Guidebook on Afforestation and Reforestation CDM Projects in India





Forests and Climate Change Division
Indian Council of Forestry Research and Education
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भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद्
(आइएसओ 9001:2008 प्रमाणित संस्था)
(पर्यावरण एवं वन मंत्रालय, भारत सरकार की एक स्वायत संस्था)
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Foreword

Climate change is one of the greatest challenges of our time. Fossil fuel burning and deforestation have emerged as principal anthropogenic sources of rising atmospheric carbon dioxide (CO_2) and other green-house gases and consequential global warming. There is a compelling, comprehensive, consistent, and objective evidence that human beings are altering the climate in ways that threaten our societies and the ecosystems. Due to inherent inertia of the climate system, the phenomenon of climate change cannot be prevented in its entirety. However, it is still possible through cooperation among international community and individual countries to stabilize CO_2 concentration in the atmosphere.

Forests are both source and sink of carbon and, therefore, are an integral part of international agreements dealing with climate change. Globally, forests are considered to provide a large mitigation opportunity at relatively lower costs along with significant co-benefits. On the other hand, climate change may also affect the economic and social systems of forest dependent communities. With nearly 200,000 villages classified as forest fringe villages in India, there is obviously large dependence of communities on forest resources. Climate change further adds to the challenge of livelihood issues in these populations.

The Indian Council of Forestry Research and Education is working proactively in the field of forests and climate change, and is contributing significantly to climate change issues at national and international level. ICFRE has contributed to India's Initial and Second National Communication to United Nations Framework Convention on Climate Change (UNFCCC). It is also engaged actively in capacity building of stake holders for developing Afforestation/Reforestation Clean Development Mechanism (A/R CDM) Projects. Since the beginning of Kyoto Protocol, ICFRE has created an enabling environment for development of A/R CDM projects in India. As a result, India is among the leading countries in the A/R CDM projects. Encouraged with this success and with the financial support from University of Tuscia Italy, ICFRE has developed a Guidebook on Afforestation Reforestation CDM Projects in India.

I am hopeful that the guidebook brought by ICFRE will help developing better understanding of complicated A/R CDM Modalities and Procedures in a simple language that is easily understood by the stakeholders. I compliment the contributors for putting in their best efforts for conceptualizing and preparing this guidebook.

(Dr. V.K. Bahuguna)

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Preface

The Clean Development Mechanism (CDM) of Kyoto Protocol is one of the most flexible mechanisms for project-based emission reduction activities in developing countries. The Kyoto Protocol establishes legally binding emissions cuts at 5.2 per cent below 1990 levels by 2012. The uncertainty about the second commitment period of this Protocol is now over. The agreement in Durban extended Kyoto Protocol for the second commitment period. Parties willing to join Second Commitment Period will take commitment to reduce emissions below 1990 levels by 2020 in accordance with their Copenhagen pledges. The second commitment period under the Kyoto Protocol is set to begin on January 1, 2013 and end either on December 31, 2017 or December 31, 2020. The commitments and the length of commitment period will be decided in Doha during COP 18 of the UNFCCC.

The Land use, Land use Change and Forestry (LULUCF) sector can provide relatively low cost opportunities to combat climate change. However, globally the development of forestry projects under CDM is rather slow. CDM project submission process to the CDM Executive Board is cumbersome. Poor understanding of CDM A/R modalities and procedures has been one of the primary reasons for high rate of rejection of these projects. Still India is the leading country in the world with 18% share of total registered A/R CDM projects.

Although A/R CDM is a very small part of the overall CDM mechanism, the A/R CDM projects have helped in the sustainable development of degraded and unproductive lands. In most cases the benefits from these projects have flown to the participating communities. In Durban, Parties have agreed that Afforestation/Reforestation Clean Development Mechanism (A/R CDM) projects will remain eligible in the second commitment period. The modalities and procedures for afforestation and reforestation project activities under the CDM, shall apply, *mutatis mutandis*, to the second commitment period. Encouraged with Durban COP decision and considering the potential of A/R CDM in India, ICFRE has developed a Guidebook for 'Afforestation Reforestation CDM Projects' in India'. I hope the guidebook will be helpful to the various stakeholders to understand the finer nitty-gritty of developing A/R CDM projects in a simple workable language.

(Sandeep Tripathi)

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Executive Summary

With Kyoto Protocol in force, carbon has become a tradable commodity. Under Clean Development Mechanism (CDM) of the Kyoto Protocol, reduction in emission of greenhouse gases (GHGs) or their secure capture can earn carbon credits through projects based activities registered with CDM Executive board. The Durban COP has agreed for the second commitment period of Kyoto Protocol and there will be no change in modalities and procedures for Afforestation reforestation CDM projects for the second commitment period. The purpose of this guidebook is to familiarize the CDM project developers with afforestation and reforestation Clean Development Mechanism (A/R CDM) in India. The structure of the guidebook is designed in such a way that the readers can actually go through the processes and procedures of A/R CDM project activity by following the instructions given in the guidebook.

This guidebook would give a clear and comprehensive illustration of what project developers have to do in order to implement an A/R CDM project activity and it would also give useful tips in order to understand how CDM project activities are carried out. Institutions and processes, giving an overview of the CDM related bodies and entities and organizations, which supervise and affect CDM project activities, have been described. It covers the processes that are to be followed while developing and implementing an A/R CDM Project activity. Project cycle and project types as well as approval process of project activities and methodologies has also been covered. An attempt has been made to provide technical guidance on how to fill out the A/R CDM project design document (CDM-PDD) and new baseline and monitoring methodologies forms (CDM-NMB and CDM-NMM, respectively). Rules specific to A/R CDM projects types have also been explained.

Modalities and Procedures for the CDM A/R projects are very different from other type of CDM projects. Therefore characteristics of carbon credits from forestry projects have been specifically dealt in greater details. The credits generated by forestry CDM projects are expiring in nature, i.e., they expire after a certain period from the date of their issuance. Two types of expiring credits are generated from forestry projects, they are tCERs and lCERs. How and when these credits expire, and how they are replaced, is also explained. Market mechanism of forestry projects is also given to help the readers to understand what types of carbon markets exist and where the credits can be sold. Case studies of three successfully registered A/R CDM projects in India are also given. The projects selected for this purpose belong to different typologies of A/R CDM projects. The project from Sirsa (Haryana) is the world's first small scale CDM project. The project from Himachal Pradesh is developed through public Mid Himalayan Watershed Development Project (a public entity) and its stakeholder constituents namely, Forest Department, Government of Himachal Pradesh, local Gram Panchayats (GPs) and the World Bank. The project from ITC Bhadrachalam is developed by a private entity.

The annexes given at the end of the guidebook provide additional information that will help the readers to keep them abreast with the latest in A/R CDM projects. This includes a list of approved A/R CDM methodologies including approved consolidated methodologies and the

tools for demonstration and assessment of additionality. Various other tools approved till date by the CDM Executive board have also been listed.

Further Annexes also provide a list of accredited Designated Operational Entities (DOEs) for A/R CDM projects in India, list of globally registered A/R CDM projects and the constitution and functioning of National CDM authority (NCDMA). An Annex also describes in detail about the procedures for tree measurements, estimation of biomass, volume and carbon in a forested stand. Information about the various terrestrial carbon pools that can be accounted for carbon measurement in an A/R CDM project is also given.

Original COP/MOP decisions pertaining to A/R CDM projects, modalities and procedures for A/R CDM projects have been re written in as far as possible, a simple and easily understandable language for the benefit of A/R CDM Project developers and other stakeholders. Readers are also advised to refer to the CDM web site (http://cdm.unfccc.int/) for up-to-date and comprehensive information on the CDM afforestation and reforestation project activities.

Authors

1

Introduction

The average temperature of earth's surface has risen by 0.74 degrees C since the late 1800s. It is expected to increase by another 1.8° C to 4° C by the year 2100 - a rapid and profound change - should the necessary action not be taken. Even if the minimum predicted increase takes place, it will be larger than any century-long trend in the last 10,000 years (IPCC, 2007).

The principal reason for the mounting thermometer is a century and a half of industrialization: the burning of ever-greater quantities of oil, gasoline, and coal, the cutting of forests, and the practice of certain farming methods.

These activities have increased the amount of "greenhouse gases" in the atmosphere, especially carbon dioxide, methane, and nitrous oxide. Such gases occur naturally - they are critical for life on earth, they keep some of the sun's warmth from reflecting back into space, and without them the world would be a cold and barren place. But in augmented and increasing quantities, they are pushing the global temperature to artificially high levels and altering the climate. Eleven of the last 12 years are the warmest on record, and 1998 was the warmest year.

The current warming trend is expected to cause extinctions. Numerous plant and animal species, already weakened by pollution and loss of habitat, are not expected to survive the next 100 years. Human beings, while not threatened in this way, are likely to face mounting difficulties. Recent severe storms, floods and droughts, for example, appear to show that computer models predicting more frequent "extreme weather events" are on target.

The average sea level rose by 10 to 20 cm during the 20th century, and an additional increase of 18 to 59 cm is expected by the year 2100. (Higher temperatures cause ocean volume to expand, and melting glaciers and ice caps add more water.) If the higher end of that scale is reached, the sea could overflow the heavily populated coastlines of such countries as Bangladesh, cause the disappearance of some nations entirely (such as the island state of the Maldives), foul freshwater supplies for billions of people, and spur mass migrations.

Agricultural yields are expected to drop in most tropical and sub-tropical regions - and in temperate regions too - if the temperature increase is more than a few degrees C. Drying of continental interiors, such as central Asia, the African Sahel, and the Great Plains of the United States, is also forecast. These changes could cause, at a minimum, disruptions in land use and food supply. And the range of diseases such as malaria may expand.

Anthropogenic climate change is a "modern" problem - complicated, involving the entire world, tangled up with difficult issues such as poverty, economic development and population growth. Dealing with it will not be easy. Ignoring it will be worse. The overwhelming concern

with the problem of Climate Change was reflected at the Earth summit in 1992 where most countries joined an international treaty - the **United Nations Framework Convention on Climate Change** - to begin to consider what can be done to reduce global warming and to cope with whatever temperature increases are inevitable. The objectives of the UNFCCC are to i) stabilize greenhouse gas (GHG) concentrations at levels that prevent dangerous anthropogenic interference with the climate system ii) to ensure that economic development proceeds in a sustainable manner and iii) to prevent any threat to future food production. The convention enjoys near universal acceptance with 194 countries signing the treaty. In 1997, a number of nations approved an addition to the treaty, called the **Kyoto Protocol**, which has more powerful (and legally binding) measures. The Protocol's first commitment period begun in 2008 and ends in 2012. Now parties are in the process of developing a strong multilateral framework to ensure that there is no gap between the end of the Kyoto Protocol's first commitment period in 2012 and the entry into force of a future regime.

The Kyoto Protocol: The Kyoto Protocol was adopted at the third conference of parties (COP 3) of UNFCCC in Kyoto on 11 December 1997. The Protocol commits Annex I Parties (developed countries) to individual, legally-binding targets to reduce their GHG emissions. Changes in land-use can positively impact atmospheric CO_2 concentrations by either: i) decreasing emissions that would occur without intervention, or ii) sequestering CO_2 from the atmosphere into vegetation and the associated soil. Preventing deforestation, decreasing the impact of logging or preventing the drainage of wetlands or peat lands are practices that decrease emissions. In contrast, planting trees, changing agricultural tillage or cropping practices, or re-establishing grasslands sequester carbon. The Kyoto Protocol recognised the role that changes in the use of land and forests have on the global carbon cycle. Parties to the Protocol can use credits generated either by sequestering carbon or by reducing carbon emissions from land use to help them reach their reduction targets. Carbon credits can be produced within the emission-source country or in an alternative industrialised nation (Joint Implementation [JI], Article 6). In addition, the Protocol includes a mechanism by which industrialised (Annex I) nations can offset some of their emissions by investing in projects in non-industrialised (non-Annex I) nations (CDM, Article 12).

2

Clean Development Mechanism

Article 12 of the Kyoto Protocol defines Clean Development Mechanism (CDM). The purpose of clean development mechanism is to assist Parties not included in Annex I (i.e. developing countries) in achieving sustainable development and in contributing (developed countries) to the ultimate objective of the convention, and to assist parties included in Annex I in achieving compliance with their quantified limitation and reduction commitments.". The CDM is a project based mechanism and aims to assist developing countries in achieving sustainable development by promoting environment friendly investments in their countries from industrialized country governments and businesses. Afforestation and reforestation in the land use, land-use change and forestry (LULUCF) sector are covered under CDM in the first commitment period of the protocol i.e. 2008-2012. The second commitment period under the Kyoto Protocol will begin in January 1, 2013 and end either on December 31, 2017 or December 31, 2020. The commitments and the length of commitment period will be decided in Qatar during COP 18 of the UNFCCC. Afforestation and reforestation will be the only eligible activity under Sect oral Scope 14 of CDM for the second commitment period as well.

The UNFCCC established a CDM Executive Board that is charged with approving or rejecting project designs and methodologies, registering and administering project auditors (designated operational entities) and approving the issuance of certified emission reductions.

The institutions involved and process of CDM project activity

Before going in for detailed process involved in the CDM Project formulation , project cycle and it submission process let us get familiar with the various institutions involved in the CDM. The various institutions involved in the submission and approval process of CDM Afforestation and reforestation projects are as follows:

COP/MOP: As the CDM is a mechanism under the Kyoto Protocol, the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (COP/MOP) shall have authority over and provide guidance to the CDM.

The CDM Executive Board (CDM EB): For the actual operation of the CDM, the executive board (EB) is the body that supervises the CDM, under the authority and guidance of the COP/MOP. The responsibilities of the EB include:

- Approve new methodologies related to, inter alia, baselines, monitoring plans and project boundaries;
- Review provisions with regard to simplified modalities, procedures and the

definitions of small scale project activities and make recommendations to the COP/MOP; and

Be responsible for the accreditation of operational entities, in accordance with accreditation standards, and make recommendations to the COP/MOP for the designation of operational entities.

This responsibility includes:

Decisions on re-accreditation, suspension and withdrawal of accreditation; and

Operationalization of accreditation procedures and standards.

The EB is also responsible for, among others, making recommendations to the COP/MOP on further modalities and procedures for the CDM; reviewing the accreditation standards; reporting to the COP/MOP on the regional and subregional distribution of CDM project activities; and developing and maintaining the CDM registry. The EB comprises of ten members from Parties to the Kyoto Protocol.

Since November 2001, it has been holding meetings every two to three months. Meeting reports, agenda and relevant documents, including webcast of the meetings are available on the CDM web site at http://cdm.unfccc.int/EB/Meetings. The EB has following panels and working groups to assist it in the performance of its functions.

Methodologies Panel: The Methodologies Panel (Meth Panel) was established to develop recommendations to the EB on guidelines for methodologies for baselines and monitoring plans. Specifically, the Meth Panel:

Prepares recommendations on submitted proposals for new baseline and monitoring methodologies;

Prepares draft reformatted versions of proposed new baseline and monitoring methodologies approved by the EB;

Prepares recommendations on options for expanding the applicability of methodologies and provide tools for project participants to choose among approved methodologies of a similar nature; and

Maintains a roster of experts and selects experts who are to undertake desk reviews to appraise the validity of the proposed new methodologies.

Furthermore, the Meth Panel elaborates recommendations to the EB on:

Revisions to the project design document, in particular on sections relevant to baseline and monitoring;

Draft “decision trees, and other methodological tools, where appropriate, to guide choices in order to ensure that the most appropriate methodologies are selected, taking into account relevant circumstances”;

Guidance on identified modalities and procedures contained in the annex to decision

3/CMP.1 with a view to facilitating the development of project-based methodologies by project participants. Such modalities and procedures shall be identified by the panel and addressed in accordance with guidance provided by the EB;

Further work on items identified in "Terms of references for establishing guidelines on baselines and monitoring methodologies" [Appendix C of the CDM M&P] as appropriate; and amendments on the annex on indicative simplified methodologies for small-scale CDM project activities.

Since the Meth Panel held its first meeting in June 2002, it has been holding meetings every two to three months. Meeting reports, agenda and relevant documents are available on the CDM web site at http://cdm.unfccc.int/Panels/meth.

When a new methodology is submitted to the Meth Panel, the Meth Panel selects experts from a roster of experts, to obtain an appraisal of the validity of the methodology by undertaking a desk review. The Meth Panel will make a recommendation to the EB based on the desk review no later than one month after the receipt of the new methodology.

Accreditation Panel: The CDM Accreditation Panel (CDM-AP) prepares the decision making of the EB in accordance with the procedure for accrediting operational entities. CDM-AP chooses an ad hoc Assessment Team (CDM-AT). The CDM-AT shall undertake an assessment of the applicant and/or designated operational entities and prepare an assessment report for the CDM-AP. A team shall be composed of a team leader and at least two team members chosen to serve in a team for an assessment at a time.

Afforestation and Reforestation Working Group: The working group on afforestation and reforestation for CDM project activities (AR WG) was established to prepare recommendations on submitted proposals for new baseline and monitoring methodologies for A/R CDM project activities. It works in cooperation with the Meth Panel to evaluate proposed new baseline and monitoring methodologies.

Designated Operational Entity: A designated operational entity (DOE) is either a domestic legal entity or an international organization accredited and designated on a provisional basis by the EB until confirmed by the COP/MOP.

A DOE has the following two key functions in the CDM project cycle.

i) Validation: It validates a proposed CDM project activity, and subsequently requests registration of the proposed CDM project activity.

ii) Verification and Certification: It verifies emission reduction of a registered CDM project activity, certifies as appropriate, and requests the EB to issue Certified Emission Reductions (CERs) accordingly.

A DOE can perform either validation or verification and certification on the same CDM project activity. However, upon request, the EB may allow a single DOE to perform all these functions within a single CDM project activity. For small-scale CDM project activities, the same DOE may undertake validation, and verification and certification.

3

Land Use, Land Use Change and Forestry (LULUCF)

The Land use, Land use Change and Forestry sector can provide relatively low cost opportunities to combat climate change, either by increasing the removal of GHGs from the atmosphere through carbon sinks (e.g. by planting trees) or by reducing emission (e.g. by checking deforestation). The various issues related to forestry sector are referred to as Land Use, Land Use Change and Forestry (LULUCF) in the Kyoto Protocol. For the first commitment period (2008-2012), Annex I Parties are limited in the extent to which they can use offsets from LULUCF to meet their reduction commitments. The total additions to an Annex I Party's assigned amount from emissions that can result from LULUCF project activities under the CDM is constrained at one per cent of base year emissions of that country per year for the five years of the commitment period.

Forest definitions under LULUCF

a. **"Forest"** is a minimum area of land of 0.05- 1.0 hectares 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 meters at maturity in situ.

A forest may consist either of closed forest formations where trees of various story 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 meters 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;

b. **"Afforestation"** is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and / or the human-induced promotion of natural seed sources.

c. **"Reforestation"** is 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 that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.

Eligible forestry activities that can be undertaken under afforestation and reforestation (A/R) CDM projects: The Afforestation and Reforestation (A/R) activities are the only eligible activities under LULUCF in the CDM may be large or small scale, single or multiple species, pure forestry or farm forestry systems such as:

(i) Establishment of woodlot on communal lands, reforestation of marginal areas with native species, e.g., slopes, around and between existing forest fragments (through planting and natural regeneration).

(ii) New large-scale industrial plantations.

(iii) Establishment of biomass plantations for energy production

(iv) Small-scale plantations by land owners.

(v) Introduction of trees into existing agricultural systems (agro forestry, if it fulfills the host country definition of forest).

(vi) Rehabilitation of degraded areas through tree planting or assisted natural regeneration.

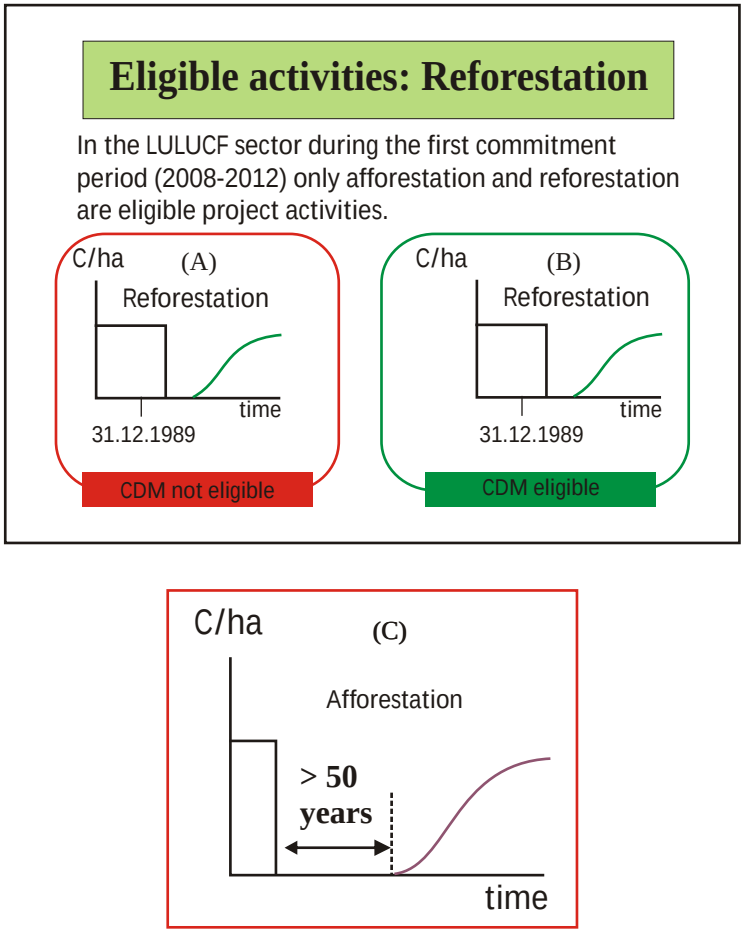


Figure 1: Eligible activities under Reforestation (A & B) and Aforestation (C) Under reforestation activity if the deforestation on proposed land has occurred after 31-12-1989 such lands are not eligible (Figure 1 A), Where deforestation has taken place before 31-12-1989 (Figure 1, B) such lands are eligible for CDM. For afforestation (Figure 1, C) lands historically not forested for past 50 years are eligible.

4

Planning A/R CDM Project Activity

Project participants: Project participants are those who want to start a CDM Afforestation reforestation activity. The participants could be (a) A party (here countries those who have signed Kyoto Protocol are called parties) involved and / or (b) A private and / or public entity authorized by a party to participate in a CDM project activity. For example, the first globally registered small scale CDM A/R project activity is "Afforestation CDM Pilot Project Activity on Private Lands Affected by Shifting Sand Dunes in Sirsa, Haryana" was proposed by Haryana C.D.M Variksh Kisan Samiti (Haryana CDM Tree Farmers Society), Ellenabad, Sirsa. Here the project developer is Haryana Forest department and the farmers of the Haryana C.D.M Variksh Kisan Samiti are project participants.

Eligibility criteria for CDM projects: Before planning an A/R CDM Project on the targeted land, the projected developer must examine that whether all the eligibility criterion of a A/R project are fulfilled. Project participants in the CDM project must meet the following conditions as per para 28- 31 of Decision 3 CMP.1.

i. Participation of the parties in a CDM project activity is voluntary. The Project must be approved in a voluntary way by the developer of the project and the host country.

ii Parties participating in the CDM shall designate a National Authority for the CDM. Every country must have a designated national authority (DNA) as a focal point for granting host country approval to projects. In India, the national authority for CDM is called National CDM Authority (NCDMA) which is situated in the Ministry of Environment forests Government of India, New Delhi. Secretary, Ministry of Environment of Forest is the Chairperson of the NCDMA and Director, Climate Change is the Member Secretary of the NCDMA,

iii. A Party not included in Annex I (Annex I are the developing countries listed in the UNFCCC who have been targeted to reduce their Green house gas emissions) may participate in a CDM Project activity if it is a Party to the Kyoto Protocol.

iv. It has selected and reported its definition of forests to the Executive Board through its designated national authority for the CDM: (Para 8; 5/CMP.1), selecting a single minimum unit from following three criterion

(A) A single minimum tree crown cover value between 10 and 30%.

(B) A single minimum land area between 0.05 and 1 hectare.

(C) A single minimum tree height value between 2 and 5 metres.

Host Party definition of forest: Each party must report to CDM Executive Board (EB) a single minimum tree cover value between 10 - 30%; a single minimum land area between 0.05 - 1.0 ha; single minimum tree height value between 2 - 5 m.

The definition of forest for the purpose of A/R CDM projects communicated by National CDM Authority of India is as follows:

? a single minimum tree crown cover value between 10-30 % is 15 %

? a single minimum land area value between 0.05 and 1 ha is 0.05ha

? a single minimum tree height value between 2 and 5 m is 2 m

Land where afforestation or reforestation activity is proposed must satisfy the cutoff date criteria for implementing these activities. Project developer must demonstrate that the activity is a reforestation or afforestation project activity: For reforestation project activities, demonstrate that the land was not forest on 31 December 1989. For afforestation project activities, demonstrate that for at least 50 years vegetation on the land has been below the thresholds adopted by the host country for definition of forest. For example, if it is a reforestation activity, then the deforestation on such lands would have taken place before 31 December 1989 (See Figure 1-and B). Here deforestation means the forested lands were below the national threshold as on 31-12-1989. For afforestation activity, land should not have been historically forested for past 50 years (Figure 1-C). In the PDD the land eligibility must be proved otherwise the projects are liable to be rejected by CDM EB. CDM EB has now simplified the criteria of proving land eligibility which are as follows:

In order to demonstrate afforestation and/or reforestation project activity, project participants shall provide information that reliably discriminates between forest and non-forest land according to the particular thresholds adopted by the host country, *inter alia*:

(a) Aerial photographs or satellite imagery complemented by ground reference data; or

(b) Land use or land cover information from maps or digital spatial datasets; or

(c) Ground based surveys (land use or land cover information from permits, plans, or information from local registers such as cadastre, owners registers, or other land registers).

If options (a), (b), and (c) are not available/applicable, project participants shall submit a written testimony which was produced by following a Participatory Rural Appraisal (PRA) methodology or a standard Participatory Rural Appraisal (PRA) as practised in the host country.

Additionality, baseline, leakage and permanence: CDM has four core and interlinked concepts that need to be understood to develop projects to deliver credits under the CDM of the Kyoto Protocol.They are: additionality, baseline, leakage and permanence.

Additionality: CDM allows an Annex I Party and a non-Annex I Party to co-operate and carry out a project in the non-Annex I Party that will sequester carbon (or reduce emissions). Certified emission reduction credits (CERs) are created through the project and transferred to the Annex I

Party, which is now able to emit an equivalent number of units of carbon while meeting its targets. Thus, the atmospheric concentration of greenhouse gases remains unchanged as a result of the transaction. The Annex I Party is assisted in meeting its commitments cost-effectively while, the non-Annex I Party benefits in meeting sustainable development goals.

However, if the project that sequesters the carbon (or reduces emissions) would have taken place without the CDM transaction, then greenhouse gases in the atmosphere will increase as a result of the transfer of CERs. For example, if an area would have been reforested, either through deliberate management action or through natural processes, irrespective of the CDM transaction, then the CDM transaction simply allows the Annex I Party to emit more greenhouse gases. The definition of additionality under Marrakech accord is "The proposed afforestation or reforestation project activity under the CDM is additional if the actual net greenhouse gas removals by sinks is increased above 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 registered CDM afforestation or reforestation project activity…". This definition focuses more on identifying the additional component than on project eligibility. CDM EB has issues additionality tools that the project developer can use to prove the additionality of the proposed CDM A/R project. Project developers are strongly advised to apply the additionality tools to establish the additionality of the CDM A/R project.

Baseline: Technically, the CDM is a baseline-and-credit trade mechanism, not a cap-and trade mechanism. Therefore, enhancements of removals by afforestation and reforestation projects must create real, measureable and long-term benefits related to the mitigation of climate change, and must be additional to any that would occur in the absence of the certified project activity. The "in the absence" scenario is also referred to as the baseline scenario. The Marrakech Accords define a baseline scenario as one that "reasonably represents greenhouse gas emissions that would occur in the absence of the proposed project activity" and is derived using an approved baseline method. The Marrakech Accords also state that the project baseline shall be established "in a transparent and conservative manner regarding the choices of approaches, assumptions" and that it shall be established "on a project-specific basis". In summary, the baseline is the most likely course of action and development over time, in the absence of CDM financing. The figure 2 shows the concept of carbon stocks in the project and baseline scenarios with time.

For A/R CDM projects the baseline scenario can either be estimated and validated upfront and then "frozen" for the first phase of the crediting period (that is, 30 years for single crediting period or the first 20 years of up to 60 years for renewable crediting period), or it is also possible to monitor the baseline during the afforestation or reforestation project. However, even in the latter case, it is still necessary to establish a methodology upfront on how to select the control plots and monitor them, and to provide an upfront estimation of the baseline, including the associated emissions and removals of greenhouse gases. The upfront estimation is for information only the results of the monitored baseline would be used for calculating actual emission reductions.

Estimated removals with & without Project | Net GHG removal

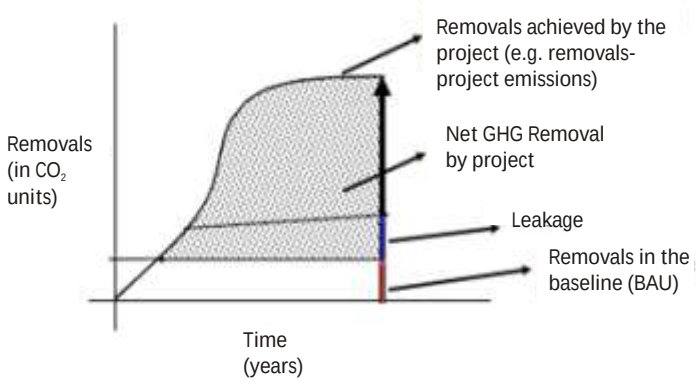


Figure 2: The concept of carbon stocks in the project and baseline scenarios

Leakage: Ideally a CDM projects will be sequestering more carbon within the project area, but the project activities may change activities or behaviours elsewhere. These changes may lead to reduced sequestration or increased emissions outside the project boundary, negating some of the benefits of the project. This is called leakage. A simple example is a project that reforests an area of poor quality grazing land, but displacement of grazing activity leads to clear land outside the project boundaries to establish new pastures, thus resulting in GHG emission outside the project boundary because of CDM project activity. The types of activities that might result in leakage vary with the type of projects, but both LULUCF and non-LULUCF projects are subject to leakage.

Permanence: Owing to biological nature of the credits generated by a CDM A/R project, there was considerable concern that carbon sequestration would be subject to a risk of re-emission, due to either human action or natural events such as wildfires. This was called the permanence risk and it is unique to LULUCF projects under the Protocol. The credits arising from CDM afforestation and reforestation projects are considered temporary or expiring CERs, but could be re-issued or renewed every five years after an independent verification to confirm sufficient carbon was still sequestered within the project to account for all credits issued. This deals effectively with the permanence risk and guarantees that any losses of sequestered carbon for which credits have been issued will have to be made up through either additional sequestration elsewhere or through credits derived from non-LULUCF activities. Two types of temporary credits were agreed: temporary CERs (tCER) and long-term CERs (lCERs). Issues relating to these expiring credits are described in chapter 6.

Other important definitions specific to A/R CDM projects

Carbon pools: Following carbon pools are considered for measurement of carbon in a CDM Project:

(i) above-ground biomass,

(ii) below-ground biomass,

(iii) litter,

(iv) dead wood

(v) soil organic carbon

(Detailed definition of carbon pools is given in Annexure V)

However, project developer is free to choose any or all the carbon pools depending on the methodology adopted or proposed.

Project boundary: When project participants start an A/R CDM project activity, a project boundary needs to be clearly defined to calculate GHG removals by sinks per unit of area or in the total area. The project boundary geographically delineates the afforestation or reforestation project activity under the control of the project participants. The project activity may contain more than one discrete area of land. In another word, the project boundary is a physical line surrounding piece(s) of land, and one A/R CDM project activity could be composed of different pieces of land.

Baseline net GHG removals by sinks: It is 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 CDM project activity.

Actual net GHG removals by sinks: It is the sum of the verifiable changes in carbon stocks in the carbon pools within the project boundary, minus the increase in emissions of the GHGs measured in CO_2 equivalents by the sources that are increased as a result of the implementation of the afforestation or reforestation project activity, while avoiding double counting, within the project boundary, attributable to the A/R CDM project activity.

Net anthropogenic GHG removals by sinks: It is the actual net GHG removals by sinks minus the baseline net GHG removals by sinks minus leakage.

Small-scale CDM (SSC) projects: The small-scale projects for LULUCF are those that result in net anthropogenic greenhouse gases (GHGs) removals of less than 16 kilotonnes of CO_2 per year, which is equivalent to 4360 t of Carbon, and are developed or implemented by low-income communities or individuals. Small-scale CDM project activities follow the same stages of the project cycle as specified in the CDM Modalities & Procedures. In order to reduce transaction costs, however, modalities and procedures are simplified for SSC project activities. Project activities may be bundled or portfolio bundled at the stages of PDD development, Validation, Registration, Monitoring, Verification and Certification in the project cycle.

An overall monitoring plan that monitors performance of the constituent project activities on a simple basis may be proposed for bundled project activities. If bundled project activities are registered with an overall monitoring plan, this monitoring plan shall be implemented and each verification/certification of the emission reductions achieved cover all of the bundled project activities.

Other essential requirements of A/R CDM project are:

The project must contribute towards achieving the host country's sustainable development goals such as:

(a) **Social well-being:** The CDM project activity should lead to alleviation of poverty by generating additional employment, removal of social disparities and contribution to provision of basic amenities to people leading to improvement in quality of life of people.

(b) **Economic well being:** The CDM project activity should bring in additional investment consistent with the needs of the people.

(c) **Environmental well being:** This should include a discussion of impact of the project activity on resource sustainability and resource degradation, if any, due to proposed activity; bio-diversity friendliness; impact on human health; reduction of levels of pollution in general.

(d) **Technological well being:** The CDM project activity should lead to transfer of environmentally safe and **sound** technologies that are comparable to best practices in order to assist in up gradation of the technological base. The transfer of technology can be within the country as well from other developed countries also.

Real, measurable, and long-term benefits related to the mitigation of climate change: Activities, under CDM A/R project must be real, measurable and have long-term benefits and effects. Biologically sequestered carbon is actually unstable and thus proper management is required to ensure decade(s)-long storage.

Reductions in emissions that are additional to any activity that would occur in the absence of the proposed project activity: The project must lead to 'real', 'measurable' and 'additional' reductions of GHG emissions. The project is additional if it really generates a reduction of GHG compared to the activities that would have been carried out in the absence of CDM projects. The GHG emissions of a CDM project must be lower than those generated by a reference scenario (baseline). The reference scenario is the scenario that translates the evolution trends of the GHG emissions in the absence of the CDM project.

No diversion of Official Development Assistance (ODA) fund: If a project is financed by sources of public funding, this must not result in a diversion of official development assistance, and the sources of public funding must be separate and not be counted towards the financial obligations of the Annex I countries.

Transfer of environmentally safe and sound technology: The project should lead to transfer of environmentally safe and sound technology and know-how.

5

Project Cycle for CDM Projects

CDM Project Cycle: By comparison with a traditional project, the CDM project cycle is characterized by the criteria of eligibility related to taking into account the carbon component that requires the consideration of certain additional stages. This relates in particular to the approval of the host country, the preparation of the project design document (PDD), the registration, verification and certification of the carbon credits. The whole of these stages requires additional time and costs compared to a traditional project.

The implementation of a CDM project comprises seven major steps:

Step I: Project design and formulation: The first step in developing a CDM project is to design the Project Concept Note (PCN), or Project idea note (PIN) which reduces the GHG emissions followed by developing the project design document (PDD). The PDD is a legal CDM document. It defines the project baseline to estimate net carbon emission reductions.

Step II: National approval: The Designated National Authority (DNA) of the host country approves the proposed CDM project against national sustainable development objectives; The DNA issues a letter of approval for the proposed CDM project. In India, the DNA is **National Clean Development mechanism authority (NCDMA)** under the Ministry of Environment and Forests, Government of India.

Step III: Validation and registration: The PDD, in particular the baseline, needs to be assessed and validated by an independent organization or Designated Operational Entity (DOE). The DOEs are accredited by the CDM Executive Board, and are responsible for ensuring compliance of the proposed project with CDM rules. CDM project registration is done by CDM EB on the recommendation of DOE.

Step IV: Project financing: Investors provide capital for the proposed CDM project. Contracts are signed for the sale of carbon (project income stream). Some carbon buyers pay upfront costs of CDM and expected pay back through carbon contract. Some carbon buyers may also choose to take equity or provide finance for the project.

Step V: Monitoring: The project developer monitors and records carbon emissions and changes in baseline. CDM project participants collect and achieve all relevant data necessary for calculating GHG emission reductions by a CDM project activity, in accordance with the monitoring plan written in the registered PDD.

Step VI: Verification and certification: A different Designated Operational Entity (DOE) independently verifies carbon reductions, and certifies the amount of Certified Emissions Reductions CERs generated by the CDM project. For small-scale projects, the simplified

methodology allows for one DOE to perform these tasks. Upon special request to CDM EB same DOE can validate and verify A CDM Project activity.

Step VII: Issuance of CERs: The Executive Board issues Certified Emission Reductions (CERs) based on the verified project performance.

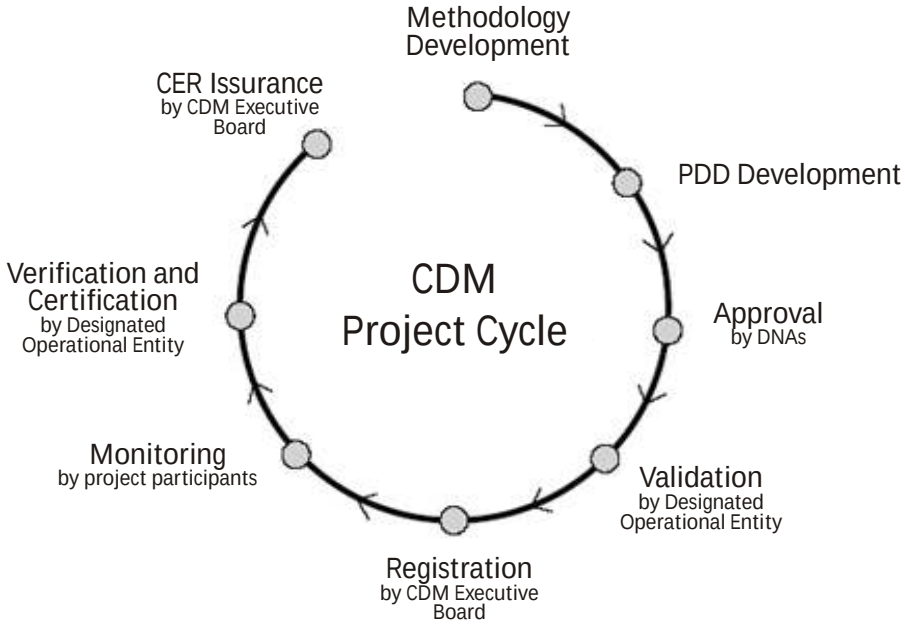


Figure 3: CDM Project cycle

CER: A special product of CDM projects

A Certified Emission Reduction (CER) is carbon currency generated through CDM projects. It is the carbon credits output of Clean Development Mechanism (CDM) projects, as defined by the Kyoto Protocol.

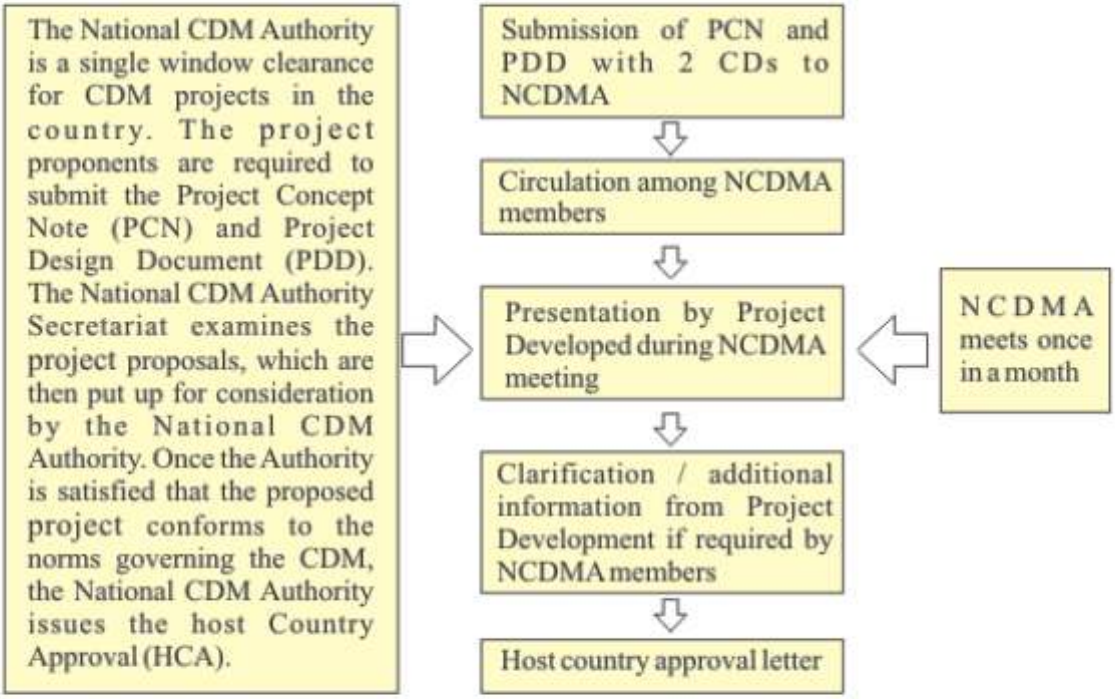
CDM projects should result in real, measurable and long- term benefits in terms of Climate Change mitigation. A unit of green house gas reduction that has been generated and certified under the provisions of the Kyoto Protocol is termed, as Certified Emission Reduction (CER) is equal to one tonne of carbon- dioxide equivalent.

CER is issued through a due diligence process carried out by the CDM Executive Board in Bonn, and may be traded in international markets.

Table: Overview of a CDM Project cycle

Step 1 Plan a project activity	CDM project participant plan a project activity and submit it in the form of a PIN to the potential CER Buyers.
Step 2 Project Design Document PDD	Once the PIN is accepted a project design document is prepared. There is a standard PDD format for A&R activities and the project proponent are not allowed to temper with Standard PDD format, even font type and size is not allowed to be changed. Project proponent can seek help of a consultant for developing PDD.
Step 3 Host Country approval	Project participant submits the PDD to the host country DNA. The DNA will look for the essential criteria from host country point of view and examine the criteria of sustainable development and voluntary participation. Project proponent may be asked by NCA to make a presentation about the project before the DNA. It is not necessary to show the investor interest at this stage. Host country approval has to be in writing.
Step 4 Validation and Registration	Validation is a process of independent evaluation of a project activity against the requirement of CDM on the basis of PDD. Validation is carried out by an independent Designated Operational Entity (DOE). Host country approval precedes validation. After the completion of validation the DOE recommends the project for registration with the CDM executive board. Registration is the formal acceptance as CDM project activity.
Step 5 Monitoring	CDM project participant collect and store all necessary data for calculating GHG reductions achieved by the project activity according to the laid down monitoring plan as per the PDD.
Step 6 Verification Certification	It is the periodic independent review of and ex post monitoring of the GHG emission reduction. Verification is also carried out by a DOE. Validation and verification acts are to be conducted by separate DOEs for a project but upon request to CDM executive board the same DOE can perform both tasks. For SSCs the same DOE can perform validation and verification. The DOE certifies that the project has achieved the GHG reduction as verified.
Step 7 Issuance of CERs	The Executive board will issue CERs equal to verified amount of GHG reductions on recommendation of certification by the DOE.

The host country approval process is as below:



Project Concept Note (PCN): Prior to selection of CDM projects, project participants are asked to submit Project Concept Note to the NCDMA. The template for PCN is available on MoEF website at: http://www.moef.nic.in.

Project Design Document (PDD): It is necessary to prepare a PDD in order to be registered as CDM project activity. The Project Design Document (PDD) for afforestation and reforestation project activities (CDM-A/R-PDD) and Glossary of terms have been developed by the CDM Executive Board. CDM EB keeps them revising periodically. CDM Glossary of terms, important clarifications by EB on terms and information to be filled in the forms, general explanations on how to fill forms (e.g. fill in English, not change logos, etc.), explanations relating to each field in a form are given in these guidelines.

Project Developers are advised to

- Always read very carefully the latest version of guidelines before filling in forms
- Also need to consult clarifications and guidance from the Board (see UNFCCC/CDM web site section for this) before filling forms.
- Not to add logos, change text, forms, font or fields
- Important clarifications be careful in adhering to them in filling the CDM-PDD (i.e. definition of project participants)

? The Glossary of terms for A&R project activities provides also for key definitions to be taken care of in filling forms

The PDD shall include following items for A/R Projects under CDM:

A. General description of the proposed A/R CDM project activity

B. Duration of the project activity / crediting period

C. Application of an approved baseline and monitoring methodology

D. Estimation of *ex ante* net anthropogenic GHG removals by sinks and estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period

E. Monitoring plan

F. Environmental impacts of the proposed A/R CDM project activity

G. Socio-economic impacts of the proposed A/R CDM project activity

H. Stakeholders' comments

Annexes

Annex 1:Contact information on participants in the proposed A/R CDM project activity

Annex 2: Information regarding public funding

Annex 3: Baseline information

Annex 4: Monitoring plan

A. General description of the project

Besides the description of the project site, location, physical parameters, types and condition of vegetation at the project site etc, this section must clearly give description of:

(i) Communities located in and around the project area including basic socio-economic information (using appropriate methodologies such as livelihoods framework).

(ii) Current biodiversity in the project area along with the list of endangered and threatened species residing in and around the project area.

(iii) Legal title to the land, rights of access to the sequestered carbon, current tenure and land use at the project site. A guarantee must be given that the project does not require the relocation of the people, or any relocation is 100% voluntary and fundamentally helps resolve land tenure problems in the area.

B. Duration of the project activity / crediting period

(i) A timeframe for the project's duration and the rationale used for determining the project lifetime should be discussed in the PDD.

(ii) The project developer should define the period over which tCERs and / or lCERs will be claimed for A/R project activity.

(iii) Proper explanation must also be given, if the accounting period for carbon credits differs from the project lifetime.

C. Application of an approved baseline and monitoring methodology

(i) The project proponents must develop a defensible and well-documented "without Project" future land-use scenario and baselines projections, including the information on influence of without-project scenario on local community, biodiversity and water and soil resources.

(ii) A clear description must be given on key parameters, data sources and assumptions used in the baseline estimate, and assessment of uncertainties.

Potential sources of leakage, measures to minimize potential leakage must be identified.

D. Estimation of *ex ante* net anthropogenic GHG removals by sinks and estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period: The *ex ante* (projected estimation of) net anthropogenic GHG removals by sinks and estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period is required to be given here using the applied methodology.

Things to be done for estimation of GHG emission by sources are as follows:

(i) Estimate GHG emissions by sources.

(ii) Estimate leakage.

(iii) Estimate total project activity emissions.

(iv) Estimate anthropogenic emissions by sources of GHGs of the baseline.

(v) Discussion on how the uncertainties have been addressed.

E. Monitoring methodology and plan

(i) A description must be given on identification of the required data and data quality.

(ii) It should be remembered that the verification does not coincide with the peaks in carbon stocks.

(iii) In case of a new methodology, a description should be given on the methodology and assessment of the strengths and weaknesses of the methodology.

F. Environmental impacts of the proposed A/R CDM project activity

(i) The project must generate net positive impacts on the environment and biodiversity within the project boundaries and within the project lifetime, measured against the baseline conditions.

(ii) Use of appropriate methodologies to estimate changes in biodiversity as a result of the project.

(iii) The Genetically Modified Organisms (GMOs) should be avoided to generate carbon credits.

(iv) A description of plans to mitigate the negative impacts of the project must be documented, if any

(v) Demonstration of the activities that are likely to improve soil and water resource must be given compared to the baseline.

G. Socio-economic impacts of the proposed A/R CDM project activity

(i) Use of appropriate methodologies (e.g. livelihood framework) to estimate the net benefits or loss to communities resulting from planned project activity.

(ii) Documentation of local stakeholders participation in the project's planning.

(iii) The project design must include a process for hearing, responding to and resolving community grievances within a reasonable period of time, if any.

(iv) The project proponent must quantify and mitigate likely negative social and economic offsite impact.

(v) A proper monitoring plan for quantifying the impacts on community must be taken into consideration.

H. Stakeholders' comments

(i) A brief description of the process by which comments by the local stakeholders have been invited and compiled, should be given.

(ii) Documentation and methodology for defining local stakeholders.

(iii) Informing local stakeholders, how they can access the project documentation.

(iv) The comments of the identified stakeholders should be provided in the form of summary.

(v) The explanation on how due account has been taken of comments received.

(vi) The DOE, which validates the CDM project, must make the PDD available for public comments for a period of 45 days as against the 30-day period for normal CDM projects.

(vii) Project proponent may use best practices for community involvement. The best practices include: respect for local traditions and customs, local stakeholder employment etc.

Validation and verification of the emissions reductions by the Designated Operational Entity (DOE): The emission reductions of the Project need to be measurable and need to be validated/ determined and verified by a Designated Operational Entity accredited by the CDM EB.

Issues to be addressed in order to qualify for consideration as CDM project activity: The various issues such as implications for sustainable development, development of baseline, selection of carbon pools to be measured, non-permanence of carbon stocks, additionality,

leakage, methods of monitoring and verification, capacity building required and transaction cost involved in developing, implementing, monitoring and verification of projects are unique to the LULUCF Projects.

Baseline and additionality are interlinked issues as establishing baseline for the project is necessary to know whether the project is additional or not. The issues of additionality, baseline and leakage are discussed as follows:

Additionality: A CDM project activity is additional if anthropogenic emissions of GHGs by sources are reduced below those that would have occurred in the absence of the registered CDM project activity, whereas the A/R project activity under the CDM is additional if the 'actual net greenhouse gas removals by sinks' are increased above the sum of changes in carbon stocks in the carbon pools within the project boundary that would have occurred in the absence of the registered CDM afforestation or reforestation project activity.

Ideally, additional A/R CDM project activities would meet following criteria as below:

(i) Increase net carbon sequestration compared to what would have happened otherwise;

(ii) Do not result in the increased deforestation elsewhere; and

(iii) Contribute to sustainable development.

The project developers while preparing the A/R Project activity must consider the following points:

Emission reduction additionality: The project should lead to real, measurable and long term GHG mitigation. The additional GHG reductions are to be calculated with reference to a baseline.

Financial additionality: The procurement of Certified Emission Reduction (CERs) should not be from Official Development Assistance (ODA).

CDM EB has developed additionality tools for determination of additionality of A/R CDM Projects. The “additionality tool” provides a general framework for demonstrating and assessing additionality and is to be applicable to a wide range of project types, though some project types may require adjustments. Project participants proposing new baseline methodologies may incorporate this “additionality tool”. When project participants choose to use an approved baseline methodology that prescribes the use of the additionality tool for demonstration of additionality, they must use this tool in conjunction with the approved methodology to be applied. The “additionality tool” provides for a step-wise approach to demonstrate and assess additionality. Tools for additionality determination are given in CDM website: www.unfccc.int/cdm.

Baseline: The baseline for a proposed afforestation and reforestation project activity under the CDM is the scenario that reasonably represents the sum of changes in carbon stocks in the carbon pools within the project boundary that would have occurred in the absence of the proposed afforestation or reforestation project activity under the CDM.

In calculating the 'baseline net greenhouse gas removals by sinks', project participants must choose not to account for one or more carbon pools, and / or emissions of the GHGs measured in CO_2 equivalents, while avoiding double counting. Double counting may arise in the process by accounting the carbon pools twice, say for e.g. the above-ground biomass and litter are two different carbon pools but after a period of time the above-ground biomass i.e. leaf etc. of tree turn into litter, thus a check should be made in the process of accounting carbon pools so as to avoid double counting. This is subject to the provision of transparent and verifiable information that the choice will not increase the expected 'net anthropogenic GHG removals by sinks' (Para 21 of decision 5/CMP.1).

Selection of most plausible baseline scenario: In choosing a baseline methodology for an A/R project activity under the CDM, project participants shall select from among the following approaches, the one deemed most appropriate for the project activity, taking into account any guidance by the Executive Board, and justify the appropriateness of their choice: {Decision 5/CMP.1 para 22 (a), (b) and (c)}

(a) Existing or historical, as applicable, changes in carbon stocks in the carbon pools within the project boundary

(b) Changes in carbon stocks in the carbon pools within the project boundary from a land use that represents an economically attractive course of action, taking into account barriers to investment

(c) Changes in carbon stocks in the pools within the project boundary from the most likely land use at the time the project starts.

The project proponent must also take into account the following:

? Baselines should be precise, transparent, comparable and workable.

? Should avoid overestimation. The methodology for determination of baseline should be homogeneous and reliable.

? Potential errors should be indicated.

? System boundaries of baselines should be established i.e., determine the system boundary within which the project activity takes place and which comprise those emission sources that are significant and measurable and under the control of project participants.

? Interval between updates of baselines should be clearly described. The baseline of the proposed project activity should be monitored periodically so as to make sure that the reductions are additional.

? Role of externalities should be brought out (social, economic and environmental).

? Should include historic emission data sets wherever available.

? Lifetime of project cycle should be clearly mentioned.

? In order to ensure that A/R CDM projects only generate credits that reflect the net GHG impact of the Project (i.e. human induced emissions) the definition of baseline would need to reflect that:

- Forestry projects result in carbon removals.
- Changes in carbon stocks and emissions can occur on project land in the absence of any project e.g. through natural regeneration or degradation or through deforestation.
- Implementing forestry projects can also result in changed levels of anthropogenic emissions of CO_2 and other gases.

The project proponent could develop a new methodology for its proposed project activity or could use one of the approved methodologies by the CDM Executive Board. The CDM EB has till date approved twenty (20) methodologies for A/R CDM projects of which two are consolidated methodologies and seven are small scale A/R CDM Projects (Annexure 1). The approved methodologies can be used considering the applicability condition of the project. Adopting an approved methodology will drastically reduce the transaction cost. For approved methodology by the CDM EB, project developers are advised to check the UNFCCC / CDM website time to time.

Leakage: Leakage for emission reduction CDM projects is defined as the net change of anthropogenic emissions by sources of green house gases (GHGs) which occurs outside the project boundary, and which is measurable and attributable to the CDM project activity.

Leakage can occur if an A/R project activity causes emissions to increase and / or removals to decrease outside the spatial / accounting project boundary that is used to define the GHG benefits of the project act where leakage occurs, it would mean that the environmental effects of a project is different (less or more that the number of CERs it generates). There are several potential causes of leakages in an A/R CDM project activity:

- Increased deforestation rate elsewhere.
- Displacement of some baselines emissions. For example, although a project activity may reduce emissions from livestock grazing on the project site, these emissions may just be displaced elsewhere.
- Does not include all carbon pools (or emissions source) in its baseline, and some of the excluded carbon pools decrease (or emissions increase) during the crediting lifetime of the project.
- Increase emissions and / or reduces sequestration during part of the project's life (e.g. during site preparations and planting) but does not subtract these increase emissions from the subsequent emission benefits of the project.

The starting date of a CDM project activity is the date at which the implementation or construction or real action of a project activity begins. A/R CDM projects initially suffered a very high rejection rate owing to stringent Modalities and Procedures (M&P) laid down by CDM EB for these projects and improper understanding of these procedures. Some of the reasons for rejection of earlier submitted projects and methodologies are as follows:

- Not defining land eligibility,

? Improper selection of baseline scenario and approach,

? Not proving additionality,

? Improper addressing of leakages and uncertainties etc.

? Not following 5/CMP.1 requirements

? IPCC Guidance not used

? Language (drafting) problems

? Scope and applicability (too broad/narrow)

? Data, equations (errors, lack of quality, not possible to monitor)

? Assumptions and parameters are not adequately chosen

? The methodology fails to provide means for determination of CDM eligibility of the area to be reforested"

? The methodology does not make correct use of CDM A/R terminology:

? Formula do not relate to definition in CDM A/R Modalities and Procedures

? Leakage is not addressed correctly

A pictorial representation of carbon benefits as net anthropogenic GHG removal by sinks is shown in figure 3.

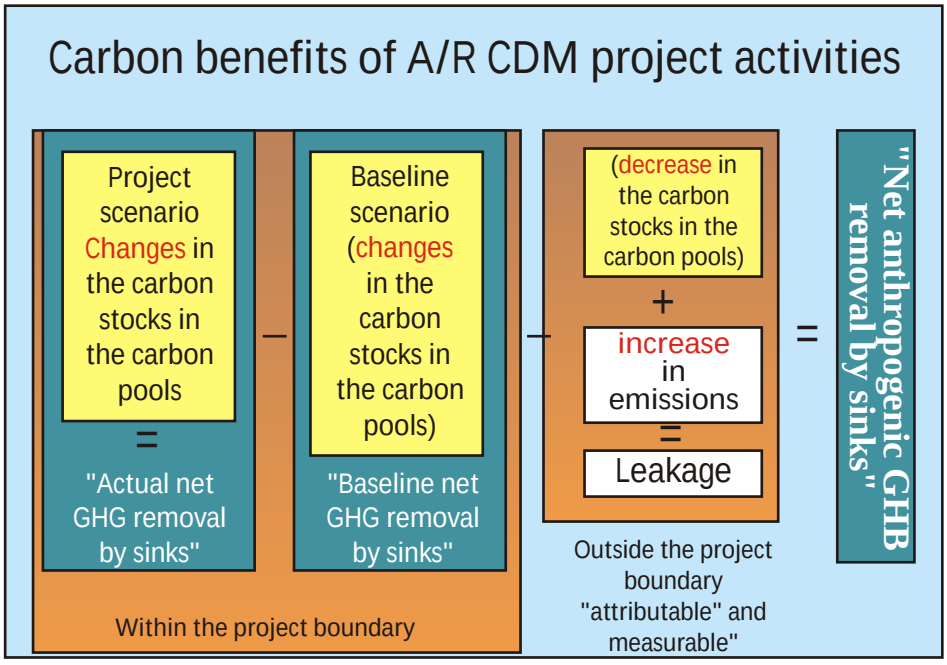


Figure 3: Assessing net GHG removal from an A/R CDM project activity

A/R CDM methodology submission and approval process:

CDM EB has issued guidelines for **"Procedure for submission and consideration of proposed new methodology for afforestation and reforestation project activities under CDM".** The proposed new baseline and monitoring methodology complete in most recent version along with draft PDD is submitted to CDM EB (UNFCCC Secretariat) through a DOE. The secretariat shall forward the document to one member of ARWG (Afforestation and Reforestation Working Group) to assess the quality of submission and to grade it between '1' and '2' with a one paragraph note substantiating the appraisal. For '1' case the document is considered as received by board and '2' is returned to the project proponent. A DOE/AE may voluntarily take pre assessment of the methodology and in this case no assessment of ARWG is needed. The proposed new methodology is made available on UNFCCC website for public input for 15 days. The proposed methodology is then made available to ARWG at least 10 weeks prior to its next meeting. Upon receipt of a proposed new AR methodology two members of WG are selected on rotational basis for desk review. Each desk reviewer under the guidance of the chair of the RA WG shall prepare his/her recommendations as per the provisions of the CDM A/R M&P, using the current version of the desk review form and forward it to ARWG within 10 days from the receipt of it. The AR WG taking into consideration the public comments and recommendations of the desk reviewers prepare its preliminary recommendations regarding the approval of proposed new A/R methodology to the EB in the prescribed form.

Before preparing its preliminary recommendations AR-WG may request through secretariat and via DOE to project participant for certain technical information. The information is then made available to CDM EB and to public. The ARWG then forwards its preliminary recommendations to the project participant through Secretariat via DOE. The project participant must provide clarification within 10 days from the receipt of the clarification from DOE. The final recommendation then forwarded to CDM EB and made publicly available. After the receipt of the recommendations CDM EB considers the proposal at its next meeting and the decision is made publicly available as 'A' for approval, 'B' for resubmission and 'C' for rejection. A 'B' case methodology with required changes can be resubmitted to EB only once and on its resubmission a 'B' case is reconsidered by AR WG without further desk review. If such case with required changes is not resubmitted within five months it is considered as 'withdrawn'.

6

Characteristics of Carbon Credits from Forestry Projects

In contrast to CERs generated by energy and other emission reduction projects, CERs from LULUCF projects are of limited validity due to the non-permanent nature of vegetation as a sink. The regulations of the CDM define the credits from forestry projects as short-term credits (tCERs "temporary Certified Emission Reductions") and long-term credits (lCERs "long-term Certified Emission Reductions") with different durations of validity. Both tCERs and lCERs are of temporary nature and have to be replaced upon expiry. This is because non-permanence is a greater problem with LULUCF activities than with other sectors where reductions are permanent in the sense that an avoided emission will never reach the atmosphere (IPCC 2000). In contrast, forestry projects mitigate climate change as long as the carbon remains stored in the vegetation and soil. However, forest sinks are potentially reversible through disturbances such as fires or the conversion of forest land back to pasture land, for example, which causes the carbon to be released back to the atmosphere, and reverses the climate benefit. The choice between tCERs and lCERs is up to the project developer, and it is important to consider the implications of the choice.

For both types of expiring CERs, there is the choice between one single crediting period, with a non-renewable baseline of a maximum of 30 years on the one hand, and a baseline of a maximum of 20 years, which then can be revised and renewed up to two times. Thus, up to three consecutive crediting periods, summing up to a maximum of 60 years, are achievable for AR projects. The operational lifetime of the forestry activity can be no shorter than the chosen crediting period. Another common feature is the verification period of five years. The first verification is at any point in time during the crediting period, but afterwards the carbon stocks will need to be re-verified every five years. Terms and timeframes used in the context of temporary CERs are depicted in figure 4.

Proper project design needs to make sure that rotation length and verification cycles do not coincide in such a way that verification is taking place systematically at the point of time when carbon stocks are peaking (Decision 5/CMP.1, Article 12 (d). Upon re-verification, the liability for non-permanence moves to the credit owner, who can replace CERs upon expiration with any type of emission permits, AAUs, ERUs, RMUs, CERs, or with newly certified expiring CERs of the same type. Once a project has decided to use either ICERs or tCERs, it needs to stick to this decision until the end of the crediting period. On expiration, tCERs and ICERs can in no case replace each other.

There are two limitations imposed on expiring credits. One results from paragraph 14 of Marrakech Decision 3/CMP.1, which stipulates that CERs from AR may not exceed one percent of each Annex-1 Party's base year emissions annually. Due to the fact that forestry projects have

long operational periods before the first expiring CERs are certified, this limitation is not seen to be critical for the first commitment period. The rule on how to impose this limitation domestically is left to the individual Annex-1 Parties. Another limitation of A/R CERs is that they cannot be carried over ("banked") to a subsequent commitment period (Decision 5/CMP.1, paragraph 41, 45). Given the limited amount of A/R credits within the CDM, this rule is of no practical relevance to the value of expiring CERs.

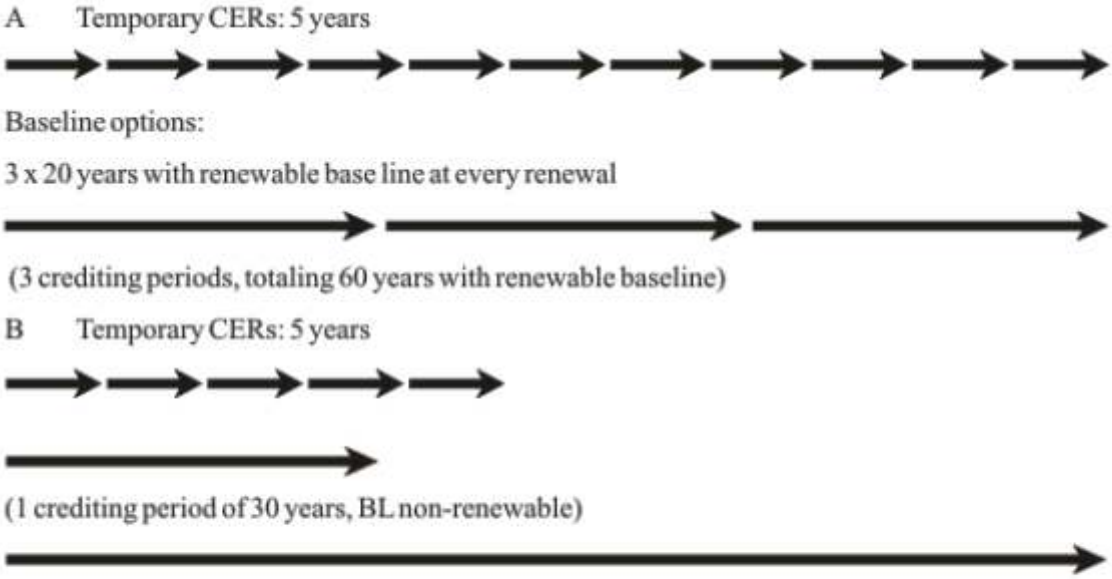


Figure 4: Terms and timeframes used in the context of temporary CERs

Standards for premium forestry credits:

The Climate, Community and Biodiversity Project Design Standards (CCB Standards) evaluate land-based carbon mitigation projects in the early stages of development. The CCB Standards help:

- identify projects that simultaneously address climate change;
- support local communities;
- conserve biodiversity;
- promote excellence and innovation in project design; and
- mitigate risk for investors.

The development of the Climate, Community & Biodiversity Standards was spearheaded by the Climate, Community & Biodiversity Alliance (CCBA) a partnership among research institutions, corporations and environmental groups, including Conservation International, the Hamburg Institute of International Economics, The Nature Conservancy, Pelangi (Indonesia), BP, GFA, Intel, SC Johnson, Weyerhaeuser, CATIE, CIFOR and ICRAF.

The CCB Standards require projects to comply with fifteen criteria to demonstrate compelling net benefits for mitigating climate change, conserving biodiversity, and improving socio-economic conditions for local communities. Independent auditors will use the criteria to determine whether projects can demonstrate that they yield truly additional benefits, in other words, benefits that would not have occurred without the project. The mandatory criteria also ensure, among other things, that monitoring programs are in place, no carbon credits will be earned from genetically modified trees, and that communities are appropriately involved in the design of the project. Exceptional projects can earn Silver or Gold Status depending on how many optional criteria are met. Optional criteria cover issues such as native species use, climate change adaptation, water and soil resource enhancement, and community involvement. CCB compliance can be validated and verified on a standalone basis or as an add-on to the audit of regular Kyoto compliance. Further information can be obtained from http://www.climate-standards.org .

7

Market Mechanisms for A/R CDM Projects

The nature of market mechanisms for sale of CERs has continuously changed over time. Before 2004 public funds or multilateral agencies were the only players in the carbon market. The prototype carbon fund of the World Bank and the Dutch and Japanese investment programmes represented most of the investments in CDM projects. However, since 2005 CER market has witnessed a lot of voluntary markets, and private investments including banks, which are in search of capital gains for their clients in new and growing sector. Some projects include the buyer of credits from a very early stage e.g. the CDM Forestry Project in Himachal Pradesh, which has a buy-back guarantee with the World Bank. Some are even funded by the National or local Governments as additional measures like the one in Haryana.

However, for selling in the international carbon market, the value of carbon benefit and its impact on project viability are influenced by several factors such as the amount of CERs generated by the project, the price of CERs and the transaction cost involved in securing CERs. The amount of CERs generated by the project depends on the GHGs displaced by the Project and the crediting period selected. The price of CERs is determined in the carbon market. Various issues involved in marketing of CERS are discussed here.

Transaction costs: Transaction costs are those that arise from initiating and completing transactions to secure CERs. These consist of pre-operational costs (i.e., costs spread out over entire crediting period and trading costs.

Some examples of transaction costs are as follows:

- Developing the project proposal, developing baselines, consultations, workshops etc.
- Periodic measurement, monitoring and verification of baseline etc.
- CDM processing costs, validation by operational entity, registration of CDM projects, negotiations with potential investors etc.

Transaction costs play an important role in determining the viability of CDM projects for the carbon credit seeking partners or institutions in Annex 1 countries as well as stakeholders in host countries. If the transaction costs are minimized the forestry projects can be made attractive to all the stakeholders.

Sources of project funds

i. Loans or debts to funds lent to CDM project owners by financiers. Debt can be obtained through public markets (bonds) or private placements (bank loans and institutional debt)

ii. Equity refers to funds funneled to the CDM project by company shareholders. Equity may be sourced from internal sources (sponsors) or external investors (public or private markets). The return on equity is obtained either from dividends or from sale of shares.

iii. Grants are funds provided by the institutions and governments to CDM project owners and developers who contribute to donor's objectives. Grants need not be repaid and often times cover only a percentage of project costs.

iv. Upfront payment for CER purchase: The carbon purchase agreement often stipulates payments on agreed price upon delivery of CERs but CERs buyers sometimes provide upfront payment upon purchase.

Like conventional projects, financing CDM projects can be arranged either through corporate or project financing. In case of ongoing A/R CDM Projects in India, following sources of funding are there:

S. No.	Name of A/R CDM Project	Source of Funding
1	Himachal Pradesh Reforestation Project. (IBRD) as a trustee for BioCarbon Fund (BioCF)	International Bank for Reconstruction and Development
2	Haryana small scale afforestation project: Sirsa Forest Department	Haryana CDM Variksh Kisan Samiti, Ellenabad, Sirsa through Haryana
3	ITC Bhadarchalam Reforestation Project development initiatives conceptualised this project activity	ITC Ltd. under its social
4	Improving Rural Livelihoods Through Carbon Sequestration By Adopting Environment Friendly Technology based Agroforestry Practices	International Bank for Reconstruction and Development as a trustee for BioCarbon Fund
5	The International Small Group and Tree Planting Program (TIST), Tamil Nadu, India	Private entity: Tree Planting India Private Limited and Climate Change Capital Carbon Fund II s.à r.l.
6	Bagepalli CDM Reforestation Programme	Agricultural Development and Training Society (ADATS)

Markets for afforestation/reforestation CDM activities

Afforestation/Reforestation projects are uniquely beneficial as they can be implemented almost anywhere, including in the Least Developed Countries. Trees can be planted in the poorest regions and benefit the poorest communities. Terrestrial carbon sequestration was a key topic in

the many discussions and negotiations leading up to the Kyoto Protocol, because it had been shown that sinks projects could play an important role at relatively low cost, especially in non-Annex I countries. Fears of permanence and leakage with afforestation/reforestation LULUCF projects have led to continuation of its exclusion from potentially the biggest CDM market of EU TS. The scale with which CDM-LULUCF can be used to meet commitments under the Kyoto Protocol is presently limited to 1 percent of the total assigned amount of the first commitment period. An additional hindrance to afforestation/ reforestation projects is that they can only attain temporary credits that must eventually be replaced with permanent credits. Thus, afforestation/ reforestation can only be a temporary solution for any buyer, which in turn leads to lower prices.

At the moment, World Bank is the largest buyer of forestry CDM credits, with the BioCarbon Fund having compiled a portfolio of candidate projects that are estimated to deliver up to 22m carbon credits. Assuming a continuation of their past purchase strategy, it may be estimated that the World Bank will enter in purchase agreements for up to 9m carbon credits.

Estimation of prices for forestry CDM credits

Presently, World Bank is among the few buyers of CDM forestry credits. The price ranges from Emission Reduction Purchase Agreement (ERPAs) and Letter of Commitment LoC of the World Bank project portfolio are therefore the best indication of attainable prices for forestry CDM credits. The BioCarbon Fund has bought carbon credits from forestry projects for prices of USD 3.75-4.35 per t CO_2-e. These prices refer to the carbon removals in a forestry project until the end of the Kyoto Protocol's second commitment period (Neeff and Henders, (2007).

These prices provide an indication, but cannot be related directly to the prices of tCERs or lCERs, because the World Bank buys carbon removals under its own particular scheme that differs from the Kyoto credits. Only later, these particular carbon credits get converted into Kyoto-compliant credits. Prices for tCERs will be lower because tCERs can be issued in 5-year intervals, which is not the case if selling to the World Bank. Prices paid by the World Bank provide an indication of attainable prices for tCERs and lCERs.

Recommendation on the selling of tCERs or lCERs

The project proponent of reforestation projects under the CDM has a basic choice between two types of credits, namely tCERs and lCERs

- tCERs: Temporary certified emission reductions refer to the total amount of carbon sequestered since project start. These credits are issued periodically (i.e. every five years) and expire at the end of the commitment period subsequent to the period in which they were issued.
- lCERs: Long-term certified emission reductions refer to the amount of carbon sequestered since the last verification. They expire at the end of the crediting period (i.e., after 5-60 years, depending on the time point of issuance) for which they were issued. If carbon is lost, lCERs must be replaced either by permanent credits or by other lCERs from the same project activity.

The differences between tCERs and lCERs have to be assessed on the grounds of a project's needs and a prospective buyer's preferences. The following gives an overview of advantages and disadvantages that tCERs and lCERs carry. tCERs provide an excellent opportunity as cost-effective short-term solutions for compliance with urgent commitments. Many carbon-credit users perceive tCERs as more convenient than lCERs because:

- tCERs retain greater flexibility to react to altered market conditions and to cater both short-term and long-term requirements;
- lCERs cause liabilities when carbon gets reversed due to management of plantations or due to disturbance.

One of main disadvantages of tCER projects is that they incur issuance fees every 5 years, while lCERs incur them only once.

Current status of the market for LULUCF credits

Outside of the Kyoto, LULUCF credits have been traded in the New South Wales Greenhouse Gas Abatement Scheme and in the Chicago Climate Exchange. The futures market is dominated by the Kyoto Protocol. The only notable buyer at the moment is World Bank through its dedicated carbon funds. Nevertheless, there will remain a need for CDM credits for Annex I Parties to meet their commitments. It appears likely that afforestation/ reforestation credits will form a significant supply up to the cap of 1 percent of assigned amounts

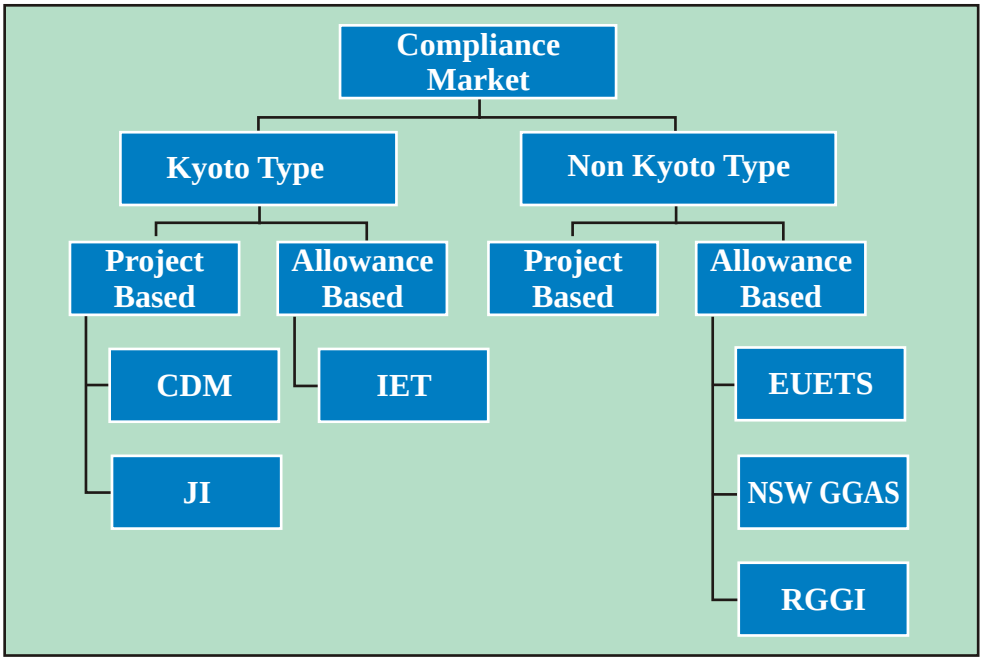


Figure 5: Structure of various compliance markets (RGGI: North American Regional Greenhouse Gas Initiative; NSW GGAS: The NSW Greenhouse Gas Reduction Scheme)

Form of payment

To date, most projects have followed the commodity model whereby buyers purchase CERs and all risk is carried by the project developer. Very few projects have followed the investment model where payments are upfront. Upfront payments have great advantages for projects, in that project development costs can be covered. However, they are likely to lead to significantly lower prices for CERs as the buyer is then paying for a commodity to be received in the future and is also sharing project risk.

Current buyers

The multilateral funds for carbon projects are overwhelmingly dominated by the World Bank, which facilitates eight carbon funds: the Prototype Carbon Fund (www.prototypecarbonfund.org), the Italian Carbon Fund (ICF; www.carbonfinance.org), the Netherlands Clean Development Facility, the Community Development Carbon Fund (CDCF), the BioCarbon Fund (BioCF; www.biocarbonfund.org), the Netherlands European Carbon Facility (NECF), the Spanish Carbon Fund (SCF) and the Danish Carbon Fund (DCF). All these funds are generally based on the same model. Industrialised countries and companies provide investments (money) that are aggregated in one "pot". These funds, along with other project funding, provide cash flow to host countries and communities to develop carbon projects and produce carbon credits, as well as pre financing for project identification and preparation activities such as capacity building, outreach and research, leading to the creation of supportive project approval systems in host countries. Funds provided during the project development stage are, for the most part, serving as a loan and are repaid when the project is implemented and carbon credits accrue. The amount of financing will be proportional to the amount of carbon credits the projects will produce, and payment will be made each year as the carbon credits are produced.

An alternative option for project developers is to obtain financing independently for Kyoto-compliant project development and implementation by developing a business plan like any other venture to raise capital. Now non- Annex I countries can develop projects without Annex I partners. The CDM Facility of the Asian Development Bank can contribute to this process. Its stated goals are to promote projects that contribute to poverty reduction, sustainable development and mitigation of greenhouse gases, lower CDM transaction costs, assist in finding competitive prices for carbon credits arising from projects, and facilitate access to finance by improving project viability.

Options for non-BioCarbon Fund buyers are Annex I governments and individual corporate entities. Unfortunately, the current exclusion of LULUCF from the EU ETS limits the involvement of companies and corporations as afforestation/ reforestation CDM buyers. Consequently, it is likely that governments will be the dominant buyers of credits.

Non-Kyoto Protocol purchases

A proportion of the volume of credits traded every year is outside the Kyoto Protocol system, principally in the voluntary US market and the mandatory market in New South Wales. In the US, the voluntary nature of the market leads to low prices for traded units, typically between \$1-\$2 t CO_2-e. This market is likely to see expansion.

Risks and uncertainties

As the project is typically paid on delivery of the temporary CERs, the dominant portion of the risk rests with the project developer (the seller). Risks to the seller refer to any event(s) that negatively effect the expected greenhouse gas (and consequently financial) benefits to the project. These risks include:

- Natural risks: fire, disease, lower than predicted growth rates, drought, floods, damaging winds;
- Anthropogenic factors: encroachment, poaching, fire, vandalism;
- Political risks: policy changes, unstable governments
- Economic risks: exchange rates, interest rates, lower than expected tCER/lCER prices, changes in opportunity cost of land. Risks are particularly acute where lCERs have been selected as the form of credit lCERs have an initial duration equal to the length of the crediting period but expire immediately if the stored carbon has diminished at the next verification.
- Opportunity Costs: This is particularly true, when a CDM Forestry Project is implemented in private lands. A farmer has to forgo all the benefits arising from other land-uses during the entire project life-cycle.

8

Case Studies of Some CDM A/R Projects in India

A brief description and applicability conditions of the methodology used for three of the Afforestation / Reforestation CDM Projects in India: (i) Haryana; (ii) ITC Bhadrachalam; and (iii) Himachal Pradesh; are given in this section to develop an understanding about the typology of A/R CDM Projects that can be developed under various land use categories. Haryana small scale afforestation project is a small scale A/R CDM project developed by a farmer's cooperative society, while other two are large scale projects. The project participant for ITC Bhadarchalam Reforestation Project is a private entity, while the project participants for Himachal Pradesh Reforestation Project are public entities. A comparative table of various parameters opted/selected by these projects is also given at the end.

Case Study 1: Haryana Small Scale Afforestation Project

This is a small scale cooperative afforestation CDM pilot project activity on private lands affected by shifting sand dunes in Sirsa, Haryana. The project proponent is a private entity named Haryana CDM Variksh Kisan Samiti, Ellenabad, Sirsa and the Project developer is Forest Department, Government of Haryana.

Description of the proposed small scale project activity: The lands planted in this small-scale A/R CDM project activity are located in the western belt of Haryana which has its border with the state of Rajasthan at the north-eastern fringe of the Indian Thar Desert. The project area is affected by aeolian (wind blown) sand, and is the degraded part of croplands spread across these eight villages, comprising of 369.87 ha belonging to 227 farmers; which is generally left fallow. Large areas of land are without any vegetation due to frequent dust storms of various intensities. These dust storms toss up large amount of sand, dust and suspended particles into the air and pollute the ambient atmosphere. The report has found that the quality of drinking water and the water table in this region has deteriorated over the years. Many villages also reportedly have lost crop lands due to shifting sands. Impacted by limited precipitation (100-200mm annually) and shifting sand dune, the cropping intensity on these degraded croplands is barely one crop every three years as against the normally two crops annually on the surrounding good croplands (as per the PRA findings). The cultivation and shifting sand dunes prevent the potential natural regeneration of forest in this area. The proposed Afforestation Reforestation CDM will establish 369.87 ha of mixed forests, using seven tree species, i.e., *Ailanthus excelsa, Acacia tortilis, Eucalyptus hybrid, Acacia nilotica, Dalbergia sissoo, Zizyphus mauritiana, Prosopis cineraria.* The project area covers eight villages falling under three administrative blocks of Sirsa district, Haryana.

Application of an approved baseline and monitoring methodology: Simplified baseline and monitoring methodologies for small-scale afforestation and reforestation project activities under the clean development mechanism implemented on grasslands or croplands AR-AMS0001 (AR-AMS0001 / Version 04.1) has been used by the project.

The methodology is applicable under following conditions:

a) Project activities are implemented on grasslands or croplands;

b) Project activities are implemented on lands where the area of the cropland within the project boundary displaced due to the project activity is less than 50 per cent of the total project area;

c) Project activities are implemented on lands where the number of displaced grazing animals is less than 50 per cent of the average grazing capacity of the project area;

d) Project activities are implemented on lands where = 10% of the total surface project area is disturbed as result of soil preparation for planting.

The latest situation of the project can be found in the paper titled First Afforestation Project in India (Single, 2012).

Case study 2: ITC Bhadarchalam Reforestation Project

The Project focuses on Reforestation of severely degraded landmass in Khammam District of Andhra Pradesh, India under ITC Social Forestry Project.

Description of the proposed project activity: Under the project activity, the degraded lands owned by the rural poor (tribals) are developed for raising plantations with Eucalyptus. The Paperboards and Specialty Papers Division (PSPD), Unit: Bhadrachalam of ITC Limited is the primary developer of this project and initiated the project activity through the local Non Governmental Organisation (NGOs). The participating NGOs are: Action for Collective Tribal Improvement and Vocational Education (ACTIVE); Human Organisation for Poverty Eradication (HOPE); Society for Health and Agriculture Department (SHADE), Society for National Integration through Rural Development (SNIRD) and Society for Elimination of Rural Poverty (SERP) all promoted by the Government of Andhra Pradesh. These bodies identified the tribal beneficiaries and grouped them into a Sangha (User Groups / Society) for taking up the plantation activity. Apart from providing finances for the project, ITC also distributes planting stock nurtured from hybrid clonal plants of Eucalyptus developed at ITC's own R&D Centre in Bhadrachalam. ITC continues to extend services such as sharing of agricultural / forestry knowledge and good practices of farming to the beneficiaries identified under the project activity.

Application of an approved baseline and monitoring methodology: The approved baseline methodology AR-AM0001/Version 02, dated 19th May 2006, Sectoral Scope: 14 has been used to determine the baseline emissions and emission reduction due to the A/R CDM project activity. The title of this baseline methodology is “Reforestation of degraded land”.

Applicability conditions of the methodology:

(a) The project activity does not lead to a shift of pre-project activities outside the project boundary. The land under the proposed A/R CDM project activity can continue to provide at least the same amount of goods and services as in the absence of the project activity

(b) Lands to be reforested are severely degraded with the vegetation indicators (tree crown cover and height) below thresholds for defining forests, as communicated by the DNA consistent with decision 11/CP.7 and 19/CP.9, and the lands are still degrading;

(c) Lands will be reforested by direct planting and / or seeding

(d) Site preparation does not cause significant longer term net emissions from soil carbon

(e) Plantation may be harvested with either short or long rotation and will be regenerated either by direct planting or natural sprouting;

(f) Carbon stocks in soil organic matter, litter and deadwood can be expected to decrease more due to soil erosion and human intervention or increase less in the absence of the project activity, relative to the project scenario;

(g) Grazing will not occur within the project boundary in the project case;

(h) The application of the procedure for determining the baseline scenario in section leads to the conclusion that the baseline approach 22(a) (existing or historical changes in carbon stocks in the carbon pools with the project boundary) is the most appropriate choice for determination of the baseline scenario and that the land would remain degraded in the absence of the project activity

The species considered for carbon sequestration are *Eucalyptus tereticornis Eucalyptus camaldulensis (*Smith and Dhen).

Case Study 3: Himachal Pradesh Reforestation Project

The title of this project activity is: Himachal Pradesh Reforestation Project Improving Livelihoods and Watersheds.

Description of the project activity: The project will be implemented in the state of Himachal Pradesh, India. The state is located in the North-Western Himalayan region of India and has 12 districts, which are categorized into four agro-climatic zones, i.e., i) Shiwalik hills, ii) Mid hills, iii) High hills and iv) Cold dry zone. The Mid-Himalayan Watershed Development Project (MHWDP) is implemented in the Siwalik hills at an altitude of 600 to 1800 metres above mean sea level, and covers 11 watershed divisions in 10 districts. The project is spread over an area of 222,951 ha and covers the catchment for major rivers of Northern India - Ravi, Beas and Sutlej.

The project has been developed through a series of consultations with MHWDP and its stakeholder constituents namely, Forest Department, Government of Himachal Pradesh, local Gram Panchayats (GPs) and the World Bank. The project seeks to implement A/R CDM activities on 4,003.07 ha of degraded lands in the watersheds of Mid-Himalayan region.

The four guiding principles of the project are: (i) adoption of native and locally preferred tree species for reforestation, (ii) involvement of the local GPs and small and marginal farmers in reforestation activities that will strengthen the ongoing watershed interventions, (iii) facilitation of technical, financial and capacity development support from MHWDP to reforestation activities, and iv) distribution of carbon revenue to the village community (GP and farmers)

The project will be implemented by the MHWDP. Many of the project activities such as protection and management would involve participation of local panchayats and their delegated committees. The A/R CDM project is developed under the umbrella of the World Bank funded MHWD Project and it expected to sequester 828,016 tCO2-e of tCERs over the first crediting period of 20-years at the rate of 10.34 tCO2-e/ha/year.

Application of an approved baseline and monitoring methodology: The Consolidated afforestation and reforestation baseline and monitoring methodology "Afforestation and reforestation of degraded land" (AR-ACM0001/version 03) is applied

(i) The A/R CDM project activity is implemented on degraded lands, which are expected to remain degraded or to continue to degrade in the absence of the project, and hence the land cannot be expected to revert to a non-degraded state without human intervention.

(ii) Encroachment of natural tree vegetation that leads to the establishment of forests according to the host country definition of forest for CDM purposes is not expected to occur.

(iii) Flooding irrigation is not part of the project activity

(iv) If project activities are implemented on organic soils, drainage is not allowed and not more than 10% of the project area may be disturbed as result of soil preparation for planting

(v) The establishment of project shall not decrease availability of fuelwood

The project proposed to plan about 45 tree species across the project area.

Comparative Assessment of Various Parameters of the three CDM-A/R Projects

Table 1. Carbon pools selected by projects

Carbon pools	Selected (answer with yes or no)		
	Haryana small scale afforestation project	ITC Bhadrachalam Reforestation Project	Himachal Pradesh Reforestation Project
Above ground	Yes	Yes	Yes
Below ground	Yes	Yes	Yes
Dead wood	No	No	No
Litter	No	No	No
Soil organic carbon	No	No	No

Table 2: A comparative statement of other project related parameters

Parameter	Haryana Small Scale Afforestation Project	ITC Bhadrachalam Reforestation Project	Himachal Pradesh Reforestation Project
Project participant Public or Pvt entity	Private	Private	Public
Area	369.87	3070.19	4003.07
Proving eligibility of land	PRA exercise	Demonstrated by satellite image map	Satellite imagery with help from FSI
CER per year	11569	57792	41400
Addressing permanaance	tCER	lCER	tCER
Crediting period (Years)	20 (with a choice of renewal twice for 20 years each)	30 (Fix)	20 (with a choice of renewal twice for 20 years each)
Operational life time of the project activity (Years)	60 Years	32	60

List of Approved CDM Afforestation and Reforestation (A/R) Methodologies

S. No.	Meth No.	Details
1	AR-AM 0001	"Reforestation of degraded land" This methodology is based on the draft CDM-AR-PDD "Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin, China (This methodology has now been merged with AR ACM 001)
2	AR-AM 0002	"Restoration of degraded lands through afforestation/ reforestation" This methodology is based on the draft CDM-AR-PDD "Moldova Soil Conservation Project"
3	AR-AM 0003**	"Afforestation and reforestation of degraded land through tree planting, assisted natural regeneration and control of animal grazing" This methodology is based on the draft CDM-AR-PDD "Assisted Natural Regeneration on Degraded Land in Albania" (This methodology has now been merged with AR ACM 002)
4	AR-AM 0004	Reforestation or afforestation of land currently under agricultural use" This methodology is based on the draft CDM-AR-PDD "Reforestation around Pico Bonito National Park, Honduras"
5	AR-AM0005	"Reforestation or afforestation of land currently under agricultural use" This methodology is based on the draft CDM-AR-PDD "Reforestation as Renewable Source of Wood Supplies for Industrial Use in Brazil"
6	AR-AM0006	"Afforestation/Reforestation with Trees Supported by Shrubs on Degraded Land" This methodology is based on the draft CDM-AR-PDD "Afforestation for Combating Desertification in Aohan County, Northern China
7	AR-AM 0007	"Afforestation and Reforestation of Land Currently Under Agricultural or Pastoral Use" This methodology is based on the draft CDM-AR-PDD "Chocó-Manabí Corridor Reforestation and Conservation Carbon Project"
8	ARAM 0008	"Afforestation or reforestation on degraded land for sustainable wood production" This methodology is based on the draft CDM-AR-PDD: "Reforestation on degraded land for sustainable wood production of woodchips in the eastern coast of the Democratic Republic of Madagascar".

9	AR-AM 0009	"Afforestation or reforestation on degraded land allowing for silvopastoral activities" This methodology is based on the draft CDM-AR-PDD: "San Nicolás CDM Reforestation Project"
10	AR-AM 0010	"Afforestation and reforestation project activities implemented on unmanaged grassland in reserve/protected areas" This methodology is based on the draft CDM-AR-PDD: "AES-Tiete Afforestation/Reforestation Project Activity Around the Borders of Hydroelectric Plant Reservoirs" (Brazil).
11	AR-AM 0011	Afforestation and reforestation of land subject to polyculture farming --- Version 1.0.1 This methodology is based on elements from the following: AR-NM0036 "Rubber outgrowing and carbon sequestration in Ghana (ROCS-Ghana)" and draft CDM-AR-PoA-DD "Rubber outgrowing and carbon sequestration in Ghana (ROCS-Ghana)", prepared by ONF-International for the Government of Ghana, Ministry of Food and Agriculture, Ghana Rubber Estate Ltd (GREL) and the Rubber Outgrowers and Agents Association of Ghana (ROAA), with support from Agence française du développement (AFD) and KFW.
12	AR-AM 0012	Afforestation or reforestation of degraded or abandoned agricultural lands --- Version 1.0.1 This methodology is based on the CDM AR-PDD "Reforestation for the purpose of combating desertification, mitigating climate change and protecting biodiversity in Santiago del Estero, Argentina - Youth Environmental Groups".
13	AR-AM 0013	Afforestation or reforestation of degraded or abandoned agricultural lands --- Version 1.0.1 This methodology is based on elements from the following methodologies: • AR-AM0003 "Afforestation and reforestation of degraded land through tree planting, assisted natural regeneration and control of animal grazing." The baseline study, monitoring and verification plan and project design document were prepared by the General Directorate for Forests and Pastures and the International Bank for Reconstruction and Development as Trustee of the BioCarbon Fund; • AR-NM0032-rev "San Carlos" Grassland Restoration through Afforestation. The baseline study, monitoring and

		verification plan and project design document were prepared by Factor CO2 Integral Services; • AR-AM0006-rev "Afforestation/Reforestation with Trees Supported by Shrubs on Degraded Land." The baseline study, monitoring and verification plan and project design document were prepared by the Institute of Forest Ecology and Environment, the Chinese Academy of Forestry, China; University of Tuscia, Italy and others.
14	AR-AM 0014	Afforestation and reforestation of degraded mangrove habitats --- Version 1.0.0 • This methodology is based on elements from the following methodologies: • ARNM0038 "Afforestation and reforestation of degraded tidal forest habitats." The draft baseline and monitoring methodology and project design document were prepared by Silvestrum on behalf of a partnership comprising IUCN, Ramsar Secretariat and Group Danone; • AR-ACM0001 "Afforestation and reforestation of degraded lands", version 05; • AR-AMS0003 "Simplified baseline and monitoring methodology for small scale CDM afforestation and reforestation project activities implemented on wetlands", version 01.
Consolidated Methodologies:		
1	AR-ACM 0001	Afforestation and reforestation of degraded land - Version 5.1.1 This methodology is based on elements from the following methodologies: AR-AM0003 "Afforestation and reforestation of degraded land through tree planting, assisted natural regeneration and control of animal grazing. AR-NM0032-rev "San Carlos" Grassland Restoration through Afforestation. AR-AM0006-rev "Afforestation/Reforestation with Trees Supported by Shrubs on Degraded Land.
2	AR-ACM 0002	Afforestation or reforestation of degraded land without displacement of pre-project activities - Version 1 This methodology is based on elements from the following methodologies:

		AR-AM0001 "Reforestation of degraded land" (Version 3) based on the draft CDM-AR-PDD "Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin, China". AR-AM0008 "Afforestation or reforestation on degraded land for sustainable wood production" (Version 3) based on the draft CDM-AR-PDD: "Reforestation on degraded land for sustainable wood production of woodchips in the eastern coast of the Democratic Republic of Madagascar".
Small Scale Project Methodologies		
1	ARAMS 0001	Simplified baseline and monitoring methodologies for small-scale afforestation and reforestation project activities under the clean development mechanism implemented on grasslands or croplands
2	ARAMS 0002	Simplified baseline and monitoring methodologies for small-scale afforestation and reforestation project activities under the CDM implemented on settlements
3	ARAMS 0003	Simplified baseline and monitoring methodology for small scale CDM afforestation and reforestation project activities implemented on wetlands
4	ARAMS 0004	Simplified baseline and monitoring methodology for small-scale agroforestry - afforestation and reforestation project activities under the clean development mechanism Version 2.0
5	ARAMS 0005	Simplified baseline and monitoring methodology for small-scale afforestation and reforestation project activities under the clean development mechanism implemented on lands having low inherent potential to support living biomass --- Version 2.0
6	ARAMS 0006	Simplified baseline and monitoring methodology for small-scale silvopastoral - afforestation and reforestation project activities under the clean development mechanism --- Version 1.0
7	ARAMS 0007	Simplified baseline and monitoring methodology for small-scale A/R CDM project activities implemented on grasslands or croplands --- Version 1.1
Power Generation from Biomass		
1	AM0042	**Grid-connected electricity generation using biomass from newly developed dedicated plantations"** This baseline methodology is based on the proposed methodology NM0133-rev "Grid-connected electricity generation using biomass from newly developed dedicated plantations," prepared by Mitsubishi UFJ Securities.

Methodological Tools for A/R CDM Projects

EB Meeting	Tool
EB 67 Annex 24	"Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass in A/R CDM project activities" (Version 01.0.1)
EB 65 Annex 28	Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities" (Version 01.0.0)
EB 60 Annex 12	"Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" (Version 01.1.0)
EB 60 Annex 11	Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity (Version 3.1.0 (Note: This tool is the former "Tool for estimation of GHG emissions from clearing, burning and decay of existing vegetation due to implementation of a CDM A/R project activity".)
EB 60 Annex 13	Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities Version 2.1.0 (Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities Version 2, EB56 Annex 13)
EB 58 Annex 15	Calculation of the number of sample plots for measurements within A/R CDM project activities Version 2.1.0 (Replaces previous version of EB 46 Annex 19 Version 2, EB31 Annex 15 Ver 1)
EB 58 Annex 14	Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities Version 1.1.0 (This tool replaces tool for estimation of Carbon Stocks, Removals and Emissions for the Dead Organic Matter Pools due to Implementation of a CDM A/R Project Activity Version 1 EB 41 Annex 14)
EB 51 Annex 15	Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity
EB 41 Annex 15	Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities Version 1

EB 39 Annex 11	Tool for calculation of GHG emissions due to leakage from increased use of non-renewable woody biomass attributable to an A/R CDM project activity Version 1
EB 35 Annex 17	Tool for the demonstration and assessment of additionality in A/R CDM project activities
EB 35 Annex 19	Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities Version 1
EB 33 Annex 14	Estimation of GHG emissions related to fossil fuel combustion in A/R CDM project activities. Version 1
EB 33 Annex 15	Procedure to determine when accounting of the soil organic carbon pool may be conservatively neglected in CDM A/R project activities
EB 33 Annex 14	Estimation of direct nitrous oxide emission from nitrogen fertilization Version 1
EB 31 Annex 16	Tool for testing significance of GHG emissions in A/R CDM project activities Version 1

List of Accredited DOEs for A/R CDM Projects in India

S. No.	Name of Entity	Contact
1	TUV / SUD Suddeutschland India, C-27 3RD Floor, Qutab Institutional Area New Delhi - 110016	Tel: 011-51688423/4/5/6/7 Fax: 011-51688421
2	TUV / NORD, TUV India Private Limited 801, Raheja Plaza - 1, L.B.S. Marg Ghatkopar (W), Mumbai - 400 086	Tel: 022-5647 7000 Fax: 022-5647 7009 Mobile: 9892824854
3	TUV Rheinland (India) Pvt.Ltd. 604, 6th Floor Pride Kumar Senate, Senapati Bapat Road Pune-411016, India	Tel: +91-20 5601135,36,37 Fax: +91-20 5601137 Cell: 09890038257
4	DET NORSKE VERITAS AS, 203 Pavani Avevue, Near Vila Marie College Gulmohar Avenue, Somajiguda Hyderabad-500082	Tel : +91 40 23372260/ 23376308/ 55250188 Fax: +91 40 23372260
5	DET NORSKE VERITAS AS, No.3/10/2 McNichols Road, Chetpet Chennai-600031	Tel : +91 44-28363071/ 28363070/ 28363357 Fax : +81 44 28362906
6	DET NORSKE VERITAS AS, P-108, Block 'F' New Alipore Kolkata-700053	Tel: 033-24789002/24583958 Fax : +91 33 24786680
7	DET NORSKE VERITAS (DNV), 201 D Poonal Chambers Second Floor, A Wing Worli Mumbai 400018	Tel: +91-022-56606639-41 Fax: +91-022-56606642 Cell: 09892201322
8	DET NORSKE VERITAS (DNV), 203 Savitri Sadan I, Preet Vihar Community Centre New Delhi 110092	Tel: 011-22531502 / 22531503 / 22531278 / 22427688 fax: +91 11 22530247
9	SGS India Private Limited, 250, Udyog Vihar Phase IV, Gurgaon - 122 015, India	Tel: 91-124-2399990 - 8 Fax : 91-124-2399764 - 5 Cell : 09891270130
10	Bureau Veritus Certification India Pvt. Ltd. (Earlier Known as BVQI) Mrawaha Centre, K. Mrawaha Marg Oppsite Saki Vihar Road Andhri (E), Mumbai - 400072	Tel: +91(0) 22 56956300, 56956302-10
11	Indian Council of Forestry Research and Education (ICFRE), P.O. New Forest Dehradun - 248006	Tel: +91 135 2750296 Fax: +91 135 2750296

List of Globally Registered A/R CDM Projects

S. No.	Registered	Project	Country	Area (ha)	Annual Reductions (Tonnes of CO_2Eq
1	10 Nov 06	Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin	China	4000	25795
2	30 Jan 09	Moldova Soil Conservation Project	Moldova	20,289.9	179242
3	23 Mar 09	Small Scale Cooperative Afforestation CDM Pilot Project Activity on Private Lands Affected by Shifting Sand Dunes in Sirsa, Haryana	India	369.87	11596
4	28 Apr 09	Cao Phong Reforestation Project	Viet Nam	365	2665
5	05 Jun 09	Reforestation of severely degraded landmass in Khammam District of Andhra Pradesh, India under ITC Social Forestry Project	India	3070.19	53392
6	11 Jun 09	Carbon sequestration through reforestation in the Bolivian tropics by smallholders of “The Federación de Comunidades Agropecuarias de Rurrenabaque (FECAR)”	Bolivia	6000	4341
7	21 Aug 09	Uganda Nile Basin Reforestation Project No.3	Uganda	341.9	5564
8	06 Sep 09	Reforestation of croplands and grasslands in low income communities of Paraguarí Department, Paraguay	Paraguay	215.2	1523
9	15 Jan 10	The International Small Group and Tree Planting Program (TIST), Tamil Nadu, India	India	106.7	7367
10	16 Nov 09	Afforestation and Reforestation on Degraded Lands in Northwest Sichuan, China	China	2,251.8	75783

11	16 Nov 09	"Reforestation, sustainable production and carbon sequestration project in José Ignacio Távara´s dry forest, Piura, Peru"	Peru	8,980.52	48689
12	07 Dec 09	Humbo Ethiopia Assisted Natural Regeneration Project	Ethiopia	2728	38343
13	02 Jan 10	Assisted Natural Regeneration of Degraded Lands in Albania	Albania	6272.36	22962
14	16 Apr10	Forestry Projects for the Basin of the Chichina River, an Environmental and Productive Alternative for the City and the Region	Columbia	4,538.7	37783
15	27 May 10	Nerquihue Small-Scale CDM Afforestation Proect using Mycorrhizal Inoculation in Chile	Chile	312.1	9292
16	21 Jul 10	Reforestation as Renewable Source of Wood Supplies for Industrial Use in Brazil	Brazil	11 711.37	75783
17	15 Sep 10	Reforestation on Degraded Lands in Northwest Guangxi	China	8671.3	87308
18	03 Dec 10	'Posco Uruguay' afforestation on degraded extensive grazing land	Uruguay	820	21957
19	07 Jan 11	AES Tiete Afforestation/Reforestation Project in the State of Sao Paulo, Brazil	Brazil	13,939	157635
20	11 Feb 11	Reforestation of Grazing Lands in Santo Domingo, Argentina	Argentina	2,292	66038
21	17 Feb 11	Argos CO2 offset Project, through reforestation activities for commercial use	Colombia	2,754	36930
22	18 Feb 11	Ibi Bateke degraded savannah afforestation project for fuelwood production (Democratic Republic of Congo)	Democratic Republic of the Congo	4.129,70	54511
23	28 Feb 11	Improving Rural Livelihoods Through Carbon Sequestration By Adopting Environment Friendly Technology based Agroforestry Practices	India	1607.7	4896
24	04 Mar 11	India: Himachal Pradesh Reforestation Project Improving Livelihoods and Watersheds	India	4,0003.07	41400

25	04 Apr 11	Kachung Forest Project: Afforestation on Degraded Lands	Uganda	2,098.9	24702
26	07 May 11	Southern Nicaragua CDM Reforestation Project	Nicaragua	813	7915
27	26 May 11	Forestry Project in Strategic Ecological Areas of the Colombia Caribbean Savannas	Colombia	18,60	66652
28	27 May 11	Bagepalli CDM Reforestation Programme	India	8933.34	92103
29	07 Jun 11	Commercial reforestation on lands dedicated to extensive cattle grazing activities in the region of Magdalena Bajo Seco	Colombia	4,373	32965
30	11 Jun 11	AberdareRange/ Mt. Kenya mall Scale Reforestation Initiative Kamae-Kipipiri Small Scale A/R Project	Kenya	1649	8542
31	20 Jun 11	Uganda Nile Basin Reforestation Project No. 5	Uganda	487.6	5925
32	01 Aug 11	Reforestation of degraded land by MTPL in India	India	14969.46	146998
33	23 Aug 11	Uganda Nile Basin Reforestation Project No 1	Uganda	468	5881
34	23 Aug 11	Uganda Nile Basin Reforestation Project No 2	Uganda	370	4861
35	29 Aug 11	Uganda Nile Basin Reforestation Project No 4	Uganda	347.1	3969
36	05 Oct 11	Aberdare Range / Mt. Kenya Small Scale Reforestation Initiative Kirimara-Kithithinia Small Scale A/R Project	Kenya	282	8809
37	03 Jan 12	SECURITIZATION AND CARBON SINKS PROJECT	Chile	2,917	72019
38	06 Mar 12	Aberdare Range/Mt. Kenya Small-Scale Reforestation Initiative Kibaranyeki Small Scale A/R Project	Kenya	206.6	7427

Definitions of Terrestrial Carbon Pools
(GPG, LULUCF, IPCC, 2003)

Pool		Description
Living Biomass	Above ground Biomass	All living biomass above the soil including stem, stump, branches, bark, seeds, and foliage. Note: In cases where forest understorey is a relatively small component of the aboveground biomass carbon pool, it is acceptable for the methodologies and associated data used in some tiers to exclude it, provided the tiers are used in a consistent manner throughout the inventory time series.
	Belowground biomass	All living biomass of live roots. Fine roots of less than (suggested) 2 mm diameter are often excluded because these often cannot be distinguished empirically from soil organic matter or litter.
Dead Organic matte	Dead wood	Includes all non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots, and stumps larger than or equal to 10 cm in diameter or any other diameter used by the country.
	Litter	Includes all non-living biomass with a diameter less than a minimum diameter chosen by the country (for example 10 cm), lying dead, in various states of decomposition above the mineral or organic soil. This includes the litter, fumic, and humic layers. Live fine roots (of less than the suggested diameter limit for below-ground biomass) are included in litter where they cannot be distinguished from it empirically.
Soil	Soil organic matter	Includes organic carbon in mineral and organic soils (including peat) to a specified depth chosen by the country and applied consistently through the time eries. Live fine roots (of less than the suggested diameter limit for below-ground biomass) are included with soil organic matter where they cannot be distinguished from it empirically.

Note: *National circumstances may necessitate slight modifications to the pool definitions used here. Where modified definitions are used, it is good practice to report upon them clearly, to ensure that modified definitions are used consistently over time, and to demonstrate that pools are neither omitted nor double counted*

Tree Measurements, Estimation of Biomass, Volume and Carbon in a Forested Stand

Role of Forests and especially plantations as potential carbon sinks has gained importance in the recent years owing to the carbon dioxide capture capability of plantations in mitigating Climate Change. This annex is concerned with forest measurement from individual tree to stand of trees and a brief on measurement and estimation of tree volume and biomass. Measurement of things is a fundamental part of any scientifically based discipline. In tree and forest measurement some things are not measured directly like volume of wood that is harvested from a large area. When something is difficult to measure or cannot be measured directly at all, methods are used to approximate or estimate it. These methods often involve measuring parts of the things, parts of which can be relatively measured. Then mathematical procedures are used to convert the measurements of the parts to make an estimate of the size of the whole thing.

These measurements will effective, if accuracy, precision, and bias will be addressed properly. Accuracy in measurements will ensure true value. This may be inaccurate due to limitation of measuring equipments or estimation method, inability in understanding about the characteristics to be measured. The remedial measures for achieving accuracy lie in proper understanding of the characteristic, effective handling of equipments, and other associated precautions. Bias is difference between the averages of repeated measurements with true value. Bias cannot be eliminated, however can be minimised and mainly arises due to inherent limitation about the measurement or estimation techniques. The precision is essential requirement of any estimates. It is the variation in a set of repeated measurements. It arises due to the limitations in the techniques and is measured by the amount of variation in the set of measurements.

Diameter Measurements

The simplest and more common and arguable the most important thing measured on trees in forestry is the diameter of their stems. Amongst other things, tree stem diameter correlates closely with other parameters which are difficult to measure (i.e. Biomass), it reflects the value of a tree. The standard convention is to measure at breast height 1.37 m.

The most convenient point of measurement for diameter is on the bole near the ground. However, due to the nature of tree growth i.e. shape, size, and position, it is desirable to measure diameter at the same relative position on the bole. This relative position on bole is Breast Height (termed diameter at breast height or DBH), at a fixed height above the ground. In India it measured at 1.37 m above ground. The decision of breast height is based on location and position of tree on the terrain. DBH measurement of location of normal and irregular shape tree are given in figure A-1

? For slopping ground, this distance measures from the uphill side of the stem.

? For leaning trees (on level ground), the point will be on the under-side of the tree parallel to the axis of the stem.

? For leaning trees on sloping ground, the point will be decided based on common sense by imagine that the earth is rotating so that the tree is vertical and then locate the point as for a sloping tree.

? Trees forked below breast height should be treated as a double stem i.e. two separate tree.

? Trees forked above breast height should be treated as a single stem and measured according to the position of tree on ground or hills.

? Trees forking at breast height or slightly above are measured at the point of minimum diameter below the fork.

? Coppice crops should be measured from ground level, not from stool level.

Besides this, following precautions should also be ensured for proper accurate measurements.

? The loose mounds of soil and litter should be displaced and cleaned.

? The vines, moss, loose bark and other loose material at breast height should be removed.

? The breast height should be fixed by using a fixed height (bh) stick.

? Measure at right angles to the stem axis. Keep tapes taut.

? Special attention should be placed for buttressing and fluting situations to ensure standardisation and comparability of records. Normally, measurement is made above the buttress/fluting. Where this extends well up the bole, an arbitrary height is specified, e.g. 3 m above ground.

The diameter may be measured by rapping tape firmly around the stem, perpendicular to axis. The point must be marked for repeated measurements for assessing growth rate to ensure that the same position will be measured in each occasion. Dendrometer are permanently fixed for long term measurements of diameter in a sample plot. Diameter tape [Mostly calibrated with unit of pi (π) i.e.3.142] are also used. The diameter can also be measured through Calipers. Caliper are often quicker, however measure stems only across one diameter of their cross-section. This bias may be reduced by taking two measurements, at right angles to each other, and estimates of mean of these two measurements as stem diameter. Now, some more precise optical instruments are also available. Diameter measurement at breast height may not be representative in some cases such as deformity, swelling, branches, malformation, wound etc. at that point. In this cases following considerations should be followed.

1. Two measurements equidistant above and below the breast height should be recorded. If the difference in measurements is low, arithmetic mean will serve the purpose, otherwise, quadratic mean will be a better option.

2. Alternatively, measurement may be recorded from a single point by selecting one position of representative size. However, this may introduce subjective bias.

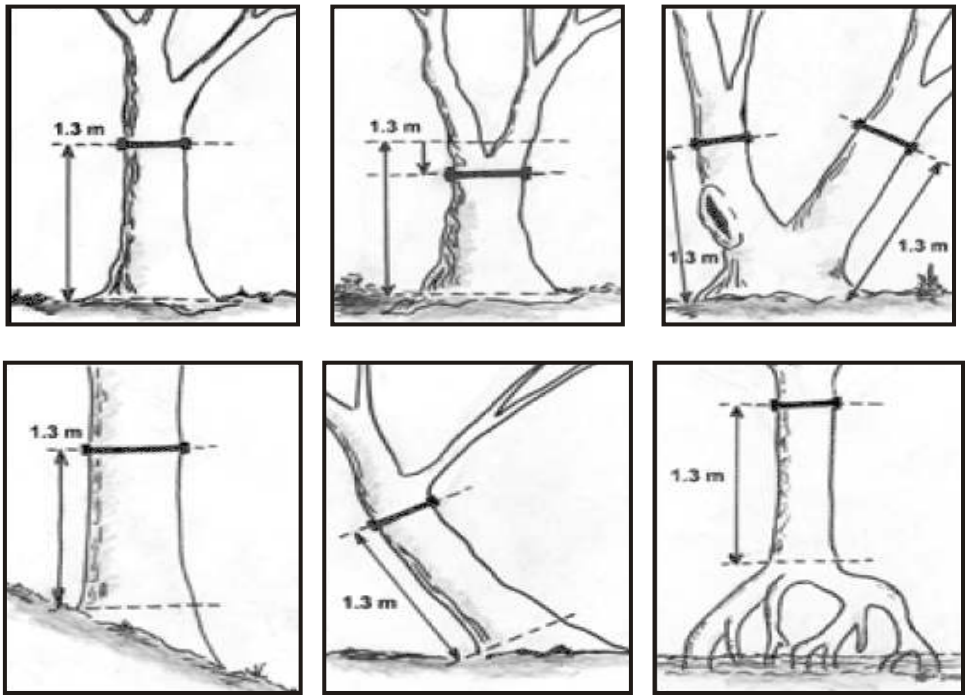


Figure: dbh measurement of location of normal and irregular shape tree

Height Measurement

The height of tree is important characteristics for measuring the total amount of wood contained in tree. It is the vertical distance from ground level to the height green point on the tree known as tip of the tree. Identifying actual tree top and the fact that the tree top may not be directly over the base of the tree are main sources of error for tree height measurements. Therefore, the concept of merchantable tree heights is adopted with the view of utilisation perspective. It is the height of the tree (or the length of trunk) up to which a particular product may be obtained. Height can be measured through Ocular estimate, Non Instrumental, Shadow method, Single Pole method, Instrumental. The height can be measured by specially designed instruments specifically for tree-height measurements such as clinometers, altimeters, relascopes, or hypsometers.

Instrumental measurement: Instruments are based either on geometric principles of similar triangles or on trigonometric principles based on relations between the sides of right angled triangles. As a general rule, height measurement using trigonometric instruments should be made from a point on the ground such that the angle of observation to the tip of the tree lies between 30 and 45 degrees, i.e. the observer should stand between 1 and about 1.5 times the tree height away from the tree. Christen hypsometer, Smythies hypsometer, improvised calipers are instruments Based on properties of similar triangles and Brandis hypsometer, Abeny's level, Haga altimeter, topographical Abeny's level, Relaskop, Tele relaskop, Blume-Leiss hypsometer, Dendrometer are instruments based on trigonometrical principles.

Indirect methods for measuring the height of a standing tree: Indirect methods involve the use an instrument called a hypsometer. A hypsometer is an instrument used to calculate the heights of trees by triangulation.

Leaning trees: There are two general methods of measuring the height of leaning trees, direct and indirect. The direct methods are the same as for a vertical tree (i.e. climbing or using height sticks) while for indirect methods, modified method must be used. It is imperative that field crews involved in measuring tree heights inspect each tree closely for lean and, if a lean is detected, take appropriate action. Extreme error is most likely to occur when the operator stands in the plane of lean (i.e. the tree is leaning directly towards or away from the operator) and does not use the appropriate method. Depending on where the observer stands in the plane of lean, the error will vary from maximum positive to maximum negative.

The most common errors include:

1. Measuring the leaning tree as if it is vertical, i.e. distance measured to tree base instead of the to the point directly beneath the tip. The plumb line is an essential adjunct to the height measuring instrument (to establish the point beneath the tip).
2. Instrument error. All instruments should be checked periodically against some standard or known height and adjust as necessary.
3. Operator and recording error. - personal error is always likely, e.g. :
   (i) incorrect setting of distance or booking of angles and distances, incorrect reading;
   (ii) forgetting to add on the section of tree below eye level or forgetting to sight to the tree base;
   (iii) measuring to wrong tip - shaking the tree may help!
   (iv) difference of opinion amongst observers in nominating the tip of an umbrageous crown.
4. Effects of wind sway. Accurate readings are impossible in high winds. Preferably sight to the tip in a plane at right angles to wind direction.

Estimates of tree biomass

Biomass is defined as the total amount of aboveground living organic matter in trees. It is generally expressed as oven-dry tons per unit area. More recently there has been increasingly interest in measurement of the weight that is the biomass of tree. Furthermore it is not just stem which are of interest but the whole biomass of the tree. Biomass can be measured directly or through estimation functions.

Biomass by direct measurement:

Direct measurement of biomass involves felling, dissecting and weighing different components of tree. Diameter of the trees in a sample plot is measured. The entire diameter range is then divided into different diameter classes. Representative sample trees from each diameter class (close to the mean DBH of that class) are harvested in each plantation for biomass estimation. All the tree components (leaves, twigs, branches, bark, bole) including roots were

separated immediately after felling and their fresh weights recorded in the field. The representative samples of each tree component are taken for oven dry weight estimation.

The bole portion of the sample trees was cut into 2m long sections (billets) for convenience of weighing. Approximately 5-cm broad disc was removed from the base of each billet for estimation of fresh and dry weights of bark and wood (under bark) and also for the estimation of volume (over bark and under bark) of the main bole (upto a diameter limit of 5cm over bark). The average diameter of the two successive discs was taken to calculate the volume (over bark and under bark) of each section and finally the volume of each section was added up to get the volume of main bole (over bark and under bark).

The root systems of tree is completely excavated excluding their fine rootlets. All possible care is taken to remove the soil particles sticking to the roots and fresh weight taken immediately to prevent the weight loss. Representative root sample was also taken for its dry weight estimation and determining mineral contents.

The stand biomass (t ha^{-1}) was obtained by multiplying the dry weights of the sample trees by the number of tree in respective diameter classes followed by summation of biomass in each diameter class. By felling, dissecting and weighing of trees Difficult time consuming exercise. More difficult when root is excavated

Biomass estimation functions:

Given the difficulty associated with direct measurement of tree biomass, attempts have been made to develop functions to allow tree biomass estimation from simply measured characteristics standing trees. Allometry is the relation between the size of an organism and the size of any of its parts. Allometric equation is usually expressed in power-law form or in logarithmic form and are widely used in many biological disciplines to describe systematic changes in morphogenesis, physiology, adaptation, and evolution. Once an allometric equation has been developed, the biomass can be estimated in a forest stand using just the simple measurements of diameter. The general form of allometric equation's is usually written as,

$y = bx^a$

or, in natural logarithmic (ln) terms, $\ln y = \ln b + a \ln x$

where b is a constant (called the "allometric coefficient"), and a is the allometric exponent.

These equations should be avoided outside the specified diameter range, otherwise the estimates may be tend to overestimated.

If local allometric equations are available, the biomass can be assessed easily by using them. If such equations are not available, then it is better to develop site-specific allometric equations by collecting data from individual trees.

Stem wood volume

Volume of wood contained in the stem is one of the most important measurements made in forestry. Stem biomass is often derived from stem volume by multiplying its volume by wood

density. Methods for measurement of tree volume can be destructive (the tree is felled before measurement) or non destructive (the tree is measured standing). In either case there will inevitably be some bias in final measurement in tree volume, because these methods can not take account fully of the natural irregularities that occur in any tree stem. The principal method used to measure tree stem volume is known as the sectional method. It involve measuring stems in short sections, determining the volume in each section and summing then to give the total volume. Tree volume is measured using one of following three formulae each named after person who first developed it:

1. Smalian's Formula, $V_S=pl(d_L^2+d_U)8$
2. Huber's Formula, $V_S= pldm^2/4$
3. Newton's Formula $V_S= pl(d_L^2+4d_M^2+d_U)/24$

Where:

V_S= Volume of a section of stem
l = length of the section
d_L= Stem diameter at lower end (Commonly referred to as large end diameter)
d_U= Stem diameter at upper end (Small end diameter)
d_M= Midway Stem Diameter

Total volume estimation from diameter and height:

Various functional forms of stem volume function have been used by different workers. Generally two basic form have been used, both allow estimation of total stem volume from ground to tip, V, over or under bark from measurements of stem diameter at breast height, D, over or under bark and total height H. The two functional forms are

$V=a+bD^2+cH+dD^2H+eH^2+fD^2H^2$……..

and

$V= aD^bH^c$

In these functions the terms a,b,c,d…. are parameters. That is they will take particular values in the functions developed for a particular species in a particular region

Estimation of change in carbon stocks in living biomass:

Detailed forest inventory or monitoring system contains data on growing stock, and, ideally, also on annual increment. If appropriate allometric biomass functions are available it is good practice to use those equations directly. Carbon fraction and basic wood density could also be incorporated in such functions.

Carbon stock change is calculated by multiplying the difference in oven dry weight of biomass increments and losses with the appropriate carbon fraction. This section presents methods for estimating biomass increments and the losses. Increments include biomass growth. Losses include fellings, fuelwood gathering, and natural losses. For estimation of biomass also stock change method given by IPCC GPG (2003) is normally applied. This requires biomass

carbon stock inventories for a given forest area at two points in time. Biomass change is the difference between the biomass at time t_2 and time t_1, divided by the number of years between the inventories

$\Delta C_{FFLB} = (Ct2\ \ Ct1)/t2\text{-}t1$

And $C = [V \times D \times BEF] \times (1+R) \times C$

Where:

$\Delta C_{FF\ LB}$ = annual change in carbon stocks in living biomass (includes above- and belowground biomass) in forest land remaining forest land, tonnes C yr-1

C t2= total carbon in biomass calculated at time t 2, tonnes C

C t1= total carbon in biomass calculated at time t1, tonnes C

V = merchantable volume, m3 ha-1 Tree volume of a stand are normally available in forest inventory and growing stock data.

D = basic wood density, tonnes d.m. m-3 merchantable volume (Species wise information on Basic wood density are available in literature

BEF = biomass expansion factor for conversion of merchantable volume to aboveground tree biomass, dimensionless. Biomass expansion factor is defined as: the ratio of total aboveground oven-dry biomass density of trees with a minimum dbh of 10 cm or more to the oven-dry biomass density of the inventoried volume

R = root-to-shoot ratio, dimensionless

CF = carbon fraction of dry matter (default = 0.5), tonnes C (tonne d.m.)-1

In general the stock change method will provide good results for relatively large increases or decreases of biomass, or where very accurate forest inventories are carried out. The default method for estimating the changes in aboveground and belowground biomass uses a series of equations. These require activity data on area of different land-use categories, according to different forest types or management systems, corresponding emission and removal factors, and factors to estimate biomass loss.

In India volume table and volume equations for most of the plantation species are already developed by various Institutes of Indian Council of Forestry Research and Education (ICFRE) primarily by Forest Research Institute Dehradun and other forestry establishments of the country. These are available in form of local volume table and also general volume tables. Users can use these functions by using required parameters of height and diameter in these table or equations.

Constitution and Functioning of National CDM authority (NCDMA)

The Seventh Conference of Parties (COP-7) to the UNFCCC decided that Parties participating in CDM should designate a National Authority for the CDM and as per the CDM project cycle, a project proposal should include written approval of voluntary participation from the Designated National Authority of each country and confirmation that the project activity assists the host country in achieving sustainable development.

Accordingly the Central Government constituted the National Clean Development Mechanism (CDM) Authority for the purpose of protecting and improving the quality of environment in terms of the Kyoto Protocol. The composition of the "National Clean Development Mechanism (CDM) Authority" is as follows:

1.	Secretary (Environment and Forests)	Chairperson
2.	Foreign Secretary or his nominee	Member
3.	Finance Secretary or his nominee	Member
4.	Secretary, Industrial Policy and Promotion or his nominee	Member
5.	Secretary, Ministry of Non Conventional Energy Sources or his nominee	Member
6.	Secretary, Ministry of Power or his nominee	Member
7.	Secretary, Planning Commission or his nominee	Member
8.	Joint Secretary (Climate Change), Ministry of Environment and Forests	Member
9.	Director (Climate Change), Ministry of Environment and Forests	Member-Secretary

The National Clean Development Mechanism (CDM) Authority receives projects for evaluation and approval as per the guidelines and general criteria laid down in the relevant rules and modalities pertaining to CDM in addition to the guidelines issued by the Clean Development Mechanism Executive Board and Conference of Parties serving as Meeting of Parties to the United Nations Framework Convention on Climate Change.

The evaluation process of CDM projects includes an assessment of the probability of eventual successful implementation of CDM projects and evaluation of extent to which projects

meet the sustainable development objectives, as it would seek to prioritize projects in accordance with national priorities.

The National Clean Development Mechanism (CDM) Authority can recommend certain additional requirements to ensure that the project proposals meet the national sustainable development priorities and comply with the legal framework so as to ensure that the projects are compatible with the local priorities and stakeholders have been duly consulted.

The Authority ensures that in the event of project proposals competing for same source of investment, projects with higher sustainable development benefits and which are likely to succeed are accorded higher priority.

The Authority also carries out the financial review of project proposals to ensure that the project proposals do not involve diversion of official development assistance in accordance with modalities and procedures for Clean Development Mechanism and also ensure that the market environment of the CDM project is not conducive to under-valuation of Certified Emission Reduction (CERs) particularly for externally aided projects.

The Authority carries out activities to ensure that the project developers have reliable information relating to all aspects of Clean Development Mechanism which include creating databases on organizations designated for carrying out activities like validation of CDM project proposals and monitoring and verification of project activities, and to collect, compile and publish technical and statistical data relating to CDM initiatives in India.

The Member-Secretary of the National Clean Development Mechanism (CDM) Authority is responsible for day-to-day activities of the Authority including constituting committees or sub-groups to coordinate and examine the proposals or to get detailed examination of the project proposals.

The National Clean Development Mechanism (CDM) Authority has the powers:

(a) to invite officials and experts from Government, financial institutions, consultancy organizations, non-governmental organizations, civil society, legal profession, industry and commerce, as it may deem necessary for technical and professional inputs and may co-opt other members depending upon need.

(b) to interact with concerned authorities, institutions, individual stakeholders for matters relating to CDM.

(c) to take up any environmental issues pertaining to CDM or Sustainable Development projects as may be referred to it by the Central Government, and

(d) to recommend guidelines to the Central Government for consideration of projects and principles to be followed for according host country approval.

CDM Glossary

Additionality: Under the Kyoto Protocol, only projects that 'would not occur except for CDM' would qualify for credits under Kyoto protocol. A project has to be 'additional' in order to qualify as a CDM project. This means that any project activity with the possibility of being implemented without the 'CDM' provisions would not be accounted for as 'additional'.

"An afforestation or reforestation project activity is additional if the net enhancement of sinks is higher than those that would have occurred in the absence of the registered CDM project activity, and if the project activity itself is not a likely baseline scenario".

Afforestation: "Afforestation" is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources.

Baseline and Baseline Scenario: The baseline represents the forecast emissions of a company, business unit or project, using a 'business as usual scenario', often referred to as the 'baseline scenario'.

Carbon market: The carbon market is a term that refers to " loose collection of diverse transactions where emission reductions are exchanged".

Carbon sequestration: The process of removing additional carbon from the atmosphere and depositing it in other "reservoirs," principally through changes in land use. In practical terms, carbon sequestration occurs mostly through the expansion of forests.

CDM Executive Board (EB): The CDM Executive Board was founded at COP7 in 2001, its aim being to supervise the Clean Development Mechanism, under the authority and guidance of the COP. The COP named 10 members and 10 alternates to the CDM Executive board. The CDM Executive Board is authorized to approve methodologies for baselines, monitoring plans and project boundaries, accredit operational entities and develop and maintain the CDM registry.

CER (Certified Emission Reduction): A unit equal to one metric tonne of carbon dioxide equivalent that may be used by Annex I countries towards meeting their binding emission reduction and limitation commitments under the Kyoto Protocol.

Clean Development Mechanism (CDM): The CDM is a flexibility mechanism established by Article 12 of the Kyoto Protocol for project-based emission reduction activities in developing countries. The CDM is designed to meet two main objectives: to address the sustainable development needs of the host country, and to increase the opportunities available to Annex I Parties to meet their reduction commitments for GHGs.

Crediting period fixed (also fixed crediting period): "Fixed Crediting Period" is one of two options for determining the length of a crediting period. In the case of this option, the length and starting date of the period is determined once for a project activity with no possibility of renewal or extension once the project activity has been registered. The length of the period can be a maximum of 30 yrs for a proposed CDM A/R project activity.

Crediting period renewable (also renewable crediting period): "Renewable crediting period" is one of two options for determining the length of a crediting period. For A/R projects, a single crediting period may be of a maximum of 20 years. The crediting period may be renewed at most two times (maximum 60 years), provided that, for each renewal, a designated operational entity determines that the original project baseline is still valid or has been updated taking account of new data, where applicable.

Greenhouse Gases (GHGs): The greenhouse gases in most contexts are the six gases regulated under the Kyoto Protocol, determined to be the main contributors to the Greenhouse Effect. The three basic gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O). In addition to these three GHG's, there are other gases which occur on a very limited basis in nature: Hydrofluorocarbons (HFC's), Perfluorocarbons (PFC's), Sulphur Hexofluoride (SF_6).

Kyoto Protocol: The Protocol to the UNFCCC signed at the third COP meeting in Kyoto in 1997, establishing binding commitments on Annex I countries Greenhouse Gas emission reduction targets of 5.2% below 1990 levels by 2008-2012. The Kyoto protocol was ratified and entered into force on 16th February 2005 when Russia ratified the protocol.

Land use, land-use change, and forestry (LULUCF): Refers to the impact of land use by humans and changes in such land use on greenhouse-gas emissions: expanding forests reduces atmospheric carbon dioxide; deforestation releases additional carbon dioxide; various agricultural activities may add to atmospheric levels of methane and nitrous oxide

Leakage: Leakage for A/R projects activities is the increase in GHG emissions by sources which occurs outside the boundary of A/R project activity under CDM and which is measurable and directly attributable to the A/R, CDM project activity. Net Anthropogenic removal of GHG by sinks is the actual net GHG removal by sinks minus the baseline net GHG removals by sinks minus Leakage.

Marrakech Accords: Agreements reached at COP-7, which set various rules for "operating" the more complex provisions of the Kyoto Protocol. Among other things, the accords include details for establishing a greenhouse-gas emissions trading system; implementing and monitoring the Protocol's Clean Development Mechanism; and setting up and operating three funds to support efforts to adapt to climate change.

Reforestation: "Reforestation" is 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 that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.

Sinks: Carbon "sinks" refers to the removal of greenhouse gases (GHGs) from the atmosphere through land management and forestry activities that may be subtracted from a countries allowable level of emissions.

Stakeholders: Stakeholders mean the public, including individuals, groups or communities affected, or likely to be affected, by the proposed CDM project activity or actions leading to the implementation of such an activity. For any CDM project stakeholder consultation and participation in the course of development of the PDD validation and the project activity is a mandatory requirement as per decision 17/CP.7.

Sustainable development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Transaction costs: Transaction costs are those that arise from initiating and completing transactions to secure CERs. These consist of pre operational costs (i.e, costs spread out over entire crediting period and trading costs.)

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About ICFRE

Indian Council of Forestry Research and Education (ICFRE) an autonomous body of the Ministry of Environment and Forests, Government of India, is the apex organisation in the national forestry research system, has been undertaking the holistic development of forestry research through need based planning, promoting, conducting and coordinating research, education and extension covering all aspects of forestry. The Council deals with the solution based forestry research in tune with the emerging issues in the sector, including global concerns such as climate change, conservation of biological diversity, combating desertification and sustainable management and development of resources. ICFRE has eight Regional Research Institutes and four Research Centres located in different bio-geographical regions of the country to cater the forestry research needs of the nation.

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