standard*. Having ensured that the monitoring report meets all the requirements, the DOE prepares the verification and certification report and submits it to the UNFCCC secretariat for approval by the CDM Executive Board. Along with the verification and certification report, the DOE also submits a request for issuance of tCERs or lCERs, as applicable to the project, in favour of the project participants.

Chapter 6. Programme of Activities

Summary. A programme of activities (PoA) comprises of a series of similar project activities (‘component project activities’ or CPAs) under an umbrella programme. Programmatic approach is efficient way of organising project activities and reduces transaction costs. This chapter summarises the main distinguishing features of an A/R CDM programme of activity.

6.1 Programme of activities

A program of activities (PoA) comprises of component project activities (CPAs) undertaken in the same or similar socioeconomic and technological circumstances and providing the same type of economic product or services. A PoA can be thought of as an incentive scheme that promotes anthropogenic GHG emission reductions or net anthropogenic GHG removals by sinks through a series of uniformly designed and implemented projects.

A PoA operates at two levels—at the level of the program and at the level of the individual CPAs. The program level management provides the organizational structure governing the eligibility, design, operation, monitoring and crediting of individual CPAs included within the PoA. The CPA level consists of implementation of specific activities organised as projects through which emission reductions or removals are achieved. Multiple CPAs can be included in a PoA at the time of its registration and additional CPAs can be added at any point in the life of the PoA.

The entity responsible for organising the CPAs into a PoA and managing the PoA is called the ‘coordinating and managing entity’ (CME). The entities responsible for the individual CPAs continue to be called the project participants.

Box 6.1 A/R CDM programme of activity

An A/R CDM programme of activity may be thought of as a series of typical plantation projects to be implemented in different geographic or administrative units but under similar socioeconomic conditions. For example, reforestation of denuded watersheds is an activity that might characterized by a uniform pattern of ownership (public ownership), financial constraints (no direct financial return is expected, though economic and environmental gains are high), and capacity (local communities and public service entities with limited managerial and technical capacity). Thus the criteria of eligibility of the CPAs to be included in a PoA can be developed around such barriers and the PoA can be registered. Later on, any subsequent watershed that is taken up for reforestation as a new CPA only needs to be checked in respect of meeting these eligibility criteria.

If reforestation of one watershed is not financially attractive and hence deserves carbon revenue to be supported, other watersheds would be in the same situation.

Project cycle of a programme of activities

The general requirements applicable to the project cycle of individual A/R CDM project activities also apply to an A/R CDM programme of activity. However, since the PoA is managed at two different levels, some aspects of application of the CDM rules stand modified. In particular, the coordinating and managing entity (CME) is the principal actor interacting with the governance institutions of the CDM. The project participants responsible for the individual CPAs are responsible to the CME and support him by providing the necessary information and documentation.

The additionality of the CPAs under a PoA is translated into "eligibility criteria" for inclusion of the CPA into the PoA. The

design of the PoA thus standardises the conditions (e.g. those affecting profitability, barriers, performance) under which a conforming CPA is expected to be eligible and additional. The additionality of the CPAs is therefore agreed in advance provided that the CPAs conform to the 'eligibility criteria' for being included under the PoA. The CME, at the time of validation of the PoA, is required to develop eligibility criteria for inclusion of CPAs in the PoA and include these criteria in the 'programme of activity design document' (PoA-DD). As the PoA gets implemented, the CME may include more CPAs under the PoA.

The start date of a PoA can be either the date of notification of the intention to seek the CDM status by the CME to the secretariat and the DNA, or the date of publication of the PoA-DD for local stakeholder consultation. The duration of an A/R CDM PoA may not exceed 60 years, counting from the start date of the PoA. The start date of a CPA is the earliest date at which the implementation of the CPA begins.

6.2 Validation and registration of a programme of activities

The interested CME should submit, through a DOE, an A/R CDM PoA for validation after completing a PoA design document (PoA-DD) in the prescribed form. Along with the PoA-DD, the CME should submit a CPA design document (CPA-DD) using the appropriate CPA-DD form.

6.3 Monitoring, verification and issuance under a programme of activities

The CME of a PoA is required to maintain all monitoring results of all CPAs in accordance with the record keeping system identified in the registered PoA-DD. An integrated PoA-level monitoring report should be prepared, containing results of monitoring of all the CPAs included in the PoA. At the same time, the results of monitoring of individual CPAs should also be provided in the integrated monitoring report. The CME should make available the PoA monitoring report to a DOE for verification and certification purposes.

Appendix A

A Run-through Example of Developing an A/R CDM PDD

Summary. This appendix describes, by way of an example, how an A/R CDM project activity design document can be developed. Even though the example is set in a hypothetical situation, it illustrates practical application of the rules of the CDM. We select the approved methodology AR-ACM003 for our project because we do not have any wetland in our project area.

Scene setting

Imagine we are working somewhere in a forest reserve in a developing country. Among extensive barren tracts of forest land, we find a small watershed of 300 ha which has been lying barren[1] for several decades now and which we are considering for our A/R CDM project. Within the area, however, there are a few groves of trees preserved by people as sacred groves. Of these groves, three are larger than 0.05 ha and hence must be excluded from the project boundary because 0.05 ha is the minimum area threshold reported by the DNA of the host country for defining forest for the purpose of CDM. Tree groves occupying less than 0.05 ha do not constitute forest, even if these have a crown cover exceeding the minimum tree crown cover threshold. These large groves are surveyed in field and their location and shape is carefully plotted on the map[2]. We find that the total area occupied by these large groves is 4 ha. Thus, out of 300 ha, an area of 296 ha is eligible for our project.

Land eligibility

The land, excluding the area occupied by the three large tree groves, is eligible for implementing an A/R CDM project activity because it

[1] By 'barren' we mean that the tree crown cover, on the average, is less than 15% which is the threshold tree crown cover for defining forest for the purpose of hosting A/R CDM projects in the host country.

[2] Note that there is no requirement for putting up a physical boundary or a fence around these groves. Also, if a part of the watershed were to have numerous small tree groves each occupying an area greater than 0.05 ha, we could have excluded the whole block of area in which these groves were located if we didn't want to survey individual groves because of the cost involved.

had no forest on 31 December 1989[3]. We provide the evidence of this fact by producing two satellite imageries of the area—one dating before 31 December 1989, and the other dating after this date[4].

Baseline scenario

To determine the baseline scenario for this land, we examine the possible uses of this land in coming years. Since the land is reserved for forests, no other activity is expected to take place here except reforestation. Is reforestation likely to happen here? We note that reforestation in this area is not expected to take place in foreseeable future because no private investment can take place in this land (which is state-owned); and the provisions in the public budget (either in the national budget or in the provincial budget) are not likely to lead to reforestation. This is sufficient evidence to prove that the most likely baseline scenario for this land is continuation of the status quo (i.e. the land will continue to lie barren as it is today).

Baseline removals

Next step is to estimate the changes in carbon stocks in the carbon pools of this land that would occur in the baseline scenario. The land contains a few scattered (and deformed) trees per hectare and very scanty woody shrub vegetation. The trees are not likely to put on any increment since occasional fuel gathering activity, along with grazing by animals during post-monsoon months, takes place here. The level of biomass per hectare is more or less static over the last several years, or it is slightly declining. Therefore, it is safe to assume that the expected net increase in the aboveground biomass in the area is zero[5].

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[3] This requirement comes from the tool "Demonstration of eligibility of lands for A/R CDM project activities".

[4] However, we must note that satellite imageries are not the only acceptable evidence for this purpose. We could also have met this requirement by conducting a participatory rural appraisal (PRA) exercise and producing the outcome as an evidence of the fact that there was no forest in the area on that date. The tool on eligibility of land allows us several other options as well.

[5] However, we must note that even if the tree biomass in the baseline were to be increasing, our A/R CDM project could still have gone ahead. We could have used the default method for estimation of tree biomass increment as provided in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" using the simplified 'proportionate crown cover' method.

Pre-project carbon stocks

Our next step is to estimate how much tree biomass per hectare is present in the area at the start of the project[6]. If we determine the precise value of this parameter (i.e. tree biomass per hectare), it might require a lot of work and turn out to be costly in comparison with its importance. So we decide to get a 'conservative' estimate of this parameter. To do this in a simple way, we estimate the upper bound of the mean tree crown cover in the area. For this, we randomly select twenty plot centres spread over the 296-ha area and at each plot centre we drive a peg into the ground and attach a 30 m tape to the peg and swing the free end of the tape into a circle and count all the trees present within this circular plot. We also measure approximately the crown diameters of the trees present within the plot. Some plots may have no tree at all, others may have a few trees. For each plot, we calculate the percentage tree crown cover by dividing the total crown area of trees by the area of the plot (which is $\pi \times 30^2$ or 2827 sqm). Upon summarizing plot data (*see* Table A.1) we find that the average tree crown cover in the area is 2.56% at the most, i.e. the upper bound of the crown cover is 2.56%. We multiply this by the parameter 'aboveground biomass content' from Table 3A.1.4 of the *IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry* (IPCC-GPG-LULUCF 2003)[7] and we find that the aboveground tree biomass in the area is 1.869 tonne dry matter per hectare (t d.m.ha^{-1})[8].

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[6] Note that "carbon stock in tree biomass" is different from the "change in the carbon stock in tree biomass". The fact that one is zero does not mean that the other is also zero. The pre-project carbon stock in tree biomass is estimated and provided in the PDD, but it enters into calculations only at the time of the first monitoring—it must be subtracted from the project tree biomass estimated from sample plot measurements at the time of monitoring because the pre-project trees will get measured along with the project trees. However, if we could avoid these trees from being counted as project trees, which would make our inventory more complicated, we could also exclude their biomass from accounting.

[7] This is provided in the simplified 'proportionate cover method' available in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities". Since the default method will not significantly affect our final estimation of tCERs (because the biomass in the baseline of our project is very small), we opt for the default method of estimation. If our baseline were to have a large crown cover (say 12%), we would have considered measuring biomass in sample plots, either by harvesting and weighing all woody vegetation in smaller plots or by using tree allometric equations in conjunction with DBH measurements of all trees in each plot.

[8] We find that 'aboveground biomass content (dry matter) in forest' in the host country is listed as 73 t ha^{-1} in the IPCC table mentioned in the tool.

Table A.1 Plot values of tree crown cover

Plot number	No. of trees	Mean crown diameter (m)	Plot crown area (m^2)	Plot crown cover
1	3	2.3	12.46	0.44%
2	2	3.1	15.10	0.53%
3	0	0	0.00	0.00%
4	0	0	0.00	0.00%
5	1	3.6	10.18	0.36%
6	5	2.8	30.79	1.09%
7	3	3.4	27.24	0.96%
8	8	2.6	42.47	1.50%
9	0	0	0.00	0.00%
10	0	0	0.00	0.00%
11	11	2.1	38.10	1.35%
12	6	4.5	95.43	3.38%
13	24	3.6	244.29	8.64%
14	19	2.4	85.95	3.04%
15	7	1.9	19.85	0.70%
16	8	2.6	42.47	1.50%
17	21	3.1	158.50	5.61%
18	0	0	0.00	0.00%
19	22	2.7	125.96	4.46%
20	0	0	0.00	0.00%
			Mean	1.68%
			SD	2.29%
			SEM	0.51%
			$t_{90\%}$	1.729
			$CI_{90\%}$	0.89%
			LB	0.79%
			UB	2.56%

We increase this by 25% to account for the root biomass[9] of the trees and find that pre-project tree biomass in the area is 2.336 t d.m.ha^{-1}, which is equivalent to a carbon stock[10] of 4.283 tCO_2e ha^{-1}.

[9] A default value of 0.25 for the root-shoot ratio of trees in the baseline is provided in the tool.

[10] To convert a given quantity of tonne dry matter (t d.m.) of tree biomass into carbon stock, we multiply it first by 0.47 (which is the carbon content of tree biomass, called carbon fraction), and then by 44/12 (which is the ratio of molecular weights of carbon dioxide and carbon).

We note that shrub crown cover in the area is far below 5% and therefore we do not need to estimate carbon stock in the pre-project shrub biomass[11].

We further note that since carbon stock in tree biomass in the baseline is not likely to increase. The carbon stock in the carbon pools of dead wood and litter is also not likely to increase. We therefore account baseline changes in carbon stock in the above-ground biomass, below-ground biomass, dead wood, and litter pools as zero.

Ex-ante estimation of actual net GHG removals

One of the requirements in the PDD of an A/R CDM project is to estimate in advance how much GHG removals are likely to be achieved under the project. This is done by projecting the growth of the trees to be planted or to be regenerated. In our project we propose an assisted natural regeneration method: cutback operations combined with seed-sowing on contour trenches and planting of nursery-raised seedlings in gaps. We will use native species only, since our aim is to restore the forest to its natural state. For projecting the biomass growth of a mixed forest we cannot use any species-specific increment data (and, what is more, no such data is available). Therefore we estimate annual diameter increments using data from sample trees existing in the project area (or a nearby area) and use a default allometric equation[12] to convert tree diameter into tree biomass.

In order to obtain a weighted average of expected diameter increments in dominant tree species in the area, we note that 80% of trees in the area are covered by five tree species, although in different proportions. We can therefore estimate the average expected diameter increment on the basis of these five tree species.

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[11] Note that if the shrub crown cover were to be somewhere near 5%, we would be required to estimate it. The same sample plots which were used for estimation of tree crown cover could have been used for estimation of shrub crown cover.

[12] The equation selected by us is *AGBM=exp[-1.996+2.32*ln(D)]*, which we take from "Estimating Biomass and Biomass Change of Tropical Forests: a Primer. (FAO Forestry Paper - 134)" by S Brown. We select the equation for dry forests growing in an area receiving annual rainfall of more than 900 mm which is the case for our project area. We must note, however, that ex-ante estimation of tree biomass is only an approximate estimation and no precision requirements are prescribed by the methodology for this. Therefore, we could also have used any other allometric equation (e.g. an equation from Table 4A.1 of IPCC-GPG-LULUCF 2003).

To get annual diameter increments expected in trees of these species we measure DBH of three sample trees of each species and determine their age by counting growth rings after felling the trees. The data obtained is summarised in Table A.2 and it shows that the mean annual increment in DBH, averaged over the five tree species, is 1.09 cm per year.

Table A.2 Mean diameter increment observed in sample trees

	Tree 1		Tree 2		Tree 3		Mean		Dia. incr. (cm yr^{-1})		
Spp.	Dia (cm)	Age (yr)	Dia (cm)	Age (yr)	Dia (cm)	Age (yr)	Dia (cm)	Age (yr)	Spp. mean	Spp. weight	Contr.
A	14	15	17	20	34	26	21.67	20.33	1.07	0.50	0.53
B	18	20	14	16	16	15	16.00	17.00	0.94	0.20	0.19
C	21	14	15	15	11	15	15.67	14.67	1.07	0.10	0.11
D	22	13	25	16	17	15	21.33	14.67	1.45	0.10	0.15
E	8	7	11	9	9	8	9.33	8.00	1.17	0.10	0.12
										1.00	1.09

However, we know that tree diameter increments are not constant over the life span of trees. The diameter increments will be smaller in the beginning, will be higher in mid-age years, and will decrease towards maturity. Therefore, we transform the DBH increments into a symmetric triangular (linear) distribution over a period of 30 years, i.e. we assume that for the first 15 years the DBH increment will be uniformly increasing, and during the last fifteen years the DBH increment will be uniformly decreasing[13] while the mean increment during the 30-year period will be 1.09 cm. The resulting diameter increments and the expected diameters of the mean tree are shown in columns (c) and (e) respectively of Table A.3.

[13] We do this for reasons of simplicity. We could also have used a logistic growth function to project tree diameter over time. The alternative values shown in columns (d) and (f) of Table 3 were computed using the logistic growth equation $D_t = \phi_1 / \{1 + \exp[-(t - \phi_2)/\phi_3]\}$ where ϕ_1 is the diameter at maturity, ϕ_2 is the time required to attain half the diameter at maturity, and ϕ_3 is the time elapsed between the two events of attaining (i) half the diameter at maturity, and (ii) three-fourths of the diameter at maturity.

Table A.3 Tree diameter increment over project period (cm)

Year	ΔD_{CONST}	ΔD_{TRIANG}	ΔD_{LOGIS}	D_{TRIANG}	D_{LOGIS}
(a)	(b)	(c)	(d)	(e)	(f)
1	1.09	0.07	0.00	0.07	0.00
2	1.09	0.22	0.50	0.29	0.50
3	1.09	0.36	0.58	0.65	1.08
4	1.09	0.51	0.66	1.16	1.73
5	1.09	0.65	0.75	1.82	2.48
6	1.09	0.80	0.84	2.62	3.32
7	1.09	0.94	0.94	3.56	4.26
8	1.09	1.09	1.05	4.65	5.31
9	1.09	1.24	1.15	5.88	6.46
10	1.09	1.38	1.26	7.27	7.72
11	1.09	1.53	1.36	8.79	9.08
12	1.09	1.67	1.45	10.46	10.54
13	1.09	1.82	1.53	12.28	12.07
14	1.09	1.96	1.60	14.24	13.66
15	1.09	2.11	1.64	16.35	15.30
16	1.09	2.11	1.66	18.45	16.97
17	1.09	1.96	1.66	20.42	18.63
18	1.09	1.82	1.64	22.23	20.27
19	1.09	1.67	1.60	23.90	21.86
20	1.09	1.53	1.53	25.43	23.40
21	1.09	1.38	1.45	26.81	24.85
22	1.09	1.24	1.36	28.05	26.21
23	1.09	1.09	1.26	29.14	27.47
24	1.09	0.94	1.15	30.08	28.62
25	1.09	0.80	1.05	30.88	29.67
26	1.09	0.65	0.94	31.53	30.61
27	1.09	0.51	0.84	32.04	31.45
28	1.09	0.36	0.75	32.40	32.20
29	1.09	0.22	0.66	32.62	32.85
30	1.09	0.08	0.58	32.70	33.43

Plugging the expected tree diameters into the allometric equation, we estimate the expected aboveground biomass of each tree. We expect to have a maximum stocking density of 1250 trees per hectare in the beginning which will stabilize over time to a stocking density of 550 trees per hectare. Combining these values we calculate above-ground tree biomass per hectare over the 30 years of our proposed project. We expand the above-ground tree biomass to total tree biomass by using the default root-shoot ratios computed from the equation provided in the tool[14]. Finally, we convert tree

[14] The equation regressing root-shoot ratio on aboveground tree biomass content is: $R=exp[-1.085+0.9256*ln(b)]/b$ where b is above-ground tree biomass in t d.m. ha^{-1}.

biomass into equivalent carbon stocks. The results of our calculation are summarized in Table A.4.

Table A.4 Ex-ante estimation of carbon stock in tree biomass per hectare

Project year	Mean DBH (cm)	Biomass (kg tree^{-1})	Stocking (tree ha^{-1})	AG tree biomass (t ha^{-1})	Root-shoot ratio	Tree biomass (t ha^{-1})	C stock in tree biomass (tCO_2e ha^{-1})
1	0.07		800				
2	0.29		1100				
3	0.65		1250				
4	1.16		1000				
5	1.82		900				
6	2.62		800				
7	3.56		700				
8	4.65	4.80	600	2.88	0.312	3.78	6.93
9	5.88	8.30	575	4.77	0.301	6.21	11.38
10	7.27	13.53	550	7.44	0.291	9.61	17.61
11	8.79	21.05	550	11.58	0.282	14.84	27.21
12	10.46	31.53	550	17.34	0.273	22.08	40.48
13	12.28	45.71	550	25.14	0.266	31.82	58.34
14	14.24	64.47	550	35.46	0.259	44.64	81.85
15	16.35	88.79	550	48.83	0.253	61.19	112.18
16	18.45	117.63	550	64.70	0.248	80.73	148.00
17	20.42	148.70	550	81.79	0.243	101.70	186.45
18	22.23	181.21	550	99.67	0.240	123.58	226.57
19	23.90	214.40	550	117.92	0.237	145.86	267.41
20	25.43	247.49	550	136.12	0.234	168.03	308.06
21	26.81	279.78	550	153.88	0.232	189.63	347.65
22	28.05	310.60	550	170.83	0.231	210.21	385.38
23	29.14	339.33	550	186.63	0.229	229.37	420.51
24	30.08	365.39	550	200.97	0.228	246.73	452.35
25	30.88	388.31	550	213.57	0.227	261.99	480.32
26	31.53	407.66	550	224.21	0.226	274.86	503.91
27	32.04	423.07	550	232.69	0.225	285.11	522.69
28	32.40	434.28	550	238.85	0.225	292.55	536.35
29	32.62	441.08	550	242.59	0.225	297.07	544.64
30	32.70	443.51	550	243.93	0.224	298.69	547.59

We note that biomass estimation cannot be provided for years 1 to 7, because the expected mean diameter in these years is far too low compared to the range of diameters for which the allometric equation selected is valid.

Using per hectare carbon stocks, we calculate total carbon stock in 296 hectare which is our project area. For this, we must use the data of year-wise area to be planted. We propose that the area of 296 hectare will be taken up for reforestation in a phased manner

over a period of three years. Areas of lands to be reforested in different years are shown in Table A.5.

Table A.5 Areas of lands to be reforested in different years

Year	Area (ha)
1	50
2	100
3	146
Total	296

By combining the data from Table 4 and Table 5, we arrive at ex-ante estimation of carbon stocks in tree biomass within the project boundary, as summarized in Table A.6.

Table A.6 *Ex-ante* estimation of carbon stock in tree biomass within the project boundary

Project year	Area 1 (ha)	C stock 1 ($tCO_2\,ha^{-1}$)	Area 2 (ha)	C stock 2 ($tCO_2\,ha^{-1}$)	Area 3 (ha)	C stock 3 ($tCO_2\,ha^{-1}$)	C stock proj (tCO_2-e)
1	50						0
2	50		100				0
3	50		100		146		0
4	50		100		146		0
5	50		100		146		0
6	50		100		146		0
7	50		100		146		0
8	50	6.93	100		146		346.67
9	50	11.38	100	6.93	146		1262.17
10	50	17.61	100	11.38	146	6.93	3030.47
11	50	27.21	100	17.61	146	11.38	4782.38
12	50	40.48	100	27.21	146	17.61	7315.58
13	50	58.34	100	40.48	146	27.21	10936.66
14	50	81.85	100	58.34	146	40.48	15835.62
15	50	112.18	100	81.85	146	58.34	22311.17
16	50	148.00	100	112.18	146	81.85	30567.82
17	50	186.45	100	148.00	146	112.18	40501.31
18	50	226.57	100	186.45	146	148.00	51581.50
19	50	267.41	100	226.57	146	186.45	63248.74
20	50	308.06	100	267.41	146	226.57	75222.49
21	50	347.65	100	308.06	146	267.41	87230.12
22	50	385.38	100	347.65	146	308.06	99011.26
23	50	420.51	100	385.38	146	347.65	110321.30
24	50	452.35	100	420.51	146	385.38	120934.11
25	50	480.32	100	452.35	146	420.51	130644.43
26	50	503.91	100	480.32	146	452.35	139269.68
27	50	522.69	100	503.91	146	480.32	146651.52
28	50	536.35	100	522.69	146	503.91	152657.10
29	50	544.64	100	536.35	146	522.69	157180.04
30	50	547.59	100	544.64	146	536.35	160150.14

Shrub biomass in project

Since we do not expect significant shrub biomass in our project area once the forest has been restored to its natural state, we make the conservative choice of accounting shrub biomass as zero.

Dead wood and litter in project

For the sake of simplicity we do not wish to make field measurements to estimate dead wood and litter in our project. Instead, we use the default factors which estimate dead wood and litter biomass in project scenario as a fraction of the above-ground tree biomass. According to the tool, dead wood and litter can be estimated as 2% and 4%, respectively, of the above-ground tree biomass which is reflected in columns (d) and (e) of Table A.7.

Changes in soil organic carbon in project

Soil organic carbon (SOC) is likely to increase as a result of regeneration of forests because input of organic matter to the soil will be greater under project scenario compared to the baseline scenario. However, it is not possible to quantify the increase in SOC using the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities", because the tool is applicable only when the land-use change occurs from cropland or grassland to forested land. The baseline land-use in our project is neither cropland nor grassland. Therefore, we make the conservative choice of accounting change in SOC pool as zero.

Project emissions

Next, we note that, the methodology only requires us to account for project emissions resulting from field-burning of biomass for the purpose of site preparation. In our project, fire will not be used for site preparation and therefore project emissions of our project are zero.

Actual net GHG removals

Taking into account the ex-ante estimation of changes in carbon stocks in various pools, as well as emissions resulting from

implementation of the project, we estimate the actual net GHG removals as summarized in Table A.7.

Table A.7 *Ex-ante* estimation of actual net GHG removals (in tCO_2e)

Project year	C stock in pools / components of pools (tCO_2e)					Change in C stock in C pools	Project emissions	Actual net GHG removals
	Tree biomass	Shrub biomass	Dead wood	Litter	Total			
(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)	(*g*)	(*h*)	(*i*)
1	0	0	0	0	0	0.00	0	0.00
2	0	0	0	0	0	0.00	0	0.00
3	0	0	0	0	0	0.00	0	0.00
4	0	0	0	0	0	0.00	0	0.00
5	0	0	0	0	0	0.00	0	0.00
6	0	0	0	0	0	0.00	0	0.00
7	0	0	0	0	0	0.00	0	0.00
8	346.67	0	6.93	13.87	367.47	367.47	0	367.47
9	1262.17	0	25.24	50.49	1337.90	970.44	0	970.44
10	3030.47	0	60.61	121.22	3212.30	1874.40	0	1874.40
11	4782.38	0	95.65	191.30	5069.32	1857.02	0	1857.02
12	7315.58	0	146.31	292.62	7754.51	2685.19	0	2685.19
13	10936.66	0	218.73	437.47	11592.86	3838.35	0	3838.35
14	15835.62	0	316.71	633.42	16785.75	5192.89	0	5192.89
15	22311.17	0	446.22	892.45	23649.84	6864.08	0	6864.08
16	30567.82	0	611.36	1222.71	32401.89	8752.05	0	8752.05
17	40501.31	0	810.03	1620.05	42931.39	10529.50	0	10529.50
18	51581.50	0	1031.63	2063.26	54676.39	11745.01	0	11745.01
19	63248.74	0	1264.97	2529.95	67043.67	12367.27	0	12367.27
20	75222.49	0	1504.45	3008.90	79735.84	12692.17	0	12692.17
21	87230.12	0	1744.60	3489.20	92463.92	12728.09	0	12728.09
22	99011.26	0	1980.23	3960.45	104951.94	12488.02	0	12488.02
23	110321.30	0	2206.43	4412.85	116940.58	11988.64	0	11988.64
24	120934.11	0	2418.68	4837.36	128190.16	11249.58	0	11249.58
25	130644.43	0	2612.89	5225.78	138483.10	10292.94	0	10292.94
26	139269.68	0	2785.39	5570.79	147625.86	9142.76	0	9142.76
27	146651.52	0	2933.03	5866.06	155450.61	7824.75	0	7824.75
28	152657.10	0	3053.14	6106.28	161816.53	6365.92	0	6365.92
29	157180.04	0	3143.60	6287.20	166610.85	4794.32	0	4794.32
30	160150.14	0	3203.00	6406.01	169759.14	3148.30	0	3148.30

Leakage emissions

We note that the only service provided by the vacant forest lands in the baseline scenario is seasonal grazing of livestock for a few

months after the monsoon season. Grazing activity will be displaced to areas within the project (by rotation, for the first two years), and then temporarily outside the project area until the regenerated trees are big enough to be safe against damage from livestock. Since the emissions from grazing activity will not increase because of displacement of grazing, the leakage emissions in our project are accounted as zero[15].

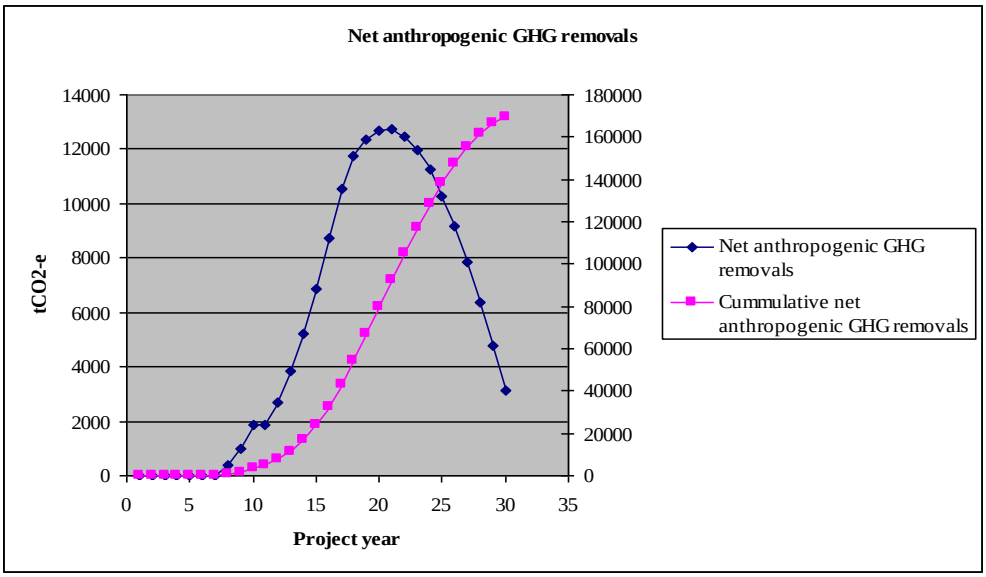

Figure A.1 Net anthropogenic GHG removals over the project period

Net anthropogenic GHG removals

By subtracting leakage emissions and baseline removals (both of which happen to be zero in our project) from the actual net GHG removals, we obtain year-wise and cumulative net anthropogenic GHG removals of our project, as summarized in Table A.8 and shown in the Figure A.1. Ex-ante estimation of cumulative net anthropogenic GHG removals is also the ex-ante estimation of tCERs.

[15] However, if forested areas were to be cleared to accommodate grazing of livestock displaced from the project area, leakage emissions equal to the carbon stocks held in various carbon pools of the forested areas cleared would have been accounted.

Table A.8 Ex-ante estimation of net anthropogenic GHG removals by sinks (tCO_2)

Project year	Baseline net GHG removals	Actual net GHG removals	Leakage emissions	Net anthropogenic GHG removals	Cumulative net anthropogenic GHG removals
1	0	0.00	0.00	0.00	0.00
2	0	0.00	0.00	0.00	0.00
3	0	0.00	0.00	0.00	0.00
4	0	0.00	0.00	0.00	0.00
5	0	0.00	0.00	0.00	0.00
6	0	0.00	0.00	0.00	0.00
7	0	0.00	0.00	0.00	0.00
8	0	367.47	0.00	367.47	367.47
9	0	970.44	0.00	970.44	1337.90
10	0	1874.40	0.00	1874.40	3212.30
11	0	1857.02	0.00	1857.02	5069.32
12	0	2685.19	0.00	2685.19	7754.51
13	0	3838.35	0.00	3838.35	11592.86
14	0	5192.89	0.00	5192.89	16785.75
15	0	6864.08	0.00	6864.08	23649.84
16	0	8752.05	0.00	8752.05	32401.89
17	0	10529.50	0.00	10529.50	42931.39
18	0	11745.01	0.00	11745.01	54676.39
19	0	12367.27	0.00	12367.27	67043.67
20	0	12692.17	0.00	12692.17	79735.84
21	0	12728.09	0.00	12728.09	92463.92
22	0	12488.02	0.00	12488.02	104951.94
23	0	11988.64	0.00	11988.64	116940.58
24	0	11249.58	0.00	11249.58	128190.16
25	0	10292.94	0.00	10292.94	138483.10
26	0	9142.76	0.00	9142.76	147625.86
27	0	7824.75	0.00	7824.75	155450.61
28	0	6365.92	0.00	6365.92	161816.53
29	0	4794.32	0.00	4794.32	166610.85
30	0	3148.30	0.00	3148.30	169759.14

Monitoring Plan

In the monitoring plan we are required to provide information as to how we will carry out ex-post (actual) estimation of carbon stocks and carbon-stock changes in various carbon pools as well as project emissions and leakage emissions.

We note that the methodology does not require us to monitor carbon-stock changes in the baseline. The pre-project carbon stock

in tree biomass has already been estimated by us and documented in our PDD. We will use this estimate in our first monitoring report which will be the outcome of implementation of our monitoring plan. We also note that we do not have to monitor project emissions and leakage emissions since these are accounted as zero.

We further note that changes in soil organic carbon are not required to be monitored in our project because these changes are conservatively accounted as zero.

The carbon stocks and changes in carbon stocks occurring in the carbon pools of (i) below-ground biomass, (ii) dead wood, and (iii) litter are not required to be monitored because carbon stocks in these pools are accounted as a fixed percentage of carbon stocks in above-ground tree biomass.

Therefore, in our project the only carbon pool to be monitored is the above-ground biomass, and within this pool we will monitor only the above-ground tree biomass since we have made the conservative choice of not accounting for the biomass of shrubs in our project.

Monitoring of aboveground tree biomass

For project monitoring purposes we will use tree allometric equations which convert tree diameter into tree biomass. We have the choice of either developing new equations or modifying existing equations that fit data obtained from sample trees harvested from the project area. We choose the option of developing new allometric equations, at the time of monitoring, so as to get an unbiased and accurate estimate of tree biomass[16].

Since we are regenerating a mixed forest to its natural state, we will develop a generalized allometric equation by regressing tree diameter (DBH) against field data of tree biomass across the tree species that will be present in the regenerated forest[17].

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[16] We could have made the other choice of modifying an existing equation to fit field data from sample trees harvested from within the project area. While applying an existing equation we are allowed to modify it in such a way that it gives a conservative estimate of tree biomass but as close to the unbiased estimate as it can go.

[17] While developing species-specific allometric equations requires harvesting fewer sample trees because of a closer correlation between the DBH and tree biomass, if there are more than four or five species planted in mixed stands (rather than in species-wise blocks), it is more convenient to develop and apply a generalized equation that is valid across species. Developing a generalized equation will require us to have a larger sample (e.g. 50 to 60 trees) but when we add up all the trees to be felled for each species (in case of a number of species-

Sample plots

We will apply our generalized allometric equation to all trees falling within circular sample plots having a radius of 12.61 m (i.e. we will employ fixed area plots of size 0.05 ha). Sample plots within a stratum will be laid out in a systematic manner with a random start. Since no clear-cutting will take place in our project area, we choose the option of installing permanent sample plots. This means we will record the locations of plot centres and preserve these locations in database. Plot centres, however, will not be visible in field. When we are required to produce a monitoring report after the first monitoring report we can opt for re-measuring only a fraction of plots to estimate the increase in biomass since the first monitoring report. This will ensure that our plot measurement costs are reduced.

Stratification

At the time of monitoring, we will stratify the project area into areas having (i) low, (ii) medium, and (iii) high aboveground tree biomass per hectare[18]. We do not propose any ex-ante stratification map in the PDD since we do not know, in advance, in what pattern the spatial distribution of biomass of the natural forest will emerge.

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specific equations), the generalized allometric equation will prove to be more economical in terms of effort. Apart from this, with a generalized equation our plot-census fieldwork will get simplified because we will not have to identify and record tree species while recording tree diameters.

[18] It is not necessary to assign specific cut-off values to define where a stratum begins and where it ends. We can just make a visual inspection (or take a look at the freely available Google Earth image of our project area) and assign parcels of areas to one stratum or another. Also, a stratum does not have to comprise of geographically contiguous areas. A stratum is a list (and a map) of areas which appear to have similar biomass density. Once we have firmed up the list of areas by strata and demarcated the boundaries of areas on map (based on field-survey of the boundaries), these lists with maps constitute our sampling frame. To draw sample plots from a stratum we will divide the stratum into 0.05 ha square cells. We will number these cells from 1 to *N*. To pick up *n* samples at random, we will generate a random cell number between 0 and *N/n*. We will make this cell as the starting point and then pick up every n^{th} cell from here until we reach *N*. The centres of the sampled cells will be the centres of our sample plots. We will pick up the latitude-longitude (or local X-Y coordinates) of these plot centres from the map (these can also be calculated for us by the computer), and using a GPS we will navigate to the plot centres in field. At each plot centre in field we will drive a peg into the ground, tie one end of a tape of 12.61 m length to the peg, and swing the free end of the tape into a circle, thus defining the boundary of our sample plot. We will repeat the procedure for each stratum.

Sample size

In view of the variability of natural forest that we expect to regenerate, we assume that a sampling fraction of 1.5% will be adequate to meet the precision requirement stipulated by the methodology. Thus, in a stratum having an area of 100 ha, number of sample plots will 30 (so that the area sampled will be 1.5 ha or 1.5%). However, we cannot predict the variability of biomass content per hectare in the actual forest that will be emerging in our project, and hence we keep the option of determining actual sample size at the time of monitoring.

Conclusion

This completes the essential aspects of our A/R CDM project. It remains to complete the PDD form by inserting the details we have worked out above in their appropriate places and to submit our PDD to a DOE for validation and onward submission to the UNFCCC secretariat.

Appendix B

Glossary of terms

This appendix contains definition of CDM terms relating to afforestation and reforestation project activities. The user may like to refer to the Glossary of CDM terms for a full set of CDM terms and definitions.

Actual net GHG removals by sinks
The sum of the verifiable changes in carbon stocks in the carbon pools within a project boundary that are attributable to an A/R or SSC A/R CDM project activity or PoA (A/R), as applicable, minus any increase in anthropogenic GHG emissions by sources (measured in carbon dioxide equivalents) within the project boundary that is caused by the implementation of the A/R or SSC A/R CDM project activity or PoA (A/R), as applicable.

Afforestation
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 human-induced promotion of natural seed sources.

Annex I Party
A Party that is included in Annex I to the Convention or a Party that has made a notification under Article 4, paragraph 2(g) of the Convention.

A/R CDM project activity
An afforestation or reforestation measure, operation or action that aims to achieve net anthropogenic GHG removals by sinks, whether as a whole project or as a part of a project.

Baseline net GHG removals by sinks
The sum of the changes in carbon stocks in the carbon pools within the project boundary that would have occurred in the absence of the A/R or SSC A/R CDM project activity or PoA (A/R).

Carbon pools
Above-ground biomass, below-ground biomass, litter, dead wood and soil organic carbon. This definition applies to A/R and SSC A/R CDM project activities and PoA (A/R).

A/R CDM modalities and procedures
Modalities and procedures for afforestation and reforestation project activities under the CDM, as adopted by the CMP in decision 5/CMP.1 and including any subsequent amendments.

CDM modalities and procedures
Modalities and procedures for a clean development mechanism as adopted by the CMP in the annex to decision 3/CMP.1 and including any subsequent amendments.

SSC A/R CDM modalities and procedures
Modalities and procedures for SSC A/R CDM project activities under the CDM, as adopted by the CMP in decision 6/CMP.1, including any subsequent amendments.

Certification
The written assurance by a DOE that an A/R CDM project activity or PoA achieved the net anthropogenic GHG removals by sinks since the start of the project, as verified.

CER (certified emission reduction)
A unit issued for emission reductions from CDM project activities or PoAs (non-A/R) in accordance with the CDM rules and requirements, which is equal to one metric tonne of carbon dioxide equivalent, calculated using global warming potentials defined by decision 2/CP.3 or as subsequently revised in accordance with Article 5 of the Kyoto Protocol. See also the definition for "lCER" and "tCER".

CME (coordinating/managing entity)
An entity authorized by all participating host country DNAs involved in a particular PoA and nominated in the MoC statement as the entity that communicates with the Board and the secretariat, including on matters relating to the distribution of CERs, tCERs or lCERs, as applicable.

Convention
The United Nations Framework Convention on Climate Change (UNFCCC).

CPA (component project activity)
A single measure, or a set of interrelated measures under a PoA, to reduce GHG emissions by sources or result in net anthropogenic

GHG removals by sinks, applied within a designated area defined in the baseline methodology(ies).

CPA-DD (CPA design document)
The document prepared by the CME which sets out in detail, in accordance with the CDM rules and requirements, the CPA which is to be undertaken. The form of CPA-DD, and guidelines on preparing the CPA-DD, are publicly available on the UNFCCC CDM website.

Crediting period
The period in which verified and certified GHG emission reductions or removals by sinks attributable to a CDM project activity or CPA, as applicable, can result in the issuance of CERs, lCERs or tCERs, as applicable, from that CDM project activity or CPA. The time period that applies to a crediting period for a CDM project activity or CPA, and whether the crediting period is renewable or fixed, is determined in accordance with the CDM rules and requirements.

DNA (designated national authority)
The body granted responsibility by a Party, among other things and where applicable, to issue a letter of approval with respect to CDM project activities or PoAs on behalf of that Party, in accordance with the CDM rules and requirements.

DOE (designated operational entity)
An entity designated by the CMP, based on a recommendation by the Board, as qualified to validate proposed CDM project activities and PoAs, as well as verify and certify reductions in anthropogenic emissions by sources of GHG and net anthropogenic GHG removals by sinks.

Eligibility of land
The determination of which land meets the conditions required to be included in an A/R or SSC A/R CDM project activity or PoA (A/R), in accordance with the CDM rules and requirements.

Forest
"Forest" is a minimum area of land of 0.05–1.0 hectare with tree crown cover (or equivalent stocking level) of more than 10–30 per cent with trees with the potential to reach a minimum height of 2–5 metres at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density

of 10–30 per cent or tree height of 2–5 metres are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest.

GHG (greenhouse gas)
A greenhouse gas listed in Annex A to the Kyoto Protocol, unless otherwise specified in a particular methodology.

Host Party
A Party involved not included in Annex I to the UNFCCC on whose territory a CDM project activity or PoA, as applicable, is physically located.

Issuance
The instruction by the Board to the CDM Registry Administrator to issue a specified quantity of CERs, lCERs, or tCERs for a project activity or PoA, as applicable, into the pending account of the Board in the CDM registry, for subsequent distribution to accounts of project participants in accordance with the CDM rules and requirements.

Kyoto Protocol
The protocol to the Convention adopted in Kyoto, Japan, on 11 December 1997, which entered into force on 16 February 2005. The Kyoto Protocol, among other things, sets binding targets for the reduction of GHG emissions by Annex I Parties.

lCER (long-term certified emission reduction)
A unit issued pursuant to Article 12 of the Kyoto Protocol for net anthropogenic GHG removals by sinks from an A/R or SSC A/R CDM project activity or PoA (A/R), which expires at the end of the crediting period of the A/R or SSC A/R CDM project activity or PoA (A/R) for which it was issued. It is equal to one metric tonne of carbon dioxide equivalent. See also the definitions of "CER" and "tCER".

Leakage
The increase in GHG emissions by sources or decrease in carbon stock in carbon pools which occurs outside the boundary of an A/R or SSC A/R CDM project activity or PoA (A/R), as applicable, which is measurable and attributable to the A/R or SSC A/R CDM project activity or PoA (A/R), as applicable.

Monitoring
Collecting and archiving all relevant data necessary for estimating or measuring the net anthropogenic GHG removals by sinks.

Monitoring plan
The plan which sets out the methodology to be used by project participants or CMEs for the monitoring of, and by DOEs for verification of the amount of reductions of anthropogenic emissions by sources or removals by sinks of GHGs achieved by the CDM project activity or PoA, as applicable.

Monitoring report
A report prepared by a project participant which sets out the GHG emission reductions or net GHG removals of an implemented registered CDM project activity or PoA for a particular monitoring period.

Net anthropogenic GHG removals by sinks
In the context of A/R or SSC A/R CDM project activities or PoAs (A/R), the actual net GHG removals by sinks minus the baseline net GHG removals by sinks minus leakage.

Non-Annex I Parties
Parties to the Convention that are not included in Annex I to the Convention.

PDD (project design document)
The document prepared by the project participant of a CDM project activity which sets out in detail, in accordance with the CDM rules and requirements, the CDM project activity which is to be undertaken. The form of PDD, and guidelines on preparing the PDD, are publicly available on the UNFCCC CDM website.

PoA (programme of activities)
A voluntary coordinated action by a private or public entity which coordinates and implements any policy/measure or stated goal (i.e. incentive schemes and voluntary programmes), which leads to anthropogenic GHG emission reductions or net anthropogenic GHG removals by sinks that are additional to any that would occur in the absence of the PoA, via an unlimited number of CPAs.

PoA-DD (PoA design document)

The document prepared by the CME of a PoA, which sets out in detail, in accordance with the CDM rules and requirements, the PoA which is to be undertaken. The form of PoA-DD and guidelines on preparing the PoA-DD are publicly available on the UNFCCC CDM website.

Project boundary
Boundary that geographically delineates the A/R or SSC A/R CDM project activity or CPA (A/R) under the control of the project participant as determined in accordance with the CDM rules and requirements.

Project participant
A Party involved that intends to participate, or a private and/or public entity authorized by the DNA of a Party involved to participate in a CDM project activity or PoA, as applicable.

Reforestation
The 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 has been converted to non-forested land.

Registration
The formal acceptance by the Board of a CDM project activity or PoA validated by a DOE as a CDM project activity or PoA, as applicable. Registration is the prerequisite for the verification, certification and issuance of CERs, lCERs or tCERs, as applicable, related to that CDM project activity or PoA.

Small-scale A/R CDM project activity
An afforestation or reforestation measure, operation or action:
(a) Where the average projected net anthropogenic GHG removals by sinks for each verification period do not exceed eight kilotonnes of carbon dioxide equivalent per year; and
(b) Which is developed or implemented by low income communities and individuals as determined by the host Party.

Start date
In the context of a CDM project activity or CPA, the earliest date at which either the implementation or construction or real action of a CDM project activity or CPA begins. In the context of a CDM PoA, the date on which the coordinating/managing entity officially notifies the secretariat and the DNA of their intention to seek the CDM status or the date of publication of the PoA-DD for global

stakeholder consultation in accordance with the relevant CDM rules and requirements.

tCER (temporary certified emission reduction)
A unit issued pursuant to Article 12 of the Kyoto Protocol for an A/R CDM project activity or SSC A/R CDM project activity, which expires at the end of the commitment period following the one during which it was issued. It is equal to one metric tonne of carbon dioxide equivalent.

Validation
The process of independent evaluation of a CDM project activity or PoA by a DOE against the requirements of the CDM rules and requirements, on the basis of the PDD or PoA-DD and CPA-DDs.

Verification
The periodic independent evaluation and ex post determination by a DOE of the net anthropogenic GHG removals by sinks achieved by the A/R or SSC A/R CDM project activity or PoA.

Appendix C

List of regulatory documents

This appendix contains the list of the regulatory documents applicable to A/R CDM project activities. Regulatory documents can be classified into hierarchical categories as listed below. The documents have been assigned numbers for facilitating citing of their reference in the body of the manual.

C.1 CMP decisions

The reader interested in the high level source documents on the CDM may consult the following documents:

C.1.1 The Kyoto Protocol

C.1.2 Decision 3/CMP.1 - Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol

C.1.3 Decision 5/CMP.1 - Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol

C.1.4 Decision 6/CMP.1 - Simplified modalities and procedures for small-scale afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol and measures to facilitate their implementation

The reader interested in development of A/R CDM project activities should consult the following documents:

C.2 CDM Standards

C.2.1 Clean development mechanism project standard

C.2.2 Clean development mechanism validation & verification standard

C.2.3 Clean development mechanism project cycle procedure

C.3 A/R CDM methodologies

C.3.1 Afforestation and reforestation of degraded mangrove habitats

C.3.2 Afforestation and reforestation of lands except wetlands

C.4 Small-scale A/R CDM methodologies

C.4.1 Simplified baseline and monitoring methodology for small scale CDM afforestation and reforestation project activities implemented on wetlands

C.4.2 Simplified baseline and monitoring methodology for small scale CDM afforestation and reforestation project activities implemented on lands other than wetlands

C.5 A/R CDM methodological tools

C.5.1 Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities

C.5.2 Demonstrating eligibility of land for A/R CDM project activities.

C.5.3 Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities

C.5.4 Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities

C.5.5 Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities

C.5.6 Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities

C.5.7 Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass in A/R CDM project activities

C.5.8 Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity

C.5.9 Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity

C.5.10 Calculation of the number of sample plots for measurements within A/R CDM project activities

C.6 A/R CDM methodological guidelines

C.6.1 Establishment of standardized baselines for afforestation and reforestation project activities under the CDM

C.6.2 Guidelines for completing the proposed new afforestation and reforestation baseline and monitoring methodology form

C.6.3 Guidelines on accounting of specified types of changes in A/R CDM project activities from the description in registered project design documents

C.7 A/R CDM forms

C.7.1 F-CDM-AR-PDD - Project Design Document form for Afforestation and Reforestation CDM project activities

C.7.2 F-CDM-SSC-AR-PDD - Project design document form for small-scale afforestation and reforestation CDM project activities

C.7.3 F-CDM-AR-PoA-DD - Programme design document form for afforestation and reforestation CDM programmes of activities

C.7.4 F-CDM-SSC-AR-PoA-DD - Programme design document form for small-scale afforestation and reforestation CDM programmes of activities

C.7.5 F-CDM-AR-CPA-DD - Component project activity design document form for afforestation and reforestation component project activities

C.7.6 F-CDM-SSC-AR-CPA-DD - Component project activity design document form for small-scale afforestation and reforestation component project activities

C.7.7 CDM-AR-NM-FORM - Proposed new afforestation and reforestation baseline and monitoring methodology form