Monitoring report form
(Version 03.1)

Monitoring report

Title of the project activity	**India: Himachal Pradesh Reforestation Project – Improving Livelihoods and Watersheds**
Reference number of the project activity	4174
Version number of the monitoring report	1
Completion date of the monitoring report	15/03/2013
Registration date of the project activity	04/03/2011
Monitoring period number and duration of this monitoring period	1st Monitoring period (01/07/2006 - 31/12/ 2012)
Project participant(s)	HPMHWDP, IBRD as trustee of Bio Carbon Fund.
Host Party(ies)	Government of India
Sectoral scope(s) and applied methodology(ies)	14: Afforestation and Reforestation AR-ACM0001 version 03: Afforestation and Reforestation of Degraded Land.
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	1,70,746 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	61,194 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>> The Mid Himalayan Watershed Development Project (MHWDP) is being implemented in the Indian State of Himachal Pradesh. The state is located in the North-Western Himalayan region of India and has 12 districts, which are categorized into four agro-climatic zones, i.e., i) Shiwalik hills, ii) Mid hills, iii) High hills and iv) Cold dry zone. The Project area lies in the mid and high Siwalik hills between an altitude of 600 to 1800 meters and covers 11 watershed divisions in 10 districts. spread over the catchments of Ravi, Beas and Sutlej, major rivers of Northern India.

The A/R CDM project has been developed under the umbrella of the MHWD Project. It has been developed and implemented through a series of consultations involving MHWDP and its stakeholder constituents namely, Forest Department (Government of Himachal Pradesh) local institutions, Gram Panchayats (GPs); and the International Bank for Reconstruction and Development as a trustee of the BioCarbon Fund. The project is implementing A/R CDM activities on 4003.06 ha of degraded lands on 420 land parcels in the watersheds spread over 177 Gram Panchayats of Mid-Himalayan region.

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

The major objectives of the project are to:

- improve the productive potential of the degraded land or watershed catchment by enhancing biomass production and carbon stocks on degraded lands included in the project,
- sequester Green House Gases (GHG) removals by sinks through reforestation on degraded forest, community and private lands, and
- contribute revenues from the project to improvement of livelihoods and incomes of rural households residing in the watersheds covered under the project.

The project is expected to restore degraded lands through reforestation activities and bring value addition to the catchment treatment activities undertaken as part of the MHWDP.. The project is also expected to provide multiple benefits to poor households through meeting their needs of small timber, firewood, minor forest produce, besides providing employment opportunities and revenue from the sale of certified emission reductions. The three reforestation models implemented in the project are outlined below.

i) Restoration forestry model: In this model, reforestation of degraded forestland is undertaken by planting 1,100 plants/ha of mostly native species. This model of restoration forestry aims to protect the watersheds, conserve biodiversity, and regenerate the native flora, supplemented with planting of native tree species on degraded sloping high altitude lands of selected GPs. Regenerated forests are expected to provide non-timber forest products to local communities and improve their livelihood opportunities. This model has covered 2947.27 ha.

ii) Community forestry model: This model is being undertaken for reforestation of degraded community lands (common land). The species included in this model are largely native species. The reforestation activity will lead to protection of watersheds, improvement in biomass required to meet the local community needs of small timber, fuelwood, fodder for

livestock and non-timber forest products. This model covers 225.04 ha and the density of planting in this model is 1,100 trees per hectare.

iii) Farm forestry model: This model covers an area of 29.15 ha and includes reforestation of abandoned or long-term fallow private lands with tree species and aims to provide fruits and fodder to the land owners. The density of planting is 1,100 trees per hectare. Through this model, land owners derive fuelwood, employment apart from protecting the abandoned land.

The A/R CDM project contributes to sustainable development in the following ways:

- Restoration of highly vulnerable and degraded lands - forestland (un-demarcated forests), degraded community land and degraded and abandoned private lands in the Mid-Himalayan watersheds, which are subjected to severe soil erosion and unsustainable land use practices.

- Participation of local communities, particularly small and marginal farmers in plantation activities on degraded common lands, degraded forestlands and private degraded lands through planting of multi-purpose species and implementing sustainable forest management practices.

- Generation of employment through silvicultural activities such as nursery raising, site preparation, seedling transportation, planting, fencing and maintenance of plantations. About 343 person days/ha of employment is expected to be generated from the implementation of three models during the project period

- Promotion of biodiversity conservation, soil conservation and environmental protection through planting and protection of native tree species, reduction in soil erosion and prevention of downstream siltation of water bodies.

- Supply of multiple products to the local communities.

- Transfer of revenues accrued from the project to gram panchayats and individual participating farmers through a pre-project agreement.

The project will continue to be implemented and managed by the MHWD project authorities till 2016 or beyond (if extended) and subsequently by the State Forest Department. The Project Directorate will manage and transfer the carbon revenue to local stakeholders, i.e. panchayats and/or individual farmers. In addition to carbon revenue, the restoration, community and farm forestry activities will bring additional benefits to the local communities such as land reclamation, increased biomass supply and livelihood opportunities.

The project has brought in several development perspectives (with relevant implementation tools) for the Watershed and NRM sector in general. This includes development of local level institutional mechanisms for the sale of Certified Emission Reductions (CERs); testing of carbon purchase transactions and accumulation of experience in implementation of CDM project activities; development and testing of local financial arrangements for restoration of degraded lands and identification of resource-poor farmers as the beneficiaries of the project. Being the first of its kind, the project is also expected to have significant demonstration effect in the country. In fact the addition of Bio-carbon component in watershed project of HP has been a pioneering effort in India.

A.2. Location of project activity

>> The project is located in the mid-altitude region of Himachal Pradesh at elevations ranging between 600 and 1800 metres above mean sea level. The project area covers Dharamshala and Bilaspur regions, encompassing 11 watershed divisions namely Nahan, Swarghat, Solan, Namhol, Kullu, Rampur, Mandi, Sujanpur, Dharamshala, Nurpur and Chowari. The Figure A.2.1. shows project area covering various districts of Himachal Pradesh.

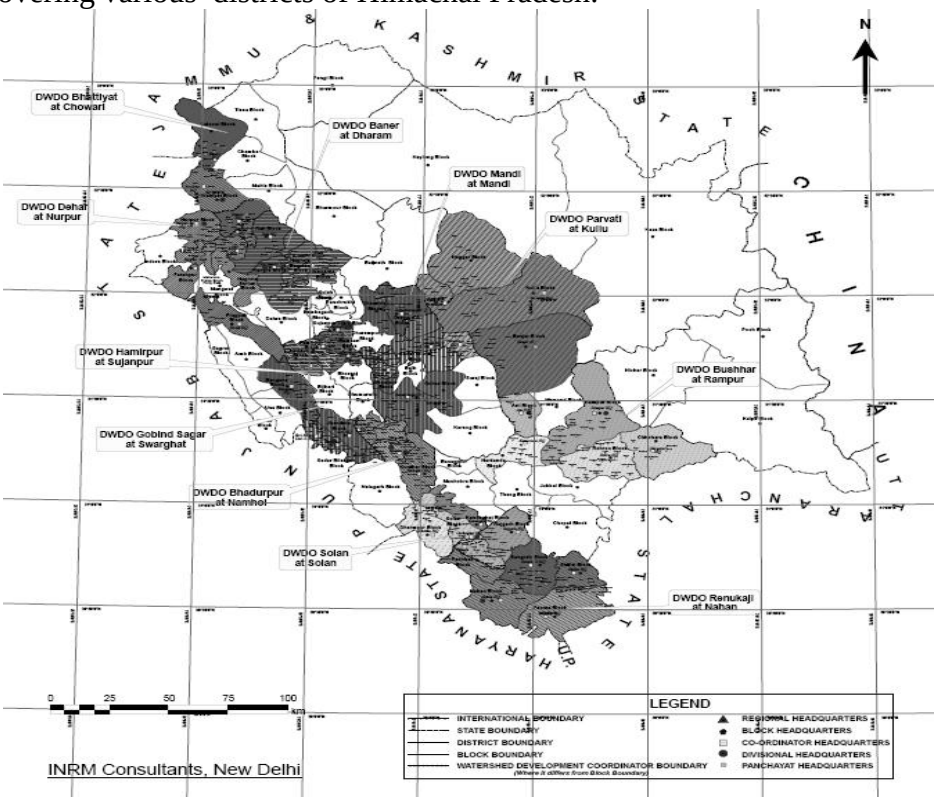

Figure A.2.1: Map of Himachal Pradesh with watershed divisions marked and selected divisions identified

Details of land parcels included in the project, their location, Parcel ID, altitude and area are presented as **Annex--A.2**

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government of India	Mid Himalayan Watershed Development Project	No
Kingdom of Spain	International Bank for Reconstruction and Development as a trustee of BioCarbon Fund	Yes

A.4. Reference of applied methodology

>> "Afforestation and Reforestation of degraded land" (AR-ACM0001/version 03.

A.5. Crediting period of project activity

>> 20 Years

SECTION B. Implementation of project activity

B.1 The Project has been implemented as a Sub Project of Mid Himalayan Watershed Development Project (MHWDP) involving HP Forest Department and the local institutions ie Gram Panchayats (through community user groups). The officials responsible for coordinating project implementation, and organization of data/information/reporting of the project have been designated at various levels.

Out of the project area of 4003.07 has, a total of **3210.19** ha area has been implemented under the project until December, 2012 and the remaining 792.88 ha not been implemented. Phasing of reforestation activity from 2006-07 to 2012-13 by the project strata is given in **Annex B** 1.1

The selection of species was based on the their suitability for the altitude, slope, topography and site quality. Focus was on native species or species that are widely adapted to the location. Further, among the suitable species, those with moderate to high growth rate of biomass and ability to provide multiple benefits to the community are selected.

The project includes degraded forestland, community land and private land categories, for which planting models – restoration forestry, community forestry and farm forestry, respectively were adopted, and based on altitude, each of the three models were further divided into high, medium and low altitude. As a a result, nine (9) project strata were identified..

Fencing: was used to protect about 50 percent of the project area while the remaining area did not require fencing.

Seed: High quality seeds have been selected from the forest and plantation sources for raising seedlings. The seeds collected were tested for their germination ability and growth in the nurseries.

Nursery Technology: Decentralized nurseries have been established in different watershed divisions and even at Gram Panchayat level, which reduced the transportation cost as well as the vehicular emissions. Species were raised in the nursery for a period of 12 to 18 months. All the nursery activities were carried out using manual labour. The seedlings raised in the nurseries were transported to land parcels for planting. To ensure better survival of plants, nursery activities focused on developing sturdy and profuse root system of seedlings used in planting.

Site preparation: This involved clearing of weeds from an area of about 0.06 m^2 for each seedling and digging pits of 45x45x45cm. Clearing of existing shrubs and weeds has been restricted to only the pit area of the seedling (0.06 m^2 per pit). The total area disturbed at per hectare was insignificant at around 70 m^2/ha (0.007% of area planted). This helped to protect the soil and moisture and to avoid oxidation of soil organic matter. Slash and burn practice were not used in the project area to avoid the emissions of greenhouse gases. All land preparation activities were carried

out using manual labour.

Planting*:* Planting was carried out during monsoon months (July-Aug and Nov-Dec). The replacement planting was carried out to replace the failed seedlings during the second to fifth year after planting. About 25% has been replaced during first replacement and 10% subsequently, depending on the mortality of the planted seedlings.

Fertilizer and manure application: It was decided not to apply both organic and inorganic fertilizer to the plants.

Species mix: A wide range of species have been used in the plantations to ensure that communities' requirements for timber and non-timber product supplies are met.

Weeding and cultural operations*:* Weeding was carried out manually to reduce the competition for the planted seedlings. Manual weeding was done twice a year for 5 years during September and February. Cultural operations did not result into disturbance of top soil.

Tending, thinning operations*:* The silvicultural operations were not carried out as the project is in the early stages of growth and establishment.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

>> None

B.2.2. Corrections

>> None

B.2.3. Permanent changes from registered monitoring plan or applied methodology

>> None

B.2.4. Changes to project design of registered project activity

>> None

B.2.5. Changes to start date of crediting period

>> None

B.2.6. Types of changes specific to afforestation or reforestation project activity

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As per the "Guidelines on accounting of specified types of changes in A/R CDM project activities from the description in registered project design documents" (Version 02.0) (Annex 24, EB 66), the changes in planting schedule in terms of year-wise area planted and species composition have not impacted the baseline scenario and additionality of the project. Therefore, as per the paragraph 6 of the "Procedures for notifying and requesting approval of changes from the project activity as described in the registered project design document" (EB 48, annex 66) and the "Guidelines on accounting of specified types of changes in A/R CDM project activities from the description in registered project design documents" (Version 02.0) (Annex 24, EB66), these changes are identified as minor, and are to be confirmed by the designated operational entity at the verification without the need for submitting a notification or a request for approval, as listed in table B.2.6.1 below.

The types of changes of A/R CDM project from the description in the registered PDD confirming to

the "Guidelines on accounting of specified types of changes in A/R CDM project activities from the description in registered project design documents" (Version 02.0) (Annex 24, EB66) are tabulated below:

	Types of changes from the Project description in the PDD of an A/R CDM project activity	**Applicability to the project**
a)	Changes in year wise area s planted, possibly resulting in a part of the project area not being planted;	Yes, as result of minor changes in year wise area planted relative to the schedule of planting proposed in the PDD; 3210.19 ha out of 4003.07 ha. has been planted until December 2012 and efforts are underway to plant the remaining area of 792.88 ha.
b)	Changes in species composition, if the changes are demonstrated at verification to be consistent with the baseline identification and additionality demonstration made at the validation stage;	Yes, changes in species composition s occurred during the project implementation. Due to degraded site conditions and other location specific factors, survival and growth rates of some species were not as projected in the PDD. In addition, small changes to the stand models needed to be made as per the project implementation requirements.
c)	Changes in stocking density, if the changes are demonstrated at verification to be consistent with the baseline identification and additionality demonstration made at the validation stage:	No changes
d)	Changes in timing and choice of silvicultural operations:	No, change in silvicultural operations
e)	Changes in timing of harvest occurring before the third verification;	No
f)	Changes related to collection of non-timber forest products;	No
g)	Changes in tree/shrubs propagation methods;	No
h)	Changes in post –harvest replanted/regeneration methods;	Not applicable as planted areas are not harvested
i)	Changes in technology employed;	No
j)	Changes in inputs (e.g. fertilizers, certified seeds, watering);	No
k)	Changes in stratification for sampling;	No
l)	Changes in type of sample plots (e.g. temporary,	No

	permanent, point – sampling);	
m)	Changes in number of sample plots and their allocation to strata;	Yes, the calculation of number sample plots and their allocation to the project strata has been revised from original 168 sample plots to 152 sample plot.
n)	Changes in the project boundary (limited to reduction in project area), if the changes are demonstrated at verification to be consistent with the baseline identification and additionality demonstration made at the validation stage:	No

As per the "Guidelines on application of specified versions of A/R CDM methodologies in verification of registered A/R CDM project activities" (Version 01.1) (EB68, Annex31 [1], several early versions of methodologies applied in registered A/R CDM project activities contain requirements that were withdrawn during revisions/improvements of these methodologies. The guidelines (EB68, Annex31) allow a registered A/R CDM project activity to apply, at the time of verification, the improvements in the methodology that occurred after the date of registration of the project activity. The applicability of these guidelines to the implemented project is listed in the table below.

Requirement	Guidelines	Applicability to the project
Monitoring of data and parameters	(i) Only data and parameters obtained from field measurement are required to be monitored; (ii) Monitoring is not required for data, parameters, or variables appearing as intermediate values in calculation steps and those taken from existing sources (e.g. published literature)	Yes, data and parameters required to be monitored in the A/R methodological tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" were monitored.
Sampling design, sample plot lay-out, and marking of permanent sample plots	(i) Use of temporary sample plots; (ii) Random lay-out of sample plots; (iii) A maximum allowable relative margin of error of the mean, for estimation of aboveground tree biomass, of ± 10% at 90% confidence level shall be allowed.	Yes, 90% confidence level was applied.
Accounting for uncertainty	Requirements related to uncertainty assessment, uncertainty analysis, methods of combining uncertainties, and uncertainty in expert judgment are superfluous and compliance with these requirements shall not be enforced.	Yes, separate uncertainty analysis was not conducted as per these guidelines.

[1] http://cdm.unfccc.int/filestorage/4/4/29ZGXIPMWLUC7QY5R43NABH0SDK68T.pdf/eb68_repan31.pdf?t=STF8bW1mZXlsfDAw0p3_9jqbQ9-Du-NC78K1

Field measurement of soil organic carbon	(i) Instead of field measurement of soil organic carbon, the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" shall be used for areas which meet the applicability conditions of the tool; or (ii) The value of change in soil organic carbon shall be set to zero. Consequently, monitoring of data and parameters related to estimation of changes in soil organic carbon shall not be required.	Yes, A/R methodological tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" was used for estimation of changes in soil organic carbon pool.
Clearance or burning of herbaceous vegetation	(i) Changes in carbon stocks resulting from clearance of herbaceous vegetation shall be set to zero; (ii) Emissions resulting from clearance or burning of herbaceous vegetation shall be set to zero. Consequently, monitoring of data and parameters related to (i) and (ii) above shall not be required.	Yes, loss of carbon in living herbaceous vegetation was not accounted for.
Estimation of emissions of nitrous oxide from use of fertilizers	Estimation and accounting of emissions of nitrous oxide from use of fertilizers shall not be required. Consequently, monitoring of data and parameters related to the above-mentioned emissions shall not be required.	The project did not use nitrogenous fertilizers. Therefore, emissions of nitrous oxide from use of fertilizers were not required to be monitored.
Burning of fossil fuel	Estimation and accounting of emissions from burning of fossil fuel, both within and outside the project boundary, shall not be required. Consequently, monitoring of data and parameters related to the above mentioned emissions shall not be required.	Yes, emissions from burning of fossil fuel, both within and outside the project boundary were not monitored and accounted for.

SECTION C. Description of monitoring system

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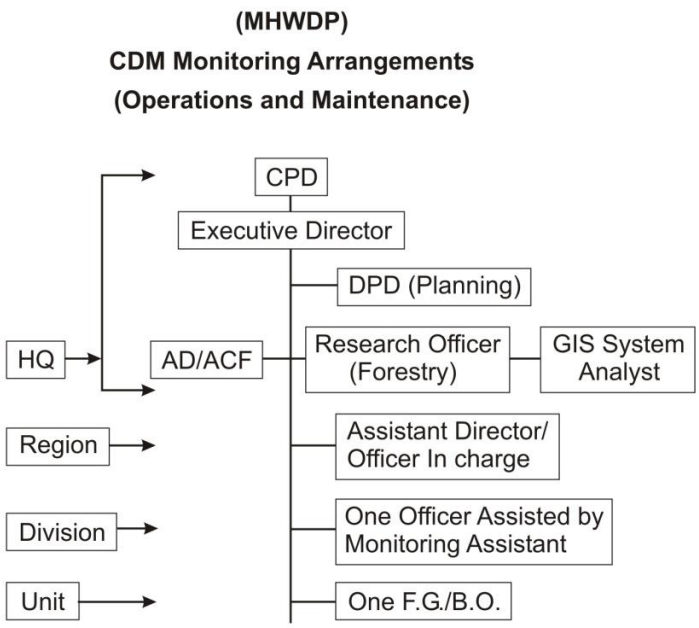
An effective monitoring system has been put in place through which periodic monitoring is carried out. The monitoring covers parameters such as area planted, condition of parcels, survival, growth, status of contractual agreements etc. Plantation Journals are being maintained and updated for each parcel to reflect relevant information. The organogram depicted below gives the existing structure **:**



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In addition to the parameters noted in section D2, the parameters monitored in the project include the following.

Growth and Survival of seedlings*:* The survival of seedlings is checked through annual monitoring until seedling establishment.

Geographical Coordinates: the Geographic coordinates of the project boundary checked as part of the monitoring

Participation of GPs/ User Groups: Regular monitoring is done to check the participation of beneficiaries. Also, to ensure that Joint Forest Management practices are effectively carried out in the field

Natural Hazards: monitoring covers natural events such as fire is done to assess the risk and implement preventive measures.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

(Copy this table for each piece of data and parameter.)

Data / Parameter:	$BEF_{1,J}$
Unit:	Dimensionless
Description:	Biomass expansion factor for conversion of annual net increment (including bark) in stem biomass to total above-ground tree biomass increment for species *j;* Dimensionless
Source of data:	IPCC (2003) GPG LULUCF, Table 3A.1.10
Value(s) applied):	1.2

Purpose of data:	For conversion of stem biomass to above-ground tree biomass in the project.
Additional comment:	The lower value of BEF referenced in the IPCC (2003) GPG LULUCF, Table 3A.1.10 is applied

Data / Parameter:	Rj
Unit:	Dimensionless
Description:	Root-shoot ratio for tree species or group of species *j* / kg d.m.yr^{-1} (kg d.m.yr^{-1})$^{-1}$
Source of data:	IPCC (2003) GPG LULUCF, Table 3A.1.8
Value(s) applied):	0.24
Purpose of data:	For calculation of above-ground tree biomass to below ground tree biomass in the project.
Additional comment:	The mean value of the root-shoot ratio for tropical and sub-tropical forest, referenced in the IPCC (2003) GPG LULUCF, Table 3A.1.8 has been adopted.

Data / Parameter:	Dj
Unit:	Dimensionless
Description:	Basic wood density for species *j* / t d.m. m-3
Source of data:	IPCC (2003) GPG LULUCF, Table 3A.1.10
Value(s) applied):	Annex I (Spread sheet) to the Monitoring Report
Purpose of data:	For conversion of volume in m^3 of wood to biomass in tonnes.
Additional comment:	

Data / Parameter:	**CF_j**
Unit:	Dimensionless
Description:	Carbon fraction of dry matter for species of type *j* / t C t^{-1} d.m.
Source of data:	IPCC (2003) GPG LULUCF
Value(s) applied):	0.5
Purpose of data:	For conversion of biomass to carbon
Additional comment:	The lower value of BEF referenced in the IPCC (2003) GPG LULUCF, Table 3A.1.10 is applied

D.2. Data and parameters monitored

(Copy this table for each piece of data and parameter.)

Data / Parameter:	A
Unit:	ha
Description:	Total area of the project

Measured/ Calculated / Default:	Measured
Source of data:	Project monitoring
Value(s) of monitored parameter:	4003.07 ha
Monitoring equipment:	GPS and GIS
Measuring/ Reading/ Recording frequency:	Measured at the start of the project and thereafter at monitoring intervals prior to each periodic verification.
Calculation method (if applicable):	Sum of all project strata
QA/QC procedures:	Checked during monitoring period
Purpose of data:	Calculation of actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	A_i
Unit:	ha
Description:	Total area of stratum i
Measured/ Calculated / Default:	Measured.
Source of data:	Project monitoring
Value(s) of monitored parameter:	
Monitoring equipment:	GPS and GIS
Measuring/ Reading/ Recording frequency:	Measured at the start of the project and thereafter at monitoring intervals covering each verification
Calculation method (if applicable):	NA
QA/QC procedures:	Checked during monitoring period
Purpose of data:	Calculation of actual net GHG removals by sinks
Additional comment:	

	Forest	Community	Private	Total
Low	976.21	125.33	232.06	
Medium	969.75	66.90	221.43	
High	1230.90	100.83	79.66	
Total	3176.86	293.06	533.15	4003.7

Data / Parameter:	$A_{sp,i}$
Unit:	ha
Description:	Area of sample plot i

Measured/ Calculated / Default:	Measured
Source of data:	Project field measurement
Value(s) of monitored parameter:	500 m^2
Monitoring equipment:	GPS and GIS
Measuring/ Reading/ Recording frequency:	At the end of monitoring period prior to each periodic verification
Calculation method (if applicable):	NA
QA/QC procedures:	QA/QC procedure includes multiple levels: checks of sample plot measurement by field project staff and by the staff of project monitoring unit
Purpose of data:	Calculation of actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	DBH
Unit:	cm
Description:	Diameter at breast height (1.37m) of live trees
Measured/ Calculated / Default:	Measured
Source of data:	Measurement on permanent sample plots
Value(s) of monitored parameter:	Values of DBH in cm recorded on sample plot measurement forms and transferred to Ecalculation spreadsheet.
Monitoring equipment:	Diameter tape/caliper
Measuring/ Reading/ Recording frequency:	At the end of monitoring period prior to each periodic verification
Calculation method (if applicable):	
QA/QC procedures:	Diameter measurements are randomly checked in the field by the staff of the project. The project monitoring unit also conducts checks
Purpose of data:	Calculation of actual net GHG removals by sinks
Additional comment:	Measurement of diameter of trees above minimum *DBH* on permanent sample plots following forest inventory procedures

Data / Parameter:	H
Unit:	Meters
Description:	Tree height
Measured/ Calculated / Default:	Measured

Source of data:	Project field measurement
Value(s) of monitored parameter:	Tree height in meters is recorded on sample plot measurement forms and transferred to calculation spreadsheet
Monitoring equipment:	
Measuring/ Reading/ Recording frequency:	At the end of monitoring period prior to each periodic verification
Calculation method (if applicable):	NA
QA/QC procedures:	Height measurements are randomly checked during sample plot measurement to ensure accuracy of measured data .
Purpose of data:	Calculation of actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	t2, t1
Unit:	Years
Description:	Time in interval between measurements of sample plots
Measured/ Calculated / Default:	Measured
Source of data:	Project
Value(s) of monitored parameter:	
Monitoring equipment:	
Measuring/ Reading/ Recording frequency:	At the end of monitoring period prior to each periodic verification
Calculation method (if applicable):	NA
QA/QC procedures:	Checked as part of project monitoring
Purpose of data:	Calculation of carbon stock change between monitoring periods
Additional comment:	

Data / Parameter:	ABiomassBurn,t
Unit:	ha
Description:	Area affected in the biomass burn
Measured/ Calculated / Default:	Measured
Source of data:	Project monitoring
Value(s) of monitored parameter:	
Monitoring equipment:	Field survey/GPS
Measuring/ Reading/ Recording frequency:	Measured subsequent to the occurrence of a fire event

Calculation method (if applicable):	NA
QA/QC procedures:	Checked as part of project monitoring
Purpose of data:	Calculation of project emissions
Additional comment:	

D.3. Implementation of sampling plan

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Sampling has been implemented as per the monitoring plan and described in the sub sections below:

Sampling design and stratification:

- Stratification according to planned A/R CDM project activity has been done, adopting stand models suitable to the three broad land categories (Restoration forestry, Community forestry, Farm forestry) and altitudes (low– 600 to 1100 meters, medium–1100 to 1400 meters, high – 1400 to 1800 meters) translate into 9 strata Restoration forestry :low, medium and high strata
- Community forestry: low, medium and high strata
- Farm forestry : low, medium and highstrata

Sample size

The number of plots for monitoring depend on species variation, accuracy and monitoring interval. The samples size (n) was estimated as per the procedure of the tool for "Calculation of the number of sample plots for measurements within A/R CDM project Activities, Version 02".

The list of sample plots along with their strata details are presented in **Annex I** (Calculation spreadsheet) to the Monitoring Report.

The allowable error on per-plot basis (±10%) of the expected mean biomass carbon stock per plot in living trees was estimated as per the "Guidelines on application of specified versions of A/R CDM methodologies in verification of registered A/R CDM project activities" (Version 01.1) (EB68, Annex31[3]. The sample size has been revised based on the actual variation of the carbon stock changes determined from sample plot measurements.

The total number of sample plots to be selected for monitoring for each stratum is given in Table D. The total number of sample plots selected for monitoring is152.

[3] http://cdm.unfccc.int/filestorage/4/4/29ZGXIPMWLUC7QY5R43NABH0SDK68T.pdf/eb68_repan31.pdf?t=STF8bW1mZXlsfDAw0p3_9jqbQ9-Du-NC78K1

Table D3.1 a. Number of sample plots for each stratum for monitoring as per registered PDD

Land category	Reforestation model	Altitude	Area (ha)	Number of sample plots
Degraded forestland	Restoration forestry	Low	976.2	35
		Medium	969.7	35
		High	1230.9	45
Degraded community land	Community forestry	Low	125.3	14
		Medium	66.9	8
		High	100.8	11
Degraded and abandoned private land	Farm forestry	Low	232.1	9
		Medium	221.4	8
		High	79.7	3

Table.D. 3.2 Number of sample plots for each stratum for monitoring as per actual planted area

Land category	Reforestation model	Altitude	Area (ha)	Number of sample plots
Planted - Degraded forestland	Restoration forestry	Low	931.56	35
		Medium	876.73	34
		High	1136.54	45
Planted - Degraded community land	Community forestry	Low	107.69	14
		Medium	56.66	8
		High	60.69	10
Planted - Degraded and abandoned private land	Farm forestry	Low	11.44	1
		Medium	22.79	0
		High	6.08	1
Unplanted – Degraded land (forest/community/ private land)	Unplanted area	Low	232.02	
		Medium	68.07	
		High	492.84	
				148

Locating sampling plots

To avoid subjective choice in location of plotsthe permanent sample plots were located systematically with a random start, which is considered good practice in GPG-LULUCF. This was accomplished with the help of a GPS in the field. The geographical position (GPS coordinates), stratum of eachsample plot was recorded and archived.

Layout of Sample Plots

The centre point of sample plot was fixed with a pegand GPS co-ordinates were recorded. With the help of a rope,12.5 mtrs either sides of the centre point on horizontal line were marked.Then = perpendicular line with respect to horizontal line were marked. The 10 meters width either side of the centre point on perpendicular line was measured

Then the parallel lines were connected to make a rectangle of size 25*20 meters plot and the accuracy of the

plot dimensions was checked with diagonal method.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

>> The *ex ante* baseline net GHG removals by sinks accounting for above and belowground biomass is insignificant and are considered zero. As per the PDD (para E3, page 74), the baseline carbon stock changes also need not be monitored during the project crediting period.

E.2. Calculation of project emissions or actual net GHG removals by sinks

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Estimation of changes in the carbon stocks

The verifiable changes in the carbon stock in tree above-ground biomass and below-ground biomass within the project boundary are estimated as per the equations of the AR ACM0001 Version 03 referenced below.

$$\Delta C_P = \sum_{t=1}^{t^*} \Delta C_t * \frac{44}{12} * 1year - E_{BiomassLoss}$$ Equation (13) of AR ACM0001 Version 03

where:

ΔC_P	Sum of the changes in carbon pools in above-ground and below-ground tree biomass, and soil organic carbon in the project scenario; t CO_2-e
ΔC_t	Annual change in carbon stock in above-ground and below-ground tree biomass, and soil organic carbon pools for year *t*; t C yr^{-1}
$E_{BiomassLoss}$	Increase in CO_2 emissions from loss of existing woody biomass due to site-preparation (including burning), and/or to competition from forest (or other vegetation) planted as part of the A/R CDM project activity; t CO_2-e
t	*1, 2, 3, …t** years elapsed since the start of the A/R project activity; yr
44/12	Ratio of molecular weights of CO_2 and carbon; t CO_2-e (t C)$^{-1}$

ΔC_t has been estimated using the following equation:

$$\Delta C_t = \sum_{i=1}^{M_{PS}} (\Delta C_{AG,i,t} + \Delta C_{BG,i,t} + \Delta C_{DW,i,t} + \Delta C_{LI,i,t} + \Delta C_{SOC,i,t})$$ Equation (14) of AR ACM0001 Version 03

1. where:

ΔC_t	Annual change in carbon stock in all carbon pools for *year t*; t C yr^{-1}
$\Delta C_{AG,i,t}$	Annual carbon stock change in above-ground biomass of trees for stratum *i*, (possibly average over a monitoring period); t C yr^{-1}
$\Delta C_{BG,i,t}$	Annual carbon stock change in below-ground biomass of trees for stratum *i*, (possibly average over a monitoring period); t C yr^{-1}
$\Delta C_{DW,i,t}$	Annual change in the dead wood carbon pool in stratum *i*,; t C yr^{-1} (**per the registered PDD, this pool is excluded from project monitoring and accounting**)

$\Delta C_{LI,i,t}$	Annual change in the litter carbon pool in stratum *i*,; t C yr^{-1} (**per the registered PDD, this pool is excluded from project monitoring and accounting**)
$\Delta C_{SOC,i,t}$	Annual carbon stock change in the soil organic carbon pool for stratum *i*, time *t*; t C yr^{-1}
i	*1, 2, 3, ... M_{PS}* strata in the project scenario
t	*1, 2, 3, ... t^** years elapsed since the start of the A/R CDM project activity

Changes in the deadwood and litter carbon pools that are excluded from monitoring and accounting are set equal to zero.

Aboveground and Belowground Tree Biomass

The carbon stock change in above-ground and below-ground tree biomass per unit area was estimated on the basis of field measurements in permanent sample plots. For this purpose, Biomass Expansion Factors (*BEF*) method has been used.

BEF method

Step 1: Measurements of diameter at breast height (*DBH*, at typically 1.3 m above-ground level), and height (*H*), of the trees above minimum *DBH* of 2 cm were conducted on the permanent sample plots

Step 2: Stem volume of trees was estimated based on volume equations

Step 3:*BEF*, was applied to convert the stem volume into total above ground tree volume.

Step 4: The above ground tree volume was converted into carbon stock by multiplying with basic wood density and the carbon fraction:

$$C_{AB\_tree,l,j,i,sp,t} = V_{l,j,i,sp,t} * D_j * BEF_{2,j} * CF_j$$ Equation (15) of AR ACM0001 Version 03

where:

$C_{AB\_tree,l,j,i,sp,t}$	Carbon stock in above-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C $tree^{-1}$
$V_{l,j,i,sp,t}$	Stem volume of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; m^3 $tree^{-1}$
D_j	Basic wood density of species *j*; t d.m. m^{-3}
$BEF_{2,j}$	Biomass expansion factor for conversion of stem biomass to above-ground tree biomass for species *j*; dimensionless
CF_j	Carbon fraction of biomass for tree species *j*; t C t^{-1} d.m. (IPCC default value = 0.5 t C t^{-1} d.m.)
l	Sequence number of trees on plot *sp*
i	*1, 2, 3, ... M_{PS}* strata in the project scenario
j	*1, 2, 3, ... S_{PS}* tree species in the project scenario
t	*1, 2, 3, ... t^** years elapsed since the start of the A/R CDM project activity

Step 5: Carbon stock in above-ground biomass was converted to the carbon stock in below-ground

biomass by multiplying with root-shoot ratio

$$C_{BB\_tree,l,j,i,sp,t} = C_{AB\_tree,l,j,i,sp,t} * R_j$$ Equation (16) of AR ACM0001 Version 03

2. where:

$C_{BB\_tree,l,j,i,sp,t}$	Carbon stock in below-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C tree^{-1}
$C_{AB\_tree,l,j,i,sp,t}$	Carbon stock in above-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C tree^{-1}
R_j	Root-shoot ratio appropriate for biomass stock, for species *j*; dimensionless

Step 6: Carbon stock in above-ground and below-ground biomass of all trees present in plot *sp* in stratum *i* at time *t* was calculated (i.e., summation over all trees *l* by species *j* followed by summation over all species *j* present in plot *sp*)

$$C_{tree,i,sp,t} = \sum_{j=1}^{S_{PS}} \sum_{l=1}^{N_{j,i,sp,t}} (C_{AB\_tree,l,j,i,sp,t} + C_{BB\_tree,l,j,i,sp,t})$$ Equation (17) of AR ACM0001 Version 03

where:

$C_{tree,i,sp,t}$	Carbon stock in trees on plot *sp* of stratum *i* at time *t*; t C
$C_{AB\_tree,l,j,i,sp,t}$	Carbon stock in above-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C tree^{-1}
$C_{BB\_tree,l,j,i,sp,t}$	Carbon stock in below-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C tree^{-1}
$N_{j,i,sp,t}$	Number of trees of species *j* on plot *sp* of stratum *i* at time *t*
l	Sequence number of trees on plot *sp*
i	*1, 2, 3, ...* M_{PS} strata in the project scenario
j	*1, 2, 3, ...* S_{PS} tree species in the project scenario
t	*1, 2, 3, ...* t^* years elapsed since the start of the A/R CDM project activity

3. **Step 7:** Calculate the mean carbon stock in tree biomass for each stratum:

$$C_{tree,i,t} = \frac{A_i}{A_{sp_i}} \sum_{sp=1}^{P_i} C_{tree,i,sp,t}$$ Equation (18) of AR ACM0001 Version 03

where:

$C_{tree,i,t}$	Carbon stock in trees in stratum *i*, at time *t*; t C
$C_{tree,i,sp,t}$	Carbon stock in trees on plot *sp* of stratum *i* at time *t*; t C
A_{sp_i}	Total area of all sample plots in stratum *i*; ha
A_i	Area of stratum *i*; ha
sp	*1, 2, 3, ...* P_i sample plots in stratum *i* in the project scenario

i	*1, 2, 3, … M_{PS}* strata in the project scenario
t	*1, 2, 3, … t^** years elapsed since the start of the A/R CDM project activity

Annual carbon stock change in tree biomass for each stratum was calculated :

$$\Delta C_{AG,i,t} + \Delta C_{BG,i,t} = \frac{C_{tree,i,t_2} - C_{tree,i,t_1}}{T}$$ Equation (22) of AR ACM0001 Version 03

where:

$\Delta C_{AG,i,t}$	Annual carbon stock change in above-ground biomass of trees for stratum i; t C yr^{-1}
$\Delta C_{BG,i,t}$	Annual carbon stock change in below-ground biomass of trees for stratum i; t C yr^{-1}
$C_{tree,i,t}$	Carbon stock in trees in stratum i, at time t; t C
T	Number of years between monitoring time t_2 and t_1 ($T = t_2 - t_1$); yr
i	*1, 2, 3, … M_{PS}* strata in the project scenario
t	*1, 2, 3, … t^** years elapsed since the start of the A/R CDM project activity

Soil organic carbon

The rate of change in SOC stock in project scenario was estimated as per the latest version of *A/R Methodological Tool - Tool for estimation of changes in soil organic carbon stocks due to the implementation of A/R CDM project activities*, version 01.1.0 (EB 60 Annex 12).

The project complies with all the applicability conditions of the tool as described below.

(a) The areas of the project to which this tool is applied:

(i) Do not fall into wetland category: None of the project areas fall in the category wetlands.

- The areas of the project do not fall into the category of wetland. This has been confirmed by the information from cadastre and field visits conducted during project design, implementation, and site visits during validation and verification.

(ii) Do not contain organic soils as defined in Annex A: glossary of the IPCC GPG LULUCF 2003:

- The project soils are not organic soils and comply with the requirements 1 and 2 of the glossary of IPCC GPG LULUCF 2003.

(iii) Are not subject to any of the land management practices and application of inputs as listed in the Tables 1 and 2;

- The project soils are not subjected to management practices and input applications listed in Table 1 of the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities"(Version 01.1.0).

(b) The A/R CDM project activity meets the following conditions:

(i) Litter remains on site and is not removed in the A/R CDM project activity;

- Litter is accumulated throughout the period of forest establishment and growth and remains undisturbed in the project area during entire rotation period of the forest.

(ii) Soil disturbance attributable to the A/R CDM project activity is:

- In accordance with appropriate soil conservation practices;
  - Soil disturbance from site preparation in the project activity is as per the land management and soil conservation practices of the Government of Himachal Pradesh..
  - There is a limited soil disturbance from site preparation in the project activity and the site disturbance is not repeated within 20 year period.

$$SOC_{INITIAL,i} = SOC_{REF,i} * f_{LU,i} * f_{MG,i} * f_{IN,i}$$ AR Tool (1)

where:

$SOC_{INITIAL,i}$	SOC stock at the beginning of the A/R CDM project activity in stratum *i* of the areas of land; t C ha^{-1}
$SOC_{REF,i}$	Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation. normally forest) by climate region and soil type applicable to stratum *i* of the areas of land; t C ha^{-1}
$f_{LU,i}$	Relative stock change factor for baseline land-use in stratum i; the land use factor of grassland is adopted as the lands under the baseline are degraded lands and pastures. As per A/R Methodological Tool - *Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities*, Table 6, Annex 12, EB60, land use factor of 1.0 is applied.
$f_{MG,i}$	Relative stock change for management regime, dimensionless; as per A/R Methodological Tool - *Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities*, Table 6, Annex 12, EB60, the management factor of 0.7 for severely degraded lands is applied.
$f_{IN,i}$	Relative stock change factor for baseline inputs in stratum *i* of the areas of land; dimensionless. No inputs are used in the baseline, therefore as per A/R Methodological Tool - *Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities*, Table 6, the input factor of 1.0 is applied.
i	= 1, 2, 3, … strata of project, dimensionless.

The values $SOC_{REF,1}$, $f_{LU,i}$, $f_{MG,i}$, and $f_{IN,i}$ are taken from the Table 3 and Table 6 of AR Tool. The climate regime applicable to the project is warm temperate moist as per the IPCC climate zones[4] and soils of Therefore, SOC_{REF} stock for mineral soil corresponding to tropical dry climate regime and sandy soils in Table 3 of AR Tool has been adopted.

$$SOC_{INITIAL,i} = SOC_{REF,i} * f_{lu,i} * f_{MG,i} * f_{IN,i}$$

$$SOC_{INITIAL,i} = 34 * 1.0 * 0.7 * 1.0$$

$$= 23.8 \text{ t C } ha^{-1}$$

[4] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_03_Ch3_Representation.pdf
Approved spreadsheet to facilitate the calculation of changes in soil organic carbon showing IPCC major climate zones, Annex to **A**/R Methodological Tool - *Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities*

There has been less than 10% site disturbance due to site preparation activities, therefore, as per the paragraph 9 of the tool, equation 2 of A/R Methodological Tool, the soil carbon loss is zero.

$$SOC_{loss,i} = 0 \qquad \text{AR Tool (2)}$$

$SOC_{loss,i}$ = Loss of SOC caused by soil disturbance attributable to the A/R CDM project activity, in stratum *i* of the areas of land; t C ha^{-1}

i = 1, 2, 3, … strata of the project, dimensionless

The rate of change in SOC stock in project scenario until the steady-state SOC content is reached is estimated as follows:

$$dSOC_{t,i} = 0 \quad \text{for t < t prep, I} \qquad \text{AR Tool (4)}$$

$$dSOC_{t,i} = \frac{SOC_{LOSS,i}}{1year} \quad \text{for t = t prep,I} \qquad \text{AR Tool (5)}$$

$$dSOC_{t,i} = \frac{SOC_{REF,i} - (SOC_{INITIAL,i} - SOC_{LOSS,i})}{20} \quad \text{for t prep i < t} \leq \text{t prep,I +20} \qquad \text{AR Tool (6)}$$

Where,

$dSOC$	Rate of change in SOC stock in stratum I of the areas of land in year t, t C ha^{-1}yr^{-1}
$t_{PREP,i}$	= The year in which first soil disturbance takes place in stratum *i* of the areas of land
$SOC_{LOSS,i}$	= Loss of SOC caused by soil disturbance attributable the A/R CDM project activity in stratum *i* of the areas of land; t C ha-1
$SOC_{REF,i}$	Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation, normally forest) by climate region and soil type applicable to stratum *i* of the areas of land; t C ha^{-1}
$SOC_{INITIAL,i}$	SOC stock at the beginning of the A/R CDM project activity in stratum *i* of the areas of land; t C ha^{-1}
i	= 1, 2, 3, … strata of project, dimensionless
t	= 1, 2, 3, … years elapsed since the start of the A/R CDM project activity

$$dSOC_{loss,i} = \frac{34 - (23.8 - 0)}{20} = 0.51$$

As per the tool, value of the rate of change of SOC stock is 0.51 t C ha^{-1} yr^{-1}

The change in SOC stock for all the strata of the areas of land, in year *t*, is calculated as:

$$dSOC_{i,t} = \frac{44}{12} * \sum_{i} Ai * dSOC_{i.t} * 1year$$

AR Tool (8)

where:

$\Delta SOC_{i,t}$	= Change in SOC stock in areas of land meeting the applicability conditions of this tool, in year *t*; t CO2-e
A_i	= The area of stratum *i* of the areas of land; ha
$dSOC_{t,i}$	= The rate of change in SOC stocks in stratum *i* of the areas of land; t C ha^{-1} yr^{-1}
i	= 1, 2, 3, … strata of project, dimensionless.

E.3. Calculation of leakage

>> The potential sources of leakage relevant to A/R CDM project was assessed based on the guidance presented in the latest version of the A/R Methodological Tool, "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity (Version 01)".

As per the guidance of the above A/R Tool, the project is not subject to leakage emissions attributable to displacement of pre-project for the following reasons.

(a) There has been no pre-project agricultural activity in the areas included in the project, which confirms that there is no displacement of agricultural activities.

(b) The grass/fodder production in the project is greater than the grass production in the baseline, which clarifies that if the planned AR-CDM project activity produces more grass or fodder than the base activity, leakage due to conversion of land for grazing need not be accounted (page 68, Section D2 of PDD).

The A/R CDM project has also implemented the following measures to minimize potential leakage from the grazing:

- Grass production under the A/R CDM project is estimated to be doubling of the pre-project grass production[5]
- Local communities are permitted to harvest and stall feed the livestock
- Under the watershed development project, there are activities that promote stall feeding to avoid grazing
- Under the watershed project the farmers are encouraged to shift to high yielding or crossbred cows, which are stall-fed, thereby avoiding the need for their grazing.

LK = 0

Therefore, leakage emissions associated with the project are assessed to be **zero.**

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO_2e)
Total		61,194	0	61,194

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	1,70,746 t CO_{2e}	61,194 t CO_{2e}

E.6. Remarks on difference from estimated value in registered PDD

>> The value was estimated on the basis of either available average data for the State or from data supplied by Forest Survey of India. These were the figure arrived at taking into consideration different types of conditions of forest areas. Moreover growth and yield figure for many Spices were unavailable. Those figures were projected using mathematic tools. The actual growth in the field on the other hand has been lower than projected. It is because of preference in selection of those areas which suffered from adverse climatic and other conditions prevailing. Also a few species such as deodar initially show slower rate of growth in unfavorable conditions, resulting in less carbon stocking.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	61,194 t CO_{2e}	Not Applicable (monitoring period ended on 31 December 2012)

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Document information

Version	*Date*	*Description*
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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