PREPERATION OF PROTOCOLS FOR AVAILING CARBON FINACE FOR FORESTS OF KERALA

Project No.627.4/11

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Abbreviations

AR or A/R –Afforestation/Reforestation

AFOLU- Agriculture, Forestry and other Land Use

AGB-Above Ground Biomass

BGB-Belowground Biomass

CDM- Clean Development Mechanism

CDM-AR or AR-CDM- Clean Development Mechanism Afforestation or Reforestation

CERs- Certified Emission Reductions

COP- Conference of the Parties

EUETS- European Union Emission Trading Scheme

ERU- Emission Reduction Unit

GHG-Green House Gas

GPP- Gross Primary Production

IFM- Improved Forest Management

IPCC-Intergovernmental panel on climate change

KYP- Kyoto Protocol

LULUCF-Land Use Land Use Change and Forestry

lCER- long term CER

$MtCO_2e$ – Million metric tons of CO_2 equivalent

MDF- Moderately Dense Forest

NPP- Net Primary Production

OF-Open Forest

REDD- Reduction of Emissions from Deforestation and Forest Degradation

SOM-Soil Organic Matter

UNFCCC- United Nations Framework Convention on Climate Change

UNCED- United Nations Conference on Environment and Development

UNEP-United Nations Environmental Programme

VCS- Voluntary Carbon Standard

VER-Voluntary or Verified Carbon Emission

VDF-Very Dense Forest

VERs- Verified Emission Reductions

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1. INTRODUCTION

Unequivocal scientific evidence shows that, since the industrial revolution, the burning of fossil fuels and the destruction of forests have caused the concentrations of heat-trapping greenhouse gases to increase significantly in our atmosphere, at a speed and magnitude much greater than natural fluctuations would dictate (IPCC, 2007a). If concentrations of greenhouse gases in the atmosphere continue to increase, the average temperature at the Earth's surface could grow from 1.8 to 4 ºC above 2000 levels by the end of this century (IPCC, 2007a). Impacts of climate change, many of which are already being seen, include temperature increase, sea level rise, melting of glaciers and sea ice, increased coral bleaching, changes in the location of suitable habitat for plants and animals, more intense droughts, hurricanes and other extreme weather events, increased wildfire risk, and increased damage from floods and storms. People living in marginal, poverty-stricken areas are most at risk for being severely and negatively impacted by climate change, as their livelihoods are closely tied to ecosystems which provide water for drinking, wildlife for hunting, fishing and medicinal plants (African Development Bank, 2003). Protecting forests can both mitigate climate change and protect the ecosystem services people depend on. The role of forests in the carbon cycle as trees absorb carbon dioxide from the atmosphere during photosynthesis and, in the process of growing, transform it to the solid carbon that makes up their bark, wood, leaves and roots. When trees are cut down and burned or left to decompose, the solid carbon chemically changes back to carbon dioxide gas and returns to the atmosphere. In the case of timber harvesting, only a fraction of the harvested trees make it into long-term wood products such as houses, chairs and tables. For example, one study estimates that for every tree harvested using conventional logging techniques in Amazonia, 35.8 additional trees were damaged (Gerwing, et al., 1996). As much as 20 percent of usable timber volume that was extracted from a typical hectare was never removed and instead left to rot in the forest. Furthermore, less than 35 percent of the timber that made it to the sawmill was actually converted into usable boards. Hence, the majority of the forest vegetation ends up as waste, and whether burned or left to decay, emits carbon dioxide gas as it breaks down (The Nature Conservancy, 2010). It is estimated that forests and other terrestrial systems annually absorb approximately 2.6 gigatons of carbon (GtC), or 9.53 gigatons of carbon dioxide equivalent ($GtCO_2e$), while deforestation and degradation of forests emit approximately 1.6GtC (5.87$GtCO_2e$), for net absorption of 1GtC (3.67 $GtCO_2e$) (IPCC, 2007b). Forests therefore play an important role in carbon cycle.

The global carbon cycle act as both a “sink” and a “source” (emitting carbon dioxide). The 1.6GtC emitted by deforestation and degradation of forests accounts for 17.4 percent of total emissions from all sectors, more than the emissions of the entire global transportation sector (IPCC, 2007c). Thus, policy and economic incentives to curb deforestation and forest damage have the potential to enhance the natural functioning of the world’s forests in sequestering, or storing, carbon and to reduce their role as a source of emissions.

1.1 Climate change and forest degradation

While deforestation refers to the entire loss of patches of forest through clearing and conversion to other land uses (e.g., farming, ranching and development), forest degradation refers to the loss of biomass (living vegetation) in forests through timber harvest, fuel wood gathering, fire and other activities which do not result in complete conversion to other land uses. In its classification of “forest”, the Intergovernmental Panel on Climate Change (IPCC) uses a minimum crown cover of 10 percent. Thus, by this definition, up to 90 percent of a forest can be cleared before it is considered deforested. As such, forest degradation can lead to substantial carbon emissions, and is often an important precursor to deforestation. Also, openings in the forest canopy caused by forest degradation increase the risk of forest fire, which in turn increases the risk of conversion of land to pasture for grazing and ultimately conversion for agriculture (Griscom, et al., 2009). The IPCC estimates that of the 17.4 percent of emissions from forestry, approximately 2.2 percent are a result of tropical forest degradation (from logging alone). The estimate, however, appears to substantially underestimate emissions from logging and does not consider other forms of degradation such as fuelwood harvest and fire, which depending on location can significantly add to emissions (Putz, et al., 2008).

The Kyoto Protocol, the first specific commitment to protect the shared resource of the climate system, was negotiated in 1997 and set binding targets for 37 industrialized countries and the European Community ("Annex I" countries) to reduce greenhouse gas emissions an average of five percent below1990 emissions levels over the first five-year commitment period (2008 to 2012). All other countries, or "Non-Annex I" countries, mainly developing nations are not currently bound to emission reduction targets. The United States did not ratify the Kyoto Protocol, thus is not bound by these targets. The Clean Development Mechanism (CDM) was created as a part of the Kyoto Protocol to help Annex I countries meet their emissions targets, and to encourage the private sector and developing countries to contribute to emissions reduction efforts. The CDM allows emissions removal projects in developing countries to earn certified emissions reduction credits, which can be traded and sold, and used by industrialized countries to meet a part of their targets under the Kyoto Protocol. In the forest sector, the CDM only allows for emissions reductions through afforestation/reforestation (AR), and it does not include activities aimed at Reducing Emissions from Deforestation and Degradation (REDD) and Improved Forest Management (IFM). The CDM rules governing AR activities are extremely complex and, thus far, only very few projects have been registered, under CDM.

In 2005, The Coalition of Rainforest Nations, led by Papua New Guinea and Costa Rica, put forth a proposal to reconsider including REDD under the UNFCCC and subsequent protocols. Since then, the push for REDD inclusion has picked up momentum. The 2007 UNFCCC meeting in Bali resulted in the creation of the "Bali Roadmap," an agreement to negotiate a new post-2012 climate change protocol by the December 2009 UNFCCC meeting in Copenhagen, which contained a commitment to include REDD but it took extensive discussions and debates to came in to an agreement, finally in 2013 at Warsaw the participating nations agreed for REDD+ mechanisms.

1.2 Carbon emission trading

There are various financial mechanisms which could fund forest carbon activities, both public and private, ranging from upfront grants or other payments for forest conservation to ex-post purchase of carbon credits from forest carbon projects within a "carbon market." Various carbon markets—some regulatory (e.g., CDM, European Union Emission Trading Scheme (EU ETS), New South Wales and RGGI) and others voluntary (e.g., Chicago Climate Exchange)—have developed to facilitate the trading of emissions allowances or credits for emissions reductions. Currently, only voluntary markets allow offsets from all three types of forest carbon projects (AR, REDD and IFM). Functioning voluntary markets are demonstrating that there is demand for emissions reductions generated from forest carbon activities, with a total market value of $705 million in 2008 and ten percent of the transaction volume coming from projects in the forest sector (Hamilton, et al., 2009). Many of the challenges associated with measuring, monitoring and accounting for emissions reductions from forest carbon activities can be addressed with approaches that have been applied to projects developed for voluntary markets (The Nature Conservancy, 2010). Official registries for these reductions assure that such credits are unique and traceable. Some compliance markets, such as the CDM and RGGI, allow for AR activities, but others, such as the EU ETS, exclude forest carbon entirely. Not all countries support the use of markets to fund emissions reductions from the forest sector and instead prefer the use of public funding.

Types of forest carbon activities Reducing Emissions from Deforestation and Degradation (REDD), Improved Forest Management (IFM), and Afforestation/Reforestation (AR), are the three types of actions most often referred to collectively as “forest carbon activities” and each of which, if designed properly, can produce real, measurable and verifiable carbon benefits. These activities can be used alone in single projects or in combination for a larger-scale overall strategy to help mitigate climate change.

The forestry sector accounts for more than 17% of total global greenhouse gas (GHG) emissions (IPCC, 2007d). Small-scale forestry is increasing in developed countries (Zhang et al., 2009), and forest industries are seen as having the potential, with effective management, to operate as a net sink for carbon (Palm et al., 2009; Parks et al., 1997; Pearce et al., 2003). Schlamadinger and Johns (2007) asserted that A/R projects have the most potential in developing countries due to the higher growth rates of tropical forests, the availability of land, and synergies with the need for future biomass. There has been criticism of offset projects at a fundamental level as allowing developed countries a cheap way to avoid reducing emissions (Bullock et al., 2009). In response to these concerns the CDM sets a cap on an industrialized country’s inclusion of CDM A/R CERs in its emissions accounting of 1% of the country’s base year emissions (Hendrick and Black, 2007).

With regards to the emission trading schemes progress across the globe is steady. A total of eight new carbon markets opened their doors in 2013 alone (World Bank, 2014). With these new joiners world’s emission trading schemes are worth about US$30 billion excluding the Kyoto emission trading and it is notable that China, one of the world’s largest emitter now houses the second largest carbon market in the world covering 1,115 megatons of carbon dioxide equivalent ($MtCO_2e$), after the EU ETS with its 2,084 $MtCO_2e$ cap in 2013(World Bank, 2014).

2. HISTORY OF CLIMATE CHANGE AND CARBON FINANCE

The high-accuracy measurements of atmospheric CO_2 concentration, initiated by Charles David Keeling in 1958, constitute the master time series documenting the changing composition of the atmosphere (Keeling, 1958, 1961). These data have iconic status in climate change science as evidence of the effect of human activities on the chemical composition of the global atmosphere. Keeling's measurements on Mauna Loa in Hawaii provide a true measure of the global carbon cycle, an effectively continuous record of the burning of fossil fuel. They also maintain an accuracy and precision that allow scientists to separate fossil fuel emissions from those due to the natural annual cycle of the biosphere, demonstrating a long-term change in the seasonal exchange of CO_2 between the atmosphere, biosphere and ocean. Later observations of parallel trends in the atmospheric abundances of the $13CO_2$ isotope (Francey and Farquhar, 1982) and molecular oxygen (Keeling and Shertz, 1992) uniquely identified this rise in CO_2 with fossil fuel burning.

`Global warming induced by climate change has widespread economic consequences in human life mainly in developing countries or tropical regions (Kelman and Jennifer, 2009). The people living in developing countries either do not have resources to combat climate change or are not aware of its adverse ecological and economic impacts despite climate change being an inevitable truth that will affect their life physically and economically (Stern, 2007). If appropriate strategies to combat climate change are implemented adequately, then the impacts of global warming can be reduced. Many models have been developed to predict the impacts of climatechange.

India is home to many forest ecosystems containing a variety of exclusive flora and fauna, which are great sources of products and services for the Indian population. These products are in danger as a result of the change in ecosystem induced by global warming. Thus India with a population of over a billion is highly vulnerable to the climate change impacts. If the cost associated with climate change is concerned the industrialized nations will owe more than $600 billion to the developing nations for disturbing the balance of nature and forcing them to invest heavily to mitigate the adverse effects of climate change. This amount is three times the conventional debt that the developing countries owe to the developed ones. However, this debt should be considered as an obligation of the developed countries towards the developing countries. The developed countries should now pay for their uncurbed exploitation of natural resources so far and for polluting the atmosphere, a universal resource in the past (Simms et al., 1999). The west can contribute to the East and South through less energy intensive technologies and by facilitating the adoption of the Clean Development Mechanism (CDM) with equity considerations.

2.1 The history of climate change negotiations

In 1988, the United Nations Environmental Programme (UNEP) and the World Meteorological Organization (WMO) established the Intergovernmental Panel on Climate Change (IPCC) to synthesize all climate change-related research and provide a scientific review of the current state of climate knowledge. The first IPCC Assessment Report, published in 1990, inspired the international community to develop an international political platform to coordinate their response to the issue. The United Nations Framework Convention on Climate Change (UNFCCC) was subsequently developed to provide such a platform.

The UNFCCC was negotiated between February 1991 and May 1992 to address the need for joint action to combat climate change. The Convention was opened for signature during the

United Nations Conference on Environment and Development (UNCED) (also called the Rio Earth Summit) in June 1992. On 21 March 1994, shortly after the 50th instrument for approval (known as ratification) had been received, the UNFCCC entered into force. To date, 195 countries have ratified the Convention. These countries are referred to as the "Parties" to the Convention. The ultimate aim of the Convention is to "stabilize GHG concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system." The Convention also provides that "such a level [of GHG concentrations] should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner."

In order to attain this objective, the convention provides for the creations of various bodies. The "supreme body" of the convention–its highest decision making authority is the conference of the parties (COP). The COP is an association of all the countries that are parties to the convention. The COP is assisted by two subsidiary bodies. The Subsidiary Body on Scientific and Technological Advice (SBSTA) links scientific, technical and technological assessments, the information provided by competent international bodies, and the policy-oriented needs of the COP. The Subsidiary Body for Implementation (SBI) was created to develop recommendations to assist the COP in reviewing and assessing implementation of the Convention and in preparing and implementing its decisions.

Parties realized that in order to address the actions that drive climate change, concrete commitments were required from participating countries, and this led to the negotiation of a protocol beginning in 1995. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997. It commits industrialized countries to stabilize GHGs, according to the levels agreed to in the Protocol, instead of simply encouraging them to do so, as the Convention does. This agreement represented the first time that binding emission reductions targets were set for 37 industrialized countries. The Kyoto Protocol's "first commitment period" covered the period of 2008-2012. During these four years, the 37 countries were to reduce their GHG emissions by an average of 5% compared with their GHG emission levels in 1990. The Kyoto Protocol focuses on developed countries, because there was recognition that they were to be held "historically responsible" for the increase in GHGs. Developing countries were not bound by specific emission reduction targets through the Kyoto Protocol. Developed countries, as well as countries in transition to a market economy, are known as Annex I Parties under the UNFCCC. In order to enter into force, the Protocol needed ratification by at least 55 Parties, and those Parties needed to account for at least 55% of global carbon dioxide emissions in 1990. This threshold was reached at the end of 2004, and the Protocol became a legally-binding instrument on 16 February 2005.

During the period between the adoption of the Kyoto Protocol and its entry into force, the Buenos Aires Plan of Action, which was agreed in November 1998 at the fourth meeting of the Conference of the Parties (COP 4), defined the process for finalizing the rules and operational details of the Protocol. At COP 7 in Marrakesh, Morocco, in November 2001, delegates reached agreement on outstanding matters in the Marrakesh Accords. These Accords consisted of a package of draft decisions on many of the details of the Kyoto Protocol, including the flexible mechanisms, reporting and methodologies, land use, land-use change and forestry (LULUCF), and compliance. The Marrakesh Accords also addressed issues such as capacity building, technology transfer, responding to the adverse effects of climate change, and the establishment of three funds: the Least Developed Countries Fund (LDCF), Special Climate Change Fund (SCCF), and the Adaptation Fund.

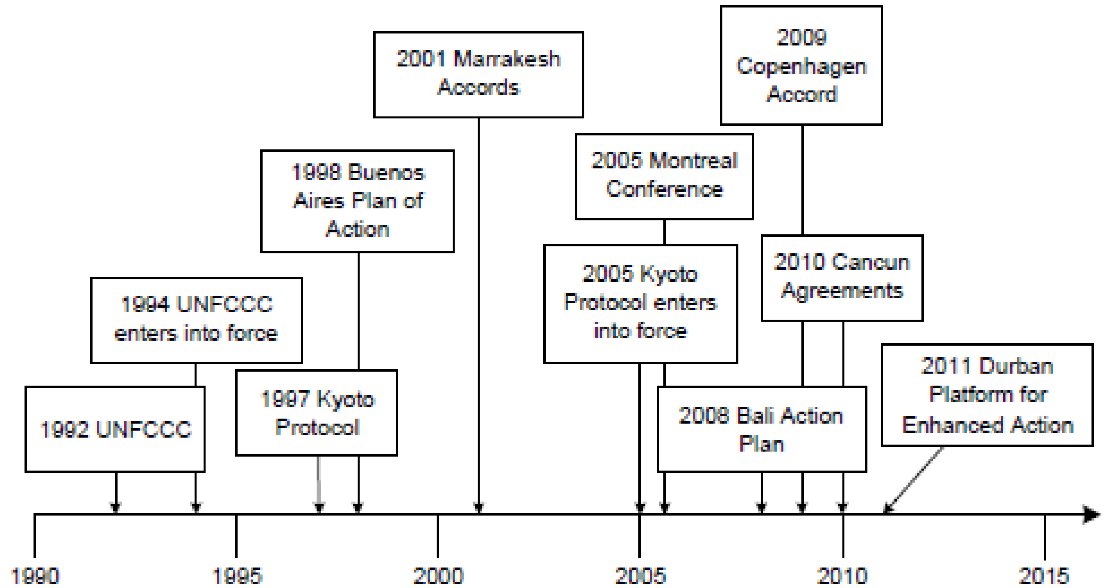


Fig1. Major events and dates of the climate change negotiations

Since the Kyoto Protocol entered in to force, countries who signed the Agreement and observing countries have gathered each year during the COP for formal discussions on implementing the Protocol, in what is called the Meeting of the Parties (MOP) to the Kyoto Protocol. In December 2005, at COP 11 in Montreal, Canada, MOP 1 convened. Delegates began to address the post-2012 period (when the first commitment period in the Kyoto Protocol would expire) and established a new subsidiary body, the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP). At COP 11, delegates established a "Dialogue on Long-term Cooperative Action to Address Climate Change by Enhancing Implementation of the Convention." Both the Dialogue and the AWG aimed to address potential future climate change agreements— respectively under the UNFCCC (which would include non-Parties to the Kyoto Protocol, such as the United States) and under the Kyoto Protocol.

Two years later, at the UN Climate Change Conference in Bali in December 2007, delegates adopted a “roadmap” to initiate a new negotiating process. The Bali Action Plan aims at long-term cooperative action beyond 2012, and includes the establishment of a subsidiary body under the UNFCCC, the Ad Hoc Working Group on Long-term Cooperative Action (AWG-LCA), which replaced the “Dialogue.” The focus of its work was to devise strategies to implement the five categories of the Bali Action Plan: shared vision, mitigation, adaptation, technology and financing. The goal was to finish these negotiations in time for the 2009 Copenhagen Climate Change Conference, so that a successor agreement to the Kyoto Protocol could enter into force by the end of the first commitment period in 2012.

The UN Climate Change Conference in Copenhagen, Denmark, took place in December 2009. Approximately 120 Heads of State and Government attended this high profile event, but it was marked by disputes over transparency and process. During the high-level segment, informal negotiations among the Heads of State and Government from many of the major industrialized countries and representatives of regional and other negotiating groups resulted in a political agreement, the “Copenhagen Accord,” which was then presented to the COP plenary for adoption. After 13 hours of debate, delegates ultimately agreed to “take note” of the Copenhagen Accord, which meant it was not legally binding.

The Copenhagen Accord called for Parties to identify their country’s pledge to take action. In 2010, over 140 countries indicated support for the accord and more than 80 countries also provided information on their national mitigation targets or actions. However, no agreement was reached on Copenhagen on long term goals beyond 2012. Therefore, parties agried to extend the mandates of the AWG-LCA and AWG-KP for another year.

In 2010 in Cancun, Mexico, the COP adopted the Cancun Agreements, which included key steps forward in mitigation, adaptation, transparency of actions, technology development, mobilization of finance, actions to protect forests, and building capacity globally. Parties recognized the need for deep cuts in global emissions in order to limit global average temperature rise to $2^{o}C$ and keep the global long-term goal under regular review.

Most recently, in Durban, South Africa, in November 2011, Parties to the Kyoto Protocol agreed on a second commitment period of the Protocol, to begin in 2013. Delegates agreed that a new agreement with legal force involving the efforts of all countries under the Convention would be finalized by 2015, and enter into force by 2020. Parties also agreed to launch the new Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) with a mandate "to develop a protocol, another legal instrument or an agreed outcome with legal force under the Convention applicable to all Parties." The new negotiating process, which began in May 2012, is scheduled to end by 2015. The outcome is expected to enter into force and be implemented from 2020 onwards.

2.1.2 Post agreement negotiations

Current international negotiations on climate change are an example of post agreement negotiation. Countries disagree on a splendid variety of contentious issues (Dimitrov, 2010). One disagreement pertains to the legal architecture of the future climate policy regime: whether to extend the Kyoto Protocol that places the onus on industrialized countries or create a new global agreement with obligations for all major emitters- or both. In addition, the method of determining national targets for emission reduction is disputed. The European Union and the Alliance of Small Island advocated a classic “top-down approach” of determining global targets based on science based goals. Others such as Australia the USA and China fought for a bottom-up approach allowing every country to determine its national goals regardless of global environmental results. Other key debate pertain to obligations for developing countries level and mechanisms of international funding for climate policy in poor countries the role of agriculture and forestry in calculating emission levels (LULUCF); the transfer of environmentally friendly technologies and the creation of an adaptation framework.

Twenty rounds of formal negotiations occurred in the four years between Bali and Durban (December, 2011). In a historic breakthrough , the Cancun agreements of 2010 established for the first time an official global goal of limiting temperature rise to below 2^{o}C, and stipulated that developing countries will take nationally appropriate mitigation actions. The deal also included a principled agreement to establish a Global Adaptation Framework; an international registry for developing country policies and a Green Climate Fund to provide up to US$ 100 billion per year for climate policy by 2020.

The negotiations suffered a major blow at Durban 2011. After two weeks of discussions, including three days of intense high-level talks between environment ministers, states decided to postpone a globally binding climate treaty for at least nine years. Only three countries openly supported this outcome (Australia, Canada and the United States), while others accepted it exchange for a continuation of Kyoto Protocol. The EU privately considered boycotting the conference and island nations described the outcome as a form of hara-kiri that places entire nations on death row. The collective decision is to continue negotiations with a new deadline of

2015 for finalizing an agreement for after 2020. This constituted an open admission that the Bali mandate had failed and turned the famed post 2012 policy in to a post 2020 possibility. A second major decision was to extend the Kyoto Protocol, with a second commitment period. Analysts points two stipulations weaken Kyoto 2: first, the duration of the new commitment period will be decided at a later unspecified date (five or eight years, until 2017 or 2020). Second, Kyoto 2 relies on voluntary national commitments to be determined by countries domestically. The text merely invites countries to report internationally their policy goals. Thus, the original Kyoto Protocol with its binding absolute emission reductions was replaced by a bottom-up approach and voluntary goals, without even obliging countries to communicate those goals internationally. Today the global negotiations have been placed on hold and prospects for change over the next several years are seems to be bleak.

2.1.3 Beyond multilateral climate governance

Traditionally, the multilateral treaty-making process overseen by the UN has been equated with climate governance. Most studies of climate politics are concerned with the negotiation, impact and effectiveness of this process and center their analyses on the development of major agreement- the United Framework Convention for Climate Change (UNFCCC, 1992), the Kyoto Protocol and the more recent attempts to move beyond Kyoto with the Copenhagen Accord (2009) and Durban Agreements (2011). Most public international effort has been directed in to this multilateral process as well. Essentially the, UN process has been climate governance, for good or bad, for the last 25 years.

Nevertheless the UN process could not produce an effective response to climate change. The future of multilateral negotiations also appears dim given the disappointing outcome of the recent negotiations. Yet far from lacking a response to climate change as the UN process has floundered. More recently, a new system of transnational governance has emerged to address climate change (Andonova et al., 2009; Hoffmann, 2011; Abot, 2012; Bulkeley et al., 2012). This decentralized approach to climate governance engages multiple actors at multiple levels and is only loosely connected to the multilateral process. Global networks of cities are working to alter municipal economies, transportation systems and energy use. Corporations are forming alliance with environmental NGOs to devise large and small ways to deliver climate friendly technology and move towards a low carbon economy. States, provinces, environmental organizations and corporations are engaged in developing carbon markets that promise low cost means of reducing emissions. These transnational governance experiments are shaping how individuals, communities, cities, countries, province, regions, corporations and nation states respond to climate change.

3. FORESTRY AND CLIMATE CHANGE

In the terrestrial system, carbon is sequestered in rocks and sediments, in swamps, wetlands and forests, and in the soils of forests, grasslands and agriculture. About two-thirds of the globe's terrestrial carbon, exclusive of that sequestered in rocks and sediments, is sequestered in the standing forests, forest under-storey plants, leaf and forest debris, and in forest soils. In addition, there are some non-natural stocks. For example, long-lived wood products and waste dumps constitute a separate human-created carbon stock. Given increased global timber harvests and manufactured wood products over the past several decades, these carbon stocks are likely increasing as the carbon sequestered in long lived wood products and waste dumps is probably expanding. A stock that is taking-up carbon is called a "sink" and one that is releasing carbon is called a "source." Shifts or flows of carbon over time from one stock to another, for example, from the atmosphere to the forest, are viewed as carbon "fluxes." Over time, carbon may be transferred from one stock to another. Fossil fuel burning, for example, shifts carbon from fossil fuel deposits to the atmospheric stock. Physical processes also gradually convert some atmospheric carbon into the ocean stock. Biological growth involves the shifting of carbon from one stock to another. Plants fix atmospheric carbon in cell tissues as they grow, thereby transforming carbon from the atmosphere to the biotic system. The amount of carbon stored in any stock may be large, even as the changes in that stock, fluxes, are small or zero. An old-growth forest, which is experiencing little net growth, would have this property. Also, the stock may be small while the fluxes may be significant. Young fast-growing forests tend to be of this type. The potential for agricultural crops and grasses to act as a sink and sequester carbon appears to be limited, due to their short life and limited biomass accumulations.

A sink is defined as a process or an activity that removes greenhouse gases from the atmosphere. Carbon sequestration is the extraction of the atmospheric carbon dioxide and its storage in terrestrial ecosystems for a very long period of time - many thousands of years. Forests offer some potential to be managed as a sink, that is, to promote net carbon sequestration.

Table 1. Average carbon stocks for various biomes (t ha^{-1})

Biome	**Plants**	**soil**	**Total**
Tropical forest	54	55	109
Temperate forest	25	43	68
Boreal forest	29	153	182
Tundra	3	57	60
Croplands	1	36	37
Tropical Savannas	13	52	65
Temperate grasslands	3	105	108
Desert/Semi desert	1	19	20
Wetlands	19	287	306
Weighted Average	**14**	**59**	**73**

Source: IPCC

The role of forests in carbon sequestration is probably best understood and appears to offer the greatest near-term potential for human management as a sink. Unlike many plants and most crops, which have short lives or release much of their carbon at the end of each season, forest biomass accumulates carbon over decades and centuries. Furthermore, carbon accumulation potential in forests is large enough that forests offer the possibility of sequestering significant amounts of additional carbon in relatively short periods – decades. Fortuitously, forests managed for timber, wildlife or recreation sequesters carbon as a by-product. Forests may also be managed strictly to sequester carbon. Such a focus on biomass accumulation could provide a somewhat reduced amount of other forest ecosystem services such as biodiversity. However, if forests managed for carbon sequestration are allowed to mature and remain unharvested, one of the long term effects may be enhanced biodiversity. There are four components of carbon storage in a forest ecosystem. These are trees, plants growing on the forest floor (under-storey material), detritus such as leaf litter and other decaying matter on the forest floor, and forest soils. Carbon is sequestered in the process of plant growth as carbon is captured in plant cell formation and oxygen is released. As the forest biomass experiences growth, the carbon held captive in the forest stock increases. Simultaneously, plants grow on the forest floor and add to this carbon store. Over time, branches, leaves and other materials fall to the forest floor and may store carbon until they decompose. Additionally, forest soils may sequester some of the decomposing plant litter through root/soil interactions. Forest transitions from one ecologic al condition to another will produce substantial carbon flows –forests can be a carbon source or a sink. It is important to carefully assess exactly what is happening to the carbon as the forest changes to determine the forest's sink/source contribution. Net forest carbon may be released, thereby making the forest a source, due to biomass reductions from fire, tree decomposition, or logging, any of which will reduce the forest biomass. In the case of decomposition or fire, forest carbon is released into the atmosphere. Standing trees and the organic layer of forest soils are both significant carbon reservoirs. If the area under forest increases then the size of this reservoir also increases.

3.1 Policies for mitigating climate change through forestry

In December 1997 at the meeting of the UNFCCC in Kyoto, Japan agreed in principle to reduce emissions of GHGs. The Kyoto Protocol establishes the notion of a 'commitment period' during which net emissions are measured. Emissions between 2008 and 2012, the first commitment period, include direct emissions from fossil fuels, emissions of CFCs, nitrous oxide and CH_4 from agriculture and any net change in carbon reservoirs such a s forests. The latter can provide positive or negative. All these GHG emissions are converted to CO_2 equivalents because their influences on climate vary. Methane as previously mentioned is 23 times worse than CO_2 as a GHG and so pastoral farming has GHG emissions despite being mostly carbon neutral because it converts CO_2 to CH_4. A nation that increases its carbon storage in forests during a commitment period can use this to calculate a reduction in net emissions while another that reduced its forest store of C would increase its emissions during the commitment period.

Annex I countries can attempt to limit their emissions by investing in emission reduction projects in non-Annex I countries through 'clean development mechanism'. Annex I countries were given carbon credits known as Assigned Amount Units (AAUs) equivalent to their agreed emission targets in tonnes of CO_2-e. If they exceeded their emission targets, then they would need to purchase credits and their net emission was less than their targets, then they would have AAU to sell. The CDM allowed them to earn credits by reducing emissions or by developing in non-polluting ways that involved additional expenditure.

Emission trading has resulted in a bewildering array of carbon credits. The following are credits important for forestry sector recognized by the Kyoto Protocol:

RMU: Removal Units are emission allowances that are generated in addition to AAUs as a result of an increase in national carbon sinks. RMUs expire at the end of a commitment period.

ERU: Emission Reduction Units are created by projects in industrialized countries that are considered to be additional; i.e. they involve extra expenditure to establish non-polluting substitutes for polluting processes. They are generated when one annex I country creates emission reductions in another annex I country

CER: Certified Emission Reductions are credits derived from CDM projects

In developing nations CERs have the potential to undermine emission trading schemes by inflating carbon credit currency; CERs cause credit inflation because there is no requirement for emitters to account for their emissions RMUs on the other hand, represent real reductions in atmospheric GHGs, but strangely they are often regarded as lesser credits compared with ERUs or CERs (Euan et al., 2013).There is a general perception that forest establishment is only a temporary solution and that the value of the credits is somehow lost. If forest based credits are measured and accounted for so that people awarded credits need to repay them when their forest becomes an emission source.

Developing nations can seek reward for reduction in deforestation via the REDD+ mechanism agreed through the United Nations. This programme aims to attach a value to carbon storage and could see large amounts of money flow from developed nations to developing ones in return for reductions in rates of deforestation and forest degradation. The programme requires verification of emission reductions and rewards might be made via carbon credits or through direct financial payments.

Given a high enough credit price in a nation's GHG emission trading scheme and also the provision for awarding credits for sequestration by forests., carbon trading can change the value of forest investments. For instance the New Zealand scheme (IETA, 2013) allows owners of forests established after 1989 to claim credits for sequestration earned after 2008, but these credits must be repaid if carbon stocks fall below what has been claimed when forests are harvested. In this scheme the benefit for forest owners arises from changes in annual cash flows within a forest investment. A typical plantation forestry investment involves large costs for establishment, overheads and tending through the rotation with one very large revenue stream at the end of a rotation. Carbon cash flows are the reverse of this pattern, with revenue stream from carbon credits throughout the rotation and then a large carbon credit cost at the time the large harvest revenue is received.

3.2 Forestry and CDM projects

Forests act as a carbon sink and assist in reducing the carbon content in the atmosphere. However sequestration is regarded as temporary storage of CO_2 because cutting and burning of trees again releases the previously stored carbon. There are projects in the energy and other sectors where reduction in carbon emission can be permanently effective. Looking in to this non-permanent nature, only two types of forestry projects in land use, land-use change and forestry (LULUCF) are currently allowed under the Kyoto Protocol. Thus the Kyoto protocol provides lower priority to the intangible benefits of other forestry projects such as forest conservation and avoiding deforestation.

Despite forest being one of the most trusted allies of human beings forestry sector gets differential treatment. Forestry projects are capable of providing an integrated approach to both ecological and environmental restoration coupled with other co-benefits such as erosion prevention, watershed protection, enhanced biodiversity and provision of forest resources for local people. LULUCF projects can help in emission reduction in numerous ways, such as reduction in deforestation, reduction in fire risks or changes in forest harvesting. This shows that in the context of CDM LULUCF projects have an added value (ITTO, 2006). However in 2001, in the seventh COP in Marrakesh, Morocco it was decided that at least for the first commitment period, LULUCF projects under the CDM should be limited to afforestation and reforestation activities, which are defined as follows:

- “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 and seedling, and/or the human-induced promotion of natural seed sources (UNFCCC, 2003)

- "Reforestation" is the direct human induced conversion of non-forested land to forested land through planting and seedling, and/or the human induced promotion of natural seed source on land that was forested but 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 as on 31 December 1989

Land use, land-use change and forestry include afforestation and reforestation of degraded land and agroforestry, provided they meet the criteria set up by the CDMEB. AR-CDM project activities are subject to the specific modalities and procedures of the CDM, which were adopted in the COP9 in December 2003. The CDMEB has defined the following threshold values for the definition of forest; it has further authorized the host country to decide the adequate definition of the forest within its territory, to segregate the already existing forest area from the project boundary.

- Minimum crown cover: 10%-30%
- Minimum height at maturity of vegetation: 2-5m
- Minimum area: 0.05-1ha

Government of India has adopted the following definition of forest (CDM) for India (UNFCCC, 2008):

- Minimum crown cover: 15%
- Minimum height at maturity of vegetation: 2m
- Minimum area: 0.05ha

However, the information related to the state of vegetation since 1990 can be difficult to obtain due to the constraints related to the availability of historical land-cover data. Hence, the executive board clarifies for this situation that the proof of status of forest in 1990 could also be based on the following

- Aerial Photographs
- Ground-based surveys
- A participatory rural Appraisal, if the above two options are not available/ applicable

3.3 Classification of forestry projects based on scale

The afforestation and reforestation projects under CDM provide a wide scope for the integration of both environmental sustainability and socio-economic benefits to the communities by availing more livelihood opportunities ensured by additional income generated by the selling of CERs. These projects have also been classified in to two categories based on their size:

1. Small-scale afforestation and reforestation CDM project:

   A small scale afforestation and reforestation project activity is defined as an afforestation or reforestation measure, operation, or action targeting net removal of anthropogenic GHGs of less than 8 kilo tonnes (KT) of CO_2 per year. Generally, small-scale projects are developed or implemented by low income communities and individuals, as determined by the host party. These projects enjoy certain advantages such as use of simplified modalities and procedures, no adaptation tax, and reduced registration and administration fees. Afforestation and reforestation projects of 16KT CO_2 represent about 400-800ha for a typical forest project planting fast-growing species.

2. Large scale afforestation and reforestation CDM project:

   On the contrary, a large-scale afforestation and reforestation project activity under the CDM is defined as the measures targeting net anthropogenic GHG removal by sinks greater than 8KT CO_2 equivalents per year.

This classification of forestry projects is done to facilitate the smaller projects by giving them preferential treatment in many stages of project formulation.

3.4 Non-permanence nature

CERs issued under CDM projects are vulnerable to various problems such as fire, deforestation and natural disasters which make them temporal in nature. Therefore in discussions regarding the full inclusion of forestry project in to CDM the major bone of contention remains the risk of losing the sequestered carbon (ITTO, 2006). Consequently the parties agreed at COP9 that credits arising from afforestation and reforestation projects under the CDM would be temporary, but that they can be reissued or renewed (every five years) after an independent verification certifies that sufficient (equivalent to the issued CERs) carbon still sequestered within a project to account for all the credits issued.

3.5 Scope of forestry projects in Kyoto Protocol

LULUCF projects have been excluded from one of the biggest CDM markets, that is, European Union Emission Trading System, citing the uncertainty related to the non-permanence nature and leakages associated with forestry projects. This restriction has cost a great deal in terms of economic gains and motivation for individuals, communities and private players in developing forestry projects. Even under the Kyoto Protocol mechanism, the trading of afforestation and reforestation CDM related CERs restricted to only 1% of the total assigned amount per year of the first commitment year.

3.6 Crediting period

The crediting period for an afforestation and reforestation project activity under CDM is the period during which the net anthropogenic GHG removals by sinks are verified and certified by a DOE for issuing CERs. Project participants can choose between the following two options for the length of a crediting period (CIFOR, 2005):

1. Fixed crediting period

   It is a crediting period of a maximum of 30 years without the possibility of renewal or extension once the proposed afforestation and reforestation CDM project activity has been registered.

2. Renewable crediting period

   It is a crediting period of maximum 20 years which may be renewed up to two times (maximum 60 years) provided that, for each renewal, the DOE determines that the original project baseline is still valid or has been updated taking account of new data.

4. OVERVIEW OF FORESTS IN INDIA AND KERALA

India is one of the 17 mega-biodiversity countries in the world. The large area and the variety of bioclimatic conditions met within its different bio-geographical zones contribute to the great diversity of the Indian flora (Sinha, et al., 2010). Bio-geographical zones in India such as Trans Himalayan Region, Indian Desert, Semi-Arid, the Western Ghats, Deccan Peninsula, Gangetic Plains, North-East Region, Islands and Coasts are rich in genetic diversity of plant and animal life. Indian subcontinent forms the part of mega diversity hotspots of the world, occupying only 2.5% of the land area and accounting for 7.8% of the globally recorded species (Myers et al., 2000). In India, where deforestation rates have declined significantly since 1980s, climate change can be an important factor that determines the future forest biomass production. With a vast range of edaphic, climatic and physiographic conditions, forests in the country vary from evergreen tropical rain forests of Andaman & Nicobar Islands, the Western Ghats and the north-eastern States, semi evergreen rain forests, deciduous monsoon forests and thorn forests of the plains of western and central India, sub-tropical pine forests of the lower mountain zone, temperate montane forests to dry alpine scrub high of the Himalayan region. In the background that India has been implementing an aggressive afforestation movement under National Action Plan through Green India Mission and other social forestry programmes, it is imperative to formulate viable and efficient silvicultural management practices taking into consideration the impact of climate change.

4.1 Forest cover of India:

As per the latest report of the Forest Survey of India (ISFR, 2013) the total forest cover of India is 21.23% of the total geographical area. The forest cover of the country has

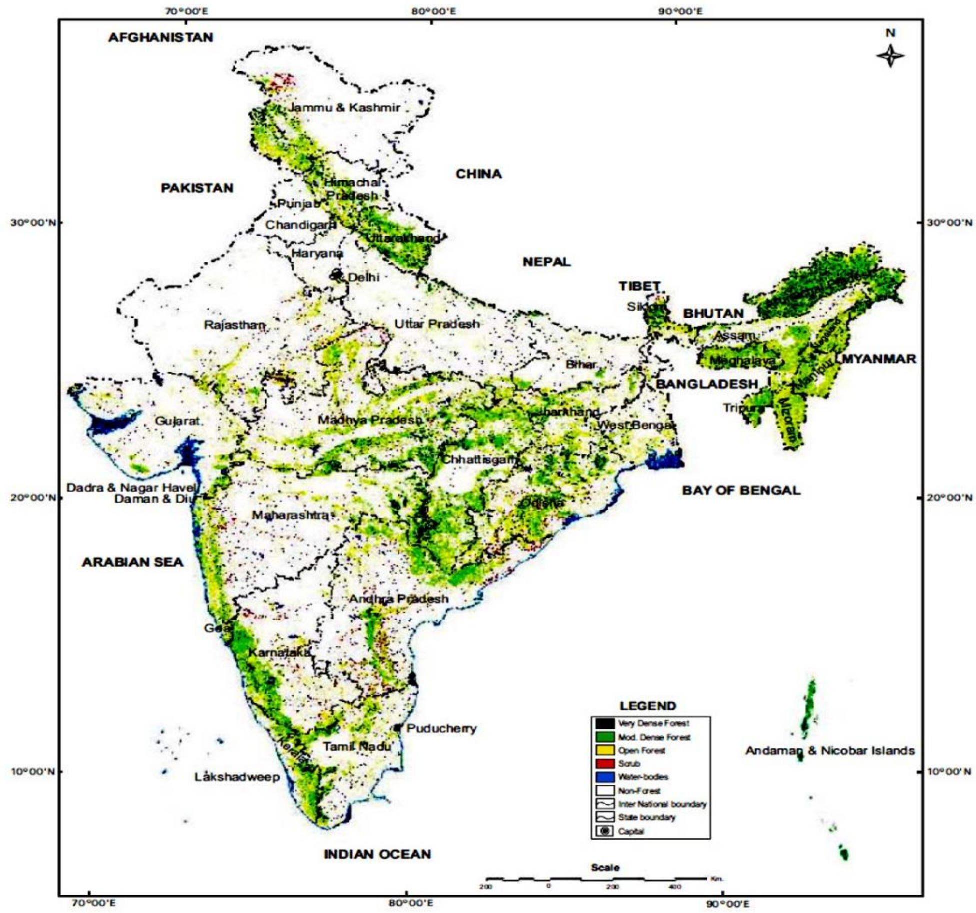


Fig 2. Forest cover map of India

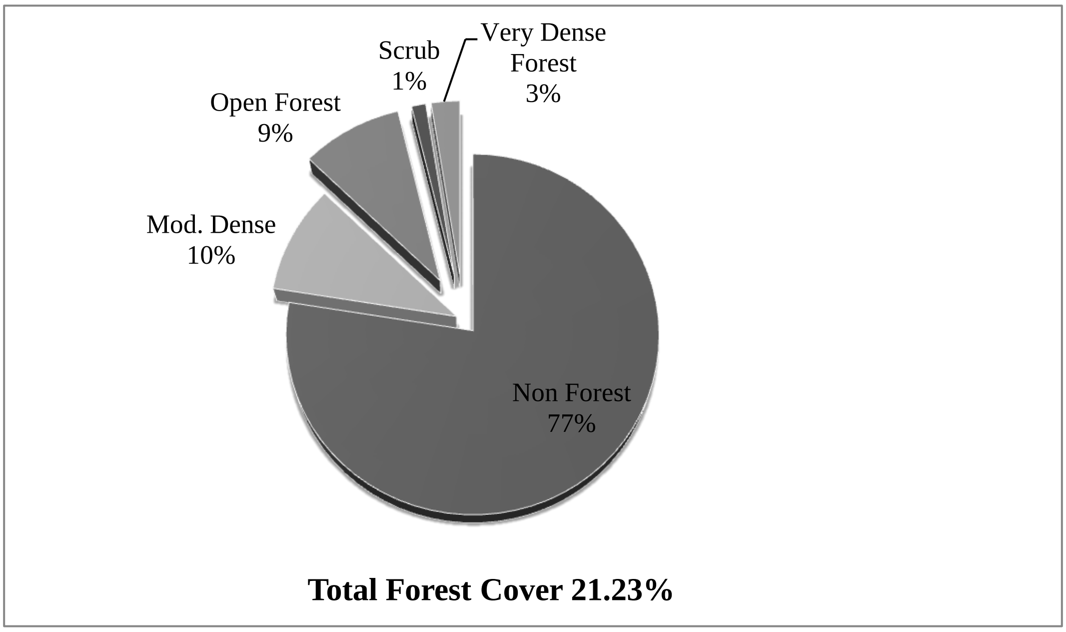
been classified on the basis of the canopy density in to pre-defined classes, viz. Very Dense Forest (VDF), Moderately Dense Forest (MDF) and Open Forest (OF). The country level forest cover is summarised in Table 1 and their proportion is depicted in a pie chart in Fig. 3. The area under VDF, MDF, and of includes mangrove cover of the corresponding density class.

As per the 2013 report, total forest cover of the country is 697,898sq km which works out as 21.23 percent of the total geographical area. In terms of density classes, area covered by VDF is 83,502sq km, that with MDF is 318,745sq km and OF is 295,651sq km. The VDF class constitutes 2.54percent, the MDF class constitutes 9.70percent and the OF class constitutes 8.99percent of the total geographical area of the country

Table 2 Forest cover in different density classes

Class	Area (sq. km.)	% geographical area
Forest cover		
a) VDF	83,502	2.54
b) MDF	318,745	9.70
c) OF	295,651	8.99
Total forest Cover*	**697,898**	**21.23**
Scrub	41,383	1.26
Non Forest	2,547,,982	77.51
Total Geographical Area	3,287,263	100.00

*includes 4,629sq km under mangroves



(Source: ISFR, 2013)

Fig 3. Forest cover of India

4.1.1 Trees Outside Forest Cover and Tree cover

Trees outside forest cover refers to all trees growing outside recorded forest areas irrespective of patch size. The estimates of tree cover in the states and UTs are given in Fig 3 The state having maximum tree cover area is Maharashtra (9,142sq km), followed by Gujarat (8,358sq km), Rajasthan (7,860sq km) and J&K (7,664sq km). Considering the percentage of geographical area of state/UTs the Union territory of Lakshadweep shows highest percentage of tree cover (16.69percent) followed by Goa (9.03percent.)

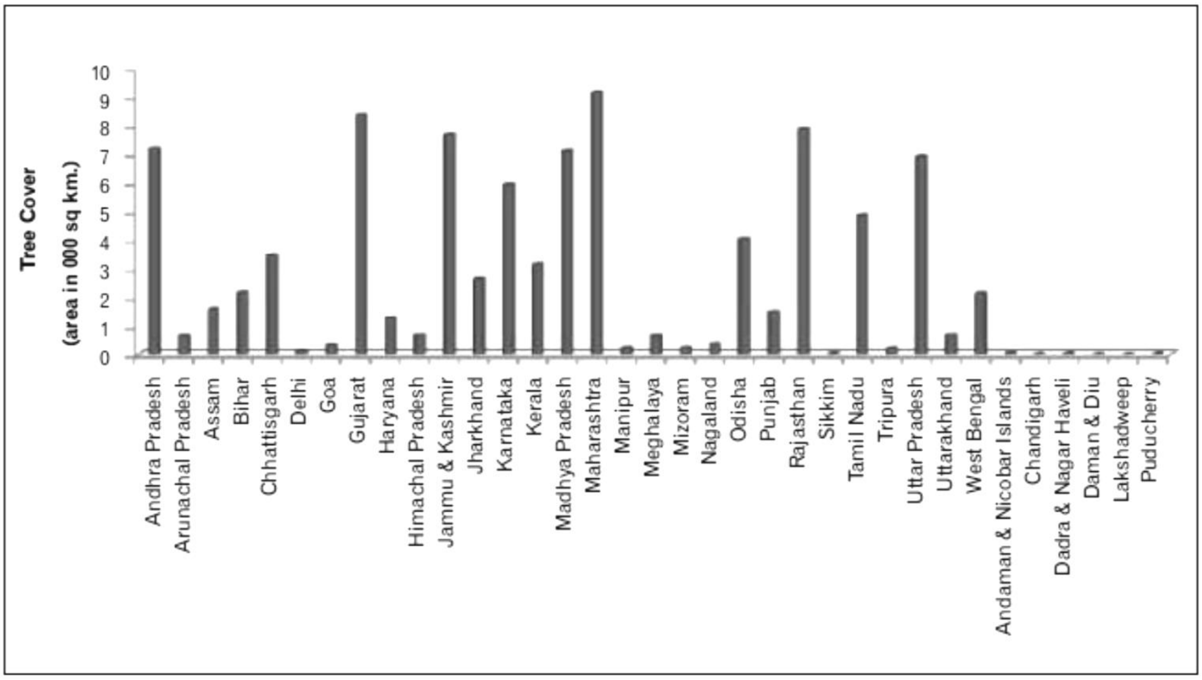


Fig 4. Tree cover in states and UTs

4.2 Carbon stock in India’s Forests:

Forest Survey of India (FSI) has been one of the major contributors on forest biomass estimation and carbon stock change. In 2010, FSI has completed estimation of forest carbon stock and change between two time periods viz. 1994 and 2004 as part of second national communication (SNC) to the UNFCCC.

Table 3. Change in carbon stock in forest land between 1994 and 2004 (million tonnes)

Component	Carbon stock in forest land in 1994	Carbon stock in forest land in 2004	Net change in carbon stock
AGB	1784	2101	317
BGB	563	663	100
Deadwood	19	25	6
Litter	104	121	17
Soil	3601	3753	152
Total	**6071**	**6663**	**592**

The area and carbon stock in forestland during 1994 was estimated to be 660549 km^2 and 6071 Mt respectively. The area and carbon stock in forest during 2004 was estimated to be 690171 Km^2 and 6663Mt respectively. Thus the net increase of carbon stock in India's forest during 1994-2004 is 592Mt. FSI had also done a comprehensive study on state/UT wise per hectare carbon stock. Table…shows the state/UT wise carbon stock in different carbon pools.

Table 4. State/UT wice carbon stock in different carbon pools

State/UT	Area in Km^2	AGB	BGB	Deadwood	Litter	SOM	Total
Andhra Pradesh	44,372	35.42	13.74	0.16	1.09	39.28	89.70
Arunachal Pradesh	67,777	34.54	7.74	0.55	2.37	96.85	142.07
Assam	27,645	16.11	3.70	0.38	1.96	38.95	61.10
Bihar	5,579	29.45	11.06	0.19	0.75	42.77	84.23
Chattisgarh	55,863	36.46	12.11	0.43	1.15	48.70	98.85
Delhi	176	11.29	2.54	0.10	0.53	32.03	46.50
Goa	2,164	19.03	5.07	0.42	1.44	51.57	77.52
Gujarat	14,715	23.68	8.56	0.21	0.67	44.02	77.14
Haryana	1,587	24.86	8.54	0.13	0.46	45.91	79.91
Himachal Pradesh	14,369	44.15	11.63	0.37	1.65	54.41	112.20
Jammu& Kahmir	21,273	45..17	12.34	0.35	1.46	54.30	113.62
Jharkhand	22,591	36.48	14.11	0.19	0.54	43.37	94.70
Karnataka	35,251	33.07	9.58	0.40	4.84	76.77	124.66

Kerala	15,565	38.25	9.75	0.55	3.86	75.53	127.95
Madhya Pradesh	76,013	34.25	13.08	0.20	0.92	41.34	89.79
Maharashtra	47,476	29.73	10.28	0.40	1.83	58.56	100.80
Manipur	17,086	15.29	5.00	0.29	2.24	58.03	80.86
Meghalaya	16,988	13.65	3.73	0.46	2.90	67.02	87.77
Mizoram	18,684	8.48	1.75	0.35	1.47	40.36	52.41
Nagaland	13,719	12.08	3.11	0.43	1.86	77.19	94.67
Orissa	48,374	30.41	10.08	0.38	1.56	45.04	87.46
Punjab	1,558	28.02	10.35	0.16	0.37	49.95	88.85
Rajasthan	15,850	20.64	8.08	0.13	0.40	26.97	56.22
Sikkim	3,262	32.22	9.24	0.48	1.40	78.46	121.80
Tamil Nadu	23,044	31.72	10.63	0.34	2.04	47.04	91.77
Tripura	8,155	17.34	3.57	0.63	1.96	48.75	72.25
Uttar Pradesh	14,127	29.50	8.93	0.27	1.11	40.60	80.42
Uttarakhand	24,442	43.51	11.25	0.51	2.31	59.29	116.88
West Bengal	12,413	29.45	9.33	0.23	1.42	56.04	96.48
Andaman & Nicobar	6,629	49.83	15.12	1.99	4.59	79.72	151.25
Chandigarh	15	29.50	10.13	0.18	0.69	52.20	92.70
Dadra & Nagar Haveli	221	23.67	5.63	0.59	1.99	41.54	73.42
Daman & Diu	9	3.96	0.97	0.09	0.79	32.72	38.53
Lakshadweep	25	19.90	*0.00	0.21	1.77	36.58	58.46
Puducherry	41	21.57	4.61	0.14	1.66	58.64	86.62
Total	**6,77,088**	**31.03**	**9.79**	**0.37**	**1.79**	**55.43**	**98.40**

*In Lakshadweep most of the forest cover is of *cocus nucifera* for which there is no suitable ratio available for BGB and therefore left unaccounted.

The table of per hectare carbon stock among different states/UTs suggest that Andaman & Nicobar islands is contributing maximum per hectare carbon stock of 151.25 tonnes, followed by Arunachal Pradesh (142.07 tonnes), Kerala (127.95 tonnes) and Karnataka (124.66 tonnes)

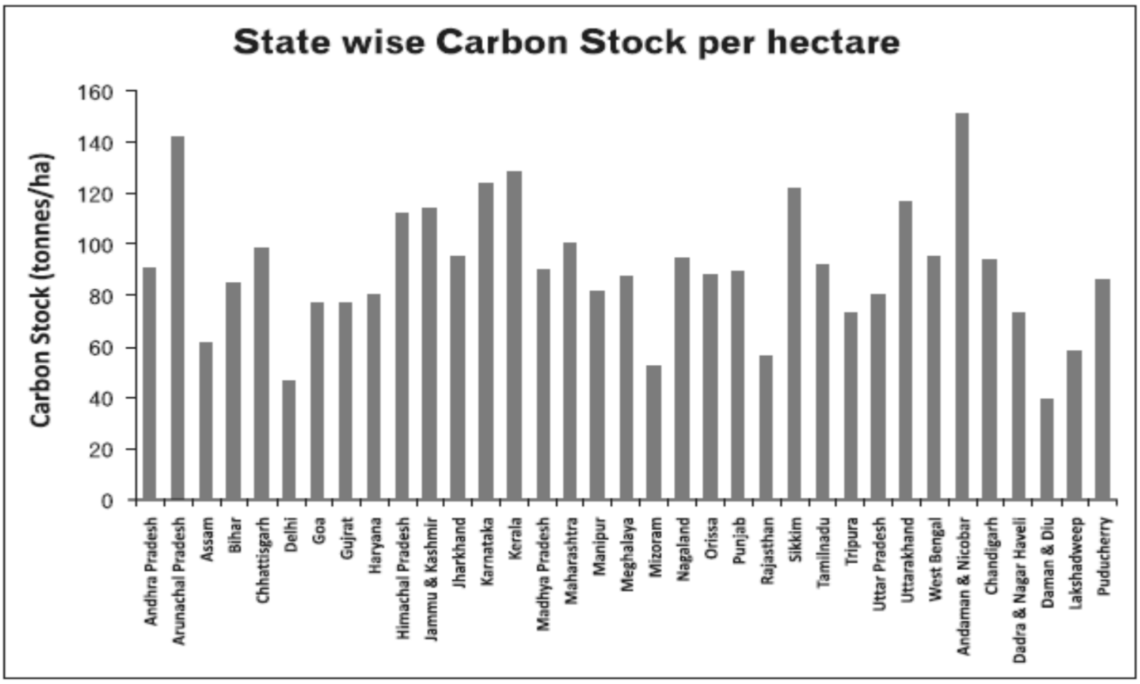


Fig 5. State/ UT-wise per hectare carbon stock

4.3 Forests of Kerala

4.3.1 Recorded forest area:

The recorded forest area in the state is 11,265 km^2 which constitutes 28.99% of state's geographical area. Reserved forests constitute 98.74% and protected forest 1.26% of the recorded forest areas.

4.3.2 Protected areas:

Kerala has 6 National parks and 15 wildlife sanctuaries covering cumulative area of 2,379 km^2 which constitutes 6.12% of the state's geographical area. Sastham kotta and Ashtamudi are wetlands of national importance located in Kollam district with an area of 3,75km^2 and 32km^2 respectively. A part of the Nilgiri Biosphere reserve also falls in Kerala

4.3.3 Forest Cover:

The forest cover in the state based on interpretations of satellite data of February, 2009 is 17,000 km^2 which is 44.52% of the state's geographical area. In terms of forest canopy density classes, the state has 1,442 km^2 area under very dense forest, 9,394 km^2 area under moderately dense forest and 6,464 km^2 area under open forest.

4.3.4 Forest cover in different forest types:

As per the FSI report, 2011 (ISFR, 2011) in accordance with C&S classification the state has 13 forest types which belongs to the seven forest type groups, viz. Tropical wet evergreen, tropical semi evergreen, Tropical moist deciduous, littoral &swamp, tropical dry deciduous, tropical thorn and mountain wet temperate forests.

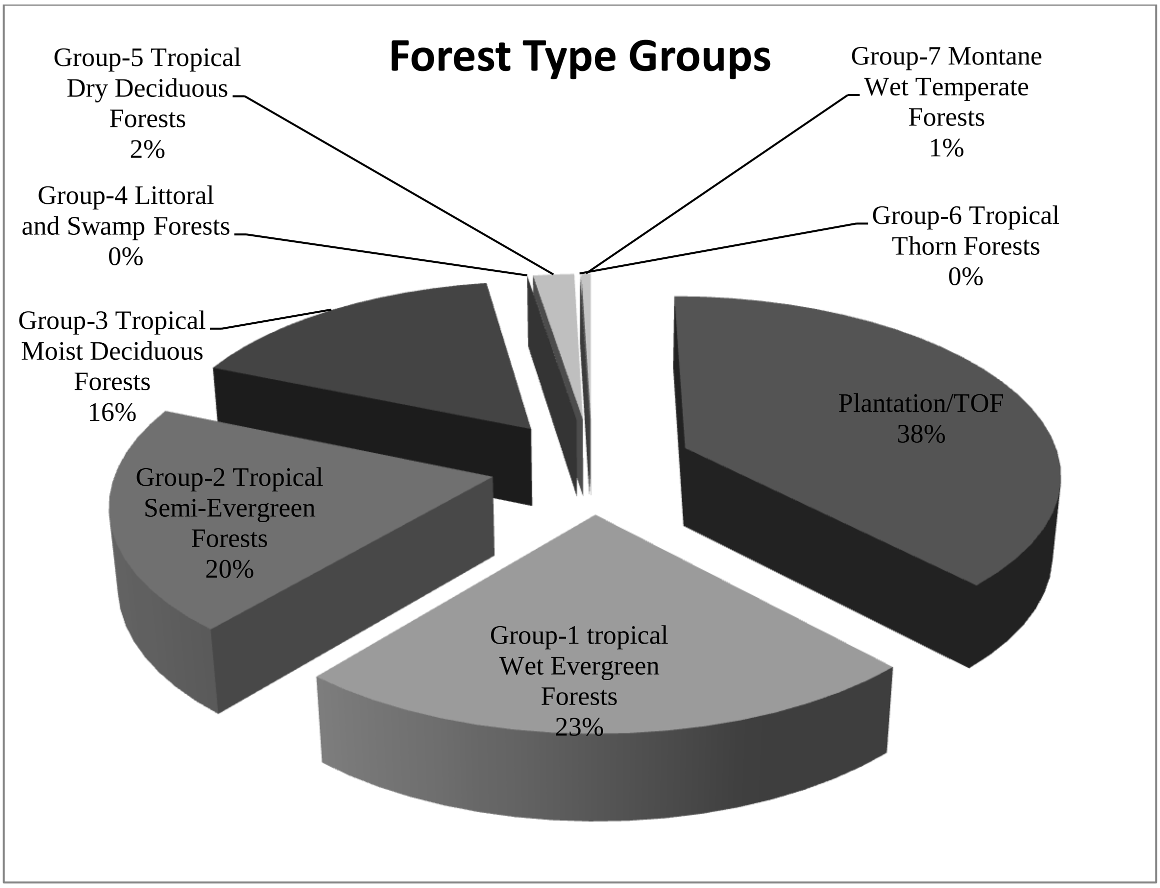


Fig 6. Forest type groups

4.3.5 Tree cover:

The estimated tree cover of the state is 2,755 km^2 which is 7.09% of the geographical area of the state. The forest and tree cover of the state is given in the table

Table 5. forest and tree cover (km^2)

Category	Area	% of Geographical Area
Tree Cover	2,755	7.09
Forest cover	17,300	44.52
Forest & Tree cover	**20,055**	**51.61**

4.4 Forest under administrative charge of KFD:

The forest area under the administrative charge of Forest Department is 11309.47 Km^2 at the close of the year 2010-2011 and forms 29.10% of the total geographical area of the state (38863Km^2). Distribution of forest area according to Legal status is given in Table 5

Table 6. Distribution of forest area according to Legal status (Km^2)

Reserve Forest	Proposed Reserve	Vested Forest + EFL	Total
9176.31	295.37	1837.79	11309.47
81.14%	2.61%	16.25%	100%

4.4.1Reserve Forest:

The forest reserved under section 19 of Kerala Forest Act and includes forest notified under section 4 of said act.

4.4.2Vested Forest:

Any forest vested in government under section 3 of the Kerala Private Forest(Vesting and Assignment), Act, 1971

4.4.3 EFL:

Ecologically fragile Land means any portion of land held by any person and lying contigious or encircled by tiguous or encircled by a reserve forest or vested forest or any other forest land owned by the Government and predominantly supporting natural vegetation; and any land declared to be EFL by the Government by notification in the official Gazette under section 4 of Kerala Forest Act.

Division wise distribution of Forest Area in charge of Kerala Forest Department according to legal status at the close of the year 2011-2012 is given in Table 6.

Table 7. Division-wise area of forest as on 31.03.2012 (km^2)

Sl. No.	Division	Reserve Forests	Proposed Reserve	Vested Forest+ EFL	Total	% of Total
Southern Circle, Kollam						
1.	TVM	359.13	5.9	3.65	368.600	3.26
2.	Thenmala	123.44	-	7.73	131.17	1.16
3.	Achencoil	284.33	-	0.20	284.54	2.52
4.	Ranni	1050.34	7.16	1.57	1059.06	9.36
5.	Punalur	280.06	-	0.17	280.22	2.48
6.	Konni	320.64	11.02	-	331.66	2.93
Total		**2417.91**	**24.0063**	**13.33**	**2455.25**	**21.71**
High Range Circle, Kottayam						
7.	Kothamanagalam	316.84	-	0.15	317.00	2.80
8.	Munnar	440.49	175.27	2.45	618.21	5.47
9.	Marayoor	13.97	47.26	0.07	61.30	0.54
10.	Mankulam	90.06	-	-	90.06	0.80
11.	Kottayam	627.28	-	31.96	659.25	5.83
Total		**1488.65**	**222.54**	**34.66**	**1745.84**	**15.44**
Central Circle, Thrissur						
12	Vazhachal	413.94	-	-	413.94	3.66
13	Chalakkudy	279.70	-	-	279.70	2.47
14	Malayattoor	617.24	0.52	-	617.77	5.46
15	Thrissur	293.74	-	4.32	298.05	2.64
Total		**1,604.64**	**0.53**	**4.32**	**1609.48**	**14.23**
Eastern circle, Palakkad						
16	Mannarkad	150.73	-	271.72	422.4535	3.74
17	Nilambur North	57.91	0.017	340.70	398.6399	3.52
18	Nilambur South	267.38	-	57.88	325.2782	2.88
19	Palakkad	73.41	-	162.08	235.4947	2.08
20	Nenmara	205.51	205.51	150.21	355.73	3.15
Total		**754.96**	**0.017**	**982.61**	**1737.60**	**15.37**
Northern circle, Kannur						
21	Kozhikode	24.39	22.96	243.08	290.45	2.57

22	Wayanad North	134.02	15.06	65.85	214.94	1.90
23	Wayanad South	66.13	6.84	274.68	347.66	3.07
24	Kannur	207.39	-	98.90	306.30	2.71
Total		**431.95**	**44.87**	**682.53**	**1159.36**	**10.25**
Agasthyavanam Niological Park						
25	TVM (WL)	212.00	-	-	212.00	1.87
26	Shenturuni	166.42	-	4.58	171.00	1.51
Total		**378.42**	**-**	**4.58**	**383.00**	**3.38**
Field Director, Kottayam						
27	Periyar East	618.00	-	-	618.00	5.46
28	Periyar West	157.00	-	-	167.00	1.39
29	Munnar	276.84	-	-	276.85	2.45
30	Idukki	130.52	-	-	130.52	1.15
Total		**1182.37**	**-**	-	**1182.37**	**10.45**
Wildlife Circle, Palakkad						
31	Parambikulam	274.14	-	-	274.14	2.42
32	Wayanadu (WL)	344.44	-	-	344.44	3.05
33	Silent valley	154.38	-	83.14	237.52	2.10
34	Peechi	122.06	3.42	-	125.49	1.11
35	Aaralam	22.34	-	32.65	55.00	0.49
Total		**917.38**	**3.42**	**115.79**	**1036.59**	**9.17**
Grand Total		**9176.30**	**295.38**	**1837.80**	**11309.48**	

Table 8. Classification of forest types as on 31.3.2012

Sl no	Type	Area (km^2)	% of total
1	Tropical wet evergreen and semi evergreen	3877.44	34.28
2	Tropical moist deciduous	3615.98	31.97
3	Tropical dry deciduous	391.36	3.46
4	Mountain sub tropical Temperate sholas	386.42	3.42
5	Plantations	1525.53	13.49
6	Grassland	501.09	4.43
7	Others	1011.67	8.95
	Total	**11309.48**	

Table 9. Range-wise area of forests on 31.03.2012

Sl. No.	Division/Range	Area (km^2)
I	**Thiruvanathapuram**	
1	Kulathupuzha	219.69
2	Palode	107.50
3	Paruthippally	41.41
	Total	**368.60**
II	**Thenmala**	
4	Ariyankavu	73.66

5	Thenmala	57.50
	Total	**131.16**
III	**Achancovil**	
6	Achancovil	88.96
7	Kallar	78.99
8	Kanayar	116.59
	Total	**284.53**
IV	**Ranni**	
9	Ranni	136.23
10	Goodrikkal	653.97
11	Vadasserikkara	268.87
	Total	**1059.06**
V	**Punalur**	
12	Anchal	148.41
13	Pathanapuram	131.80
VI	**Konni**	
14	Konni	62.72
15	Naduvathumoozhi	138.94
16	Mannarappara	130.00
	Total	**317.00**
VII	**Kothamangalam**	
17	Thodupuzha	218.38
18	Kothamangalam	12.15
19	Kaliyar	49.08
20	Mullaringad	37.38
	Total	**317.00**
VIII	**Munnar**	
21	Munnar	106.19
22	Devikulam	298.41
23	Adimali	110.87
24	Neriyamangalam	102.74
	Total	**618.21**
IX	**Marayoor**	
25	Marayoor	41.04
26	kanthalloor	20.26
	Total	**61.30**
X	**Mankulam**	
27	Mankulam	90.06
	Total	**90.06**
XI	**Kottayam**	
28	Erumeli	162.18
29	Ayyapancoil	88.07
30	Nagarampara	143.40
31	Kumili	265.59
	Total	**659.25**
XII	**Vazhachal**	
32	Charpa	59.98
33	Vazachal	90.64
34	Sholayar	138.89
35	Kollathirumed	29.34
36	Athirappily	95.09
	Total	**413.95**
XIII	**Chalakudy**	

37	Pariyaram	115.31
38	Palappilly	55.74
39	Vellikulangara	108.40
	Total	**279.70**
XIV	**Malayattoor**	
40	Kalady	72.51
41	Kodanadu	56.74
42	Thundathil	131.40
43	Kuttampuzha	187.04
44	Edamalayar	170.07
	Total	**617.76**
XV	**Thrissur**	
45	Vadakkanchery	56.85
46	Pattikkad	267.57
47	Machad	73.62
	Total	**298.05**
XVI	**Mannarkad**	
48	Attappadi	169.43
49	Agali	129.01
50	Mannarkad	124.01
	Total	**422.45**
XVII	**Nilambur North**	
51	Nilambur	140.61
52	Edavana	102.83
53	Vazhikadavu	155.18
	Total	**398.63**
XVIII	**Nilambur South**	
54	Kalikabu	59.67
55	Karulai	265.60
	Total	**325.27**
XIX	**Palkkad**	
56	Olavakkode	80.14
57	Walayar	121.80
58	Ottapalam	33.55
	Total	**235.49**
XX	**Nenmara**	
59	Nelliyampathi	206.36
60	Kollengode	68.24
61	Alathur	81.12
	Total	355.72
XXI	**Kozhikode**	
62	Peruvannamoozhi	130.69
63	Kuttiyadi	44.80
64	Thamarassery	114.95
	Total	290.45
XXII	**Wayanad North**	
65	Begoor	104.16
66	Periya	84.73
67	Mananthavady	26.04
	Total	214.94
XXIII	**Wayanad South**	
68	Kalpetta	130.11
69	Meppady	133.01

70	Chethalayam	84.54
	Total	347.66
XXIV	**Kannur**	
71	Kannavam	83.98
72	Kottiyoor	81.19
73	Thalipparamba	21.26
74	Kanjangad	59.37
75	Kasargod	60.47
	Total	306.30
Wildlife Division		
XXV	**Thiruvananthapuram**	
76	ABP, Kottoor	31.00
77	Neyyar Sanctuary	128.00
78	Peppara Sanctuary	53.00
	Total	212.00
XXVI	**Shendurney**	
79	Shendurney Sancutuary	171.00
	Total	171.00
XXVII	Periyar East ,Thekkady	
80	Periyar	376.00
81	Thekkady	99.00
82	Vallakkadavu	143.00
	Total	618.00
XXVIII	Periyar West, Peerumedu	
83	Pampa	90.07
84	Azhutha	66.93
	Total	157.00
XXIX	**Idukki**	
85	Idukki	105.36
86	Thattekad	25.16
	Total	130.52
XXX	**Parambikulam**	
87	Sunkom	81.75
88	Parambikuam	52.18
89	Orukkomban	71.83
90	Karimala	68.37
	Total	**274.14**
XXXI	**Wayanad**	
91	Tholpety	77.67
92	Kurichiyat	106.45
93	Muthanaga	74.29
94	Bathery	86.03
	Total	**344.44**
XXXII	**Silent valley**	
95	Silent Valley National Park	143.52
96	Bhavani	94.00
	Total	**237.52**
LXIV	**Munnar**	
97	Eravikulam National Park	97.00
98	Chinnar wildlife Sanctuary	90.44
99	Mathikettan shola National Park	12.81
100	Anamudi Shola National Park	32.84
101	Pampadum shola National park	11.75

102	Kurinjimala Sanctuary	32.00
	Total	**276.84**
XXXIV	**Peechi**	
103	Peechi	40.41
104	Chimmini	85.06
	Total	**125.48**
XXXV	**Aralam**	**55.00**
105	Aralam	55.00
	Total	**55.00**
	Grand Total	**11309.45**

4.4.4 District-wise forest area:

Districtwise forest area (approx.) as on 31.3.2012 is shown in Table 10

Table 10. District-wice forest area

Sl. No.	District	Area (Km^2)
1	Thiruvananthapuram	463.83
2	Kollam	840.56
3	Pathanamthitta	1533.79
4	Kottayam	100.84
5	Ernakulam	823.83
6	Idukki	2713.72
7	Thrissur	1022.75
8	Palakkad	1527.35
9	Malappuram	723.91
10	Kozhikode	290.45
11	Wayanad	907.04
12	Kannur	241.45
13	Kasargode	119.84
Total		**1139.41**

4.4.5 Forest Cover:

The forest cover in the state based on interpretation of satellite data of February 2009 is 17300Km^2 which is 44.52% of the state geographical area. In terms of forest canopy density classes, the state has1442Km^2 area under very dense forest , 9394 Km^2 area under moderately dense forest and 6464 Km^2 area under open forest. District wise forest cover in different canopy density classes are given in Table 10.

Table 11. District-wise forest cover in kerala (Km^2)

Sl no	District	Geographical area	Very dense	Moderately dense	Open forest	Total	Percent to GA
1	Thiruvananthapuram	2192	55	824	470	1349	61.54
2	Kollam	2491	75	632	623	1330	53.39
3	Pathanamthitta	2642	144	1147	464	1755	66.43
4	Alappuzha	1414	0	12	26	38	2.63
5	Kottayam	2203	12	542	335	889	40.35
6	Idukki	5019	350	2159	1421	3930	78.30
7	Ernakulam	2407	12	298	385	695	28.87
8	Thrissur	3032	181	388	362	931	30.71
9	Palakkad	4480	276	693	606	1575	35.16
10	Malappuram	3550	144	406	659	1209	34.06
11	Kozhikode	2344	32	288	271	591	25.21
12	Wayanad	2131	140	1347	288	1775	83.29
13	Kannur	2966	21	351	269	641	21.61
14	Kasargod	1992	0	307	285	592	29.72
	Total	**38863**	**1442**	**9394**	**6464**	**17300**	**44.52**

5. EMISSION TRADING SCHEMES

5.1Carbon Credit:

5.1.1 Credits under Kyoto

The Kyoto protocol established caps on the maximum quantity of greenhouse gas emissions permitted for Annex I developed and developing countries. These countries set internal quotas on emissions from installations run by local business and other organizations, generally termed ‘operators’. Countries over see this responsibility through their own national ‘registries’, which are required to be validated and monitored for compliance by the UNFCCC. Each operator is allocated an allowance of credits. Generally, each unit gives the owner the right to emit one metric ton of CO_2e. Operators that have not met their quotas can sell their unused allowances as carbon credits, while businesses that are about to exceed their quotas can buy the extra allowances as credits, privately or on the open market. Businesses alter their decision making to find the most cost effective way of operating under these regulations, either by investing in cleaner business practices or by purchasing credits from another operator with excess capacity.

Since 2005, the Kyoto template has been adopted for carbon trading by all the countries with in the European Union under its European trading Scheme (EUETS). Similar schemes are under consideration in the United States, which has not ratified the Kyoto, and in Australia, whose ratification came in to force in March 2008.

5.1.2 Kyoto’s ‘Flexible mechanisms’

The Kyoto protocol includes three mechanisms through which countries or operators in developed countries can acquire carbon credits.

1. Under *Joint Implementation* (JI), a developed country with relatively high costs of domestic emission reduction can fund carbon projects in another developed country.

2. Through the *Clean Development Mechanism* (CDM), a developed country can sponsor a greenhouse gas reduction project in a developing country where the cost of greenhouse gas reduction project activities is usually much lower, but the atmospheric level is globally equivalent. The developed country is given credits towards meeting its emission reduction targets, while the developing country receives the benefits of sustainable development and investment.
3. *International Emission Trading* (IET) helps countries trade in the international carbon credit market to cover their shortfall in allowances. Countries with surplus credits can sell them to countries with capped emission commitments.

These carbon credits projects can be created by a national government or by an operator within the country.

5.1.3 Emission markets

For trading purposes, one allowance or CER is considered equivalent to one metric tonne of CO_2 emissions. These allowances can be sold privately or in the international; market at the prevailing market price. These trade and settle internationally and hence allow allowances to be transferred between countries. Each international transfer is validated by the UNFCCC. Each transfer of ownership with in the European Commission.

Climate exchange have been established to provide a spot market in allowances as well as futures and options market to help discover a market price and maintain liquidity. Carbon prices are normally quoted in Euros per tonne of carbon dioxide or its equivalent (CO_2e). Other greenhouse gases can also be traded, but are traded as standard multiples of carbon dioxide with respect to their global warming potential (GWP). These features reduce the quota's financial impact on business, while ensuring that the quotas are met at a national and international level.

Currently there are at least six exchanges trading in carbon allowances: the Chicago climate exchange, Nord pool, PowerNext, Multi Commodity Exchange and National Commodity and Derivatives Exchange. Many companies now engage in emissions abatement, offsetting, and sequestration programs to generate credits that can be sold on one of the exchanges.

5.2 Clean Development Mechanism

The clean Development Mechanism is one of the Kyoto Protocol's three flexibility mechanisms aimed at helping industrialized countries meet their greenhouse gas reduction targets. It is a project based mechanism that allows public or private entities to from countries with emission reduction targets (Annex 1 countries) to invest in emission reduction projects in developing countries in order to earn emission reduction credits (known as certified emission reductions or CERs). These credits can be used against domestic emission reduction targets or sold to other interested parties.

The CDM is also meant to help developing countries achieve sustainable development by, for example, facilitating the transfer and /or development of low emission technologies. The CDM thus offers incentive for developing countries to maintain their active participation in the Kyoto Protocol. Most observers agree that meeting Kyoto targets would be exceedingly difficult in the absence of the CDM.

5.2.1 Advantages of the CDM

In certain circumstances, it can prove more cost-effective for entities seeking to reduce emissions to undertake CDM projects than to reduce emissions domestically. The cost of reducing GHG emissions can vary significantly from country to country and from project to project. Yet the direct benefit to the global environment of reducing GHG emissions is the same regardless of where the reduction originates.

The appeal of the CDM is that it offers an opportunity to those with emission reduction targets to lower their Kyoto compliance costs by taking advantage of lower-cost emission reduction opportunities available in developing countries.

5.2.2 CDM Potential

The potential to reduce GHG emissions in developing countries under the umbrella of the CDM is considerable and is drawing interest from many organizations. Currently among the 7530 registered CDM projects, India and China together hosts 70 per cent of the projects China shows a clear dominance in registering projects which bags 5o per cent of the total registered projects and India stands second by hosting 20 per cent of the projects, Ironically with regards to the CDM A/R projects India shows a dominance by hosting 9 CDM A/R projects and this shows our suitability and adaptability in hosting CDM A/R projects.

5.3 The Kyoto protocol and Clean Development Mechanism

5.3.1 Kyoto Protocol

The convention established the conference of parties (COP) as its supreme body with the responsibility to oversee the progress towards the aim of the convention.

At the first session of the COP (COP1) in Berlin, Germany, it was decided that post 2000 commitments would only be set for Annex I Parties. During COP3 in Kyoto, Japan, a legally binding set of obligations for 38 industrialized countries and 11 countries in Central and Eastern Europe was created to run their emissions of GHGs to an average of approximately 5.2% below 1990 levels over the commitment period of 2008-12. The targets cover six main greenhouse gases: carbon dioxide (CO_2), Methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), Perflorocarbons (PFCs); and Sulfur hexafluoride (SF6). The protocol also allows these countries the option of deciding which of the six gases will form part of their national emissions reduction strategy. Some activities in the land-use change and forestry sector such as afforestation and reforestation are also covered.

In the 2012 UNFCC held in Qatar reached in an agreement to extend the life of the Kyoto Protocol until 2020. But the agreement was sapped by the withdrawal of New Zealand, Russia, Japan and Canada, so its signatories now account for only 15 per cent of global emissions.

5.3.2 Types of emission certificates under the Kyoto Protocol

The Kyoto Protocol defines seven types of emission credits. They are characterised by their origin, but also by attributes such as their capacity to be offset against the CO_2 limitation target, traded and carried over to the next commitment period. An emission credit always equates to one tonne of CO_2 equivalent.

Emission credits from projects in developing countries (CDM) and from other industrialised or transition countries (Joint Implementation) are “certificates”. The generic term used for the “emission allowances” and “certificates” is “emission credits”. The EU uses its own emission allowances for its emission trading scheme- the European Union Allowances.

The table below shows which emission credits can be traded in the emission trading schemes (tradable) and which are taken in to account in the individual CO_2 target limits of companies. It also shows which emission credits can be carried over to the next commitment period (bankable).

Table 12. Different emission credits offsetability and tradability

Credit	Abbrev.	Kyoto code	Offsettable against the CO_2 target limit	Tradable		Bankable
				EU	Intl.	
Assigned Amount Unit	AAU	1	✓/✗	✓	✓	✓
Removal Unit	RMU	2	✓	✓	✓	✗
Emission	ERU	3	✓	✓	✓	✓

Reduction Unit (Converted form AAU)						
Emission Reduction Unit (Converted from RMU)	ERU	4	✓	✓	✓	✓
Certified Emission Reduction	CER	5	✓	✓	✓	✓
Temporary CER	tCER	6	✓/✗	✓	✓	✗
Long-term CER	lCER	7	✓/✗	✓	✓	✗
European Union Allowance	EUA	8	✓	✓		✓

Kyoto credits (CERs, ERUs, RMUs), are project based. Project based emission reductions credits are derived from the difference between a baseline and the actual emission reduction level achieved after implementing the GHG mitigation project. Kyoto credits are only issued after the reductions have been verified. A specific amount of reductions from a project will hence be available only on a year-by-year basis, depending on the performance of the project.

Emission credits (definition):

AAU: Assigned emission units are the emission allowances assigned to the various countries in the Kyoto Protocol for a commitment period.

RMU: Removal units are emission allowances which are generated in addition to AAUs as a result of an increase in the national sink performance. As sinks do not contribute to sustainable CO_2 limitation, RMUs expire at the end of the commitment period.

ERU: Emission certificates which derive from completion of JI projects between two industrialized countries.

tCER: A temporary CER is an emission certificate issued for a CDM project associated with an afforestation or reforestation project. TCERs expire at the end of the subsequent commitment period and may be renewed if carbon sequestration in forests can be proved by defined methodologies.

ICER: A long-term CER (lCER) is an emission certificate allocated for a CDM project associated with afforestation or reforestation project of the CDM lCERs expire at the end of the completed project period and cannot be renewed. They must be replaced by other emission credits unless proof of carbon sequestration is provided every five years.

EUA: EUAs (EU Allowances) are the emission allowances assigned to companies participating in the European emission trading scheme. The emission allowances are assigned to individual companies by each EU member state

5.3.3 CDM and Cooperative Mechanisms

As earlier mentioned the protocol establishes three cooperative mechanisms designed to help Annex I parties reduce the costs of meeting their emissions targets by achieving emission reductions at lower costs in other countries than they could domestically. The Figures 1 to 5 illustrates how the Kyoto's flexible mechanisms work. The mechanism gives countries and private sector companies the opportunity to reduce emissions anywhere in the world wherever the cost is lowest and they can then count these reductions towards their own targets. Any such reduction, however, should be supplementary to domestic actions in the Annex I countries.

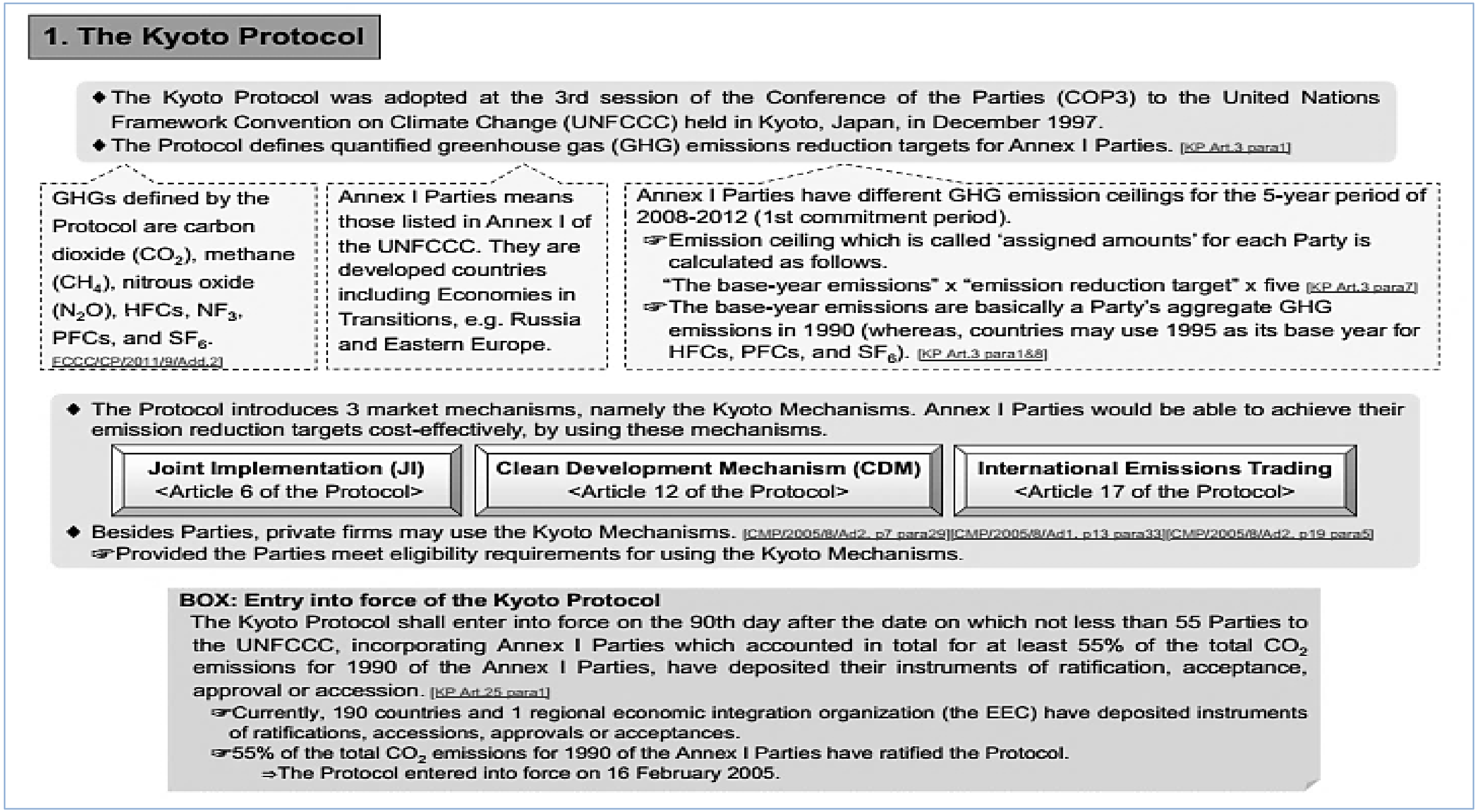


Fig 7. The Kyoto Protocol and its flexible mechanisms (Source: IGES)

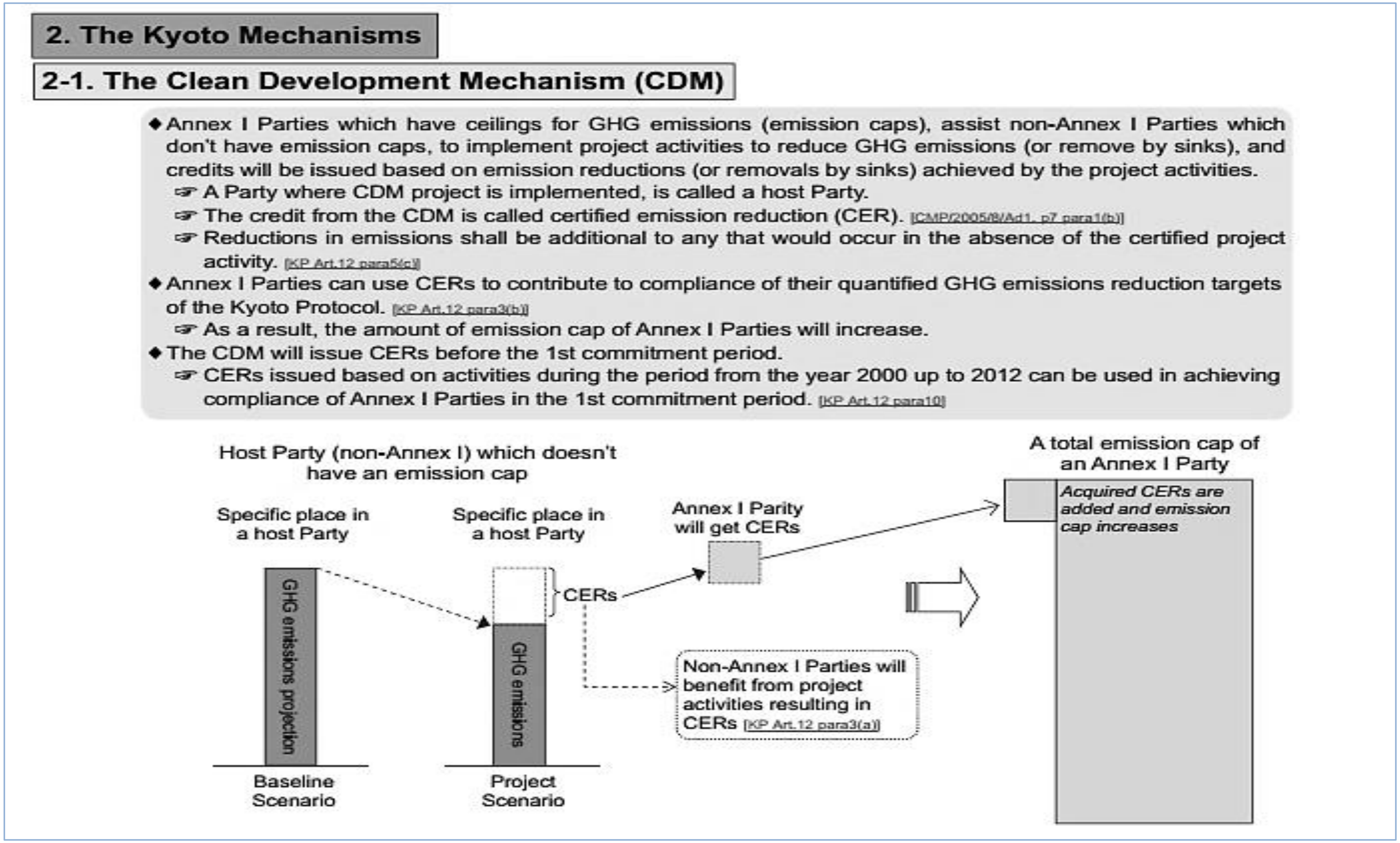


Fig 8. The Kyoto mechanisms and the CDM (Source: IGES)

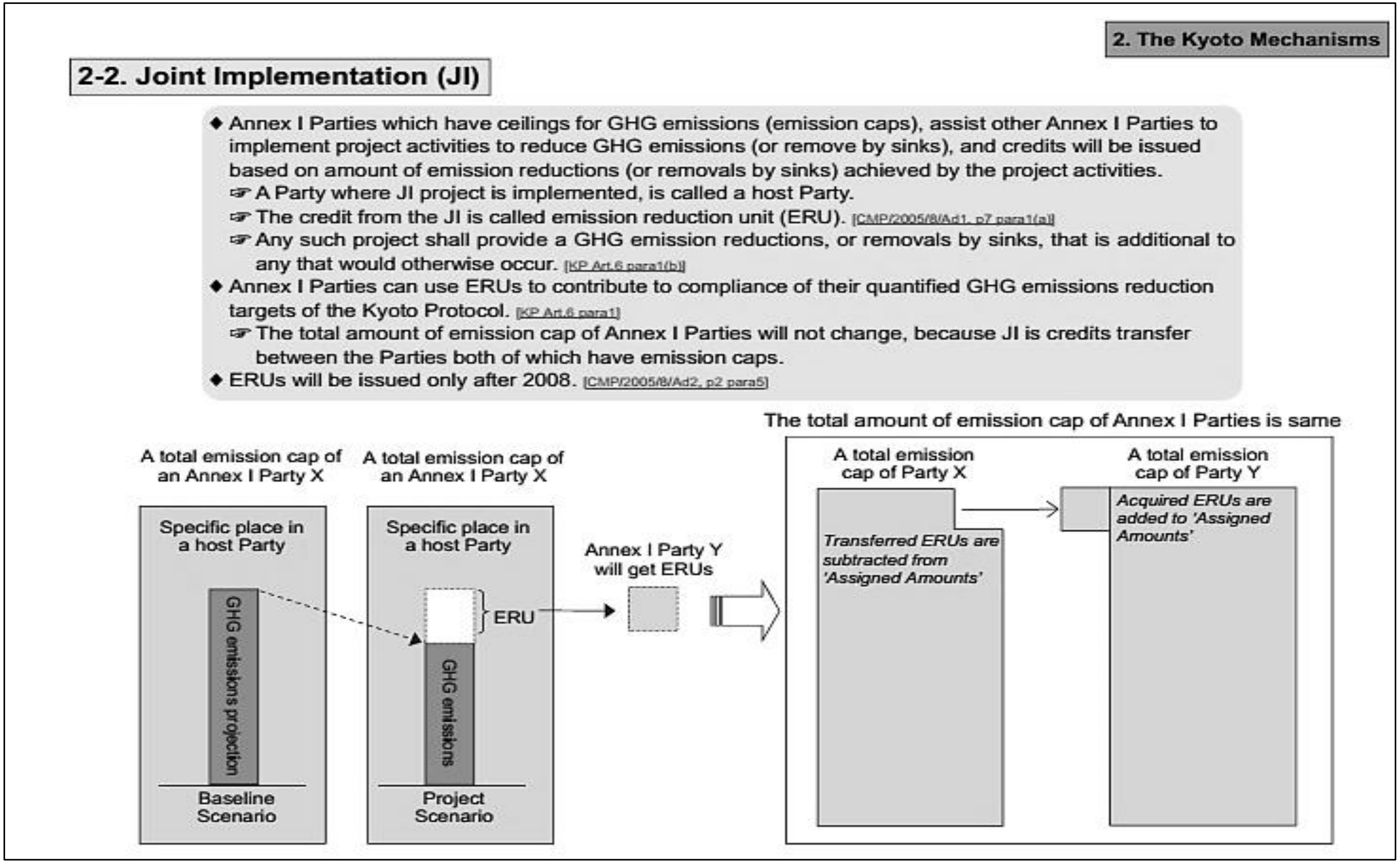
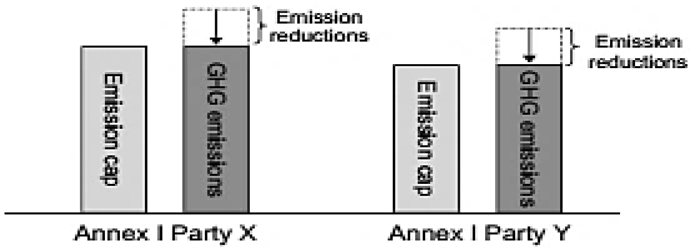


Fig 9. The mechanism of Joint Implementation (JI) (Source: IGES)

2-3. International Emissions Trading (IET)

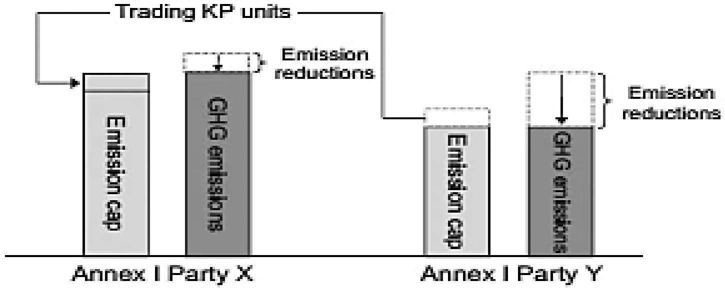
- International Emissions Trading is to trade Kyoto Protocol units (KP units) including part of assigned amounts, CERs, ERUs and etc, between Annex I Parties.
  - ☞ The total amount of emission cap of Annex I Parties will not change.
  - ☞ Only Annex B Parties of the Kyoto Protocol can participate International Emissions Trading.
  - ☞ Minimum trading unit is 1t-CO_2 equivalent.
- Through market mechanism, International Emissions Trading can decrease total cost of Annex I Parties to achieve their collective emission reduction targets.

Without International Emissions Trading



	Party X	Party Y	Total
Before ET: Emission cap	10	8	18
Trading a KP unit	-	-	-
After ET: Emission cap	10	8	18
GHG emissions	12	10	22
Necessary reduction	2	2	4
Unit cost of reduction	$200	$100	-
Total cost of reduction	$400	$200	$600
Trading cost	-	-	-
Total compliance cost	$400	$200	**$600**

With International Emissions Trading



	Party X	Party Y	Total
Before ET: Emission cap	10	8	18
Trading a KP units	1	-1	0
After ET: Emission cap	11	7	18
GHG emissions	12	10	22
Necessary reduction	1	3	4
Unit cost of reduction	$200	$100	-
Total cost of reduction	$200	$300	$500
Trading cost	150	-150	0
Total compliance cost	$350	$150	**$500**

Note: Party Y sold a KP unit to Party X at $150.

Fig 10. International emission trading mechanism to trade KP units (Source: IGES)

2. The Kyoto Mechanisms

2-3. International Emissions Trading

◆ Annex I Parties can trade following types of Kyoto Protocol units.

☞**Assigned amount unit (AAU)** [CMP/2005/8/Ad1, p7 para1(c)]

⇒ Total amount of AAUs of an Annex I Party is calculated from its base year emissions and emission reduction target

☞**Removal unit (RMU)** [CMP/2005/8/Ad1, p7 para1(d)]

⇒ Total amount of RMU of an Annex I Party is calculated from net removal of GHGs by afforestation and reforestation (A/R) activities [CMP/2005/8/Ad3, p5 para1(a)-(d)] and additional activities related to GHG removals by sinks [CMP/2005/8/Ad3, p5 para1(e)-(h)]

☞**Emission reduction unit (ERU)** from JI

☞**Certified emission reduction (CER)** from the CDM

☞**Temporary CER (tCER)** and **long-term CER (lCER)**

⇒ tCER and lCER are issued from afforestation and reforestation (A/R) CDM project activities. [CMP/2005/8/Ad1, p62 para1(g)-(h)]

BOX: Compliance assessment

GHG emission cap of an Annex I Party at the end of the 1st commitment period is as follows.

Emission cap of Annex I Party = AAUs + RMUs + Acquired credits from JI and the CDM (ERUs+CERs+tCERs+lCERs) ± Acquired and transferred KP units by International Emissions Trading

Carry-over

If an emission cap of an Annex I Party is more than its GHG emissions during the 1st commitment period, the surplus can be carried over to the subsequent commitment period. [CMP/2005/8/Ad2, p27 para15] [CMP/2005/8/Ad2, p30 para36]

☞The end of additional period is the 100th day after the date set by the CMP. [CMP/2005/8/Ad3, p101 XIII]

☞There are several restrictions for carry-over depending on the type of KP units.

Consequence of non compliance

◆If GHG emissions during the 1st commitment period of an Annex I Party is more than its emission cap, the Annex I Party will be deemed to be non compliance to the Kyoto Protocol.

◆The Party not in compliance shall be applied the following consequences. [CMP/2005/8/Ad3, p102 para5]

☞Deduction from the Party's assigned amount for the 2nd commitment period of a number of tonnes equal to 1.3 times the amount in tonnes of excess emissions;

☞Development of a compliance action plan; and

☞Suspension of the eligibility to make transfers under Article 17 of the Protocol until the Party is reinstated.

Fig 11. Compliance assessment and the trade of KP units by Annex I countries (Source: IGES)

Through emission reduction projects the mechanism could stimulate international investment and provide the essential resources for cleaner economic growth in all parts of the world.

5.3.4 CDM Administration

The CDM is supervised by the Executive Board, which itself operates under the authority of the parties. The Executive Board is composed of 10 members, including one representative from each of the five official UN regions (Africa, Asia, Latin America and the Caribbean, Central Eastern Europe and OECD), one from the small island developing states and two each from Annex I and non-Annex I Parties. The Executive Board will accredit independent organizations known as operational entities- that will validate proposed CDM project, verify the resulting emission reductions as CERs. Another key task of the EB is the maintenance of a CDM registry, which will issue new CERs, manage an account for CERs levied for adaptation and administration expenses, and maintain a CER account for each non-Annex I party hosting a CDM project. The administrative mechanism of CDM is illustrated in figures 6 to 11.

5.3.5 Participation

In order to participate in CDM, all parties (Annex I and non-Annex I Parties) must meet three basic requirements.

i) Voluntary participation

ii) Establishment of the National CDM Authority

iii) Ratification of the Kyoto Protocol

Annex I parties moreover must meet additional requirements such as the following:

i) Establishment of the assigned amount under Art. 3 of the protocol

ii) National system for the estimation of GHG

iii) National registry

iv) Annual inventory and

v) Accounting system for the sale and purchase of emission reductions.

5.3.6 Project Eligibility

The Kyoto protocol stipulates several criteria that CDM projects that satisfy. Two criteria critical could be broadly classified as additionality and sustainable development. Additionality: Article12 of the protocol states that projects must result in "*reductions emissions that are additional to any that would occur in the absence of the project activity*". The CDM projects must lead to real measurable and long term benefits related to the mitigation of climate change. The additional greenhouse gas reductions are calculated with reference to a defined baseline. Sustainable development: The protocol specifies that the purpose of the CDM is to assist non-Annex I parties in achieving sustainable development. There is no common guideline for the sustainable development criterion and it is up to the developing host countries to determine their own criteria and assessment process.

5.4 National value and benefits

The basic principle of CDM is developed countries can invest in low cost abatement opportunities in developing countries and receive credit for the resulting emission reductions, thus reducing the cut back needed within their borders . While the CDM lowers the cost of compliance with the protocol for developed countries, developing countries will benefit as well not just from the increased investment flows but also from the requirements that these investments advance sustainable development goals.

4. CDM-related bodies

4-1. CMP

- The Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP) is the ultimate decision-making body of the CDM. [EB67 Anx4 para5]
  - ☞ This body has authority over, and provides guidance to, the EB through the adoption of decisions and resolutions, published in reports of the CMP. The decisions of the CMP outline formal expectations with respect to the CDM.
  - ☞ They set direction and establish precedents which serve as reference for future decision making and basis for operating procedures. CMP decisions are treated as mandatory requirements or rules intended to ensure the successful implementation of the KP.
  - ☞ All decisions taken by the EB must be consistent with and not contradict decisions of the CMP.
- The CMP: [CMP/2005/8/Ad1, p7 para2-4]
  - ☞ Has authority over and provides guidance to the CDM;
  - ☞ Decides on the recommendations made by the EB on its rules of procedure, and in accordance with provisions of decision 17/CP.7 [CP/2001/13/Ad2 p20-49], the present annex and relevant decisions of the CMP;
  - ☞ Decides on the designation of operational entities (OEs) accredited by the EB;
  - ☞ Reviews annual reports of the EB;
  - ☞ Reviews the regional and subregional distribution of designated operational entities (DOEs) and CDM project activities.

4-2. Designated National Authority (DNA)

- Parties participating in the CDM shall set up a designated national authority (DNA) for the CDM. [CMP/2005/8/Ad1,p12 para29]
- CDM project participants (PPs) shall receive written approval of voluntary participation from the DNA of each Party involved.
  - ☞ The written approval shall include confirmation by the host Party that the project activity assists it in achieving sustainable development. [CMP/2005/8/Ad1, p15 para40(a)]
  - ☞ The details of approval procedure is up to each Party.

BOX: Communication with EB [EB62 Anx15 para11-13]

- ☞ For the purpose of facilitating communication between the EB and DNAs, and between DNAs themselves, the secretariat shall organise global and regional DNA forum meetings as per the terms of reference of DNA forums.
- ☞ The EB shall also allocate time for interaction during the EB meetings with the global DNA forum through its co-chairs **twice a year**
- ☞ The EB may invite the co-chairs of the global DNA forum to any of its meetings additional to the two meetings whenever it finds a need for further interaction with the forum

Definition of host Party [Glos ver.7 p12] [EB70 Anx38]

- ☞ A Party involved not included in Annex I to the UNFCCC on whose territory a CDM project activity or PoA, as applicable, is physically located..
- ☞ A project activity and a bundled project activity shall have only one host Party.
- ☞ The host Party is the Party in which the project activity is located, as set out in the.PDD.
- ☞ Where a methodology provides for the application of a system, such as an electricity grid, and that system extends across more than one Party, a letter of approval from the DNA is only required from the host Party.
- ☞ A letter of approval is only required from the Party in which the project activity is located, as set out in the PDD.

Fig 12. CDM administration- DNAs

4. CDM-related bodies

4-3. CDM Executive Board (EB)

- The EB supervises the CDM, under the authority and guidance of the CMP. [CMP/2005/8/Ad1, p8 para5]
- Decisions of the EB must be consistent with and support the formal decisions of the CMP. Decisions of the EB are hierarchical in nature and are published in the meeting reports of the EB and their accompanying annexes.
- Taking into account both the rule-making and rule-enforcing roles of the EB, decisions of the EB can be divided into three main classes: [EB67 Anx4 para7]
  - ☞**Regulatory decisions** relating to o the adoption of, or revision to, CDM rules and requirements to be followed by stakeholders.
  - ☞**Rulings** relating to o the determination of whether the actions of PPs, AEs and DOEs are in compliance with the CDM rules and requirements
  - ☞**Operational decisions** relating to the functioning of the EB and its support structure and include: decisions on finance; administration; programmes of work; internal operating procedures and the establishment of supporting bodies
- There is the code of conduct for member and alternate member of the EB. [EB69 Anx1]
- There is terms of reference in relation to the membership of the EB. [CMP/2010/L.8 Anx 1]

Members of the EB [CMP/2005/8/Ad1, p9 para7-12]

☞The EB comprises 10 members from Parties to the KP.

⇒1 member from each of the 5 UN regional groups, 2 other members from the Annex I Parties, 2 other members from the non-Annex I Parties, and 1 representative of the small island developing States.

⇒The 5 regional groups of the UN are: Asia, Africa, Latin America, Eastern Europe, and the Western European and Others Group

⇒As a result, 4 are from Annex I Parties and 6 are from non-Annex I Parties, unless 1 member from Asia is selected from Japan.

⇒There is an alternate for each member of the EB.

☞Members, including alternate members, of the EB are nominated by the relevant constituencies referred above, and be elected by the CMP.

⇒Vacancies shall be filled in the same way.

☞Members are elected for a period of 2 years and be eligible to serve a maximum of 2 consecutive terms.

⇒Terms as alternate members do not count.

☞5 members and 5 alternate members are elected initially for a term of 3 years, and other members and alternate members for a term of 2 years. Thereafter, the CMP elects, every year, 5 new members, and 5 new alternate members, for a term of 2 years.

☞The EB elects its own chair and vice-chair, with one being a member from an Annex I Party and the other being from a non-Annex I Party.

⇒The positions of chair and vice-chair alternate annually between a member from an Annex I Party and a non-Annex I Party.

Meeting and decision of the EB [CMP/2005/8/Ad1, p10 para13-16]

☞The EB meets as necessary but no less than 3 times a year.

☞At least 2/3 of the members of the EB, representing a majority of members from Annex I Parties and a majority of members from non-Annex I Parties, must be present to constitute a quorum.

☞Decisions by the EB is taken by consensus, whenever possible. If that is not possible, decisions shall be taken by 3/4 majority of the members present and voting at the meeting. Members abstaining from voting shall be considered as not voting.

☞Meetings of the EB are open to attendance, as observers, except where otherwise decided by the EB.

Fig 13. CDM Executive board

The EB decision [EB67 Anx4 para7-9]

CMP is the ultimate decision-making body of the CDM. CMP decisions are treated as mandatory requirements or rules intended to ensure the successful implementation of the Kyoto Protocol.

The EB is the regulatory body of the CDM. Acting under the authority and guidance of the CMP, it is fully accountable to the CMP.

Regulatory decisions: relate to the adoption of, or revision to, CDM rules and requirements to be followed by stakeholders. Regulatory decisions are reflected in the adoption of, or revisions to: standards, procedures, guidelines and clarifications;

Operational decisions: relate to the functioning of regulatory body the EB and its support structure (panels, working groups and secretariat) and include: decisions on finance; administration; programmes of work; internal operating procedures and the establishment of supporting bodies.

Rulings : relate to the determination of whether the actions of PPs, applicant entities (AEs) and DOEs are in compliance with the CDM rules and requirements.

◆CMP requested the EB to adhere to the principle that any decision, guidance, tool and rules shall not be applied retroactively. [CMP/2010/L.8 para15]

Document [EB67 Anx4 para10]

☞**Standards** are designed to achieve a uniform approach to compliance with the CDM modalities and procedures. A standard describes mandatory levels of performance (policy standard) or provides mandatory specifications (methodological standard), and as such, is used as a reference point against which compliance is evaluated. Methodological standards include methodologies and methodological tools.

☞**Procedures** contains a mandatory series of actions that must be undertaken to ensure demonstrate in a uniform and consistent way that the EB, the secretariat, PPs, DOEs and other stakeholders comply with the CDM modalities and procedures and the standards issued by the EB. Procedures relate to processes in the CDM project cycle and the operations of the EB and its support structure including, the rules of procedures of the EB and the terms of reference for the support structure

☞**Guidelines** contain supplemental information such as acceptable methods for satisfying requirements identified in standards or procedures, or instructions on how to fill out forms. Guidelines describe processes and are designed to promote a uniform approach to compliance with the applicable standards or procedure

☞**Clarifications** are issued to alleviate confusion relating to the application of requirements in a standard or procedure. Policy clarification and methodological clarification are issued by the EB.

☞**Ruling notes** explain the rationale behind a negative decision (ruling) of the EB regarding, inter alia, DOE, registering a project activity or PoAs or issuing CERs.

☞**Information Notes** contain factual information on a particular subject matter relating to the CDM rules and requirements, the functioning of the EB and its support structure, or rulings of the EB.

☞**Forms** contain pre-defined data fields to be filled in by PPs or AEs/DOEs.

☞**Glossary** is an alphabetical list of terms relating to the CDM;

☞**Recommendation** is a document endorsing, approving, supporting, providing options or recommending a course of action.

Fig 14. The decision making of EB

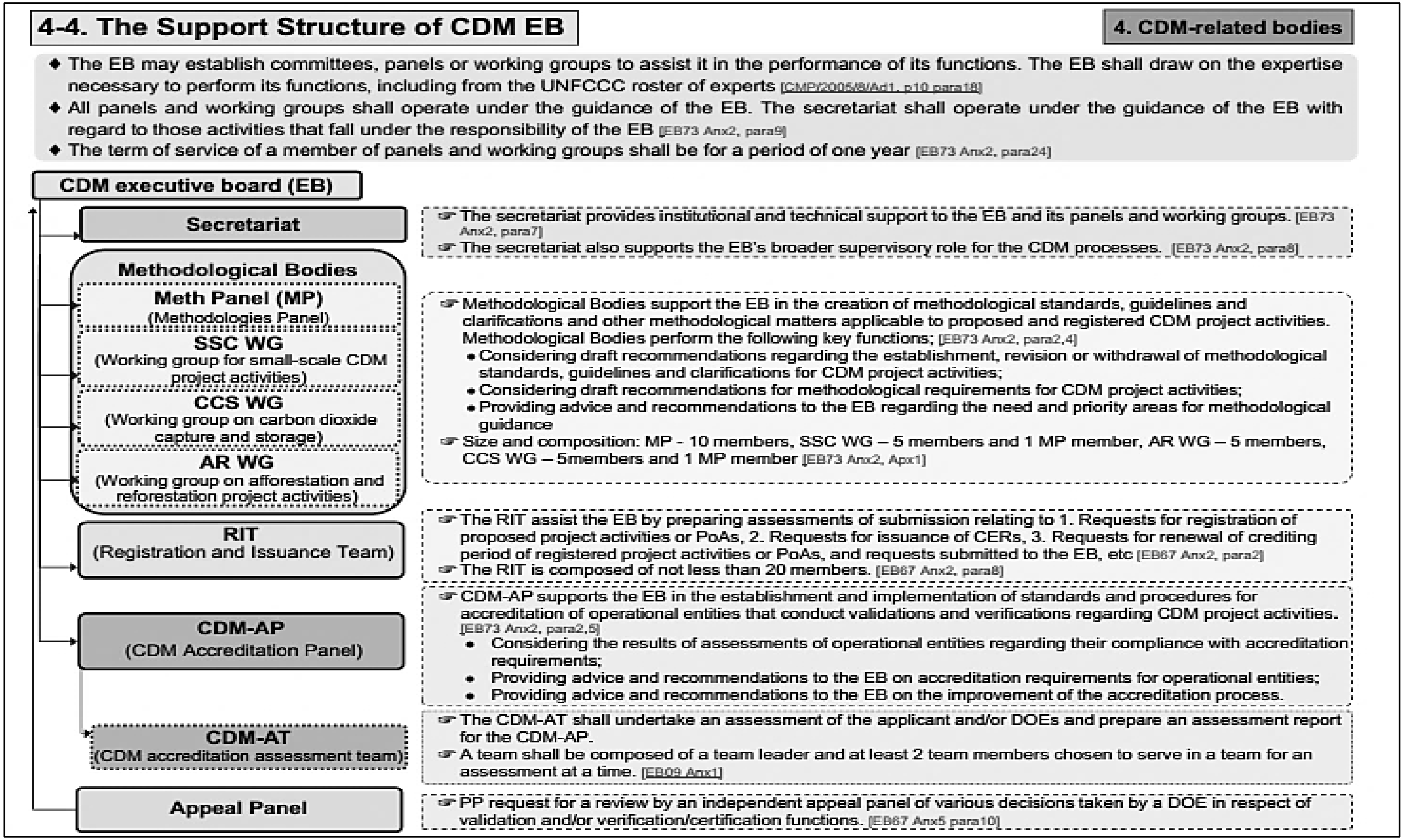


Fig 15. Support structure of CDM EB

4-5. Designated Operational Entity (DOE)

- A DOE under the CDM is either a domestic legal entity or an international organization accredited and designated, on a provisional basis until confirmed by the CMP, by the EB.
  - ☞ It validates and subsequently requests registration of a proposed CDM project activity.
  - ☞ It verifies emission reduction of a registered CDM project activity, certifies as appropriate and requests the EB to issue Certified Emission Reductions (CERs) accordingly.
- The list of DOEs is shown in <http://cdm.unfccc.int/DOE/list/index.html>.
- Upon request, the EB may allow a single DOE to perform all these functions within a single CDM project activity. [CMP/2005/8/Ad1, p12 para27(e)]

The terms used in DOE related official documents are:

- ☞ Applicant entity (AE)= once application has been duly submitted/subject to a procedure;
- ☞ Designated operational entity (DOE)= after designation by CMP;

[EB56 Anx2, p3 footnote]

Procedure for accrediting OEs [EB56 Anx2, para3]

- The CMP designates operational entities (OEs) (or withdraws their designation) based on a recommendation by the EB.
- The EB takes the decision whether or not to accredit an AE and recommend it to the CMP for designation, and to fully or partially suspend a DOE, or to withdraw accreditation of a DOE. Accreditation by the EB implies provisional designation.
- CDM-AP serves as the technical panel of the EB in accordance with its terms of reference and makes recommendations to the EB on effective implementation of the CDM accreditation process.
- CDM-AT, in accordance with the CDM accreditation procedure and under the guidance of the CDM-AP, undertakes the assessment of an AE and/or DOE, to identify the level of conformity to the CDM accreditation requirements and reports to the CDM-AP.
- The secretariat supports the implementation of the CDM accreditation procedure.

The accreditation (re-accreditation) assessment of an AE consists of following main elements:

- ☞ Desk review by a CDM-AT of the adequacy of the documented system of AE to meet the CDM accreditation requirements and perform CDM validation and verification functions;
- ☞ On-site assessment by a CDM-AT to evaluate the implementation of the system. The on-site assessment shall take place at the office of the AE and/or at any other site where the CDM functions are undertaken, as decided by the CDM-AP.

[EB56 Anx2, para4]

There is "CDM accreditation standard for operational entities (ver.4)". [EB67 Anx4]

Performance assessment

[EB56 Anx2, para6-9]

- ☞ A DOE shall be subject to performance assessment by the CDM-AT in relation to the scope of its accreditation.
- ☞ A DOE shall be subject to regular on-site surveillance. The surveillance shall be undertaken at least once in 3 years of the accredited period of a DOE.
  - ⇒ EB may extend from 3 to 5 years the frequency of reaccrediting operational entities. [CMP8/CDM]
- ☞ The EB may initiate a spot-check to be conducted at any time with a view to assessing whether a DOE still meets the CDM accreditation requirements.
- ☞ A DOE may be subject to additional desk review and/or additional on-site assessment at any time of its accreditation period as and when decided by the CDM-AP or the EB. Reasons for such additional assessments shall be conveyed to the DOE.
  - ⇒ There is the type of information regarding DOE performance to be made publicly available. [EB58 Anx1]

Fig 16. Designated Operational Entity

Suspension or withdrawal of a DOE [CMP/2005/8/Ad1, p11 para21]

The EB may recommend to the CMP to suspend or withdraw the designation of a DOE if it has carried out a review and found that the entity no longer meets the accreditation standards or applicable provisions in decisions of the CMP.

- ☞The EB may recommend the suspension or withdrawal of designation only after the DOE has had the possibility of a hearing.
- ☞The suspension or withdrawal is with immediate effect, on a provisional basis, once the EB has made a recommendation, and remains in effect pending a final decision by the CMP.
- ☞The affected entity shall be notified, immediately and in writing, once the EB has recommended its suspension or withdrawal.
- ☞The recommendation by the EB and the decision by the CMP on such a case shall be made public.
  - ⇒ It is assumed that if the CMP decides the affected DOE meets the accreditation standards, the DOE will recover from its suspension or withdrawal.

Affect to registered CDM project activities by the suspension or withdrawal of designation of a DOE [CMP/2005/8/Ad1, p11 para22-24]

- ☞ Registered project activities shall not be affected by the suspension or withdrawal of designation of a DOE unless significant deficiencies are identified in the relevant validation, verification or certification report for which the entity was responsible.
  - ⇒ There is no clear definition of "significant deficiencies."
- ☞ In this case, the EB shall decide whether a different DOE shall be appointed to review, and where appropriate correct, such deficiencies.
  - ⇒ Any costs related to the review shall be borne by the DOE whose designation has been withdrawn or suspended.
- ☞ If such a review reveals that excess CERs were issued, the DOE whose accreditation has been withdrawn or suspended shall acquire and transfer, within **30 days** of the end of review, the excess CERs issued, as determined by the EB, to a cancellation account in the CDM registry.
- ☞ Any suspension or withdrawal of a DOE that adversely affects registered project activities shall be recommended by the EB only after the affected PPs have had the possibility of a hearing.

BOX: CDM Validation and Verification Standard (VVS) version 05.0 [VVS ver.5]

- ☞ Validation and Verification Standard(VVS) is applicable to DOEs that are under contractual arrangements with PPs or CMEs to validate and/or verify any CDM project activities or PoA based on CDM methodologies previously approved by the EB.

BOX: Performance monitoring DOEs [EB73 Anx14]

- ☞ **Objective:** To foster improvement of the performance of DOEs, and provide the EB and the CDM-AP with tools for informed decision making on actions in the accreditation process. [EB73 Anx14, para 3]
- ☞ **Scope:** To e monitors the performance of DOEs through the monitoring, classification and rating of the non-compliances identified at the requests for registration, issuance or post-registration changes submitted by DOEs [EB73 Anx14, para 4]
- ☞ The procedure establishes a system to compile information to calculate indicators relevant to the performance of DOEs at the stages of request for registration, request for issuance and request for post-registration changes. [EB73 Anx14, para 5]

BOX: Annual activity report to the EB by DOEs

- ☞ A DOE shall submit an annual activity report to the EB [CMP/2005/8/Ad1, page12 para27(g)]
- ☞ There is a form to be used by DOEs
- ⇒ DOE Annual Activity Report to the EB Form (F-CDM-AAR) (ver.1.1)

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Fig 17. Suspension or withdrawal of a DOE

From the developing country perspective, the CDM can:

- Attract capital for projects that assist in the shift to a more prosperous but less carbon incentive economy
- Encourage and permit the active participation of both privet and public sectors
- Provide a tool for technology transfer
- Help define investment priorities in projects that meet sustainable development goals

Specifically, the CDM project can contribute to a developing country's sustainable development objectives through:

- Transfer of technology and financial resources
- Sustainable ways of energy production
- Increasing energy efficiency& conservation
- Poverty alleviation through income and employment generation
- Local environmental side effects

5.5 Voluntary carbon offset schemes

5.5.1 *VER (Voluntary or Verified Emission Reduction)*

Outside of Kyoto compliant mechanisms, other actions taken to reduce GHG emissions are being verified and traded in the global over-the-counter market for GHG emissions. These are categorized as Non Kyoto compliant Reductions.

Some companies are trading emission reductions in other markets, since they fail to meet all the requirements or obligations under Kyoto for certification, such as, non-compliant with "additionality" or "leakage". These so-called Verified Emission Reduction (VERs) are not a standardized commodity. While they may eventually become CERs or ERUs many of these reductions have no secondary market benefits outside of their embedded green image value or speculative value. Buyers therefore tend to pay a discounted price for VERs which takes the inherent regulatory risks in to account.

The voluntary carbon market now growing because companies, government bodies, NGOs, and others that are often not subject to binding GHG regulations wish to:

- Make a quantifiable contribution to reduce emissions
- Increase response options and flexibility of carbon management
- Enhance public relations
- Generate goodwill by entering the carbon market
- Cement strategic interest in specific offset projects
- Manage corporate social responsibility commitments
- Become carbon neutral and/or sell carbon neutral products and services

Voluntary Carbon Units are providing companies and institutions with a solution to accelerate the shift towards a low-carbon economy. This is done by channelling funds through voluntary offset programs to low carbon technologies that directly reduce GHG emissions from the production and consumption of energy and from industrial processes.

Regulations and standards:

The compliance market has evolved around a set of rules and regulations that define issuance, validity and use of emission allowances and offsets. Principally, they relate to the criteria set forth for the Kyoto Protocol's flexible mechanisms and the European Directive on Emission Trading (EU ETS). However, no similar framework has existed for voluntary emission reduction actions.

The market for VERs is not currently regulated in the way that the CER market is VERs can vary largely in their quality depending on the supplier and the buyers should make sure that they perform due diligence prior to making a purchasing decision. High quality VERs should be developed according to the principles of the CDM or a recognized standard such as emerging the Voluntary Carbon Standard (VCS), which promote sustainable development alongside GHG emission reduction objectives. A VER credit will do the same as a CER credit – it has just not necessarily gone through the same UN approved process. For instance all CER credits have individual serial numbers guaranteeing that they cannot be sold twice, as there is no internationally recognized central issuing body or common registry for VERs that process is not yet possible.

VER credits sold by Carbon Accountable are 'pre-registratio CERs' this means that the project is developed under the Clean Development Mechanism but the emission reductions are generated before the projects is registered by the Executive Board and thus cannot be claimed as CERs but are robust, real and verifiable emission reductions.

5.5.2 *Gold Standard VERs*

Main supporters: The Gold standard Foundation is backed by the WWF and more than 50 other NGOs

Type of projects:

Eligible technologies under the Gold Standard include renewable energy and energy efficiency projects. Projects that reduce methane emission through the capture of landfill gas or biogas also qualify if the gas is combusted to generate electricity.

5.5.3 VER vs CER

The main difference between a voluntary Emission Reduction (VER) project and CDM is that a VER project is not part of the Kyoto agreement and the transaction costs are therefore a lot lower. Furthermore a VER project that reduces less than 5000tCO_2eq/yr is categorized as a micro scale project where a simple PDD is required.

5.5.4 Voluntary Carbon Standard (VCS)

The Voluntary Carbon Standard (VCS) is established to provide a credible and simple set of criteria that provides integrity to the voluntary carbon market. Specifically the, The VCSs ensures that all voluntary emission reductions meet specific criteria and are independently verified, creating voluntary carbon units.

The voluntary carbon standard aims to maintain a balance between environmental rigor and ease and cost of use. This is reflected in the CS criteria. In particular, the standard seeks to ensure that emission reductions are:

- Real: All emissions reductions must be proven to have genuinely taken place to qualify as Voluntary Carbon Units.
- Measurable: All emission reductions that are proposed for verification as Voluntary Carbon Units must use recognized methodologies and techniques for quantification
- Permanent: In order to offset emissions released elsewhere, it is essential that any CU represent permanent emission reductions and are not likely to be reversed
- Additional: A key factor in the validity of a project based emission reduction is that it should be additional, i.e. result in a lower emission level than would otherwise be the case.
- Independently Verified: All emission reductions proposed for certification as VCS must be verified by an approved independent third party verifier such as DNV

5.5.5 Verification

The verification is a result oriented process to determine the emission reductions achieved by the project. It verifies continued compliance with the criteria defined under the Kyoto protocol. The verification includes

- Review of monitoring results and data collection systems linked to emission reductions.
- Review of the established practices and the accuracy of data collected as well as monitoring equipment
- Review of the management system supporting the reported emission reductions

Type of projects under VCS:

Renewable energy, energy efficiency, methane capture, industrial processes and land use and forestry, including those that combat deforestation.

Methodologies:

VCS projects may utilize CDM or voluntary methodologies, which may or may not resemble CDM procedures. Obtaining VCS status is more straightforward than achieving CDM or Gold standard certification, and is hence a more suitable standard for smaller projects.

5.6 CDM and Forestry

In theory CDM provides a win-win situation for both industrialized countries and developing countries. Industrialized countries can exploit lower cost emission reduction opportunities abroad. Developing countries many of which do not have the means today to join the global economy could attract investment in the guise of CDM projects and in the process contribute to the global effort to reduce atmospheric GHG concentrations. Forestry projects are controversial due to the uncertainties about the expected rates of carbon sequestration and the difficult to determine social and environmental impacts. Resolution of the controversies around the CDM forestry projects will depend upon the adoption of acceptable baseline methodologies to measure their effects and broad impacts.

The CDM allows the developing countries to participate in the activities that could potentially bring down the cost of meeting the Kyoto protocol’s targets and simultaneously facilitate sustainable development in the host country. In spite of some unresolved issues many developing countries are now hosting CDM forestry projects. CDM projects also hold appeal towards the private sector, as companies like ITC have begun to investigate possible projects. The UNEP has launched a project, “Capacity Development for the CDM”, to help developing countries to participate.

The CDMs Afforestation/Reforestation working group has outlined a set of methodologies that will assess the different extent to which projects actually leads to reduced Co2 concentrations in the atmosphere, are-long-term and benefit society and the environment more broadly. It will be necessary to observe the effects of individual projects before the success of the CDM can be evaluated.

Forestry projects under the CDM would harness a natural process – The carbon cycle-to reduce the concentrations of CO_2 in the atmosphere. As a mitigation effort forestry projects under the CDM would capture or sequester CO_2 from the atmosphere in to carbon pools, thereby reducing concentration of CO_2 in the atmosphere.

5.6.1 Carbon sink and photosynthesis

Photosynthesis is the primary activity that drives the carbon cycle and thus the carbon sequestration in ecosystems. Photosynthesis also known as primary production occurs when chlorophyll containing plants in the presence of sunlight use water and CO_2 to produce carbohydrates ($6CO_2+6H_2O \rightarrow C_6H_{12}O_6+6O_2$). It is by this process that CO_2 is captured from the atmosphere and sequestered or incorporated in to green plants. The amount of CO_2 that is fixed is called gross primary production (GPP) and is estimated at 120 gigatons of carbon per year. The total amount of CO_2 that is absorbed by plants 270gigatonnes per year, which is approximately a third of all the CO_2 in the atmosphere. The net carbon uptake by an ecosystem is thus the balance between the NPP and the decomposition in an undisturbed environment. This is called net ecosystem production. Due to deforestation and other land use changes, however, terrestrial ecosystems release carbon from plants and soils and can become a net source of CO_2.

Eighty percent of the carbon exchange between the land and the atmosphere occurs in the forests. Carbon fixed during photosynthesis is stored in leaves, roots, needles and bark. Some of the carbon is transferred as dead foliage and twigs and forms the litter layer. The litter layer decomposes and the carbon is transferred as organic matter to the soil. Bacterial decomposition in the soil restores the carbon to the atmosphere.

Currently the terrestrial ecosystem acts as a global sink for carbon. About fifty percent of the dry weight of a tree is carbon. Carbon uptake occurs both in vegetation and in soils. Tropical forests are the biggest carbon stocks for vegetation but the boreal forests are the biggest for soil.

5.6.2 Measuring the success of Forestry projects under the CDM

The Kyoto Protocol requires that CDM projects lead to real, additional and long term emission reduction and contribute to sustainable development. Measuring the success of forestry projects under the CDM necessarily involves measuring the extent to which the project addresse these criteria. At the 10th COP, in Buenos Aires in Dec. 2004, agreement was reached on many definitions of land use, land-use change and forestry issues mentioned by the Kyoto Protocol. These definitions relate directly to the applicability of afforestation and reforestation projects. For instance a ‘forest’ under the CDM was defined according to minimum size (0.1-1ha), minimum crown cover (10-30 percent) and minimum height of trees (2-5m.). Measuring the sequestration that occurs in CDM forestry projects will be facilitated by such definitions. Measuring the extent to which the CDM meets the requirement of sustainable development is more complex and controversial

5.6.3 Carbon stock method

A proposed methodology for assessment and monitoring of CDM forestry projects known as the carbon stock method addresses the extent to which a project leads to additional, real and long-term GHG reductions. The carbon stock method was set forth in the IPCC Good Practice Guidelines for Land-Use, Land Use Change and Forestry projects that was presented at the eighth COP at New Delhi, India in 2002. Under the proposed methodology, a series of criteria and equations would be utilized to determine carbon balances for both a baseline and a project scenario.

The annual carbon stock changes are taken in to account for the main carbon pools: AGB, litters and soil organic carbon. This methodology allows determination of the ‘additionality’ of a particular project by taking in to account the ‘with’ and ‘without’ project scenarios, along with any emissions associated with project implementation. The resulting net change in anthropogenic emissions is measured in CO_2 equivalents, representing the sum of “verifiable post project changes in carbon stock with in the reservoirs” minus the baseline minus leakage in the form of carbon release from pools outside of the project area. The carbon sequestered represents a ‘liquid contribution’ of the CDM forestry project to the increase of CO_2 sequestration within project boundaries

5.6.4 Establishing the baseline

Establishment of the baseline condition occurs at the start of the project and involves determination of the most likely land use for the project area in a “without project” or “business-as-usual” scenario. The baseline approach is defined in the “Proposed New Methodology for Afforestation and Reforestation Project Activities: Baseline” as an account of “changes on carbon stocks in the pools with in the project boundary from the most likely land use at the time of the project starts”. The determination of carbon stock changes associated with the most likely land use in the absence of the project is made by identifying and quantifying several key factors. Direct human impacts on the components if the ecosystem such as land-use conversion, anthropogenic fires, or agricultural conversion, must be projected. Natural ecosystem dynamics of the project area, including the natural succession of species, and indirect human impacts like occurrence of invasive species or climate change, must also be predicted. These factors are incorporated in to the baseline by utilizing economic modelling, policy and local practice research, available data on ecosystem variables, and on site data collection. A model based on these variables is developed for each vegetation stratum. These baseline model components are then compared against actual carbon sequestration under the “with-project” scenario, determined by carbon monitoring within the project area.

5.6.5 Project monitoring

Monitoring the carbon sequestered in a CDM forestry project area involves both modelling and data collection via remote sensing and on site sampling and measurement. Remote sensing describes different methods that involve measuring from a distance, including aerial photography, in order to develop maps for afforested and reforested areas. This spatial data can be analysed using GIS to monitor changes in forest growth and cover. On-site data collection involves techniques used for forest inventories, soil sampling, and ecological surveys. Only those carbon pools measured and monitored may be claimed for carbon credits. Vegetation is divided in to strata in order to ensure that carbon pools are being measured for geographically and ecologically homogenous areas. Experimental plots are established within these stratified areas in which the actual sampling of various carbon pools will occur. The number of experimental plots designated is based on statistical analysis and must take in to account both the typology of the vegetation and the different types of soil. These plots must be determined by the fifth year of the project. Random plots of four by twenty five meters are delineated, but lots are expanded to five by one hundred meters if trees are found within the plot with diameter exceeding 30cm.

Carbon pools include aboveground biomass (trees and herbaceous growth), belowground biomass, litter and soil. Biomass measurement procedures include dbh for trees and dry weight for herbaceous growth. The dbh measurement, taken at 1.3 meters from the ground is converted to biomass and then to a carbon estimate (50% of biomass) using standard biomass regression equations. In order to sample herbaceous biomass, two sub plots measuring one meter by one meter are delineated at random within the larger experimental plots. Within these small quadrants, all biomass at soil level is cut and fresh weight per square meter is measured. Litter, leaves, branches, twigs and other accumulating dead or decaying material on the forest floor is sampled in still smaller sub plots (0.5m. X 0.5m.) With in the one square meter quadrants. Samples are also brought back to the lab to obtain a dry weight measurement. Standing and fallen dead trees are measured in the same way as live trees, though the biomass of fallen dead trees also takes in to account the length of the trees with in the experimental plot. Belowground biomass is estimated based on an accepted ratio of AGB to BGB. This is done because methods for belowground measurement are complicated and have not yet been standardized. The standard belowground to aboveground biomass ratio, which exhibits little variation across latitudes and soil types, is listed in the IPCC guidelines as 0.2698. Soil cores are also to be taken within the experimental plots and analysed using laboratory procedures such as loss on ignition, in order to determine carbon content. Most measurement are taken annually, though soil stock changes occur even slower than biomass changes, so soil samples are to be taken every 2 years. These are recommended to be soil cores taken to a depth of 30 cm. Project verification occurs on a five year cycle with results presented to the Executive Board at this time.

The overall purpose of this carbon monitoring process is to convert carbon stock changes in to carbon credits to be sold on the market using the Certified Emission Reduction (CER) unit. In order to carry out this conversion, the carbon stock is calculated as the mean carbon sequestered for all sample plots in the project area. One ton of biomass carbon is equivalent to 3.67 ton of atmospheric CO_2 or 3.67 CER units.

5.6.6 Measuring the sustainability of CDM forestry project

Article 12 of the Kyoto Protocol states that CDM projects must help developing nations to realize sustainable development. To ensure this, the CDM project approval process includes an assessment of the ecological and socioeconomic impacts of each project.

Several sets of criteria and indicators to assess these impacts have been developed, though no single set has yet been agreed upon to serve as the standard. One example of a series of criteria and indicators to asses environmental integrity and social equity was developed in 2003 as part of a study conducted by the International Institute for Environment and Development. Criteria for environmental integrity include a net increase in the amount of carbon sequestered improvement in air, water and soil quality and maintenance of or increase in biodiversity. Assessing social equity takes in to account a number of criteria examples of which include net employment gain, quality of employment, financial commitment to social goals and local participation. This degree of social inclusion of residents in the generation of carbon credits is a key issue in assessing the contribution of CDM forestry projects to local sustainable development. More formalized options for the assessment of sustainable development at the project level include detailed environment and socioeconomic assessment that could be adapted to CDM forestry projects.

5.7 CDM Forestry projects and the problem of uncertainty

The objectives of forestry projects under the CDM is the reduction of CO_2 concentrations in the atmosphere through the cultivation of trees that sequester carbon in a way that promotes sustainable development. The IPCC’s Special Report on Climate Change and Land Use, Land Use Change and Forestry states that successful forestry projects should be transparent, consistent, comparable, complete, accurate, verifiable and efficient in recording and reporting methods in measuring the amount of change in carbon stocks. Much of the controversy around forestry projects under the CDM centre around whether such projects meet these requirements. Critics claim that trees are not permanent repositories of carbon, that it is difficult to measure how much carbon trees sequester and that such projects do not reduce GHG concentrations because they lead to additional GHG emissions elsewhere. Many of the negotiations around the use of forestry projects under the Kyoto Protocol were attempts to reach consensus on how to account for such areas of uncertainties.

5.7.1 Uncertainties regarding carbon sequestration

Forestry projects are included under the CDM due to the ability of the green plants to sequester carbon from the atmosphere and incorporate it within their chemical composition. There are many variables that determine the capacity of trees to sequester carbon, giving rise to uncertainty about the effectiveness of forestry projects as mitigation efforts

5.7.2 Uncertainties due to Tree age and species

Growing plants have a higher rate of carbon sequestration than mature plants. This is because younger trees require additional carbon to grow and synthesize various parts of their structure. However, mature trees are a large carbon pool and are able to store large amounts of carbon than younger trees. Additionally, carbon sequestration capacity has been found to be higher in longer lived trees with high density wood as compared to short-lived, low density, fast-growing trees. The old growth forest act as a carbon reservoir even though it is not experiencing net growth. Planting new trees is beneficial because growing trees have higher rates of carbon sequestration whereas mature forests hold the largest carbon pools and as such should also be protected.

The carbon sequestration rates also differ according to the species. Globally pine has a high rate of sequestration within the first two decades which rapidly declines and becomes insignificant after 70 years. In contrast, Ponderosa pine shows a steady uptake of carbon with a peak at 70 years. While teak had high sequestration potential, Palm oil was found to be a net source of carbon. This highlights the importance of the species planted in an afforestation or reforestation project.

5.7.3 Uncertainties caused due to the influence of nutrients and water

When adequate nutrients (especially nitrogen and phosphorous) are available in the soil and atmosphere, organic carbon is converted to new plant biomass. If these nutrients are limited, photosynthetic activity is reduced and as a result the carbon uptake decreases.

Nutrient-rich soils are therefore essential for the growth of plants and for carbon uptake. Northern mid latitude forests are large carbon sinks but shortages of nitrogen can limit carbon sequestration. Another factor that could affect the sequestration relates to the availability of water, an essential component of photosynthesis. Slow water infiltration, low water holding capacity and high salinity could limit plant growth and therefore sequestration.

5.7.4 Uncertainties relating to measuring sequestration

There are many uncertainties in accounting for the actual carbon stock in the carbon pool. The amount of carbon stock in a forest is calculated by measuring the carbon sequestered, the carbon stored in biomass above and belowground and the carbon found in the soil.

The amount of carbon released is accounted for by measuring the carbon lost during the process of respiration, decomposition of dead decay matter and litter by bacteria in the soil, and carbon also lost by the leakage activities. Several uncertainties affect the accounting of carbon stock in the carbon pools when forestry projects are implemented.

This include: definitional errors due to bias or inconsistencies resulting from the interpretation of the rules; classification errors causing the mis-classification of land: estimation errors due for instance to events such as the omission of errors in remote sensing; identification errors, which arise while defining the geographical boundaries of the forest projects; and sampling errors, when samples obtained for a forestry project do not sufficiently represent the whole project. Remote sensing can be used to identify lands and units of land of forestry projects. Uncertainty can arise if the satellite images are of inadequate resolution.

Errors can also occur if images are incorrectly dated and are incorrectly attributed to the wrong plot of land.

In addition to uncertainties in default carbon emission and removal factors, missing activity data gives rise to further uncertainties. Determining retrospectively the inventory for the base year (usually 1990) may be difficult for cropland management, grazing land management and reforestation. Where the net carbon emission and removals for the base year cannot be established using the default carbon emission and removal factors, they may be estimated by extrapolating a consistent time series. This requires accurate data keeping and logs on the land management history for twenty years.

5.7.5 Uncertainties relating to measuring the impact of forestry projects

Even if the amount of carbon sequestered by a forest can be accurately measured, there are significant uncertainties surrounding the effect on GHG emissions of CDM forestry projects outside the project boundaries and in to the future. The CDM working Group has proposed methodologies for accounting for these uncertainties.

5.7.6 Permenance

The use of forest projects depends on the assumption that trees sequester carbondioxide and keep it for a significant period. The life spans of forests are measured in centuries: studies have shown that tropical forests continue to sequester carbon throughout their life. It is difficult to predict with certainty that a forest’s projected sequestrations will actually occur over the life time of the trees. Stored carbon could be released back to the atmosphere through natural forces like fire, disease, and hurricanes or through human activities such as the non-enforcement of contracts, non-compliance with guarantees, expropriation, revocation of property rights, changes in policy and market risks.

5.7.7 Additionality

The Kyoto Protocol states under Article 12 that CDM projects must be additional compared to business-as-usual scenario. This means that projects must lead to more GHG reductions than would have occurred without the project. One possible objection is that a forestry project would have happened anyway either without the CDM due to commercial or political reasons. Although there are methodologies to account for additionality, different forestry projects will pose different accounting factors. Some forestry projects would probably go ahead whether or not the CDM existed, such as industrial-scale exotic-tree plantations for pulpwood or saw timber.

5.7.8 Leakage

Leakage is the unanticipated increase in GHG emissions that occur outside the boundaries of a project as a result of the activities conducted within the project boundary. Experience with leakage to date has been restricted to a few projects due to a lack of data and limited time since project inception. One controversial example is a pilot reforestation project taking place in Minas Gerias, Brazil, where reforestation may cause energy intensive pig iron industries to move to states with less environmental control. In addition, there is the possibility that land owners will be displaced, causing them to establish new pastures on presently forested land. Quantifying leakage may be difficult in some cases.

6. PROTOCOLS FOR DEVELOPING FORESTRY CARBON PROJECTS

6.1 Key changes in CDM and voluntary market since the inception of this project

The major change in the markets is that the initial crediting period for the CDM is over (2008-12) and efforts for a second commitment period was proposed in 2012, known as the Doha Amendment, in which 37 countries have binding targets is not in force yet furthermore some of the major polluters withdrawn from the treaty weakening the mechanism. The latest conference of the parties held at Lima, Peru (2014) major parties like China, India, and the U.S. have all signalled that they will not ratify any treaty that will commit them legally to reduce CO_2 emissions.

Although recent developments in the CDM market are not encouraging the voluntary carbon market is booming as REDD projects transaction volumes more than doubled to 22.6Mt CO_2e and market volume also increased by 35% to $49 million (World Bank, 2014).

6.2 Major A/R projects in Kerala

1. National Afforestation Programme (NAP)

   Location- all Kerala

   Area-4095.15

   Year- 02-12

2. Social Forestry Programme

   i. Ente Maram Padhathi (07-11)

   Location- 6261 schools in Kerala

No. of Saplings- 42.12 lakhs

ii. Nammude Maram Padhathi (08-09)

Location- 2000 plus two schools and colleges

No.of sapligs-10.57 lakhs

iii. Vazhiyora Thanal (07-09)

No. of saplings-1.22 lakhs

iv. Haritha theeram (07-09)

Location- Coastal belt of Kerala

Area- 163.4 Ha of Casuarina plantation and 14.65Ha of mangrove plantation

No. of saplings – 22.52 lakhs

v. Haritha Keralam (09-11)

Location- Unutilized lands in the village including community and institutional lands, road sides, railway sides, river banks etc.

vi. Conservation of Mangroves

Location- Vembanad and Kannur region

6.2.1 Limitations of ongoing A/R projects

1. Unavailability of information required for selecting a baseline and demonstrating additionality.

2. The project proponent (KFD) must have a detailed understanding to develop an accurate procedure for the project

3. The AR-CDM land eligibility rules are quite inflexible to accommodate current land-use decisions

6.3 Forestry projects under CDM

The clean Development Mechanism under the Kyoto Protocol allows limited participation of forestry projects. Only afforestation and reforestation (A/R) projects are allowed, as discussed earlier. The Kyoto Protocol proposes a particular format for the documentation of afforestation and reforestation projects. The project proponent must have a detailed understanding to develop an accurate procedure for the project. This understanding also helps in the easy registration of the project under the CDM Executive Board.

6.3.1 The forestry projects involve the following stages:

1. Project identification

   In the project identification stage, project proponent should identify the potential site, the estimation of labour with cost, the possible assumption of additionality, and its baseline scenario. The project should meet all the criteria set up by the host country regarding sustainable development. This is an important prerequisite for the development of forestry projects under CDM along with an accurate assumption for the afforestation and reforestation activity that the project is going to take up. In addition, it should also be estimated whether the project is a small or large scale one based on the potential delivery of CERs.

2. Project Idea Note

The project idea note (PIN) comprises a short detail of the project. Hence it should be prepared as per the requirement of the buyers and the markets. For preparing an ideal PIN, project developers should take care of the following:

- Determine the primary goals of the project according to the requirements of all stakeholders. Goals can be financially, environmentally, and development oriented
- Based on these goals, identify a cost effective and suitable afforestation and reforestation activity for the project
- Identify a boundary in which the project activities will be limited and then prepare a PIN of around four to five pages

3. Project Concept Note

Another most important aspect of an afforestation and reforestation project is determining the concept of additionality. In a concept note one should first clarify the issue of additionality with the required methodology. One should also attempt to elaborate the sustainable development indicators (including social, environmental, technological and economic well-being) because afforestation and reforestation projects with both environment and social co-benefits are prepared by buyers and investors.

In this note, the baseline scenario, methodology, project boundaries, scope, and the life span of the project should also be discussed in detail. In addition, financial indicators (flow of additional investment, internal rate of return of the project with and without CERs, agreements with stakeholders and availability of funding), technical feasibility, risk analysis and credentials with government endorsement should be classified here

4. Development of Project

4.1 Project cycle

To qualify under the CDM, afforestation and reforestation activities must be in accordance with the CDM project cycle (see Figure below), and apply an approved methodology. Achieved carbon removals are then issued as carbon credits so they can enter the carbon market for compliance with reduction targets.

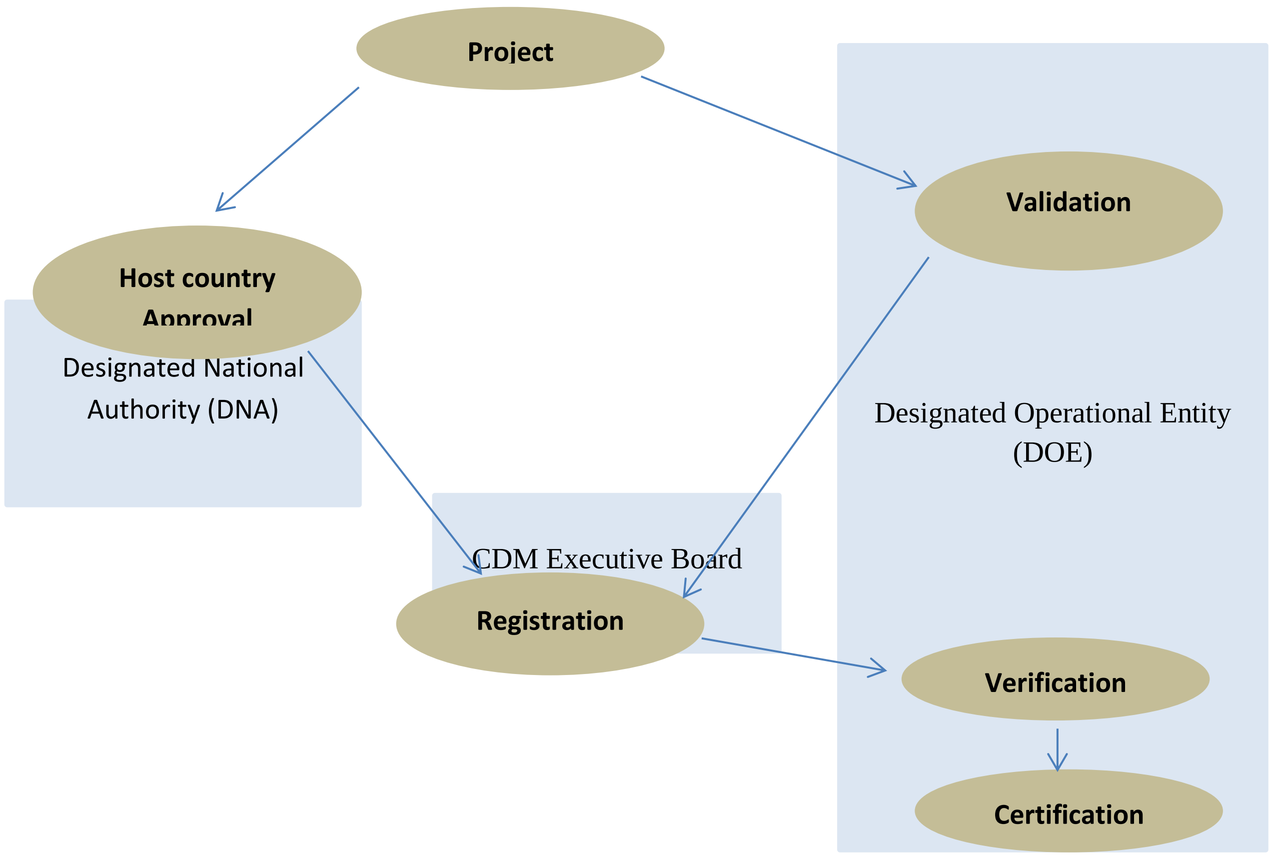

Fig: 18 CDM Project Cycle

Project Design document (PDD)

The final step of project development is preparing the project design document (PDD) and submitting it for validation.

Baseline Design

The baseline may be designed by the proponent or adapted to fit the existing methodology. Baseline study can be done with an appropriate and approved methodology, as approved by the UNFCCC. It should consider the actual scenario that would have happened in the absence of the project

Local stake Holder consultations

Consultative meetings should be held with the involvement of all stakeholders at each and every stage of project development. Designated National Authority (DNA) representatives should be invited to these meetings as observers, if possible. The PDD should explain the process by which stakeholders were engaged in the project. The participation of the stakeholders should be recorded with their comments, and the PDD must include a compiled summary of the comments

Validation

Validation is the process of independent evaluation of a proposed afforestation and reforestation project activity under the CDM by the Designated Operational Entity (DOE) against the requirements set out in decision 19 of the ninth meeting of the COP and other relevant decisions on the basis of the PDD. During the validation of a project the DOE ascertains the legality and accuracy of the assessments that are made through interview, site analysis and inspection. The validation process normally takes around four weeks

Registration

After successful validation, the DOE submits the project to the CDM Executive Board for the final approval. For the verification, certification and issuance of temporary CERs (t CERs) or long-term CERs (lCERs) to an afforestation and reforestation CDM project activity, "registration" is required. Normally this process does not take more than eight weeks. Registration is the formal acceptance by the Executive Board of a validated project as a CDM project activity. Registration is deemed final eight weeks after the date of receipt of request for the registration unless there is a request for review.

Monitoring

Monitoring refers to the maintenance of the project site for hassle free delivery of CERs and protection of the site from potential damages. It is also referred to as a collection and archiving of all relevant data mandatory for estimating or measuring the net GHG removals by sinks, which are created by the project during the crediting period, pertaining to all the activities carried out by the project participants.

Verification

Verification is the periodic independent review and ex post facto determination by the DOE of the net anthropogenic GHG removals by sinks achieved by an afforestation and reforestation project activity under the CDM since the inception of the project. For small scale CDM projects, the DOE agency validating the project verification (CIFOR, 2005). The verification and certification of CER must be conducted by a DOE different from the one that carried out the validation.

Certification

Certification of the project is done by the CDM Executive Board after the DOE provides a written confirmation that an afforestation and reforestation project activity under the CDM has achieved the net anthropogenic GHG removals by sinks since the start of the project as verified. The duration of this process is 15 days. Subsequently, the CDM Executive Board issues a certification followed by the issuance of CERs to the project applicant entities. This step is repeated after every round of submission of verification report.

Issuance of CERs

The issuance of lCERs or tCERs refers to the instruction by the Executive Board to the CDM registry administrator to issue a specified quantity of lCERs or tCERs for an afforestation and reforestation CDM project activity in to the pending account of the Executive Board in the CDM registry. The time frame for developing a carbon project that needs to be taken in to account approximately 12 months until the project is validated and 1.5 months for the registration.

Afforestation and Reforestation Methodology and Project Evolution

The registered projects under the afforestation and reforestation sector are quite few compared to the overall CDM. Some of the reasons for this are as follows:

- For the projects in this sector, the modalities and procedures were created later than those in the other sectors.
- The methodology approval process is strict and time consuming
- A/R methodologies are very complex to apply

CDM Regulations

Compliance with the AR-CDM requirements is quite challenging and should always be kept in mind at different stages. During preparation, the following challenges are notable:

- Difficulty in selecting a suitable methodology due to unclear and overlapping applicability conditions.
- Unavailability of information required for selecting a baseline and demonstrating additionality

During validation, the challenges to consider is the delay in validation of projects because of multiple revisions to methodologies and low capacity of projects to comprehend regulation and provide supportive documentation.

During verification, problems occur when a project deviates from the PDD, resulting in to changes in the monitoring plan. The redrafted plan has to be submitted again for the CDM Executive Board approval, which delays verification and credit issuance.

Limitations of CDM Land Eligibility Rules

- The AR-CDM land eligibility rules are quite inflexible to accommodate land-use decisions
- Demonstrating land eligibility is a challenging job in the absence of official records and satellite imagery, as well as the low capacity of projects to interpret data and information
- By excluding areas that are temporarily stocked with carbon, the "the land eligibility rules" make projects on agricultural lands in the tropics challenging

6.4 Development of forestry carbon projects under voluntary mechanisms

Forestry projects other than A/R are not eligible for the globally regulated CDM mechanism under the Kyoto Protocol. However there could be a variety of forestry projects that can sequester carbon, including forest conservation, reduced deforestation and degradation projects. Voluntary markets are being established to recognize these kinds of projects and those provide another scope for earning carbon credit outside the purview of CDM. However, for the documentation of forestry projects to be traded in voluntary markets, these voluntary carbon mechanisms are fragmented with complex supply chains and numerous emerging standards, which provide relevant information required during project development (table 4 gives a comparison of different VCSs in the market). Moreover historical data being limited, assessment of the benefits and drawbacks of each standard provider becomes difficult. Only some such offset projects are independently verified to agreed up-on standards but not all. These standards are numerous and overlapping, but as technology and attention increases scrutiny, ignoring them may lead to risks of ineffective reductions, unintended but adverse consequences, and even accusations of green washing (Hamilton, et al., 2007).

These carbon standards primarily assist in project development by providing guidance. Secondly they help in certification and registration along with some standards that help in providing market linkages to the project proponents. Therefore, project developers should analyse these standards well before the conception of the project and its implementation. Project proponents should take cue from a particular standard, and then they should build projects seeking guidance from the same standard. This will help in ensuring the success of a project and earning revenue from carbon credits.

6.5 Ten Steps to consider for developing a carbon forestry project

Before starting a forestry carbon project, it is important to keep several points in mind. There are ten major steps to consider for developing forestry carbon project. The first five are the feasibility assessment steps and the remaining are to be taken with a project developer who thinks that the project is viable.

- *Type and scope of the project*

  A clear idea, of which type of projects should be developed, for example afforestation, reforestation, improved farming techniques (soil carbon sequestration) and where the project should be implemented

- *Resources check*

A significant amount of time needs to be invested to develop a carbon project so it is necessary to analyse why it would be attractive to engage in undertaking a carbon sequestration project.

- *Project group*

  Farmers or villagers to be identified, who want to participate and have land or forest that can quality for the project type determined in step1. The project boundary has to be established. The project area needs to be big enough to generate carbon emission reductions to qualify for a carbon project; for a REDD project the minimum project area is around 30,000-40,000 ha and for an AR-CDM project it is around 10,000 ha. Small scale AR-CDM projects must result in GHG removals of less than 16,000 tonnes of CO2 per year. In addition clear land use and tenure rights are essential

- *Institutional backup*

  To organize, aggregate and represent farmers an institution is required, such as a community based organization, farmers' cooperative or NGO which is trusted by the project participants. It should have a robust and transparent institutional set up. In addition it is of advantage of the institution has some expertise on carbon project development, carbon measurements and accounting and business plan development.

- *Funding*

  For getting sufficient funding it is important to develop a business plan that take in to account all costs and benefits of the project. Ensure adequate funding for the initial set up for the project. With the information gathered in the first five steps, a project idea note (PIN) should be developed, which can be used further.

- *Identification of project developer*

In collaboration with the institution, a project developer has to be selected who can assist with the formulation of the project. The project developer is responsible for preparing it for the market. The developer can be backup institution (step 4), if it has sufficient experience or a specialized project developer company (Eg: Ecosecurities, Ecopositive, EC carbon, Terra Global Capital and Capital Neutral Company), or the World Bank Carbon Finance Unit

Table 13. Comparing different Voluntary Carbon Standards (VCSs)

Standard	Description	Focus on environment and social benefits	Reporting/ registration	Product Label?	Inclusion of LULUCF methodology	Geographical reach
Gold standard	Certification for offset projects and carbon credits	Yes	VER registry in development	Yes	No, energy projects only	International
The VCS	Certification for offset projects and carbon credits	No	Use bank of New York; other registry			
TBD	Yes	Yes	International	2007		
Climate, Community and Biodiversity Standards	Certification for offset projects	Yes	Projects on website	Yes	Only LULUCF	International
CCX	Internal system for CCX offset projects and CCX	No	Registry incorporated with	No	Yes	International

	carbon credits		trading platform			
Plan Vivo	Methodology and certification for offset projects and carbon credits	Yes	No	No	Community based agroforestry	International
WBCSD/WRI Protocol	Guidelines for projects and corporate GHG accounting	No	Does not include registry	No	Protocol created for LULUCF	International

Standard	**Description**	**Focus on environment and social benefits**	**Reporting/ registration**	**Product Label?**	**Inclusion of LULUCF methodology**	**Geographical reach**
VER+	Certification for offset projects, carbon credits and carbon neutral products	No	TUV SUV			
Blue Registry	Yes	Yes, joint implementation or CDM methodology	International	2007		
ISO 14064	Certification for emission	No	No	No	Yes	International

	reporting offset projects, carbon credits					
VOS	Certification for offset projects and carbon credits	No	TBD	TBD	Follow CDM or JI methodology	International

CCX-Chicago Climate Exchange; TBD- To be determined; VER-verified or Voluntary Emission Reduction; VOS- Voluntary Offset Standard; WBCSD- World Business Council for Sustainable Development; WRI- World Resource Institute. (Source: Hamilton et al., 2007)

- *Further steps with the project developer*

  From the different available standards, the appropriate one has to be selected, market demand assessed, costs and revenues calculated and a commercialization strategy developed. The project developed should start to select potential credit purchasers.

- *Project planning/ development*

  The baseline and methodology need to be selected. Projects must use approved methodologies to calculate emission reductions. The project's chance of being registered and the likelihood of more rapid project preparation increase on using approved methodologies. Asses additionality, leakage and permanence and estimate the full GHG inventory of the emissions and uptake of the project. All this information will be assembled in a carbon project document.

- *Validation*

  The project developer determines a third party certifier (accredited by a specific carbon standard) who will review the carbon project document. It is important for the project to be validated to ensure the transparency of the project design

- *Registration*

  The voluntary emission reductions (VERs) of the validated project are kept in a registry on behalf of the owner until they are bought

6.6 The Legal Steps in Developing CDM project

6.6.1 Legal steps in registering a CDM project and issuing CERs

The Marrakech accord provide the international legal requirements to establish a CDM project and further rules have been provided by later conferences of parties to the UNFCCC. As a general summary, under the international rules the implementation of a CDM project involves:

1. Obtaining formal approval from the DNA of the host country for the proposed project and an affirmation that the project will assist the host country to achieve sustainable development;
2. Obtaining formal written authorization from the party to the Kyoto Protocol of the voluntary participation of the proposed project participants;
3. Creation of a Project design Document (PDD) in the form required by the CDM Executive Board , containing details of the project activity the proposed monitoring methodology and baseline, the crediting period of the project, the project participants and the method by which the participants will communicate with the CDM Executive Board;
4. Review and validation of the Project Design Document by a DoE;
5. Registration of the project as a CDM project with the CDM Executive Board;
6. Operating the project in a manner which reduces , abates or sequesters Green House Gases;
7. Monitoring the emission reductions achieved by the project in accordance with the monitoring plan;
8. Periodic review and verification of the achieved emission reductions by another DOE;
9. Certification to the CDMEB by the second DOE that the project has achieved the number of emission reductions verified and a request to the CDMEB to issue CERs for the amount of GHG which abatement which occurred during the verification period and
10. Issuance of CERs by the CDMEB for the verification period.

The emission reductions of the project continue to be verified in certified and CERs continue to be issued until the end of the total crediting period of the project. Special rules and guidelines have been developed to allow the fast tracking of small scale emission reduction projects.

Certain purchasers of CERs or investors in CDM projects may also impose their own requirement for CDM projects such as compliance with environmental or social safeguards or accepted standards. Such requirements are issues to be explored and negotiated with the particular purchaser rather than legal requirements for the CDM.

6.6.2 Qualification as a CDM project: key legal requirements

The Kyoto Protocol and Marrakech Accords also set out the specific legal requirements which individual CDM projects must meet to be eligible for registration. Projects will need to satisfy the CDM Executive Board that they:

I. are undertaken in a host country that is a party to the Kyoto Protocol and by parties to the Kyoto protocol or by private entities that have been authorized by such parties to participate in the CDM
II. comply with the eligible requirements for a registered project under the CDM
III. assist the host country to achieve sustainable development
IV. provide real, measurable, and long term benefits related to the mitigation of climate change
V. deliver reductions in emissions that are additional to any that would occur in the absence of the certified project activity
VI. Do not result in the decision of ODA

In addition CDM projects will also need to comply with any legal requirements in the host country. Other

6.7 Agencies facilitating forestry carbon projects

Currently various national and international agencies are working in forestry carbon sector some of the popular ones are shown in the table 13.

Table 14. Various agencies facilitating forestry carbon projects (UNEP and Ecosecurities, 2007)

Name	Organization Type	Project Type	Website
3C Group	Broker	Afforestation and reforestation plantation, energy efficiency, off-grid renewable energy	www.3c-company.com/en
Action Carbone	Retailer	A&R mix native; methane; coalmines; energy efficiency; renewable energy credits	www.actioncarbone.org
Bioclimate Research and Development Ltd.	Project developer	A&R mix native	www.bioclimate.net
Carbonfund.or g	Retailer, wholesaler/ aggregator, broker, project developer	Unspecified	www.carbonfund.org
The Carbon Neutral Company	Retailer	A&R plantation; A&R mix native	www.carboneutral.org
Cleanairpass	Retailer	A&R mix native; methane:	www.cleanairpass.com

		livestock	
Climate Neutral Group	Retailer, wholesaler/aggregator, project developer	A&R plantation, A&R mix native, avoided deforestation/ management, energy efficiency, off grid renewable energy	www.climateneutralgroup.com
Climate stewards	Retailer, project developer	A&R mix native	www.climate stewardsorg.uk
Climate Mundi	Retailer, wholesaler/aggregator,broker, project developer	Avoided deforestation/management; methane, landfill	www.climatemundi.com
The Conservation Fund	Project developer, retailer	Afforestation and Reforestation	www.conservationfund.org
Conservation International	Wholesaler/ aggregator, project developer	A&R mix native, avoided deforestation / management	www.conservation.org
Ducks Unlimited Inc.	Project developer	A&R land use	www.ducks.org
Emergent Ventures India	Broker	A&R plantation; methane; livestock; energy	www.emergentventures.com

		efficiency; off grid renewable energy	
Environmental Synergy	Project developer	A&R mix native	www.environmentalsynergy.com
ERA Ecosystem Restoration associates Inc.	Retailer, project developer	A&R mix native	www.econeutral.com
Greenhouse balanced	Wholesaler/aggregator	A&R mix native	www.greenhousebalanced.com
Love Trees	Retailer, wholesaler/ aggregator, broker, project developer	A&R	www.lovetrees.ca
Native Energy	Retailer, wholesaler/ aggregator	Avoided deforestation/ management; methane; livestock; landfill; renewable energy credits	www.nativeenergy.com
The Nature Conservancy	Project developer	A&R plantation, avoided deforestation / management	www.nature.org
New Forests	Wholesaler/ aggregator, project developer	A&R, avoided deforestation	www.newforests.com.au

Offsetters Climate Neutral Society	Retailer, broker, project developer	Avoided deforestation/ management	www.offsetters.com
Prima Klima	Retailer; other: fund raising and working with project developers	A&R mix native	www.primaklimaweltweit.com
SKG Sangha	Project Developer	Avoided deforestation/ management; methane: livestock	www.skgsangha.org
Sterling Planet Inc.	Retailer	A&R mix native, energy efficiency, renewable energy credits	www.sterlingplanet.com
Tree Banking Inc.	Retailer	A&R	www.treebankinginc.com
Treeflights.com	Retailer	A&R mix native	www.treeflights.com
The Trust for Public Land	Project Developer	A&R mix native	www.tpl.org
Woodland Trust		A&R mix native	www.woodlandtrust.org.uk

6.8 Procedures to define the eligibility of lands for afforestation and reforestation activities

1. Project participants shall provide evidence that the land within the planned project boundary is eligible as an AR CDM project activity

   a. Demonstrate that the land at the moment the project starts is not forest by providing information that:

      - The land is below the national forest threshold (crown cover, tree height and minimum land area) for forest definition under decisions 11/CP.7 and 19/CP.9 as communicated by the respective Designated National Authority (DNA); and
      - the land is not temporarily unstocked as a result human interventions such as harvesting or natural causes or is not covered by young natural stands or plantations, which have yet to reach a crown density or tree height in accordance with national thresholds and which have the potential to revert to forest without human interventions

   b. Demonstrate that the activity is a reforestation or afforestation project activity:

      - For reforestation project activities, demonstrate that on 31 December 1989, the land was below the national forest thresholds (crown cover, tree height and minimum land area) for forest definition under decision 11/CP.7as communicated by the respective DNA.
      - For afforestation project activities, demonstrate that the land is below the national forest thresholds (crown cover, tree height and minimum land area) for forest definition under the decision 11/CP.7 as communicated by the respective DNA, for a period of at least 50 years

2. In order to demonstrate steps 1 (a) and 1 (b), project participants shall provide one of the following verifiable information:

- Aerial or satellite imagery complemented by ground reference data; or
- Ground-based surveys (land-use permits, land-use plans, or information from local registers such as cadastre, owners register, land use or land management register); or
- If options (a) and (b) are not available /applicable, project participants shall submit a written testimony that was produced by following a participatory rural appraisal methodology.

6.9 PDD Methodology for Large Scale Afforestation and Reforestation Projects

The project design document (PDD) is the key document involved in the validation and registration of a CDM project activity. It is one of the three documents required for a CDM project to be registered, along with the validation report from the designated operational entity (DOE) and the letter of approval from the DNA. The PDD is reviewed by the DOE during the validation process to ensure that a project meets the requirements for validation. The PDD is also used as the basis of consultation with stakeholders, which is conducted by making the PDD and related documentation publicly available on the UNFCCC website.

6.10 Suitability of current KFD Afforestation / Reforestation projects / Plantations in availing carbon finance.

6.10.1 Plantations under KFD

The total plantation area under Kerala Forest Department as on 31-03-2012 is 152552.442 ha, which comes to 13.84% of the total forest area. The distribution of plantation area of species is given in Table 14

Table 15. Plantations under Kerala Forest Department

Sl. No.	Plantations	Area (ha)	%
1.	Hardwood	88415.809	57.95
2.	Softwood	11446.248	7.50
3.	Others	42461.145	27.83
4.	Bamboo, Cane & Reeds	9862.931	6.46
5.	Mangrove	366.289	0.24
Total		**152552.422**	

6.7.2 Forest plantations under Kerala Forest Development Corporation (KFDC):

The species wise plantation area under the management of KFDC is given in table 15

Table 16. Species wise plantation area of KFDC

Sl. No.	Species	Area (ha)
1.	Eucalyptus	2425.318
2.	*Acacia auriculiformis*	2082.429
3.	Teak & Softwood	1270.50
4.	Bamboo	907.576
Total		6685.823

Kerala Forest Department is having 159238.245ha of forest plantation but for availing carbon credit under CDM, the project must satisfy certain eligibility conditions, so for finding the suitability /possibility of availing carbon credit for current plantations established by KFD we have to consider each criterion set by CDM-A/R separately.

Prerequisites:

(i) Host country: Countries must have ratified the protocol and have established a designated National authority

- India ratified the protocol in 2002 and established designated national authority. Currently India hosting a number of CDM-AR projects through state forest departments, NGOs and private industries.

(ii) Prior land use: Proof must be given that the land being utilized was not forested for at least 50 years (afforestation) or was converted to other uses before 31.12.1989 (reforestation).

(iii) Additionality: Carbon sequestration via A&R must be additional to what would have occurred without the project. The Executive Board applies stringent additionality test to project proposals. A project is not additional, if it is the most financially attractive among feasibility options. It may be additional if it overcomes barriers related to investments, technology or prevailing practices.

Rules and Modalities:

(i) Baseline: A baseline for A/R project is calculated based on the changes in carbon stocks in above and below ground biomass, litter, soil and deadwood that would have reasonably occurred without the project. To define a baseline project proponents must use an approved methodology or propose a new one to which the Executive Board must agree.

(ii) Leakage: Any increase in GHG emissions which occurs outside the project area and is measurable and attributable to the project must be minimized, monitored and subtracted from project carbon sequestration.

(iii) Credits: Two types of credits take in to account the possibility that forests may eventually release carbon.

Temporary credits: these credits expire at the end of the commitment period following that in which they were issued and must be replaced by the holder to ensure continuing carbon storage. This type of credit command a relatively low price but the producer does not pay back if carbon is lost as a result of calamities or harvest.

Long-term credits: expires at the end of the project's crediting period, a time span of up to 60 years. Prices tend to be higher and the holder must replace any that have been lost due to premature carbon release.

(iv) Contribution to sustainable development: The host country decides if a proposed project contributes to sustainable development.

(v) Environmental impacts: Project participants must submit an analysis of expected environmental impacts to the Designated Operational Entity, a privet-sector, accredited certified organization. If participants or the host country consider impacts to be significant, an environmental impact assessment must be undertaken and remedial measures carried out.

6.11 Protocol for Baseline preparation

To generate emissions reduction credits, projects must create real, measurable and long-term benefits related to the mitigation of climate change, and must be additional to the baseline scenario that would occur in the absence of the project activity (UNFCCC, 2010). It is therefore necessary to determine carbon stocks at project inception, and the predicted change in carbon stocks in the absence of project activity. This protocol describes the methods to estimate the carbon stocks in biomass at project inception here it is to be noted that different carbon standards demand different baseline requirements for REDD/AR/ Agroforestry projects and they have developed protocols for baseline standards and they amends it when required, so it is important for the project developers to follow the latest baseline protocol.

Since it is not possible to measure every tree in the project area, a sampling approach is necessary. The choices and assumptions made during sampling must be transparent, and contribute to a conservative estimate of carbon stocks (UNFCCC, 2010). It is also important that the cost of sampling, and required expertise, do not exceed those which can be supplied by the project. The methodology described ensures that sampling provides a robust estimate of baseline carbon stocks, with minimal reliance on external resources and expertise.

Methods

To quantify the carbon stocks at the start of the project it is necessary to:

1. Define project boundaries and stratify the project area;

2. Determine the carbon pools to be measured;

3. Carry out the biomass survey; and

4. Calculate the carbon stocks per hectare for each stratum.

Defining project boundaries and strata:

For each project site the boundaries of the project area should be determined using maps and remote sensing data for the local area. Carbon stocks are likely to be related to:

- Land use;
- Vegetation species;
- Slope;
- Drainage;
- Disturbance history;
- Age of vegetation; and

• Proximity to settlement.

It is therefore necessary to establish separate biomass estimates for strata which differ in their carbon stocks. Information for determining strata can be derived from satellite imagery, aerial photographs, maps of vegetation, soils and topography. The areas under each stratum should be determined before sampling is carried out.

Determining the carbon pools to be measured:

The carbon pools that could be assessed as part of a biomass survey include: aboveground biomass in trees, non-tree vegetation, leaf litter, and deadwood; and belowground biomass in roots and soil organic matter. Quantifying all of these carbon pools is likely to be time consuming and expensive, and may not provide sufficient information to justify the cost. If a carbon pool is expected to increase by only a small amount relative to the overall rate of change, and if the pool will not decrease as a result of project activities, it can make sense to exclude that pool from the baseline (UNFCCC, 2010), especially if its quantification is costly.

The biomass stored in trees and their roots are likely to be the main carbon pools in avoided deforestation projects. The carbon stored in leaf-litter and dead wood are likely to be maintained or increased by avoided deforestation projects, but leaf litter is time consuming to quantify and is unlikely to constitute a large proportion of the total carbon pool and it may therefore be excluded from the baseline. The effects of deforestation on non-tree vegetation are less certain but are unlikely to constitute a large proportion of the total carbon pool, so non-tree vegetation may be excluded from the baseline. The carbon stored in soils is expected to increase, but the cost associated with recording the carbon in soil usually prevents their inclusion in the baseline. The biomass survey will therefore concentrate on above- and below-ground tree biomass, coarse woody debris (i.e. large pieces of dead wood), and necromass (i.e. dead trees).

Carrying out the baseline survey

An estimate of the total carbon stored in the project area is obtained from an average of a predetermined number of sample plots distributed throughout the project area. For the estimate to be robust the mean from individual samples must be close to the reality for the entire area (an accurate estimate), and the variance among individual samples should be relatively small (so the estimate is precise). Nested sample plots are an efficient method for sampling trees of different sizes (see Figure 1). Coarse woody debris is surveyed along 20 m transects running north to south, and east to west, through the centre of each plot.

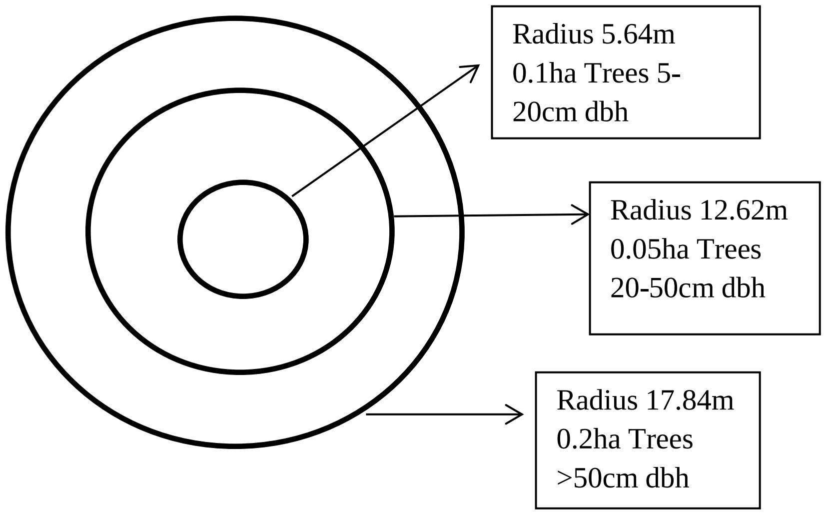

Fig. 19. Diagram of nested plots for sampling trees of different sizes.

The total number of plots necessary to ensure 95% confidence that the estimated carbon stock in each strata is accurate, with a precision of 20%, should be determined from an initial survey of around 10 plots in each stratum (Pearson et al., 2005). It is essential that plot locations are determined without bias, but it is also important that they are accessible to the survey teams. The plot locations within each stratum should therefore be determined either by selecting coordinates at random, or by selecting a path or road within the stratum at random, determining a random distance along the path using a random number generator, deciding which side of the path the plot will be located using a coin toss, and a distance from the path using a random number generator.

The centre of each plot should be marked with a buried iron stake, so that it can be relocated with a metal detector at a later date. Each plot should be assigned a unique number, and the following information should be recorded:

- location;
- latitude and longitude, using GPS and/or a map;
- elevation in m, using an altimeter and/or a map.

Each stem within the plot should be assigned a unique number, and the following information should be recorded:

- distance from plot centre, using a tape measure or laser rangefinder;
- the compass bearing to the plot centre, in degrees;
- the diameter of the stem 1.3 m above ground level (a stick marked at 1.3 m can be useful for determining the correct height to make the measurements). Be aware of the correct way to measure trees with non-standard stems (see Figure 2). Record the value in cm to one decimal place (i.e. 10.2 cm);
- the point at which the dbh measurement was made (in m above ground level)
- the height of the tree, measured directly for smaller trees, or with a clinometer or laser hypsometer
- the height of the tree, measured directly for smaller trees, or with a clinometer or laser hypsometer for larger trees. Record the value in m to one decimal place (i.e. 3.4 m); and
- the condition of the tree (i.e. dead or alive)

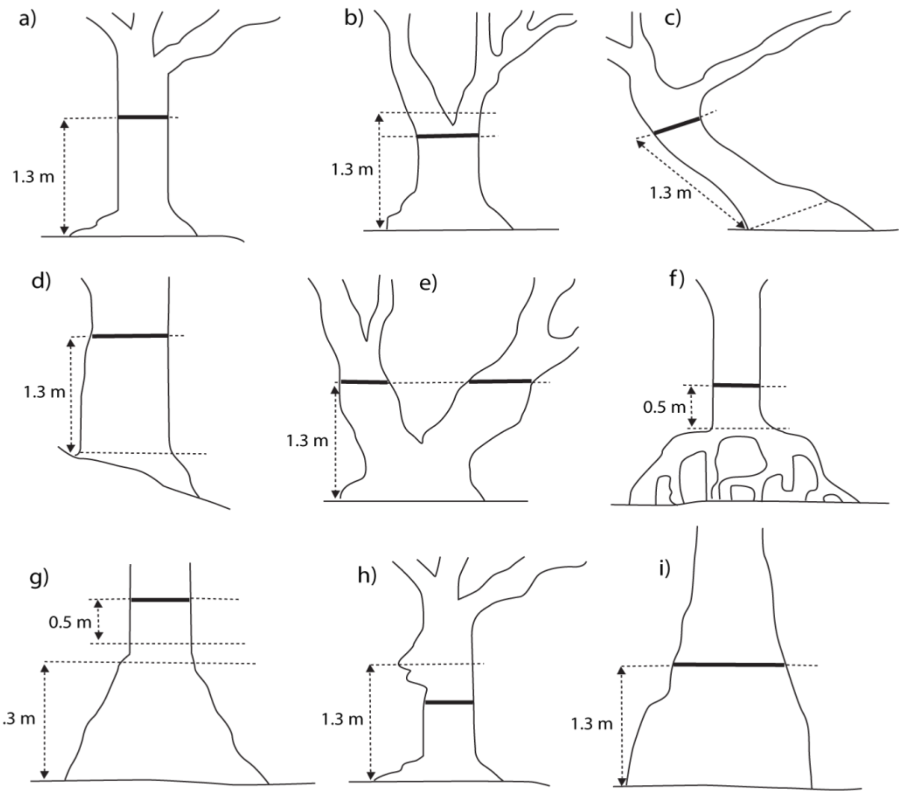

Fig 20. To determine the point of measurement for trees: a) Whenever possible record dbh at 1.3 m height b) if the tree is forked at or below 1.3 m, measure just below the fork point; c) if the tree is leaning, make sure the tape measure is wrapped around the tree according the tree's natural angle (instead of parallel to the ground); d) if the tree is on a slope measure record measure 1.3 m on the uphill side; e) if it is not possible to measure below the fork point, measure as two trees; f) if the tree has stilt roots, measure 50 cm above the highest stilt root; g) if the tree is 5 buttressed at 1.3 m, measure 50 cm above the top of the buttress; h) if the tree is deformed at 1.3 m, measure 2 cm below the deformity; i) if the tree is fluted for its entire height, measure at 1.3 m If the tree has fallen but is still alive (if there are green leaves present) measure the dbh as if it was standing). Pass the tape under any vines or roots on the stem.

Calculating the carbon stocks per hectare for each stratum:

To convert measurements of individual trees to estimates of carbon stock per hectare allometric equations, which convert measured dbh and/or height to an estimate of above ground biomass, are used. It is best to use allometric equations developed for the species and areas included in the project area, and a literature search and consultation with local universities and forestry departments should be carried out to determine the most appropriate equations to use (eg: Kumar et al., 1998., Kunhamu et al., 2006., Navas, I.E., 2006., Paul, G.B., 2013.,), KFRI has published an inventory of volume and biomass tree allometric equations for South Asia (Sandeep et al., 2014) it can also be used for selecting suitable equations. Some allometric equations also require information on the wood density of the species. The wood density of many species can be obtained from published sources (e.g. Brown 1997) or online databases (world agroforestry centre, 2001). The aboveground biomass of trees in each plot is determined by adding together the values of all trees in that plot. This is done separately for trees 5-20 cm in the 0.01 ha subplot, trees 20- 50 cm in the 0.05 ha subplot, and trees >50 cm in the 0.1ha subplot. The values for each subplot are then multiplied up to give an estimate over a standard area of 1 ha (´ 100 for 0.01 ha subplot, ´ 20 for 0.05 ha subplot, and ´ 10 for 0.1 ha subplot). Finally the values from all three subplots are added together to give the estimated aboveground biomass per hectare from that plot.

If locally derived relationships between above- and below-ground biomass are not available, values for belowground biomass are determined from aboveground biomass estimates with the equation (Cairns et al., 1997):

RBD = exp(-1.0587 + 0.8836 ´ ln(a))

Where RBD is root biomass density in kg/ha, and a is aboveground biomass density in kg/ha. The total carbon for each plot is then determined by multiplying the biomass per hectare by the proportion of biomass that is carbon. Unless a locally derived alternative is available it should be assumed that 50% of woody biomass is carbon. The average value across all plots surveyed is then applied as the carbon stock for that stratum. The total carbon stock for the project area can then be determined by multiplying the carbon stock for each stratum by the area covered by that type of forest.

Other requirements for baseline survey:

1) Equipment

- Equipment required by each survey team includes:
- a compass
- 30 m measuring tape for demarcating plots
- a plastic or wooden stake for marking plot centre during measurement
- 5 m measuring tape for recording tree diameter
- 2 m long stick with 1.3 m marked for determining point of measurement
- maps of local area
- pencils
- record sheets
- a GPS
- a clinometer
- Information requirements

2) Maps and remote sensing data

a) Regional maps, remote sensing data, and GIS coverages depicting topography, rivers and streams, population centres, legal classification, and land-use and land-cover for both project areas, and for the whole country

b) Historical remote sensing data (e.g. Landsat or SPOT) from at least 3 periods over the last 10-15 years, from regions surrounding the two project areas, and for the whole country (if available)

c) Detailed maps, remote sensing data, and GIS depicting topography, rivers and streams, population centres, legal classification, and land-use and land-cover within both project areas

3) Forestry data

a) Forest inventory data from within the project areas and areas with similar vegetation and land-use characteristics

b) Relevant literature on carbon stocks in local forests, and other land-use types present in and around the project areas

c) Locally derived allometric equations for determining above- and/or below-ground biomass of trees

d) Local, regional, and national estimates of past rates of deforestation and forest fires

4) Project information

a) Existing management plans

b) Information regarding main agent groups, drivers, and underlying causes of deforestation in and around the project areas

6.11.1 Quantifying the offset

Credits are calculated in terms of GHG removal in tons carbon ie., actual net GHG removal minus baseline net GHG removal, minus leakage. Credits may be transferred to the investor or sold via emission trading.

6.12 An Example of Developing AR-CDM PDD

By way of a run through example with the suggestions proposed by Gupta et al. (2014) for developing AR CDM project design document a sample AR CDM project developed as shown below; Even though the example is set in a hypothetical situation it illustrates practical application of the rules of the CDM through the approved methodology AR-ACM003 (UNFCCC, 2015)

6.12.1 Inception stage

Imagine we are working in one of the forest reserves of India. Among extensive barren tracts of forest land, we find a small watershed of 300ha which has been lying barren (*by barren we mean that the tree crown cover, on an average, is less than 15%, which is the threshold tree crown cover for defining forest for the purpose of hosting AR-CDM projects in the host country*) for several decades. We plan to consider this area for our AR-CDM project. Within the area, however, there are a few groves of trees preserved by people as sacred groves. Of these groves, three are larger than 0.05 ha and hence must be excluded from the project boundary because 0.05 ha is the minimum area threshold reported by Designated National Authority (DNA) of the host country for defining forest for the purpose of CDM. Tree groves occupying less than 0.05 ha do not constitute forest even if these have a crown cover exceeding the minimum tree crown cover threshold. These large groves are surveyed in field, and their location and shape are carefully plotted in the map.

We find that the total area occupied by these large groves is 4 ha. Thus, out of 300ha an area of 296 ha is eligible for our project.

6.12.2 Land Eligibility

The land, excluding the area occupied by the three large tree groves is eligible for implementing an AR-CDM project activity because it had no forest as on 31 December 1989 (*this requirement comes from the tool "Demonstration of eligibility of lands for AR-CDM project activities"*). We provide the evidence of this fact by producing two satellite imageries of the area- one dating before 31 December 1989, and other dating after this date *(However we must note that satellite imageries are not the only acceptable evidence for this purpose. We could also have* *met this requirement by conducting a participatory rural appraisal (PRA) exercise and producing the outcome as an evidence of the fact that there was no forest in the area on that date. The tool on land eligibility allows several other options as well)*

6.12.3 Baseline Scenario

To determine the baseline scenario for this land, we examine the possible uses of this land in the coming years. Since the land is reserved for forests no other activity is expected to take place here except reforestation. Then the question is reforestation likely to happen here? We note that reforestation in this area is not expected to take place in the foreseeable future because no private investment can take place in this land (which is state-owned) and the provisions in the public budget are not likely to lead to reforestation. This is sufficient evidence to prove that the most likely baseline scenario for this land is continuation of status quo.

6.12.4 Baseline removals

The next step is to estimate the changes in carbon stocks in the carbon pools of this and that would occur in the baseline scenario. The land contains a few scattered trees per hectare and very scanty woody shrub vegetation. The trees are not likely to put on any increment since occasional fuel gathering activity along with grazing by animals during post-monsoon months, takes pace here. The level of biomass per hectare is more or less static over the last several years or it is slightly declining. Therefore, it is safe to assume that the expected net increase in the aboveground biomass in the area is zero (*However, we must note that even if the tree biomass in the baseline were to be increasing our AR-CDM project could still have gone ahead. We could have used the default method for estimation of tree biomass increment as provided in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in AR-CDM project activities" using the simplified 'proportionate crown cover' method*)

6.12.5 Pre-project Carbon Stocks

Next is to estimate how much tree biomass per hectare is present in the area at the start of the project. (*"Carbon stock in tree biomass" is different from the "change in the carbon stock in the trees biomass". The fact that one is zero does not mean that the other is also zero. The pre-project carbon stock in tree biomass is estimated and provided in the PDD, but it enters in to calculations only at the time of the first monitoring; it must be subtracted from the project tree biomass estimated from simple plot measurements at the time of monitoring because the pre-project trees will get measured along with the project trees. However if we could avoid these trees from being counted as project trees, which would make our inventory more complicated, we could also exclude their biomass from accounting*). If we determine the precise value of this parameter (tree biomass ha^{-1}), it might require a lot of work and turn out to be costly in comparison to its importance. So we decided to get a conservative estimate of this parameter. To do this in a simple way we estimate the upper bound of the mean tree crown cover in the area. For this we randomly select 20 plot centres spread over the 296 ha area and at each plot centre we drive a peg in to the ground and attach a 30 m tape to the peg and swing the free end of the tape in to a circle and count all the trees present within this circular plot. We also measure approximately the crown diameters of the trees present within the plot. Some plots may have no tree at all others may have a few trees. For each plot, we calculate the percentage tree crown cover by dividing the total crown area of trees by the area of the plot. On summarizing the plot data we find that the average tree crown cover in the area is 2.56% at the most that is the upper bound of the crown cover is 2.56%. We multiply this by the parameter "aboveground biomass content" from table 3A1.4 Of the IPCC Good practice Guidance for Land Use, Land Use Change and Forestry (IPCCGPG-LULUCF, 2003) (This is provided in the simplified "proportionate cover method" available in the tool "Estimation of carbon stocks an change in carbon stocks of trees and shrubs in AR-CDM project activities". Since the default method will not significantly affect our final estimation of tCER (*because the biomass in the baseline of our project is very small), we opt for the default method of estimation. If our baseline were to have a large crown cover (say 12%), we would have considered measuring biomass in sample plots , either by harvesting and weighing all woody* *vegetation in smaller plots or by using tree allometric equations in conjunction with DBH measurements of all trees in each plot*) and we find that the aboveground tree biomass in the area is 1.896 t dry matter ha^{-1} *(AGB content (dry matter)in forest in the host country is listed as 73 t ha^{-1} in the IPCC table mentioned in the tool)*

Table 17. Plot values of tree crown cover

Plot No.	No. of trees	Mean crown dia.(m)	Plot crown area (m^2)	Plot crown cover (m^2)
1	3	2.3	12.46	0.44%
2	2	3.1	15.10	0.53%
3	0	0	0.00	0.00%
4	0	0	0.00	0.00%
5	1	3.6	10.18	0.36%
6	5	2.8	30.79	1.09%
7	3	3.4	27.24	0.96%
8	8	2.6	42.47	1.50%
9	0	0	0.00	0.00%
10	0	0	0.00	0.00%
11	11	2.1	38.10	1.35%
12	6	4.5	95.43	3.38%
13	24	3.6	244.29	8.64%
14	19	2.4	85.95	3.04%
15	7	1.9	19.85	0.70%
16	8	2.6	42.47	1.50%
17	21	3.1	158.50	5.61%

18	0	0	0.00	0.00%
19	22	2.7	125.96	4.46%
20	0	0	0.00	0.00%
SD				2.29%
SEM				0.51%
t90				1.729%
Cl90				0.89%
LB				0.79%
UB				2.56%

We increase this by 25% to account for the root biomass (*a default value of 0.25 for the root-shoot ratio of trees in the baseline is provided in the tool*) of the trees and find that pre-project tree biomass in the area is 2.336 tonnes dry matter ha^{-1}. Which is equivalent to a carbon stock *(to convert a given quantity of tonne dry matter (tdm) of tree biomass in to carbon stock, we multiply it first by 0.47 (which is the carbon content of tree biomass, called carbon fraction), and then by 44/12 (which is the ratio of molecular weights of carbon dioxide and carbon))* of 4.283 t CO_2 equivalent per hectare. We note that shrub crown cover in the area is far below 5%, and therefore we do not need to estimate carbon stock in the pre-project shrub biomass *(note that if the shrub crown cover were to be somewhere near 5% we would be required to estimate it. The same sample plots that were used for estimation of tree crown cover could have been used for estimation of shrub crown cover)*.

We further note that since carbon stock in tree biomass in the baseline is not likely to increase, the carbon stock in the carbon pools of dead wood and litter is also not likely to increase. We therefore account baseline changes in carbon stock in the aboveground biomass, belowground biomass, deadwood and litter pools as zero.

6.12.6 Ex-Ante Estimation of actual net GHG removals

One of the requirements in the PDD of the AR-CDM project is to estimate in advance how much GHG removals are likely to be achieved under the project. This is done by projecting the growth of the trees to be planted or to be regenerated. In our project we propose an assisted natural regeneration method: cutback operations combined with seed sowing on contour trenches and plantations of nursery raised seedling in gaps. We will use native species only since our aim is to restore the forest to its natural state. For projecting the biomass growth of a mixed forest, we cannot use any species specific increment data. Therefore we estimate annual diameter increments using data from sample trees existing in the project area (or a nearby area) and use a default allometric equation *(The equation selected by us is AGBM=exp[-1.996=2.32*In(D)], which we take from "Estimating Biomass and Biomass Change of Tropical Forests: a premier (FAO Forestry Paper-134)" by S. Brown. We select the equation for dry forests growing in an area receiving annual rainfall of more than 900mm, which is the case for our project area. We must note, however, that ex ante estimation of tree biomass is only an approximate estimation and no precision requirements are prescribed by the methodology for this. Therefore, we could also have used any other allometric equation from Table 4 A.1 pf IPCC-GPG-LULUCF 2003*) to convert tree diameter in to biomass.

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

To get annual diameter increments expected in trees of these species we measure DBH of three sample trees of each species and determine their age by counting growth rings after felling the trees. The data obtained are summarized in Table 17 and they show that the mean annual increment in DBH averaged over the five tree species is 1.09 cm per year.

Table 18. Mean diameter increment observed in sample trees

	Tree 1		**Tree 2**		**Tree 3**		**Mean**		**Dia. Increment (cm yr^{-1})**		
Sp.	*Dia. (cm)*	*Age (year)*	*Dia. (cm)*	*Age (year)*	*Dia. (cm)*	*Age (year)*	*Dia. (cm)*	*Age (year)*	*Species Mean*	*Species weight*	*Contr.*
A	14	17	17	20	34	26	21.67	20.33	1.07	0.50	0.53
B	18	14	14	16	16	15	16.00	17.00	0.94	0.20	0.19
C	21	15	15	15	11	15	15.67	14.67	1.07	0.10	0.11
D	22	25	25	16	17	15	21.33	14.67	1.45	0.10	0.15
E	8	11	11	9	9	5	9.33	8.00	1.17	0.10	0.12
										1.00	1.09

However, we know that tree diameter increments are not constant over the lifespan of trees. The diameter increments will be smaller in the beginning, higher in mid-age years and decrease towards maturity. Therefore, we transform the DBH increments in to a symmetric triangular (linear) distribution over a period of 30 years that is we assume that for the first 15 years the DBH increment will be uniformly increasing and during the last 15 years the DBH increment will be uniformly decreasing *(we do this for the matter of simplicity. We could also have used a logistic growth function to project tree diameter over time. The alternative values shown in column (d) and (f) of table 18 were computed using the logistic growth equation* $D_t = ø_1/\{1+exp[-(t- ø_2)/ ø_3]\}$*, where ø1 is the diameter at maturity, V is the time required to attain half the diameter at maturity, and ø3 is the time elapsed between the two events of attaining (1) half the diameter at maturity and (2) three-fourths of the diameter at maturity)* while the mean increment during the 30 year period will be 1.09cm. The resulting diameter increments and the expected diameters of the mean tree are shown in columns (c) and (e), respectively of table 18

Table 19 Tree diameter increment over project period (cm)

Year	ΔD_{CONST}	$\Delta D_{TRAIING}$	ΔD_{LOGIS}	ΔD_{TRIANG}	ΔD_{LOGIS}
(a)	(b)	(c)	(d)	(e)	(f)
1	1.09	0.07	0.00	0.07	0.00
2	1.09	0.22	0.50	0.29	0.50
3	1.09	0.36	0.58	0.65	1.08
4	1.09	0.51	0.66	1.16	1.73
5	1.09	0.65	0.75	1.82	2.48
6	1.09	0.80	0.84	2.62	3.32
7	1.09	0.94	0.94	3.56	4.26
8	1.09	1.09	1.05	4.65	5.31
9	1.09	1.24	1.15	5.88	6.46
10	1.09	1.38	1.26	7.27	7.72
11	1.09	1.53	1.36	8.79	9.08
12	1.09	1.67	1.45	10.46	10.54
13	1.09	1.82	1.53	12.28	12.07
14	1.09	1.96	1.60	14.24	13.66
15	1.09	2.11	1.64	16.35	15.30
16	1.09	2.11	1.66	18.45	16.97
17	1.09	1.96	1.66	20.42	18.63
18	1.09	1.82	1.64	22.23	20.27
19	1.09	1.67	1.60	23.90	21.86
20	1.09	1.53	1.53	25.43	23.40
21	1.09	1.38	1.45	26.81	24.85
22	1.09	1.24	1.36	28.05	26.21

23	1.09	1.09	1.26	29.14	27.47
24	1.09	0.94	1.15	30.08	28.62
25	1.09	0.80	1.05	30.88	29.67
26	1.09	0.65	0.94	31.53	30.61
27	1.09	0.51	0.84	32.04	31.45
28	1.09	0.36	0.75	32.40	32.20
29	1.09	0.22	0.66	32.62	32.85
30	1.09	0.08	0.58	32.70	33.43

Putting the expected tree diameters in to the allometric equation, we estimate the expected aboveground biomass of each tree. We expect to have a maximum stocking density of 1250 trees ha^{-1} in the beginning which will stabilize over time to a stocking density of 550 trees ha-^{1}. Combining these values we calculate aboveground tree biomass ha^{-1} over the 30 years of our proposed project. We expand the aboveground tree biomass to a total tree biomass b using the default root-shoot ratios computed from the equation provided in the tool *(the equation regressing root-shoot ratio on aboveground tree biomass content is: R= exp [-1.085+0.9256*ln (b)]/b, where b is the aboveground tree biomass in tonnes of dry matter ha^{-1})*. The results of our calculation are summarized in table 19

Table 20 Ex-ante estimation of carbon stock in tree biomass ha^{-1}

Project Year	**Mean DBH (cm)**	**Biomass (kg/tree)**	**Stocking (trees ha^{-1})**	**Average tree biomass (t/ha)**	**Root shoot ratio**	**Tree biomass (t/ha)**	**Carbon stock in tree biomass (tCO_2eha^{-1})**
1	0.07	-	800	-	-	-	-
2	0.29	-	1100	-	-	-	-
3	0.65	-	1250	-	-	-	-

4	1.16	-	1000	-	-	-	-
5	1.82	-	900	-	-	-	-
6	2.62	-	800	-	-	-	-
7	3.56	-	700	-	-	-	-
8	4.65	4.80	600	2.88	0.312	3.78	6.93
9	5.88	8.30	575	4.77	0.301	6.21	11.38
10	7.27	13.53	550	7.44	0.291	9.61	17.61
11	8.79	21.05	550	11.58	0.282	14.84	27.21
12	10.46	31.53	550	17.34	0.273	22.08	40.48
13	12.28	45.71	550	25.14	0.266	31.82	58.34
14	14.24	64.47	550	35.46	0.259	44.64	81.85
15	16.35	88.79	550	48.83	0.253	61.19	112.18
16	18.45	117.63	550	64.70	0.248	80.73	148.00
17	20.42	148.70	550	81.79	0.243	101.70	186.45
18	22.23	181.21	550	99.67	0.240	123.58	226.57
19	23.90	214.40	550	117.92	0.237	145.86	267.41
20	25.43	247.49	550	136.12	0.234	168.03	308.06
21	26.81	279.78	550	153.88	0.232	189.63	347.65
22	28.05	310.60	550	170.83	0.231	210.21	385.38
23	29.14	339.33	550	186.63	0.229	229.37	420.51
24	30.08	365.39	550	200.97	0.228	246.73	452.35
25	30.88	388.31	550	213.57	0.227	261.99	480.32
26	31.53	407.66	550	224.21	0.226	274.86	503.91
27	32.04	423.07	550	232.69	0.225	285.11	522.69
28	32.40	434.28	550	238.85	0.225	292.55	536.35

29	32.62	441.08	550	242.59	0.225	297.07	544.64
30	32.70	443.51	550	243.93	0.224	298.69	547.59

We note that biomass estimation cannot be provided for years 1 to 7 because the expected mean diameter in these years is far too low compared to the range of diameters for which the allometric equation selected is valid. Using per hectare carbon stocks we calculate the total carbon stock in 296ha which is our project area. For this we must use the data of year-wise area to be planted. We propose that the area of 296ha will be taken up for reforestation in a phased manner over a period of three years. The areas of lands to be reforested in different years are shown in Table 20.

Table 21 Areas of lands to be reforested in different years

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

By combining the data from table 19 and 20 we arrive at ex ante estimation of carbon stocks in tree biomass within the project boundary, as summarized in table 21.

Table 22 Ex-ante estimation of carbon stock in tree biomass within the project boundary

Project Year	**Area 1 (ha)**	**Carbon stock 1 (tCO2e ha^{-1})**	**Area 2 (ha)**	**Carbon stock 2 (tCO_2e ha^{-1})**	**Area 3 (ha)**	**Carbon stock (t CO_2 ha^{-1})**	**Carbon stock project (t CO_2e)**

1	50	100	-	-	-	-	-
2	50	100	-	-	-	-	-
3	50	100	-	-	146	-	-
4	50	100	-	-	146	-	-
5	50	100	-	-	146	-	-
6	50	100	-	-	146	-	-
7	50	100	-	-	146	-	-
8	50	6.93	100	-	146	-	346.67
9	50	11.38	100	6.93	146	-	1262.17
10	50	17.61	100	11.38	146	6.93	3030.47
11	50	27.21	100	17.61	146	11.38	4782.38
12	50	40.48	100	27.21	146	17.61	7315.58
13	50	58.34	100	40.48	146	27.21	10936.66
14	50	81.85	100	58.34	146	40.48	15835.62
15	50	112.18	100	81.85	146	58.34	22311.17
16	50	148.00	100	112.18	146	81.85	30567.82
17	50	186.45	100	148.00	146	112.18	40501.31
18	50	226.57	100	186.45	146	148.00	51581.50
19	50	267.41	100	226.57	146	186.45	63248.74
20	50	308.06	100	267.41	146	226.57	75222.49
21	50	347.65	100	308.06	146	267.41	87230.12
22	50	385.38	100	347.65	146	308.06	99011.26
23	50	420.51	100	385.38	146	347.65	110321.30
24	50	452.35	100	420.51	146	385.3	120934.11
25	50	480.32	100	452.35	146	420.51	130644.43

26	50	503.91	100	480.32	146	452.35	139269.68
27	50	522.69	100	503.91	146	480.32	146651.52
28	50	536.35	100	522.69	146	503.91	152657.10
29	50	544.64	100	536.35	146	522.69	157180.04
30	50	547.59	100	544.64	146	536.35	160150.14

Shrub Biomass in Project

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

Dead wood and litter in project

For the sake of simplicity we do not wish to make field measurements to estimate dead wood and litter in our project. Instead we use the default values that estimate dead wood and litter biomass in the project scenario as a fraction of aboveground-tree biomass. According to the tool, dead wood and litter can be estimated as 2% and 4%, respectively of the aboveground-tree biomass, which is reflected in the column (d) and (e) of Table 22

Changes in SOC in project

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

Project Emissions

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

Actual net GHG removals

Taking in to account the ex-ante estimation of changes in carbon stocks in various pools as well as emissions resulting from implementation of the project we estimate the actual net GHG removals a summarized in Table 22

Table 23 Ex-ante estimation of actual net GHG removals (tCO2e)

Project year	carbon stock in pools/components of pools (tCO_2e)					Change in carbon stock in carbon pools	Project emissions	Actual net GHG removals
	Tree biomass	*Shrub Biomass*	*Dead wood*	*Litter*	*Total*			
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
1	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-

8	346.67	-	6.93	13.87	367.47	367.47	-	367.47
9	1262.17	-	25.24	50.49	1337.90	970.44	-	970.44
10	3030.47	-	60.61	121.22	3212.30	1874.40	-	1874.40
11	4782.38	-	95.65	191.30	5069.32	1857.02	-	1857.02
12	7315.58	-	146.31	292.62	7754.51	2685.19	-	2685.19
13	10936.66	-	218.73	437.47	11592.86	3838.35	-	3838.35
14	15835.62	-	316.71	633.42	16785.75	5192.89	-	5192.89
15	22311.17	-	446.22	892.45	23649.84	6864.08	-	6864.08
16	30567.82	-	611.36	1222.71	32401.9	8752.05	-	8752.05
17	40501.31	-	810.03	1620.05	42931.39	10529.50	-	10529.50
18	51581.50	-	1031.63	2063.26	54676.39	11745.01	-	11745.01
19	63248.74	-	1264.97	2529.95	67043.67	12367.27	-	12367.27
20	75222.49	-	1504.45	3008.90	79735.84	12692.17	-	12692.17
21	87230.12	-	1744.60	3489.20	92463.92	12728.09	-	12728.09
22	99011.26	-	1980.23	3960.45	104951.94	12488.02	-	12488.02
23	110321.30	-	2206.43	4412.85	116940.58	12988.64	-	12988.64
24	120934.11	-	2418.68	4837.36	128190.16	11249.58	-	11249.58
25	130644.43	-	2612.89	5225.78	138483.10	10292.94	-	10292.9

								4
26	139269.68	-	2785.39	5570.79	147625.86	9142.76	-	9142.76
27	146651.52	-	2933.03	5866.06	155450.61	7824.75	-	7824.75
28	152657.10	-	3053.14	6106.28	161816.53	6365.92	-	6365.92
29	157180.04	-	3143.60	6287.20	166610.85	4794.32	-	4794.32
30	160150.14	-	3203.00	6406.01	169759.14	3148.30	-	3148.30

Leakage Emissions

We note that only service provided by the vacant forest lands in the baseline scenario is seasonal grazing of livestock for a few months after the monsoon season. Grazing activity will be displaced to areas within the project (by rotation, for the first two years) and then temporarily outside the project area until the regenerated trees are big enough to be safe against damage from livestock. Since the emissions from grazing activity will not increase because of displacement of grazing, the leakage emissions in our project are accounted as zero *(However, if forested areas were to be cleared to accommodate grazing of livestock displaced from the project area, leakage emissions equal to the carbon stocks held in various carbon pools of the forested areas cleared would have been accounted).*

Net Anthropogenic GHG Removals

By subtracting leakage emissions and baseline removals (both of which happen to be zero in our project) from the actual net GHG removals, we obtain year-wise and cumulative net anthropogenic GHG removals of our project, as summarised in table 23 Ex-ante estimation of cumulative net anthropogenic GHG removals is also the ex-ante estimation of tCERs.

Table 24 Ex-ante estimation of net anthropogenic GHG removals by sinks (tCO_2)

Project Year	Baseline net GHG removals	Actual net GHG removals	Leakage emissions	Net anthropogenic GHG removals	Cumulative net anthropogenic GHG removals
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	367.47	-	367.47	367.47
9	-	970.44	-	970.44	1337.90
10	-	1874.40	-	1874.40	3212.30
11	-	1857.02	-	1857.02	5069.32
12	-	2685.19	-	2685.19	7754.51
13	-	3838.35	-	3838.35	11592.86
14	-	5192.89	-	5192.89	16785.75
15	-	6864.08	-	6864.08	23649.84
16	-	8752.05	-	8752.05	32401.89
17	-	10529.50	-	10529.50	42931.39
18	-	11745.01	-	11745.01	54676.39
19	-	12367.27	-	12367.27	67043.67

20	-	12692.17	-	12692.17	79735.84
21	-	12728.09	-	12728.09	92463.92
22	-	12488.02	-	12488.02	104951.94
23	-	11988.64	-	11988.64	116940.58
24	-	11249.58	-	11249.58	128190.16
25	-	10292.94	-	10292.94	138483.10
26	-	9142.76	-	9142.76	147625.86
27	-	7824.75	-	7824.75	155450.61
28	-	6365.92	-	6365.92	161816.53
29	-	4794.32	-	4794.32	166610.85
30	-	3148.30	-	3148.30	169759.14

Monitoring Plan

In the monitoring plan we are required to provide information on how we will carry out ex-post estimation of carbon (actual) estimation of carbon stocks and carbon- stock changes in various carbon pools as well as project emissions and leakage emissions. We note that the methodology does not require us to monitor carbon stock changes in the baseline. The pre-project carbon stock in tree biomass has already been estimated by us and documented in our PDD. We will use this estimate in our first monitoring report, which will be the outcome of implementation of our monitoring plan. We also note that we do not have to monitor project emissions and leakage emissions since these are accounted as zero

We further note that changes in SOC are not required to be monitored in our project because these changes are conservatively accounted as zero. The carbon stocks and changes in carbon stocks occurring in the carbon the carbon pools (1) belowground biomass (2) dead wood and

(3) litter are not required to be monitored because carbon stocks in the aboveground tree biomass.

Therefore, in our project the only carbon pool to be monitored is the aboveground biomass and within this pool, we will monitor only the aboveground tree biomass since we have made the conservative choice of shrubs in our project.

Monitoring of aboveground tree biomass

For project monitoring purposes, we will use tree allometric equations that convert tree diameter in to tree biomass we have the choice of either developing new equations or modifying existing equations that fit the data obtained from sample trees harvested from the project area. We choose the option of developing new allometric equations at the time of monitoring so as to get an unbiased and accurate estimate of tree biomass (*while applying an existing equation, we are allowed to modify it in such a way that it gives a conservative estimate of tree biomass but as close to the unbiased estimate as it can go).*

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

Sample Plots

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

Stratification

At the time of monitoring we will stratify the project area in to areas having (1) low, (2) medium, and (3) high aboveground tree biomass ha^{-1}. It is not necessary to assign specific cut-off values to define where a stratum begins and where it ends. We can just make a visual inspection (or take a look at Google Earth image of our project area) and assign parcels of areas to one stratum or another. Also, a stratum does not have to consist of geographically contiguous areas. A stratum is a list (and a map) of areas that appear to have similar biomass density. Once we have firmed up the list of areas by strata and demarcated the boundaries of areas on map (based on field survey of boundaries), these lists with maps constitute our sampling frame. To draw sample plots from a stratum, we will number these cells from 1 to N. To pick up n samples at random, we will generate a random cell number between 0 and N/n. We will make this cell as the starting point and then pick up every n^{th} cell from here until we reach N. The centres of the sampled cells will be the centres of our sample plots. We will pick up the latitude-longitude (or local x-y coordinates) of these plot centres from the map and using a GPS, we will navigate to the plot centres in the field. At each plot centres in the field, we will drive a peg in to the ground, tie one end of a tape of 12.61m length to the peg, and swing the free end of the ape in to a circle, thus defining the boundary of our sample plot. We will repeat the procedure for each stratum.

We do not propose any ex-ante stratification map in the PDD since we do not know, in advance, in what pattern the spatial distribution of biomass of the natural forest will emerge.

Sample Size

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

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

7. POSSIBILITIES TO TAP CARBON CREDIT THROUGH GREEN INDIA MISSION (GIM)

7.1 The National Mission for a Green India:

The National Mission for a Green India is one of the eight missions under the National action Plan on Climate Change (NAPCC). The Mission recognizes that climate change phenomena will seriously affect and alter the distribution, type and quality of natural resources of the country and the associated livelihoods of the people. GIM acknowledges the influences that the forestry sector has on environmental amelioration through climate mitigation, food security, water security, biodiversity conservation and livelihood security of forest dependent communities.

GIM puts the “Greening” in the context of climate change adaptation and mitigation, meant to enhance ecosystem services like carbon sequestration and storage (in forests and other ecosystems), hydrological services and biodiversity; along with provisioning services like fuel, fodder, small timber and NTFPs.

Mission objectives:

- Increased forest/tree cover on 5m ha of forest/ tree cover on 5m ha of forest/ non-forest lands and improved quality of forest cover on another 5m ha
- Improved ecosystem services including biodiversity, hydrological services and carbon sequestration as a result of treatment of 10 m ha.
- Increased forest-based livelihood income of 3 million forest dependent households
- Enhanced annual CO_2 sequestration of 50-60-milion tonnes by the year 2020

7.1.1 Possibilities to obtain carbon credits

Even though the main focus of the Mission is to address mitigation and adaptation aspects in the context of climate change. There it seems to be a need for increased scientific input in the preparation of the Mission. The mitigation potential is estimated by simply multiplying global default biomass growth rate values and area. It is incomplete as it does not include all the carbon pools, phasing, differing growth rates, etc. The mitigation potential estimated using the Comprehensive Mitigation Analysis Process model for the GIM for the year 2020 has the potential to offset 6.4% of the projected national greenhouse gas emissions, compared to the GIM estimate of only 1.5%, excluding any emissions due to harvesting or disturbances. The selection of potential locations for different interventions and species choice under the GIM must be based on the use of modelling, remote sensing and field studies. The forest sector provides an opportunity to promote mitigation and adaptation synergy, which is not adequately addressed in the GIM. Since many of the interventions proposed are innovative and limited scientific knowledge exists, there is need for an unprecedented level of collaboration between the research institutions and the implementing agencies such as the Forest Departments, which is currently non-existent. The GIM could propel systematic research into forestry and climate change issues

7.2 Opportunities based on the recent recommendations by High Level Committee to review various acts administered by MoEF&CC

A committee constituted with the chairmanship of T.S.R Subramaniam reviewed the following acts (MoEF&CC, 2014)

i. Environment (Protection) Act, 1968
ii. Indian Forest Act, 1927
iii. Forest Conservation Act, 1980
iv. Wildlife (Protection), Act, 1972

v. The Water (Prevention and control of pollution) Act, 1974

vi. The Air (Prevention and Control of Pollution), Act, 1981

Major Recommendations of the committee which can contribute to the CDM-AR programs in India

1. New forestation policies to attract investment of growing forests in private land and providing a statutory safeguard, a classification of 'treelands' as distinct from forest has been recommended. Early definition of the term forest to remove ambiguity and minimize litigation. A revision in the CA policy has been outlined with the following key features- double CA area in revenue land, three times CA area in degraded forest land , encouragement to industry associations and other holders of private land to participate in CA
    - Delinking the project proponent from CA obligations after he fulfils the necessary financial commitments
    - NPV of forest land should be increased at least five times
2. Identification of no go areas which are in forest areas or inviolate zones primarily with the criteria of over 70% canopy cover and protected areas which should not be disturbed except in exceptional circumstances and that too with the prior approval of the union cabinet

3. The Committee observes that citizens and private institution are reluctant to invest in forestry or plantations, apprehending loss of their land being declared as 'forest'; on the other hand, there is a need to encourage non-forest, nongovernment land holders to engage in plantations in land owned by them (this includes public sector units also who keep large tracts fallow). The Committee suggests that even if afforested, such land may not be treated as 'forest' falling under the definition of Act.

4. It is recommended that the plantations on the sides of roads, canals and other linear structures carried out on State government land which has been kept in reserve for expansion purposes should be de-notified. It may be recalled that social forestry was encouraged on such lands to derive ecological value until the land was actually ready for the originally intended use. In many instances these lands were notified as forests on the request of the user departments so that they would obtain a degree of protection from encroachment and lopping. Similarly after acquisition, land was kept aside for expansion purposes by public sector undertakings. In many instances plantations were raised on such lands which were to be removed at the time of expansion. Such plantations also recommended to be kept out of the definition of forest.

5. 'Forest' should not include any plantation raised on private land by any individual or agency.

6. The Committee suggests that a simple set of compliance norms should be introduced, which will encourage plantation of trees on private land, and on land owned by state owned entities with permission to allow felling, transit and sale of timber and transaction of afforested land. While there is no bar on raising plantations of poplar or eucalyptus, this should be extended to include some other indigenous species also. Farm forestry is not likely to crowd out agricultural crops due to its longer gestation period; in the case of farmers this is likely to be carried out on the outer peripheries or bunds of their land. If this is encouraged there is likely to be considerable accretion to tree cover

7. To offer economic incentives for increased community participation in farm and social forestry by way of promoting and proving statutory safeguards to ‘treelands’ as distinct from ‘forest’.

8. Plantation of approved species on private lands could be considered for compensatory afforestation with facility for ‘treeland’ trading.

9. CA on private land should be at least of the proportion of 2:1. Correspondingly, the CA on degradedforest land, in appropriate cases, should be of the order of 3:1 rather than 2:1 at present.

8. OPPORTUNITIES TO LOCAL COMMUNITIES IN FORESTRY CARBON PROJECTS

In the past, co-benefits of forestry carbon projects have received less attention as compared to their emission reduction and carbon sequestration aspects. However, the spotlight on livelihood and sustainability has rightly been turned on with such co-benefits seen as being real additional and possibly measurable. These concerns arose out of the need to not just eliminate the possibilities of projects being detrimental to the local communities' well-being but moving beyond to provide positive inputs. Offset buyers would then base their decisions not only on the quantity of carbon offset but also on the quality as reflected in the livelihood and sustainability aspects (Ecosecurities, 2010).

9.1 Potential benefits to local communities

People living in villages within forest areas or in the forest fringes traditionally depend on forest based resources for sustenance and livelihoods. The villagers fulfil their demand for firewood, fodder and thatch from the adjacent forest. The most economically deprived populations however are almost entirely dependent on forests for their livelihoods which range from cattle grazing in forest areas, gathering fruits and other non-timber forest products (NTFPs) and deriving a large part of their income from wage labour. In view of the close linkages people traditionally have had with forests, extensive reforestation, preventing deforestation and other land based emission reduction activities render local people highly sensitive to changes in land-use options.

On the one hand many rural communities are eager to work in forestry carbon projects for extra income, job and other social benefits, along with offset buyers interested in offset reduction and at the same time helping the local people. But sceptics are wary that these projects may do more harm than good and can result in the loss of traditional livelihoods or resource access rights of the poorer community members. Accurately projecting and then measuring both the positive and negative impacts of a project not only is a moral imperative but also has important commercial implications (Richards and Pacifil, 2010)The co-benefits arising out of afforestation projects in general and forest carbon projects in particular are summarized as follows:

1. Increased access to resources

A good forestry carbon project may provide increased access to forest resource base and forestry products such as NTFPs, medicinal plants, gums and resins, fuel wood and timber. In many large forested Indian states which also support large populations' collection of NTFPs provide a definite supplemental income to the forest based communities. Many communities rely on these forest products for meeting their subsistence needs and generating extra income by selling them.

2. Increases the value of forests

Although forests often provide needed goods, services, and supplemental income, sound forest management may not be profitable in all situations. In such scenario, payment from carbon credits increases the value of forests, relative to other conventional land uses. Thus, these additional carbon payments can be used as a tool to finance activities required to achieve sustainable management regimes. The additional revenue thus generated by carbon benefits can be well utilized to avail the services of good nursery and improved seeds.

3. Watershed improvement

Forestry carbon projects can amplify the efficacy of the nearby watershed area thereby increasing both surface and ground water levels. These enhanced levels of water can be used for both drinking and irrigation purposes thus providing an additional water supply for the generation of crops and yield which can critical for livelihood. A recent example is the mid Himalayan watershed project in Himachal Pradesh, which is one of the CDM projects of its category.

4. Restoration of degraded lands

Plantations can prevent soil erosion and landslides through sedimentation of water. Forestry projects can restore millions of hectares of degraded lands in the developing countries. This will further control soil erosion and nutrient depletion and will restore the fertility and productivity of the agricultural fields, subsequent help maintain livelihoods if not enhancing them

5. Strengthening JFM activities

Improvement in the social network and capital of the community through joint forest management (JFM) activities is an important area where forestry contributes to livelihoods and wellbeing. Active participation in forestry projects provides a means for local communities to exercise their indigenous knowledge and to further strengthen their expertise in effective management strategies. Forestry development projects have often strengthened local institutions by involving communities in decision making.

6. Development of forest based small industries

Forestry carbon projects provide greater scope for the development of forest based small business enterprises or production units. The by-products of these forestry projects (such as silk or gum) can be used as input material for other industrial purposes. Leaves from mulberry plantation can be used in silk production units, and honey can be sold directly to food processing industries.

7. Sustainable management of forest resources

Forestry carbon projects help in sustainable management of forest resources. In addition these projects can also help establish more sustainable patterns of energy consumption by enhancing the energy efficiency of forest product use through processing plants. For instance, forestry and renewable energy projects have significantly enhanced biomass fuel resources and improved energy efficiency by introducing advance and energy-efficient cooking stoves and charcoal kilns.

Additionally opportunities for livelihood from forestry activity can be increased through recreational activities such as ecotourism or through conservation of wildlife.

9.2 Livelihood dimensions of some forestry carbon projects

9.2.1 Large-scale Industrial Pulp or Timber Plantations

Industrial plantations require skilled and unskilled labour for project development and for activities related to plantation and its maintenance. Such plantations require more labour as compared to agriculture. These plantation activities can help local inhabitants through employment and income generation. The requirement for labour decreases after the initial plantation phase ; however, if the harvesting pattern of trees is cyclic as planned, then the labour requirement will remain constant (Smith and Scherr, 2002). Sometimes communities are not allowed to access large-scale forestry projects or protected forests; this poses a threat to their livelihood and sustainable development opportunities because their lifestyle is dependent on the degraded land that has been used to develop the forestry project.

9.2.2 Community Forestry Plantations

In community forestry, forests are maintained on community lands to provide products such as gum, resins, fruits and latex. These products supplement the income of all stakeholders, including nearby communities. Extraction of these forest-based products result in to minimal impacts on the existing carbon stocks. Community forestry in particular can be termed a successful programme primarily because of social inclusion in to the projects and secondly because of its typical benefit sharing mechanism that allows its stakeholders to access the products and services of the projects in a sustainable manner. Community forestry promotes social inclusion, poverty reduction and equity within the communities by enhancing the livelihood opportunities. After value addition, when, forest produce and services are diverted to the market they subsequently generate surplus revenue for the local inhabitants (Chapagain and Banjade, 2009).

The tamarind project in southern India with Plan Vivo support is an example of agroforestry and bioenergy project. Under this innovative project small farmers with holdings of about 2ha have organized and entered in to a carbon sale agreement with “Future Forests” an international company based in the UK. The mango and tamarind plantations have been increased to more than 2ha of land belonging to a small farmer and 18 tonnes of carbon is expected to be fixed over six years. The fixed carbon has been agreed to be sold at the rate of $10 per tonne of carbon, equivalent to `8640. The company should pay this amount to the farmer in five instalments, starting from the second year: 505 (`4320) as the first instalment in the second year and the remaining 30% in the remaining three instalments in the fourth, fifth, and sixth years. Thus in addition to the income generated by the scale of fruits and other products farmers will get an extra income from the sale of carbon (Satyanarayana, 2004).

9.2.3 Agroforestry Plantations

Agroforests can be grown on fallow or crop land and mainly include valuable species such as cinnamon and coffee thus these are very useful in generating revenues for farmers (Smith and Scherr, 2002). Agroforestry can be incorporated in forestry projects where the benefit to local communities is preferred to the carbon credits because they may not generate adequate carbon credits required to make the project profitable. Moreover, such projects improve biodiversity and add value to the ecosystem services that help the communities residing near the forests.

9.2.4 Forestry Regeneration and rehabilitation Project

Forests that suffer damage due to commercial exploitation and overuse may be allowed to be restored by the communities to regenerate the linkage of services and benefits from forests. These restoration processes can directly benefit the local communities by providing them the lost sources of natural resources and NTFPs. Forest regeneration activities can also provide direct employment opportunities along with the restoration of broken link between communities and forests. Thus the sake of community, if created may help in sustained conservation of projects.

9.3 Guidelines for forestry carbon projects to address livelihood issues

An ideally designed forestry carbon project will provide an integrated approach that will include community participation, ensure no negative or minimal impacts on the existing resources of the community, and at the same time increase the overall livelihood opportunities along with the targeted carbon offsets (Nigel. et al., 2002). Some of the steps to be followed to make communities able to provide better livelihood prospects as follows:

- Explicitly include a broad range of forest management and agroforestry activities in the programmes on climate change
- Provide a broad scope for strong local stakeholder and community participation
- Implement social impact assessment for all forestry carbon projects
- Strengthen capacity at the local, national and international levels.

- Provide incentives for projects with multiple benefits
- Reduce transaction costs of community based projects

Hence, it is evident that forestry carbon projects can provide additional benefits to the communities associated with the projects. These projects can enhance both income and livelihood opportunities. Thus, land use change and forestry carbon projects with significant livelihood benefits are both possible and desirable to achieve the dual goal of CDM, climate change mitigation and sustainable development. Therefore, forestry carbon projects should be designed and managed with an aim to increase the well being of the poor. Incorporating provisions such as those proposed here would reduce the risks to local people, increase the appeal to private investors and increase the appeal to private investors, and increase the chance of success for forestry carbon projects.

9. REDD+

9.1 Emergence of REDD

The option of Reducing Emission from Deforestation and Forest Degradation (REDD) in developing countries not only averts the worst consequences of global warming but also generate enormous co-benefits for biodiversity conservation and sustainable development. Perusal and analysis of literature shows that REDD could substantially decrease the severity of climate change. Similarly information related to costs reveals that REDD is an inexpensive approach compared with emission reductions in the energy sectors of industrialized countries. The costs per ton of reducing current CO_2 emissions from deforestation by half even with pessimistic assessments, and including opportunity costs as well as REDD's implementation, transaction, administration and stabilization costs are less than a third of the current capped carbon market prices (Cacho and Lipper, 2007). As per the conservative estimates, in 2020, an annual funding of $5 billion could reduce deforestation emissions by over 20%, $20 billion by 50% and $50 billion by 66%. The latter level of funding is equivalent to only 0.13% contribution of the developed countries annual GDP to REDD. An estimate from the cost curves of the US Lieberman-Warner Bill, which determines the potential emission reductions from its market-linked funding, reveals that in 2020, the bills allocation of 2.5% of allowance revenues for REDD could reduce emissions by an amount equal to 9% of the United States' total emissions in 1990.

9.1.1 Features of global REDD+ Mechanism

The decisions and methodological guidance provided by the UNFCCC have yielded a REDD+ mechanism that can be described as having five principal features.

First, the principal objective of this REDD+ mechanism will be to abate carbon emissions from forests in developing countries through a broad range of interventions. As established by the Cancun Agreements, the following activities are eligible for support and funding under a UNFCCC REDD+ mechanism: "(a) Reducing emissions from deforestation; (b) Reducing emissions from forest degradation; (c) Conservation of forest carbon stocks; (d) Sustainable management of forest; (e) Enhancement of forest carbon stocks." (UNFCCC, 2011). This means that a REDD+ mechanism could be used either to reduce "negative changes" to forests or to enhance "positive changes" in forests (Wertz-Kanounnikoff and Angelsen, 2009) and could therefore apply to countries with declining forest cover, those that have an active forestry sector, and those where forest cover is stable or increasing (Angelsen and McNeill, 2012). On the other hand, the scope of REDD+ is normally expected to exclude status quo activities, such as a forest conservation project in a context where the forest in question is effectively protected and where finance would not lead to any additional reductions in carbon emissions, as compared to a business as usual scenario (Streck and Costenbader, 2012)

Second, a UNFCCC REDD+ mechanism should fund eligible activities on the basis of result*s* achieved in reducing or avoiding carbon emissions at a national scale (UNFCCC, 2011). While it was initially envisaged that the concept of results-based finance for REDD+ would be operationalized by setting up a multi-level system of payments for ecosystem services (PES), the REDD+ mechanism as designed within the UNFCCC embraces a much larger notion of "PES-like" performance-based payments made at a national scale rather than the direct and conditional provision of incentives at a project scale (Angelsen and McNeill, 2012). Of course, even if the

UNFCCC REDD+ mechanism does not function as a genuine PES system, this does not exclude the possibility that developing countries may initiate PES systems or authorize PES projects as part of their domestic REDD+ programmes.

Third, REDD+ activities eligible for funding under a UNFCCC mechanism must be measured, reported, and verified (MRV) (UNFCCC, 2011) and assessed on the basis of a previously developed forest emissions level or forest reference level (UNFCCC, 2011); UNFCCC, 2012b). The design of both of these elements of the REDD+ mechanism has led to contentious negotiations between countries committed to safeguarding the integrity of a REDD+ mechanism and countries concerned with safeguarding their sovereignty as well as ensuring that REDD+ does not blur the distinction between industrialized countries that must take action to reduce their carbon emissions and developing countries that are only encouraged to undertake nationally-appropriate mitigation actions. In both cases, the UNFCCC COP and Subsidiary body for scientific and technological advice (SBSTA) has provided methodological guidance as well as set up a review process that includes a technical assessment by international experts (UNFCCC , 2013b; UNFCCC, 2013c). Fourth, the UNFCCC COP has reiterated, in line with the principle of common, but differentiated responsibilities, that the pursuit of REDD+ activities by developing countries is subject to their national capabilities, capacities, and circumstances and is moreover contingent on the delivery of adequate and predictable levels of financial and technical support received from developed countries (UNFCCC, 2011; UNFCCC, 2013a). The Durban Platform further specifies that finance for REDD+ activities “may come from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources” and recognizes that “appropriate market-based activities” could be developed for this purpose (UNFCCC, 2012a). The nature and level of public and private finance that may eventually be available for the implementation of results-based actions for REDD+ will depend on a host of factors, including the decisions within the UNFCCC regarding the coordination of funding, the progress of $REDD^+$ readiness efforts in a given country, the national policies and regulations of host developing countries, and whether developed country governments or firms have committed to ambitious climate mitigation objectives that create a demand for emissions reductions achieved through REDD+ (Angelsen and McNeill, 2012).

Fifth, the UNFCCC COP has recognized that beyond the need to contribute to climate mitigation, a REDD+ mechanism should also engage with a series of important environmental, economic, and social objectives. The Cancun Agreements thus provide that REDD+ activities should, among other considerations, "be consistent with the objective of environmental integrity and take into account the multiple functions of forests and other ecosystems," "be consistent with Parties' national sustainable development needs and goals," and "be implemented in the context of sustainable development and reducing poverty, while responding to climate change." (UNFCCC, 2011) To that end, the UNFCCC COP has adopted a series of environmental and social safeguards for REDD+ activities, which include requirements that activities be consistent with transparent forest governance, Indigenous rights, and biodiversity and has recognized "the importance incentivizing non-carbon benefits for the long-term sustainability of the implementation of [REDD+] activities." (UNFCCC, 2013a).

9.2 REDD+ vs Kyoto Protocol

One of the main limitations of the Kyoto protocol with regard to forestry was that no other aspects of forestry except afforestation and reforestation were included in the Kyoto Protocol although emissions due to deforestation and degradation constitute 17% of the total

GHG emissions worldwide (Nabuurs, et al., 2007). Deforestation is one of the most prominent and widespread problems in tropical countries primarily because of the absence of any incentive mechanism for communities who are engaged in illegal and unsustainable felling to relinquish it. Secondly, the perceived opportunity cost of maintaining the forest is high; people pursue immediate economic benefits accrued due to illegal logging and timber trading rather than the indirect benefits ascertained by maintaining forest. Conservation of forest is also important because in addition to environmental benefits they supply some special social co-benefits such as employment and means for sustenance and livelihood. Despite having such a positive impact on both communities and environment, forestry is just being limited to afforestation and reforestation in the Kyoto protocol's Clean Development Mechanism. These advantages of forest conservation and deforestation have forced environmentalists to argue that REDD could be a low cost and effective strategy to mitigate climate change (Sathaye, et al., 2007).

9.3 Better forest management: A 'REDD' solution

Improved forest management will help in reducing the current and future vulnerability to climate change and will also advance adaptation and mitigation objectives jointly. Forests can safeguard communities and societies more broadly from the efforts of current climate variability such as droughts, storms, flooding and landslides in the short term. For example, forests can help protect coastal areas from storms and waves and forest based ecosystem services can help regulate hydrological flows during the years having abnormal rainfall. During drought, which affects agriculture, forest based food and other products can be consumed or sold for income. In addition, forests also help people adapt to climate change in the longer term (Seymour, 2011).

However, when forests are degraded or converted for other uses, the supply of goods and services from them is compromised. Degraded forests are less resilient to climate change compared to intact forests. For example, forest areas that have experienced fragmentation or unsustainable logging practices are more vulnerable to fire. Accordingly investment is required in the sustainable management of forests to prepare for next year's drought as well as to anticipate the 2050 shift in rainfall patterns (Seymour, 2011). However forest ecosystems are in danger as a result of climate change and exploitation pressures to meet the current food, fuel and fiber needs. Protection of forests should be seriously considered at the local and global levels; however this may pose difficult choices between current and future welfare.

Financial mechanisms being mobilized under the aegis of REDD+ may provide a source of finance for such protection, and for compensating communities for any loss of current income that such protection entails. Forest protection efforts can either help finance rural development or make some stakeholders worse off easily, depending on the sharing of REDD+ benefits at the national and local levels. Thus, there is an important trade-off between imposing risks on some of the world's most vulnerable communities in the short run and the risk of no action to reduce forest-based emissions, which benefits the global community as a whole in the long run.

CHAPTER 10 CHALLENGES AND OBSTACLES IN UNDERTAKING AR-CDM PROJECTS

10.1 Obstacles in undertaking CDM-AR projects

The potential for forestry CDM is important in face of climate change related events such as droughts, heat waves and floods. Therefore, the development dividend and carbon finance are especially appropriate where poverty alleviation and environmental protection suggests themselves as priorities of the forestry sector but the lengthy decision-making process and complex procedures have alienated potential project developers and investors. The major obstacles in undertaking CDM-AR projects is rather procedural complexities in CDM protocols than local level issues. The major obstacles in undertaking AR CDM projects are as follows.

10.1.1 Political Background

The inclusion of forest sinks in mitigation activities has been one of the most controversial issues in climate change negotiations: Accounting for forest sinks was frequently viewed as a "loophole" policy to sidestep serious measures for emissions reduction. Several parties stressed the potential risks of forestry projects: Carbon removals by forests are considered to be only temporary. Moreover, the establishment of plantations could contribute to deforestation, loss of biodiversity and harmful impacts on local livelihoods. These risks and related scepticism have, to a certain degree, impaired the political process as well as the potential of forestry CDM. Due to the resulting methodological and technical uncertainties, negotiators had great difficulty in agreeing on a scheme to account for carbon sequestration by forests. Only Afforestation and Reforestation activities were identified as qualifying for the CDM. The negotiation of modalities and procedures for forestry CDM took two years longer than for other CDM sectors (e.g., energy), which also caused some delay in investment in this sector. The temporary nature of carbon sequestration by forests was taken into account by special types of expiring carbon credits.

10.1.2 Markets for Forestry Credits

Compared to regular carbon credits, the market for temporary credits from forestry is limited. One major obstacle for AR CDM is the EU's decision to exclude forestry credits from the EU Emissions Trading Scheme, which currently holds the majority of the overall carbon market. The legal directive gives as the reason for exclusion the Community's differing priorities for climate policy, as well as the above-mentioned risks of forest sinks. Since the trading scheme covers much of the European private sector, this EU policy keeps forestry credits out of reach of one of the major demand groups. Governments, including the EU members, may still achieve part of their obligations through forestry credits. The 1%-cap of the Kyoto Protocol is actually not a quantitative obstacle: So far, transactions cover only 6% of tradable credits under the allowable 1% cap (CEC, 2003). This limitation might, however, alienate investors and credit buyers - as supposedly does the EU policy. Similarly, as a recent survey (Ecosecurities, 2006) shows, the temporary nature of credits and the risks attached to forestry credits are seen as reasons not to buy them. Despite the resulting competitive disadvantage for AR CDM, there is significant demand for forestry credits, even if at relatively low value.

In addition, while some nations are taking concrete steps forward on carbon pricing, recent developments in others are a setback. The three major emitters Japan, New Zealand and Russia officially pulled out of the second commitment period of Kyoto Protocol, Canada withdraw from the Kyoto Protocol during the first commitment period and the infrastructure created by the market based mechanisms under the Kyoto Protocol continues to be dismantled as many players, including financial institutions, private sector intermediaries and aggregators and designated Operational Entities (DOEs) have either exited the market or substantially reduced their activities. No sign of a short term recovery in demand for international credits from the existing and emerging initiative led to an intensified exodus private sector players in the last two years (World Bank, 2014). Fears abound that the demobilization of CDM market infrastructure could substantially damage the institutional memory that has been created and delay the market recovery if and when positive policy signals are given.

Since the second half of 2012 there has been a growing feeling in the CDM market that demand is saturated with little prospect of significant recovery (World Bank, 2014). In the month of February 2014 as further sign of steady decline of the CDM DNV, GL, once the biggest DOE announced withdrawal from the validation and verification service business followed by JCI in March. This exodus of dilutes the knowledge and know how that have been built up over the past 15 years. It also undermines the trust of private sector players and public confidence in the CDM in particular and carbon market in general.

10.1.3 Investments, Transaction Costs & Risks in AR-CDM

AR CDM implies long-term investment in a forestry project: Requiring high rates of financing at the beginning, forests take some time to deliver revenues and benefits. Likewise, the delivery of carbon revenues can occur only according to CDM procedures and after fulfilling the project cycle. As a result, investors face high initial costs and delayed returns, which demands the availability of initial investment capital and the ability to wait for revenues. In any case, projects need some sort of upfront-financing to bear transaction costs for AR CDM, very roughly estimated at around 150,000 USD. Apart from payment of fees or the 2% contribution of carbon credits to fund climate change adaptation in developing countries, the expenses depend on various factors: local circumstances, complexity of the project idea, consultant input as well as the costs for services by the Designated Operational Entity, etc. Projects can be designed and managed so the established forest provides early (and continuous) income, e.g., through diversification of forest uses and mixture of tree species. Since transaction costs depend very much on the scale of the project activity, simplified modalities and procedures were created for small-scale projects. However, many experts stress that the carbon credits available under the small-scale limit of 8,000 tons CO_2 are barely enough to make a project viable. This is a disadvantage for those regions where small-scale approaches would be particularly appropriate for poverty alleviation, since there project developers usually lack financial capacity. Aside from the risks typically associated with forestry projects (e.g., natural hazards), investment in AR CDM is also perceived as uncertain. This risk lowers the price paid by the carbon market depending on the stage of project development. Similarly the future developments of climate change, the lack of mitigation ambitions pre-2020 continue to slow down discussion on existing and new international market based mechanisms, the second commitment period of the Kyoto Protocol from 2013 to 2020 represent only 12% of global emissions (World Bank, 2014) and the Doha Amendment which contains the emission reduction targets parties put forward for COP 2 is not in force yet (UNFCCC, 2015). Some brokers create portfolios of projects and carbon credits, which can help to mitigate some of the risks perceived by credit buyers. Several insurance companies offer schemes for forestry risks, non-approval under the CDM, and the delivery of carbon credits. Standards, e.g., the "Climate, Community & Biodiversity Standard", can increase the value of credits at an earlier stage of project development, minimize the risk of non-approval as a CDM project, and certify contributions to sustainable development. Forest certification (e.g., Forest Stewardship Council) enhances credibility of AR projects in terms of sustainable forest management

10.1.4 Methodological and Procedural Issues

There are considerable constraints in the formulation of CDM A/R projects, and the likelihood that areas of land will be utilized in CDM A/R activities is dependent on a range of social and economic issues, food security and other factors (Zomer et al., 2008). More than other CDM sectors, AR has been technically challenging to formulation of methodologies acceptable to the Executive Board. The effort to develop a new methodology seems considerable, as approved methodologies often cover more than one hundred pages. Methodologies might not be applicable or adaptable to specific local situations, which would sometimes appear only during the course of project implementation. The project cycle for AR CDM is described as very challenging and requires input by CDM experts and foresters. In particular, the handling and writing of technical documentations demands qualified consultants. Compared to other CDM sectors, AR projects are involved in features unique to forest or land management: e.g., biodiversity, hydrology or land ownership. The procedures require a data background (e.g., proof of land eligibility) that might be costly to obtain under some circumstances (CEC, 2003). At first glance, the additionality concept seems to impair forestry CDM. Additionality and its proof are certainly a difficult issue for the CDM and not only for forestry projects. However, this ensures that the project delivers real benefits for climate change mitigation. In practice, it means that commercial large-scale plantations that would be economically viable and don't face any other barrier or laws stipulating other land uses, are not eligible under the CDM. A project might be considered additional if it comprises a mix of activities with low financial indices that would not be possible without carbon finance, e.g., a combination of agro-forestry, community forestry and conservation

10.1.5 Social and Legal Issues

Forestry projects often involve a strong social and participatory component, which becomes even more important in view of the development objectives of the CDM. The legal background is a crucial element to ensure equitable benefit sharing and to avoid social conflicts, which could impair the permanence of carbon sequestration. Contractual agreements for joint-management and shared benefits can build the legal back-up. For this reason, it is essential to consider all local interests and rights during the planning process, although it can be expensive and has conflict-potential. Some experiences report the integration of local people in monitoring procedures as highly beneficial. Tenureship has to be clear and structured for the implementation of a CDM project. One of the underlying problems is the conflict between customary and official law, where several users may have different rights for different types of land use. Another source of conflict is the displacement of pre-project land uses and in some cases also land users. Restriction of access and rights might not be effective and leads to conflicts.

10.2 AR-CDM Projects currently undertaken by different states in India

1. Himachal Pradesh reforestation project-improving livelihoods and watersheds

Himachal Pradesh is the first Indian state to sell carbon credits to the World Bank under the agreement World Bank will buy carbon credits from new forests being developed on degraded land in Himachal Pradesh under a watershed management programme called the reforestation project improving livelihood and watershed project.

The major objectives of the project are: - improvement of the productive potential of the degraded land or watershed catchment areas and enhance biomass production and carbon stocks in degraded lands, and - improvement of livelihoods and incomes of rural households residing in the selected watersheds of MHWDP, using socially inclusive and institutionally and environmentally sustainable approaches

Project participants:

Parties involved	Public and / private project participants
GOI	HPMHWDP
Kingdom of Spain	International Bank for Reconstruction and Development (IBRD) as a trustee for BioCarbon Fund (BioCF)

A summary of total land area in three land categories:

- Degraded forestland – 3176.86 ha
- Degraded community land – 293.06 ha
- Degraded private land – 533.15 ha

2. Agroforestry interventions in Koraput district of Orissa

The overall objective of the A/R CDM activity is to mitigate climate change while contributing to sustainable environmental management, community development and poverty alleviation of tribal farmers in five blocks of Koraput district in the state of Odisha.

The project is an agro-forestry initiative on non-forest land with Eucalyptus clones *(Eucalyptus camaldulensis* and *Eucalyptus tereticornis*). The total area of the project is 380.2 hectares (939.5 acres) which comprises small and fragmented parcels of land owned by the poor and marginal farmers in five blocks of Koraput district in the state of Odisha. The land owners are low income, small-scale farmers from tribal communities who lack the knowledge of plantation practices and financial means to undertake such new practices on their own.

Project participants:

Party involved	Private/public entity project participants
GOI	**Patneswari Agri. Cooperative LTD**

3. Rehabilitation of degraded wastelands at Deramandi in southern district of Delhi through reforestation

The project is being implemented by the Department of Environment, Forests and Wildlife, Government of National Capital Territory of Delhi, by specially engaging Eco-Task Force of Indian Territorial Army for reforestation of the erstwhile-degraded grasslands in project area. The project boundary is comprised of degraded grassland in Deramandi with a geographic spread of 358.5 hectares. The project in its mission envisages demonstrated and credible carbon sequestration through reforestation forestry and in meeting the objectives of Sustainable Development

4. Improving rural livelihoods through carbon sequestration by adopting environment friendly technology based agroforestry practices

The proposed A/R CDM project activity will mobilize resource-poor farmers to raise tree plantations on farmlands. It proposes to link resource poor farmers and end users of wood products in order to optimise the land use and to facilitate the co-ordination of wood producers, agronomists, financial institutions and non-governmental organizations to improve the livelihood opportunities of rural households. The project activity is implemented on the degraded farmlands or lands used for rainfed subsistence agriculture.

Project participants:

Name of party involved	Private/public entity project participants
GOI	• VEDA climate change solutions Pvt LTD • JK Paper Ltd.
Government of Canada	IBRD as a trustee for BioCarbon Fund

5. Small Scale Cooperative Afforestation CDM Pilot Project Activity on Private Lands Affected by Shifting Sand Dunes in Sirsa, Haryana

The lands to be planted in the proposed 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 sands1. 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 purpose of the small-scale A/R CDM project activity proposed by Haryana C.D.M Variksh Kisan Samiti (Haryana CDM Tree Farmers Society), Ellenabad, Sirsa (Hereafter known as *the Society*); are as follows.

- To earn carbon credits from growing of trees to be planted, under the CDM provisions of KyotoProtocol;
- To help in mitigation of global warming by planting trees for sequestration of atmospheric carbon dioxide;
- To improve the local environmental condition of soil through increasing the water holding capacity of the lands, increasing the humus in soil and also stabilizing the sand dunes, by converting the marginal and degraded croplands into forested lands;
- To increase income, provide employment opportunities, and as a result to alleviate poverty of local communities.

To realize the objectives mentioned above, 369.87 ha of mixed forests will be established, using seven tree species, i.e., *Ailanthus excelsa, Acacia tortilis, Eucalyptus* hybrid*, Acacia nilotica, Dalbergia sissoo, Zizyphus mauritiana, Prosopis cineraria.*

Conclusion

Project formulation always plays an important role in the success of a forestry carbon project. The rule and protocols for projects defined in CDM are much specified whereas in the case of voluntary mechanisms these are scattered and variable as the whole voluntary market is scattered. CDM defines various methodologies and frameworks to guide project proponents on the contrary voluntary market defines standards individually and specific to their own market. Hence care needs to be taken when any project developer frames a project in line with voluntary market and intends to trade carbon credits in the scattered voluntary market. For instance, any project proponent who aim to trade carbon credits generated by its projection Chicago climate Exchange (CCX) have to comply with the standards specified by CCX.

The viability of CDM projects will eventually depend not on technical issues but on market and legal issues such as contract negotiation and project attractiveness in the carbon market. So project developers must strive to make their projects attractive in the carbon market. For that they must be aware of the importance of project scale and CER volume for CER buyers because many buyers seek to avoid the high management cost induced by a portfolio of small projects. Other important factors influencing project attractiveness in carbon markets are low complexity, good governance, level of delivery risk and time horizon. Another important marketing factor is the possibility for a forestry project to propose innovative solutions to the problem of nonpermanance. For instance, the projects may be included in a portfolio of projects or facilitate the purchase of nonexpiring credits in replacement of its tCER and lCERs at the moment they expire.

After the creation of the CDM in 1997 many foresters were enthusiastic about this new mechanism. They envisioned the possibility of selling large quantities of carbon credits at high prices- for instance from forest conservation projects. Since 1997 the modalities and procedures of the CDM have been progressively defined and the mechanism has become increasingly restricted by complicated rules and requirements such as the rules about eligible activities, permenance, land eligibility, project cycle and associated transaction costs. As the technical issues becoming more and more cumbersome a good portion of the initial enthusiasm is lost. Project developers with sufficient technical capacity may now be able to tackle the technical issues and reach project validation. However the viability of a CDM-AR project reaches beyond the validation step and depends largely on its attractiveness in the market and the legal arrangements which it is involved.

SUMMARY

The present study was conducted to prepare protocols for availing carbon finance for forests of Kerala, with respect of the objectives mentioned salient findings are summarised below.

1. Existing A/R projects are found to be not suitable for availing carbon finance as it is not formulated in accordance with the guidelines set by UNFCCC CDM or Voluntary Carbon Standards.

2. Analysing already approved A/R projects and various guidelines set by UNFCCC and voluntary carbon standards, Formulated a simplified protocol and guidelines applicable to both CDM and VCS.

3. By way of a run through example developed an AR CDM Project design document; Even though the example is set in a hypothetical situation it illustrates practical application of the rules of the CDM through the approved methodology AR-ACM003.

4. Comparing the rules and modalities of both voluntary and regulated markets the rules set for CDM is found to be complex and difficult to implement and also while considering the current developments in the international negotiation process the future of CDM seems to be uncertain as there is little consensus within the parties for a second commitment period.

5. Considering the recent boom in the voluntary carbon market and flexible rules set by various voluntary standards voluntary carbon market is found to be most suitable for availing carbon finance for forests of Kerala.

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