CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD) Version 04

CONTENTS

PROJECT DESIGN DOCUMENT FORM
FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD) - Version 04

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

A.1. Title of the proposed A/R CDM project activity:

>> **India: Himachal Pradesh Reforestation Project – Improving Livelihoods and Watersheds**
Version 01
Date: 26 January 2009

A.2. Description of the proposed A/R CDM project activity:

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

The project has been developed through a series of consultations with MHWDP and its stakeholder constituents namely, Forest Department, Government of Himachal Pradesh, local Gram Panchayats (GPs) and the World Bank. The project seeks to implement A/R CDM activities on 10,000 ha of degraded lands in the watersheds of Mid-Himalayan region.

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

The major objectives of the project are:

- Improvement of the productive potential of degraded land or watershed catchment areas and enhance biomass production and carbon stocks in degraded lands, and
- Improvement of livelihood and incomes of rural households residing in selected watersheds of MHWDP, using socially inclusive and institutionally and environmentally sustainable approaches.

The project is expected to bring value addition to the ongoing physical catchment/drainage treatment activities undertaken as part of the MHWDP. It seeks to restore degraded lands through reforestation activities. The three plantation forestry models considered for the purpose are outlined below.

i) *Restoration forestry model:* In this model, reforestation of degraded unclassed or undemarcated/demarcated protected forest land is proposed with a tree density of 1,100 plants/ha. The species to be planted under this model include largely native species. This model aims to protect the watersheds and regeneration of native flora, supplemented with planting of native tree species on degraded sloping high altitude lands in selected GPs. This is also projected to lead to conservation of biodiversity. Regenerated forests are expected to provide non-timber forest

products to local communities and improve their livelihood opportunities. This model is proposed to cover 7,095 ha.

ii) *Community forestry model:* This model is proposed for reforestation of degraded community land (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 community needs such as small timber, fuelwood (woody litter), fodder collection for livestock and harvest of non-timber forest products. This model is expected to cover about 775 ha and the density of planting in this model is also 1,100 trees per hectare.

iii) *Farm forestry model:* This model covering an area of 2,130 ha includes reforestation of abandoned or long-term fallow private land with tree species largely providing fruits and fodder to the land owners. The density of planting is 1,100 trees per hectare. Land owners will also derive fuelwood from fallen woody litter. This will provide employment to the land owners apart from protecting the abandoned hilly land.

The project will be implemented by the MHWDP, which is an administrative unit of the Forest Department of Himachal Pradesh. Many of the project activities such as protection and management would involve participation of local panchayats and their delegated committees.

The A/R CDM project is developed under the umbrella of the World Bank funded MHWD Project and it is expected to sequester 5,058,103 tCO_2-e of tCERs over the first crediting period of 20-years at the rate of 25.29 tCO_2-e/ha/year.

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

- The project seeks to restore highly vulnerable degraded lands - forest land (undemarcated/demarcated protected 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.

- The project proposes to involve 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.

- It will generate 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 (see Table A.2.1).

- The project activities will promote 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.

- The three models of reforestation will provide multiple products to the local communities and livelihood activities.

- The carbon revenues accrued from the project will be transferred to gram panchayats and individual participating farmers through a pre-project agreement between project implementing agency and gram panchayats.

The MHWD project includes several activities that promote livestock development, fodder production, infrastructure development, institutional capacity enhancement, improvement of livelihoods and poverty alleviation.

The project will be implemented and managed by the MHWD project authorities till 2013 or beyond (if extended) and subsequently the state forest department will manage the project. The Project Directorate will manage and transfer the carbon revenue to local stakeholders such as panchayats and individual farmers. In addition to carbon revenue, the restoration, community and farm forestry activities will provide direct benefits to local communities through land reclamation, increased biomass supply and livelihood opportunities and promote regional and national development.

Table A.2.1: Employment generation potential of different reforestation models during implementation of the reforestation project activities (in person days/ha)

Activities	Restoration model	Community forestry model	Farm forestry model
Nursery raising	55	55	40
Transportation	36	36	20
Land preparation	14	14	14
Planting	65	65	45
Fencing	40	40	40
Maintenance & others	150	150	111
Total person days/ha	**360**	**360**	**270**

A.3. Project participants:

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Project participants and Party(ies) involved and their contact information is given in Annex 1.

Name of 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 a project participant (Yes/No)
Government of India (host)	• Mid-Himalayan Watershed Development Project (MHWDP*)	No
Government of Spain	• International Bank for Reconstruction and Development as a trustee for Biocarbon Fund	Yes

*MHWDP will manage the project till 2013 or beyond (if extended) and subsequently the State Forest Department will manage the project

A.4. Description of location and boundaries of the A/R CDM project activity:

A.4.1. Location of the proposed A/R CDM project activity:

The proposed project will be implemented in the mid-altitude region of Himachal Pradesh in elevations between 600 and 1800 metres above mean sea level. The project area consists of two regions namely Dharamshala and Bilaspur, encompassing 11 divisions namely Nahan, Swarghat, Solan, Namhol, Kullu, Rampur, Mandi, Sujanpur, Dharamshala, Nurpur and Chowari. The project location is depicted in Figure A.4.1. Figure A.4.1 shows all the districts of Himachal with project divisions demarcated.

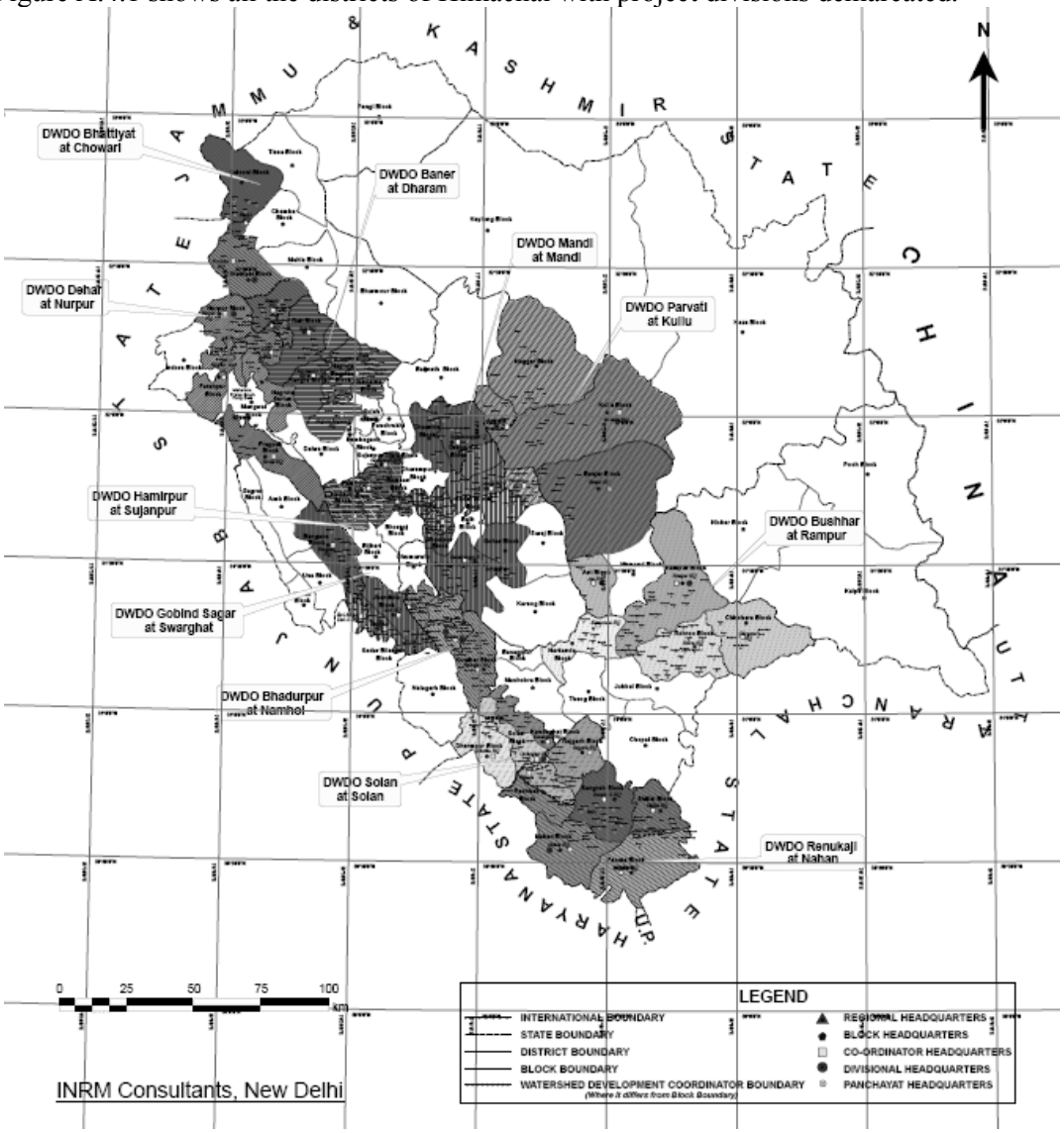

Figure A.4.1: Map of Himachal Pradesh with watershed divisions marked and selected divisions identified

A.4.1.1. Host Party(ies):

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India

A.4.1.2. Region/State/Province etc.:

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Bilaspur and Dharamshala regions encompassing 11 watershed divisions, of Himachal Pradesh

A.4.1.3. City/Town/Community etc:

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Villages in two administrative regions of the watershed project namely Bilaspur and Dharamshala.

A.4.2 Detailed geographic delineation of the project boundary, including information allowing the unique identification(s) of the proposed A/R CDM project activity:

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Project boundary

Gram panchayat is the empowered administrative as well as decision making unit on project activities, where local communities are organized into local government, under the Panchayat Act. The A/R project area consists of GPs distributed over 11 watershed divisions of Himachal Pradesh. Each GP has a geographic boundary consisting of a few villages or wards.

The project utilizes remote sensing maps and Participatory Rural Appraisal techniques in the selection of gram panchayats and land categories suitable for A/R activities. The project area consists of a cluster of multiple discrete parcels of land, ranging from 1 to 250 ha in each GP. The multiple discrete parcels of land include degraded forestland or degraded common land or degraded and abandoned private land.

- The first level of selection was based on the remote sensing maps which provided the tree crown density information, where GPs with significant land area with crown density <10% were identified.
- After identifying the GPs using the remote sensing data, Participatory Rural Appraisal (PRA) was conducted by the project authorities involving gram panchayat members as well as the local community to identify the actual land availability for A/R CDM project activity, considering the land requirements of community for grazing, and other biomass needs.
- Based on remote sensing maps and further supported by PRA, the GPs where land is available and where village communities are ready were identified and plotted on a map of the project area.

In each of the selected GPs, the final selection of plots for project activities was made using the following steps:

- Cadastral maps with various land uses and land survey number procured
- PRA to identify different land categories and their location conducted
- Data from Forest Department and revenue authorities on the extent of different land categories obtained
- Area of each parcel estimated, based on revenue records as well as GPS readings
- GPS survey of all the parcels of land was done to generate boundaries and measure area of the land parcel
    - Details of land cover and features around the identified parcel of land is recorded on a form
- Point locations of the land parcels were downloaded to give a point vector coverage
- Point coverage showing central points of the parcels were then overlaid on the remote sensing data

- Details recorded on the field forms were then used to delineate the identified parcels of the land on the remote sensing data by on-screen digitization of the polygons
- Once the land parcels were delineated on the satellite image, suitable maps of the same on a scale of 1:10,000 showing high resolution satellite image in the background was generated to facilitate demarcation of the land on the ground
- The boundaries of discrete areas will be stored in a GIS database.

The details of each parcel of land – the land category, unique geographical identification code, the farmer's name and survey number in case of private lands are recorded and will be provided to the DOE at the time of validation. Results of monitoring of location, latitude and longitude of each discrete parcel of land belonging to degraded forest, community land and private land for a sample GP is presented in Table A.4.1. The total number of parcels of land in 30 GPs is 928. The results for the remaining GPs are provided in Annex 3.1. The geographical location of all remaining project GPs will be provided at the time of validation.

A summary of the total land area belonging to the three land categories is as follows:

- Degraded forestland – 7095 ha
- Degraded community land – 775 ha
- Degraded private land – 2130 ha

Table A.4.1: Illustration of geographical location of land parcels for the project in Palog panchayat belonging to Namhol watershed division (geographical location for the remaining panchayats will be provided at the time of validation)

Code	Land category	Land parcel plot ID	Latitude	Longitude	Altitude (m)	Area (ha)
199	Degraded forestland	F1	31° 08'48.8"	077°00'43.7"	1162	11.8
			31° 08'53.1"	07700'44.1"	1191	
			31°08'54.5"	077°00'41.8"	1216	
			31°09'00.1"	077°00'41.7"	1242	
			31°09'02.4"	077°00'50.6"	1269	
			31°08'59.3"	077°00'53.0"	1266	
			31°08'49.8"	077°00'48.6"	1223	
			31°08'46.3"	077°00'50.7"	1194	
			31°08'48.9"	077°00'43.6"	1172	
	Degraded forestland	F2	31°08'14.1"	077°00'53.1"	1213	12.4
			31°08'12.7"	077°00'48.9"	1246	
			31°08'10.5"	077°00'42.1"	1281	
			31°08'09.5"	077°00'36.1"	1257	
			31°08'15.5"	077°00'34.8"	1239	
			31°08'19.5"	077°00'34.6"	1210	
			31°08'18.1"	077°00'39.2"	1185	
			31°08'22.5"	077°00'45.3"	1184	
			31°08'19.5"	077°00'52.1"	1196	
			31°08'13.9"	077°00'53.4'	1215	
	Degraded private land	P1	31°08'51.8"	077°00'35.2"	1193	5.9

			31°08'56.0"	077°00'35.7"	1202	
			31°09'01.1"	077°00'40.8"	1225	
			31°08'59.0"	077°00'41.0"	1235	
			31°08'58.2"	077°00'41.3"	1194	
			31°08'49.2"	077°00'39.7'	1180	
			31°08'52.0"	077°00'35.1"	1195	

Applying AR-ACM0001 Version 02, each discrete parcel of land has a unique geographical identification code. The boundary is defined for each discrete parcel. The discrete parcels of land are defined by polygons, and to make the boundary geographically verifiable and transparent, the GPS coordinate for corners of large polygons are recorded, archived and listed.

A.5. Technical description of the A/R CDM project activity:

A.5.1. Description of the present environmental conditions of the area planned for the proposed A/R CDM project activity, including a concise description of climate, hydrology, soils, ecosystems (including land use):

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Physiography

- Himachal Pradesh is almost wholly mountainous with a deeply dissected topography, complex geological structure and rich temperate flora in the sub-tropical latitudes. Physiographically, the state can be divided into five zones – viz. (i) Wet Sub-temperate zone, (ii) Humid Sub-temperate zone, (iii) Dry temperate-alpine High land, (iv) Humid Sub-tropical zone, and (v) Sub-Humid Sub-tropical zone. Wet Sub-temperate zone comprises Palampur and Dharamshala of Kangra District, Jogindernagar area of Mandi district and Dalhousie area of Chamba district, Humid Sub-temperate zone comprises the districts of Kullu, Shimla, parts of Mandi, Solan, Chamba, Kangra and Sirmour, Dry temperate-Alpine High land include major parts of Lahaul-Spiti, Pangi and Minnaur, Humid Sub-tropical zone consists district Sirmaur, Bhattiyat valley of district Chamba, Nalagarh area of district Solan, Dehragopipur and Nurpur areas of district Kangra, Sub-humid tropical zone Sirmour and Indora area of district Kangra.

Climate

- Climatically, Himachal Pradesh can be divided into three zones (i) The outer Himalayas, (ii) The Inner Himalayas and (iii) Alpine zone. The first zone gets an annual rainfall between 150 cms to 175 cm. In the second zone, it varies between 75 to 100 cm and the Alpine zone remains under snow for about five to six months. The average annual rainfall in the state is about 160 cm. The climate varies between hot and humid in the valley areas to freezing cold in the home of perpetual snow.

Soil

- The soils of Himachal Pradesh can be divided into nine groups on the basis of their development and physio-chemical properties. These groups are alluvial soils, Brown hill soils, Brown earths, Brown porests soils, Grey wooded or Podozolic soils, Grey brown podzolic soils, Plansolic soils, Humus and iron Podzols and Alpine hunus mountain skeletal soils.

Hydrology

- Five perennial rivers Sutlej, Beas, Ravi, Chenab and Yamuna flow through its territory. The utility of these rivers though restricted considerably by the rugged and undulating terrain of the

state, nevertheless, these rivers posses immense potential for generation of hydro-electricity. The state of Himachal Pradesh forms the catchment for these large rivers and the health of the hills and catchment is critical for the rivers.

Flora and Fauna

- It has been estimated that 66% of the land area is covered with forests. The southern tracts are dominated by sal, sisham, chir pine, dry deciduous and moist broad-leafed forests. The temperate region consists of oaks, deodar, blue pine, fir and spruce. In the uppermost region, trees are sturdy with a vast network of roots, such as Alders, birches, rhododendrons and moist alpine scrubs. The rhododendrons can be seen along the hillsides around Shimla from March to May.
- Himachal Pradesh is also said to be the fruit bowl of India with orchards scattered all over the state. Meadows and pastures are seen along the steep slopes. After the winter season, the hillsides and orchards bloom with wild flowers, while gladiolas, carnations, marigolds, roses, chrysanthemums, tulips and lilies are cultivated. The state government is gearing up to make Himachal Pradesh a flower basket of the world.
- Himachal Pradesh is habitat to a variety of animals. There are around 1,200 bird and 359 animal species in the state. This includes the leopards, ghoral, musk deer (the state animal) and monal (the state bird). It has 32 sanctuaries, 2 national parks and 3 game reserves – the largest number in the Himalayan region. The Great Himalayan National Park in Kullu district was created to conserve the flora and fauna of the main Himalayan range, while the Pin Valley National Park to conserve the flora and fauna of the cold desert.

Land use change

The net sown area of Himachal Pradesh has declined over the past decades. This indicates that there is no shift of non-cropland such as forest, revenue and common land to agricultural land. The Forest Conservation Act, 1980 of the Government of India has banned conversion of forest land to non-forest uses. Thus, the degraded forest and community land, cannot be converted to agriculture or horticulture. Thus, the most plausible baseline scenario is continued degradation of forest and community land, in the absence of the proposed A/R CDM project. Even the private degraded and abandoned land parcels have remained in that state for more than 10 years (as shown by household survey), thus the most plausible scenario in the absence of interventions is the further degradation of such lands.

State of forests

According to the latest remote sensing assessment by the Forest Survey of India, the total area under forests in Himachal Pradesh, is 14,369 sq. km (Table A.5.1). This is about 26% of the geographic area as against the National Forest Policy 1988 requirement of 2/3rd of the area to be under forest/tree cover for hilly states. Of the total area under forests, 37.9% is under open forest with 10-40% tree crown cover. When the changes in the area under different tree crown classes is considered, it can be observed from Table A.5.2 and Figure A.5.1 that the area under dense forest has declined while the area under open forest has increased (by 82%) over the period 1997 to 2005. This indicates that the forests in Himachal Pradesh are in continuous degradation as a result of biomass loss.

Table A.5.1: District-wise area under forest in Himachal Pradesh for 2005 (sq. km.)

District	Geographic area	Very dense (VD)	Moderately dense (MD)	Open forest (O)	Total
Bilaspur	1167	11	93	258	362
Chamba	6528	436	1131	843	2413
Hamirpur	1118	3	106	133	242

Kangra	5739	134	1250	495	1879
Kinnaur	6401	16	324	258	597
Kullu	5503	117	1297	527	1941
Lahaul Spiti	13835	7	28	150	185
Mandi	3950	78	929	644	1651
Shimla	5131	192	1576	611	2379
Sirmaur	2825	59	628	692	1379
Solan	1936	39	311	473	823
Una	1540	5	158	355	518
Total	**55673**	**1097**	**7831**	**5441**	**14369**

Very dense - >70% crown cover, moderately dense – 40-70% crown cover; O – 10-40% crown cover

According to the Forest Survey of India, area under dense forest has declined and area under open forests has increased during the last decade (Table A.5.2).

Table A.5.2: Area (sq. km) under forests in Himachal Pradesh during 1997-2005

Tree crown density	**1997**	**1999**	**2003**	**2005**
Dense forest (crown density >40%)	9,560	9,120	8,976	8,928
Open forest (crown density (10 to 40%)	2,961	3,962	5,377	5,441
Total	**12,521**	**13,082**	**14,353**	**14,369**

Source: FSI Reports

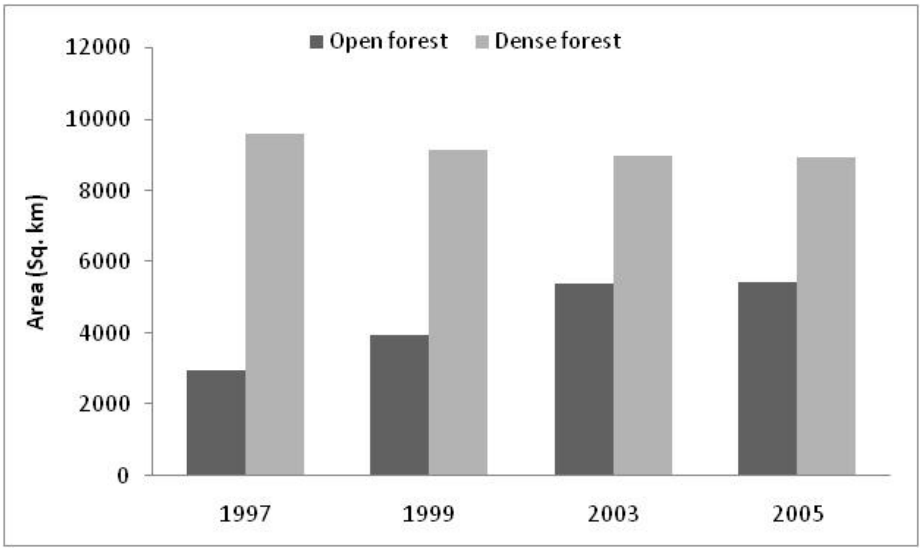

Figure A.5.1: Change in area under dense and open forest during the period 1997 to 2005 (FSI reports)

Forests in the state are subjected to degradation, due to anthropogenic pressure. Degraded or open forests are subjected to unsustainable harvesting of timber and non-timber products and heavy infestation of weeds. This has led to thinning of forest cover, loss of biodiversity, reduced biomass productivity, changes in plant community structure and composition, disturbed nutrient cycle and reduced organic carbon in soil. As a consequence, these forests have limited capacity to regenerate by natural means under the prevailing land use.

Rate of A/R activity to restore degraded lands
The area under wasteland in Himachal Pradesh is estimated to be 2.84 Mha[1] (NRSA 2003). At the current rate of A/R of the latest year 2004 of 13,414 ha annually, over 200 years are required to afforest or reforest all the potential wastelands. If the survival rate of plantations is considered, the time period required for A/R would be even longer. Thus, large parts of wasteland or degraded lands are unlikely to be afforested under the normal A/R programmes in the coming decades and would remain in degraded state in the foreseeable future.

A.5.2. Description of the presence, if any, of rare or endangered species and their habitats:

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Fauna

a. Endangered fauna

Among the faunal species that are under threat are Himalayan Ibex, Snow Leopard, Bharal, Wooly Hare, Tibetan Wolf, and Snow Cock.

b. Wildlife sanctuaries and national parks

Himachal Pradesh has 32 sanctuaries, 2 national parks and 3 game reserves. The total area covered under protected area is 12% of forest area in the state. Shikari Devi Wild Life Sanctuary is very near to the project site. The general occurrence of the wildlife in the high forests includes large animals such as Tiger and Panther. Pin Valley is located in the cold desert region of the Spiti valley. Great Himalayan National Park in Himachal Pradesh was established in 1984 and is spread over an area about 754 km.

c. Endangered flora

A number of species mostly important herbs of mid hills, particularly the high hills require special attention for conserving them (such as *Acer caesium*, *Berberis apiculata*, *Allium auriculatum* listed in Table A.5.3). These species are threatened primarily due to habitat degradation, weed invasion and over exploitation, as a result of unsustainable use to meet the livelihood needs of poor. The endangered species reported from the area are listed in Table A.5.3.

Table A.5.3: Flora under threat list of the IUCN (Source: MHWDP document)

Scientific name	IUCN Status
Acer caesium	Vulnerable
Berberis apiculata	Rare
Berberis pseudoumbellata	Indeterminate
Campanula wattiana	Rare
Silene kunawarensis	Rare
Saussurea bracteata	Rare
Saussurea costus	Endangered
Allium auriculatum	Endangered
Lilium polyphyllum	Indeterminate
Calanthe pachystalix	Endangered
Aconitum falconeri	Vulnerable
Aconitum ferox	Vulnerable
Aconitum heterophyllum	Indeterminate
Picrorhiza kurrooa	Vulnerable
Selaginella adunca	Endangered

[1]NRSA 2005. Wastelands Atlas of India

In addition to the above plant species under threat, others such as *Taxus baccata*, *Nordostachys jatamansii*, and *Podophylum hexandrum* are other floral species under threat.

d. Endemic species
The endemic species reported from the region are *Picea smithiana*, *Abies pindrow* and *Cedrus deodara*.

A.5.3. Species and varieties selected for the proposed A/R CDM project activity:

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

The criteria used for selecting tree species included;
- species native to the location
- suitability of species to soil type, slope and altitude
- rate of growth of biomass
- potential to meet the biomass requirement of communities
- need for biodiversity conservation

The approach adopted for selecting the species mix is as follows:
a) Development of separate models for degraded forestland, community land and private land categories
b) The broad three land categories are further divided into high, medium and low altitude strata
c) Inclusion of multiple species in each model and for each land category, and for each altitudinal sub-strata
d) Selection of species for each parcel, jointly by the local community (including GP members and farmers for private land) and the project authorities from a larger basket of species identified for each land category.

The major species proposed for inclusion in the reforestation models are presented in Box A.5.1.

Box A.5.1: Species included in the reforestation models for the three land categories

Reforestation model	Land category	Altitudinal strata	Species
Restoration forestry model (1100 plants/ha)	Degraded forestland and abandoned private land	Low (600-1100 m)	Walnut, Ban oak, Kelu, Deodar
		High (1400-1800 m)	Willow, Poplar, Ailanthus, Toon, Chuli, Bamboo, Siris, Ohi, Shehtoot, Pongamia, Neem
		Medium (1100-1400 m)	Robinia, Walnut, Aesculus, Ash, Maple, Khair, Kachnar, Shisham, Toon, Amla, Willow, Grewia, Celtis, Karial, Teak
		Low (600-1100 m)	Deodar, Ban oak, Kachnar, Mango, Harar, Bahera, Pecanut, Aegle, Jack fruit, Arjun, Dheoun
Community forestry model (1100	Degraded community land	High (1400-1800 m)	Birch, Silver Oak, Willow, Poplar, Robinia, Ailanthus
		Medium (1100-1400 m)	Chil, Toon, Shehtoot, Grewia, Celtis, Dhauri

Characteristic features of major species

The characteristic features of major species included in the reforestation models are described below.

Pinus roxburghii: The chir pine is a native to the Himalayas. It generally occurs at lower altitudes in the Himalayas, from 500-2000 m, occasionally up to 2300 m. It is a large tree, reaching 30-50 m height with a trunk diameter of upto 2 m. Chir pine is widely planted for timber. It is also occasionally used as an ornamental tree, planted in parks and gardens in hot dry areas, where its heat and drought tolerance is valued. It is also tapped commercially for resin. On distillation, the resin yields an essential oil, commonly known as turpentine and non-volatile resin.

Populus deltoides: This is a large tree growing upto 20–40 m in height with a trunk diameter of 1.8 m. The tree needs bare soil and full sun for successful germination and establishment in natural conditions. It usually grows near rivers, with mud banks left after floods providing ideal conditions for seedling germination. Human cultivation has allowed it to increase its range away from such habitats. *P. deltoides* tolerates frost, heavy soil, sand, slope, and water logging. It is observed to grow in warm temperate and cold temperate zones. It can be found at an altitude of up to 1000 m, and regions with a mean annual temperature of 8-14°C, and a mean annual rainfall of 600-1500 mm. Poplar is found to persist on infertile sandy, loamy, and clay soils, but thrives best on moist sandy loams or silts close to streams.

Ailanthus excelsa: This is a large deciduous tree, 18-25 m tall with straight trunk, 60-80 cm in diameter; light grey to grey brown bark. The tree is native to central, western and southern India, but is now being spread to other semi-arid and subtropical areas. *A. excelsa* grows well in semi-arid and semi-moist regions and has been found suitable for planting in dry areas with annual rainfall of about 400 mm. It is commonly found in mixed deciduous forests and some sal forests, but is rare in moist areas with high monsoons. Plant associations include *Acacia catechu*, *A. leucophloea* and *Azadirachta indica*. It is a relatively salt-tolerant species. The tree can be grown at an altitude range of up to 900 m and tolerates a mean annual temperature of 0-45° C and a mean annual rainfall of 500-2500 mm. It can be grown on a variety of soils, but thrives best in porous sandy loams. Natural regeneration occurs through seed and coppice. Seedling regeneration is generally scanty and cannot be relied upon to regenerate natural stands. Natural regeneration through coppice and root suckers is adequate as long as trees harvested are healthy. Artificial regeneration is through direct seeding or planting pre-germinated seed. Leaves are lopped for use as sheep fodder. The wood is used as fuelwood. It can also be used as timber but is perishable and is subject to insect attack and stain. The bark yields a gum of inferior quality.

Grewia optiva: This is a small to medium-sized deciduous tree, 9-12 m in height; crown spreading, bole clear, 3-4 m, and about 1 m diameter. Plants are often cultivated in the Himalayas. This is a tree of the subtropical climate. In its natural habitat, the maximum shade temperature seldom exceeds 38°C and the minimum temperature rarely drops below – 2°C. It tolerates frost during winter. The tree can be found from 0-2000 m altitude and grows on a variety of soils. Propagation is mainly through nursery-raised seedlings or stumps. Pre-sowing treatment of seeds is necessary to hasten and improve germination as the seed is hard. The ripe fruits are edible. The leaves are rated as good fodder. Leaf fodder yield is reported to be 11 ton/ha from 2-year-old plants. Green fodder yield from mature trees is reported to be 12-30 kg per tree. The wood has an unpleasant odour and is, therefore seldom used as fuel, if an alternative is available.

Azadirachta indica: Neem is a fast-growing tree that can reach a height of 15-20 m and rarely to 35-40 m. It is evergreen species but may shed its leaves in response to severe drought. The crown may reach a diameter of 15-20 m. The trunk is relatively short, straight and may reach a diameter of 1.2 m. The bark is

hard, fissured or scaly, and whitish-grey to reddish-brown. The neem tree is noted for its drought resistance. Normally it thrives in areas with sub-arid to sub-humid conditions, with an annual rainfall between 400 and 1200 mm. It can grow in regions with an annual rainfall below 400 mm, but in such cases it depends largely on the ground water levels. It can thrive on a variety of temperature and rainfall conditions. It can grow on variety of soils, but thrives best on well-drained deep and sandy soils (pH 6.2-7.0). Neem twigs are used for brushing teeth in India. All parts of the tree (seeds, leaves, flowers and bark) are used in medical preparations. Besides its use in traditional Indian medicine, the neem trees are of great importance for its anti-desertification properties and possibly as a good carbon dioxide sink (http://neemsources.com/neem.html).

Mangifera indica: Mango is a large evergreen tree growing up to 20 m height with dark green, umbrella-shaped crown with trunk up to 90 cm in diameter It thrives in both the subtropics and the tropics. In the subtropics, the cold months ensure excellent floral induction, but late frosts are a major risk; tender parts of the tree are killed by frost. In the tropics, the mango grows up to 1200 m elevation, but requires season lasting more than 3 months for fruit production. At elevations above 600 m in the tropics, the climate becomes too cool for the commercial cultivars, and the optimum temperature ranges between 24-27° C. Mango can be grown up to an altitude of 0-1200 m, mean annual temperature of 19-35° C and mean annual rainfall of 500-2500 mm. Mango trees thrive in well-drained soils with pH ranging from 5.5 to 7.5 and are fairly tolerant of alkalinity. Mango is cultivated for fruit. Mango leaves are occasionally fed to cattle. Seed kernel is a by-product of processing and can be used as livestock feed. Mango secretes large quantities of nectar and is an important source of honey. The wood is used as timber for indoor construction, furniture, carpentry, flooring, boxes, crates and boat building (canoes and dugouts).

A.5.4. Technology to be employed by the proposed A/R CDM project activity:

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The technology measures and improved practices implemented or proposed to be implemented in various phases of the project are outlined below.

Identification of lands suitable for project

The project utilizes remote sensing maps, participatory rural appraisal techniques, and geo-referenced data on discrete areas to identify lands suitable for the project. The data are organized using a geographic information system database.

Fencing of the project area

The fencing is carried out using fence posts of wood, bamboo, and stone. The wood posts are sourced from lops and tops of trees in adjoining forests and plantations, which are periodically pollarded as a traditional silvicultural practice. Bamboo fencing will be encouraged and will be adopted wherever possible. Bamboo poles extraction will be carried out in a sustainable manner. Normally about 60 poles are used per ha for fencing. Of the total project area of 10,000 ha, only 50% of the total area may require fencing while the remaining may not require fencing as they are steep precipices non-accessible to livestock and human use, at high altitudes compared to the village settlements. Wood posts will be used in 50% of area and bamboo fencing in the remaining area. Fencing is normally carried out one year prior to planting.

Seed collection

High quality seeds will be selected from the forest and plantation sources for seedlings. The seeds will be selected from plus trees identified for seed collection. The seed collected will be tested for their germination ability and growth in the nurseries.

Nursery technology

Decentralized nurseries will be established in different watershed divisions and even at panchayat level. Decentralized nurseries would reduce the transportation cost as well as the vehicular emissions. Species will be raised in the nursery for a period of 12 to 18 months as opposed to maintenance of seedlings for 4-9 months, which is traditionally followed. All the nursery activities will be carried out using manual labour. Nursery raising activity will be initiated during March-April of each year. The seedlings to be planted would be graded following the standards adopted by the state forest department. The seedlings raised in nurseries will be transported to land parcels for planting. To ensure better survival of plants, sturdy and profuse root system is required. The nursery techniques to be used for production of healthy nursery stock include:

- Root trainers to prevent coiling of seedling root system
- Better medium for growth of seedlings
- Use of organic manure / Vermi Compost in appropriate proportions

Site preparation

This involves clearing of weeds from an area of about 0.06 m^2 for each seedling and digging pits of 45x45x45cm. Traditionally pit size adopted for all species is 30x30x30cm. Clearing of existing shrubs and weeds will be restricted to only the pit area of the seedling (0.06 m^2 per pit). The plants in the remaining area will not be disturbed. The total area to be disturbed at per hectare will be insignificant at around 70 m^2/ha (0.007% per ha). This helps to protect the soil and moisture as well as reduce emissions of greenhouse gases due to burning. Disturbance of top soil will be insignificant, to avoid oxidation of soil organic matter. Slash and burn practices will not be used in the project area to avoid the emissions of greenhouse gases. All land preparation activities will be carried out using manual labour. Further, tractors and machinery cannot be used due to sloping topography of the land. Pit digging will be carried out from February to March.

Planting

Planting will be carried out during monsoon months (July-Aug and Nov-Dec). The replacement planting: will be carried out to replace the failed seedlings during the second and third years after planting. Normally, about 25% will be replaced during first replacement and 10% subsequently, depending on the mortality of the planted seedlings.

Fertilizer and manure application

It is proposed not to apply both organic and inorganic fertilizer to the plants. This is not traditionally practiced in the reforestation programmes in Himachal Pradesh.

Multiple-storied and multispecies plantations

A wide range of species will be mixed in the plantations making maximum use of solar energy and communities requirements like fast growing, timber yielding, fodder yielding, fruit yielding, etc. This is not the case in traditional departmental forestry activities.

Weeding and cultural practices

Weeding around the planted seedling will be carried out manually to reduce the competition with the planted seedlings. Manual weeding is done twice a year for 5 years during September and February. Cultural operations will not involve disturbance of top soil.

Tending, thinning and harvesting operations

The silvicultural operations such as tending, pruning, thinning and harvesting will be carried out using forestry techniques recommended by the state forest department. Silvicultural practices will be carried out with human labour so as to meet the objectives of employment generation for local communities.

A.5.5. Transfer of technology/know-how, if applicable:

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Not applicable

A.5.6. Proposed measures to be implemented to minimize potential leakage:

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The potential sources of leakage relevant to the proposed A/R CDM project (based on AR-ACM0001 methodology) include:

- Carbon stock decreases caused by displacement of pre-project activities;
  - agricultural crops
  - grazing
  - fuelwood collection
- Carbon stock decreases caused by the increased use of wood and cement posts for fencing.

The leakage estimates made from all the above sources is less than 5% of the actual net GHG removals projected for the A/R CDM project[2]. Thus, leakage estimates are not included in the estimation of net GHG removals by sinks. However, the A/R CDM project will undertake the following measures to minimize potential leakage from the above sources.

i) Carbon stock decreases caused by displacement of agricultural crops

- Degraded forest and community land considered for A/R CDM activity are not currently under crop production
- There is a legal ban on conversion of degraded forest and community lands for crop production
- These lands are sloping lands and are unfit for crop production.

ii) Carbon stock decreases caused by displacement of grazing

- Grass production under the A/R CDM project is shown to lead to nearly doubling of the pre-project grass production[3]
- Local communities will be permitted to harvest and stall feed the livestock[4]
- Under the watershed development project, there are activities aimed at promoting stall feeding to avoid grazing[5]
- Under the watershed project the farmers will be encouraged to shift to high yielding or crossbred cows, which are stall-fed, thereby avoiding the need for their grazing[6].

iii) Carbon stock decreases caused by displacement of fuelwood collection

[2] http://cdm.unfccc.int/EB/031/eb31_repan16.pdf

[3] IWDP, Kandi final reports

[4] PIP – MHWDP document

[5] PAD/PIP MHWDP document

[6] PAD/PIP MHWDP document

- A/R activities will lead to increased production and supply of fuelwood in the form of twigs, branches and dead wood[7]
- Rural households in the project area will have full access to the enhanced fuelwood production.

iv) Carbon stock decreases caused by the increased use of wood posts for fencing

- The fencing material for the project area will be sourced from sustainable sources such as lops and tops from nearby forests and plantations, where lops and tops are harvested as a part of the silvicultural practice in the existing plantations
- Bamboo will be harvested sustainably and used in locations where available. New bamboo culms are produced every 3-5 years.

A.6. Description of legal title to the land, current land tenure and rights to tCERs / lCERs issued for the proposed A/R CDM project activity:

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The Indian Forest Act of 1927 defines three classes of Government forests – Reserved Forests, Village Forests and Protected Forests.

Degraded forestland: This category is delineated from the existing reserved/protected forests and is undemarcated/demarcated protected and unclassed class III forest. This land category is owned and controlled by the State Forest Department. However, the communities have right of access to some of the identified forest products. According to the laws, felling of trees in these lands is banned as governed by the forest conservation policy, laws and regulations (Indian Forest Act of 1927, Forest Conservation Act of 1980, MFP Acts, Timber for Dwelling rights). Conversion of this land for non–forestry purposes such as agriculture or infrastructure development is banned.

Degraded community land: This category includes protected forests declared under 1952 notification; and village common land managed by communities through the Panchayat Raj Institution system or other village level institutions, in harmony with the provisions of the Participatory Forest Management rules. Conversion of this land for non–forestry purposes such as agriculture or infrastructure is banned.

Degraded and abandoned private land: These lands are owned and managed by individual farmers, often inherited or encroached long ago. These lands have been left fallow due to lack of resources or their unsuitability for crop production.

The details of the legal title to the land, current land tenure and rights to CERs for the proposed A/R CDM project activity is presented in Table A.6.1.

Table A.6.1: Tenure and rights of access to CERs

Land category	Legal title / land tenure	Use & rights for CERs
Degraded forestland	Forest Department, Govt. of Himachal Pradesh	Full transfer of CER revenue from the Forest Department to local communities permitted as per the pre-project agreement.
Degraded community land	Forest Department/Revenue Department, Govt. of Himachal Pradesh	Full transfer of CER revenue from Revenue and Forest Departments to local communities permitted as per

[7] Changer final evaluation report

		the pre-project agreement.
Degraded and abandoned private land	Individual farmer	Individual farmer to have full rights over CER revenue

A.7. Assessment of the eligibility of the land:

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The Government of India defines 'forest' as land having growing trees with:

- A minimum area of 0.05 ha,
- A minimum tree crown cover of 15%, and
- A minimum height of 2 meters.

The land selected for the project is below the national thresholds of forest (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 DNA.

This definition of forest by the Government of India complies with the UNFCCC definition. Further, the A/R CDM project activities considered for the project comply with the definition of reforestation.

Land eligibility is established according to the AR eligibility tool Version 01 "*Procedures to define the eligibility of land for afforestation and reforestation project activities*[8]", approved by the CDM Executive Board. The following two methods were adopted to prove the eligibility of land.

- *Satellite imagery for the project GPs for the period 1988/89: R*emote sensing maps of 1:50,000 scale were obtained from Forest Survey of India for the period 1988/89, which indicated that the land parcels or polygons considered for the project had tree crown cover less than 10% (FSI provided vegetation cover classification for below 10%, 10-40% and >40% crown). Sample maps are provided for a selected division (and GPs) in Figure A.6.1. Similar maps for all project GPs will be provided at the time of validation. All the project land parcels selected had a tree crown of <10%, even though Government of India has adopted a tree crown of 15% as part of the definition of forest. A vegetation survey was conducted in a sample of 30 GPs at 3 randomly selected GPs per watershed division. *GPS survey of all the parcels of land was done to generate boun*daries and measure area
  - Details of land cover and features around the identified parcel of land is recorded on a form
    - Point locations of the land parcels were downloaded to give a point vector coverage
    - Point coverage showing central points of the parcels were then overlaid on the remote sensing data
    - Details recorded on the field forms were then used to delineate the identified parcels of the land on the remote sensing data by on-screen digitization of the polygons
    - Once the land parcels were delineated on the satellite image, suitable maps of the same on a scale of 1:10,000 showing high resolution satellite image in the background was generated to facilitate demarcation of the land on the ground
  - *Ground based survey and PRA:* The project authorities visited each of the selected GPs to verify the presence or absence of forests in 2006. This was done using cadastral maps where the polygons included in the project area were verified on the ground through Participatory Rural Appraisal.

"Reforestation" is the direct human-induced conversion of non-forested land to forested land through

[8] http://cdm.unfccc.int/EB/Meetings/035/eb35_repan18.pdf

planting, seeding and /or the human induced promotion of natural seed sources, on land that was forested, but that has been converted to non-forested land. The reforestation activities will be limited to reforestation occurring on those land that did not contain forest on 31 December, 1989.

The lands to be planted in the proposed A/R CDM project are degraded unclassed forest lands and degraded community lands, which have very low tree or no tree cover below the threshold of the forest and similarly degraded abandoned private lands have tree cover below the threshold, and have been left fallow for long periods as demonstrated during PRA exercise. The land is not temporarily unstocked as a result of human intervention 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 intervention.

Therefore the land for the proposed A/R CDM project activities comply with the definition for reforestation defined by decision 11/CP.7 as described below. Further, all the project activities proposed to be implemented on the different land categories will lead to the conditions meeting the definition of forest within the timeframe of the project period, with planting of 1100 seedlings/ha.

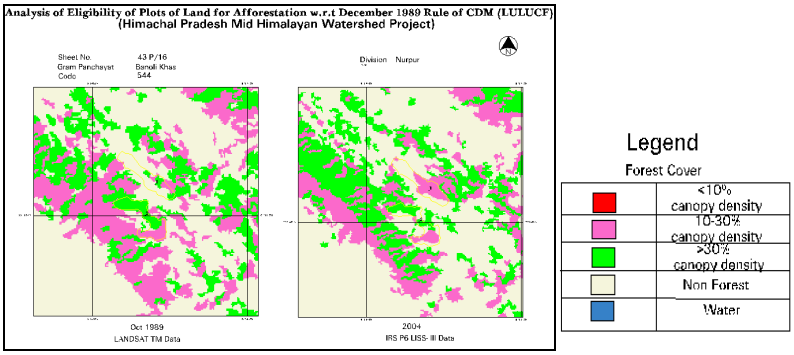


Figure A.6.1: Sample remote sensing map for selected GP

The remote sensing maps obtained for 1989/90 and 2003 clearly indicate that the land parcels selected for the project activities had <10% tree crown. This indicates that the land parcels selected were not forests on 31st December 1989, and subsequently as per the latest remote sensing assessments.

A.8. Approach for addressing non-permanence:

>>

In accordance with paragraph 38 and section K of the CDM A/R modalities and procedures[9], the following approach is selected to address non-permanence of the A/R CDM activity: 'Issuance of tCERs for the net anthropogenic greenhouse gas removals by sinks achieved by the project activity during each verification period, in accordance with paragraphs 45–50 of the CDM A/R modalities and procedures in 'Decision -/CMP.1 - Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol.

Issuance of tCER for the net anthropogenic GHG removals by sinks achieved by the proposed A/R CDM project activity is adopted. Some sequestered carbon may be released from individual parcels of land due

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

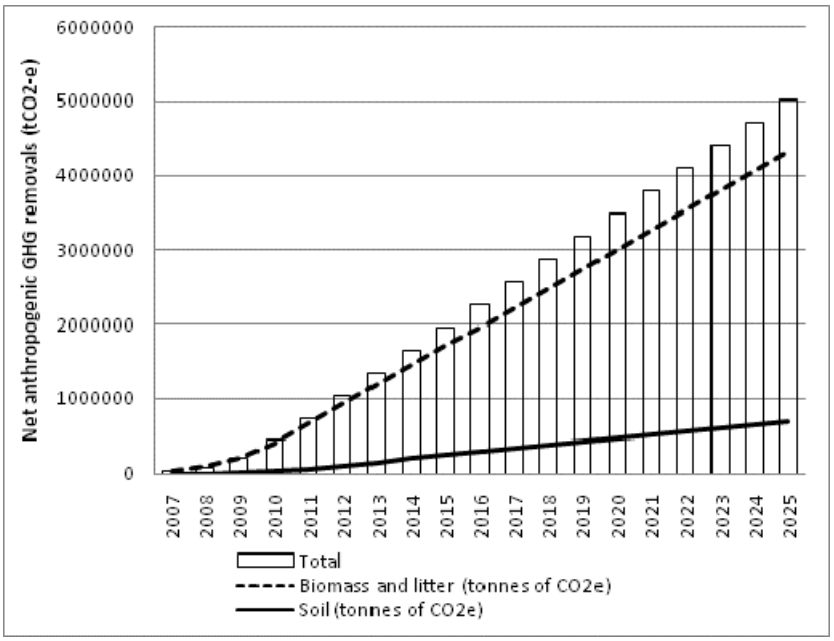
to unexpected fires, pest or other catastrophic events. In this case, an equivalent quantity of tCERs shall be replaced based on modalities and procedures of A/R CDM project activities.

A.9. Estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period:

>>

Annual net anthropogenic GHG removals by sinks are assessed by estimating the annual average actual net GHG removals by sinks due to project activities and deducting the annual average net baseline GHG removals by sinks and annual leakage emissions. The cumulative net anthropogenic emissions for the project are the sum of the annual net anthropogenic GHG removals by sinks over the crediting period of the project. However, since leakage accounts for less than 5% of the actual net GHG removals by sinks, it is excluded. The total cumulative net anthropogenic GHG removal by sinks due to project activities, excluding leakage is estimated to be 5,058,103 tCO_2-e. The overall average net anthropogenic GHG removals by sinks, excluding leakage is 505.81 tCO_2-e per ha and 25.29 tCO_2-e per ha/year.

Summary of results obtained in Sections C.7., D.1., and D.2.				
Year	**Estimation of baseline net GHG removals by sinks (tonnes of CO_2e)**	**Estimation of actual net GHG removals by sinks (tonnes of CO_2e)**	**Estimation of leakage (tonnes of CO_2e)**	**Estimation of net anthropogenic GHG removals by sinks (tonnes of CO_2e)**
2006	143	34738	-	10745
2007	471	91507	-	40691
2008	1483	213281	-	106821
2009	2921	414943	-	250448
2010	4272	667819	-	486712
2011	4984	930036	-	782158
2012	5696	1192252	-	1087582
2013	6407	1454469	-	1393007
2014	7119	1716686	-	1698432
2015	7831	1978902	-	2003856
2016	8543	2241119	-	2309281
2017	9255	2503335	-	2614706
2018	9967	2765552	-	2920131
2019	10679	3027769	-	3225555
2020	11391	3289985	-	3530980
2021	12103	3552202	-	3836405
2022	12815	3814419	-	4141829
2023	13527	4076635	-	4447254
2024	14239	4338852	-	4752679
2025	14239	4338852	-	5058103



A.10. Public funding of the proposed A/R CDM project activity:

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There is no available public funding that will result in a diversion of Official Development Assistance (ODA) and financial obligations of any Parties under the UNFCCC. Thus, no ODA will be flowing into the project activities. Public funds from Government of India or the Government of the State of Himachal Pradesh are not available for this activity. The funds provided by the MHWDP (under a World Bank funded Watershed Development Project) partially support the restoration activities in degraded forests, community lands. However, such funding support is not available for A/R activities on private lands. As a consequence, households that own the private lands would need to bear the costs. The operating and maintenance costs of the project on degraded forestlands and community lands are not fully covered by the MHWDP, especially the costs that would be incurred after the closure of the project. The operational and maintenance costs on private lands would need to be borne by the households owning the lands. It is planned to cover the funding gap with the revenues from the sale of tCERs and sustainably harvested non-timber forest products under the project.

SECTION B. Duration of the project activity / crediting period

B.1 Starting date of the proposed A/R CDM project activity and of the crediting period:

>>

1 July 2006

B. 2. Expected operational lifetime of the proposed A/R CDM project activity:

>>

60 years

B.3 Choice of crediting period:

B.3.1. Length of the renewable crediting period (in years and months), if selected:

>>
20 years, renewable twice

B.3.2. Length of the fixed crediting period (in years and months), if selected:

>>
NA

SECTION C. Application of an approved baseline and monitoring methodology

C.1. Title and reference of the approved baseline and monitoring methodology applied to the proposed A/R CDM project activity:

>> The Consolidated afforestation and reforestation baseline and monitoring methodology "Afforestation and reforestation of degraded land" (AR-ACM0001/version 02[10] is applied.

C.2. Assessment of the applicability of the selected approved methodology to the proposed A/R CDM project activity and justification of the choice of the methodology:

>>
The proposed A/R CDM project activity complies with the conditions of the methodology AR-ACM0001. The project complies with the applicability conditions of the methodology in the following ways. The land eligibility is demonstrated using the A/R methodological "tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities". According to the procedure, a two-stage approach is suggested. Here stage 1 approach is adopted.

Stage 1: Documentary evidence is provided to prove that the land categories and the land parcels selected are degraded lands. In India, the Planning Commission and the National Remote Sensing Agency (NRSA describe degraded lands as 'wastelands'. According to NRSA, which has made an estimate of the extent of wastelands (NRSA, 2005), wastelands are defined as "degraded land which can be brought under vegetation cover with reasonable effort, and which is currently under-utilized and land which is deteriorating for lack of appropriate water and soil management or on account of natural causes". NRSA has identified 28 categories of wastelands, which in fact cover all the lands which are not included under forest land definition and which are under crop production and infrastructure and settlements. According to the estimates made for Himachal Pradesh (Table C.2.1), out of 5.5 Mha of geographic area, croplands and forest land account for 1.9 Mha and wastelands account for 2.84 Mha and the rest is under infrastructure, settlements, etc. Thus, all the land categories and parcels considered for the proposed A/R CDM project do not meet the definition of forest and are not croplands and are categorized as wastelands according to NRSA. Wastelands account for 51.5% of the total geographic area of Himachal Pradesh state.

Table C.2.1: Area under different land categories

Category	Area (Mha)
Cropland	0.55
Forest land	1.44
Wasteland	2.84

[10] http://cdm.unfccc.int/EB/Meetings/038/eb38_repan07.pdf

Others	0.67
Total geographic area	5.5

- The A/R CDM project activity is implemented on degraded lands, which are expected to remain degraded or to continue to degrade in the absence of the project, and hence the land cannot be expected to revert to a non-degraded state without human intervention. The status of the three land categories is as follows.
    - *Degraded forestland:* These lands are devoid of any significant vegetation cover for the last several decades and are subjected to unsustainable biomass extraction (such as fuelwood and grass) over decades leading to loss of vegetation and continued degradation caused by soil erosion on the sloping topography (about 15-25 degrees).
    - *Degraded community land*: These lands have been continuously subjected to extensive grazing over decades, leading to loss of vegetation cover, suppression of regeneration and periodic fires. All such interventions have led to degradation of vegetation and soil erosion on the sloping topography (about 15-25 degrees).
    - *Degraded and abandoned private land*: These lands were once grasslands or forests on sloping hills, and were subjected to land conversion many decades ago (as per the information from PRA), for which no records exist. Cropping was practiced in the past. These lands were abandoned and left fallow due to low crop productivity caused by land degradation. These lands have very shallow soils subjected to continuous soil erosion and unsustainable grazing and harvesting of grass, further leading to degradation.

  Further, most of the land considered for the project (about 66% of the total project area is under degraded forestland and degraded community land) is along the higher reaches of the hills. These sloping lands are subjected to soil erosion and have low soil organic carbon as demonstrated by the SOC content per hectare compared to forests in the region (Refer to Table C.2.2).
    - 21.74 tC/ha in degraded forestland
    - 31.36 tC/ha in degraded community land
    - 27.60 tC/ha in degraded and abandoned private land

Soil organic carbon density of forests in Himachal Pradesh based on 10 observations showed that the mean carbon stock is 123.79 tC/ha (ranging from 44 to 296 tC/ha; Table C.2.2). The mean carbon stock for pine and deodar, two important species of the region, is 70 and 165 tC/ha, respectively.

The soil organic carbon status of the three degraded land categories is less than one-fourth of the carbon stock in forests of the region. Thus it is possible to state that the land categories selected are in a highly degraded state.

Table C.2.2: Average above and belowground biomass (dry tonnes) and soil organic carbon under baseline condition in different land categories

Baseline stratum	Aboveground biomass (t/ha)	Belowground biomass (t/ha)	Total biomass (above+belowground) (t/ha)	Soil organic carbon[#] (tC/ha)
Degraded forestland	3.35	0.87	4.22	21.74 *(7.40-34.42)*
Degraded community land	1.93	0.50	2.43	31.36 *(23.6-33.9)*
Degraded and abandoned private land	2.28	0.59	2.88	27.60 *(18.5-35.5)*

Soil carbon stocks in forests of Himachal Pradesh				
Deodar (2 studies)				164.74 *(286.85-42.62)*
Pine (8 studies)				69.46 *(104.83-37.63)*
Forests (10 studies)				123.79 *(295.68-44.16)*

[#]*Figures in parenthesis indicate soil organic carbon range*

- Encroachment of natural tree vegetation that leads to the establishment of forests according to the host country definition of forest for CDM purposes is not expected to occur.
    - All the three land categories considered for the CDM A/R project have remained degraded and are continuing to degrade as evident from the remote sensing maps. Remote sensing maps of tree crown over a period of 16 years (1989 to 2005) showed no significant change in the tree crown cover by remaining under 10% tree crown suggesting absence of natural regeneration.
    - The land is not suitable for natural regeneration as different species require certain specific conditions for regeneration which do not exist in the land parcels selected
    - Absence of seed sources
    - Non-suitability of land conditions for successful establishment of seedlings
- Flooding irrigation is not part of the project activity
    - The land categories are characterised by 15 to 25 degree slope, thus unsuitable for irrigation. Furthermore, there are no water sources in the hills as all water is accumulated and stored in the valley region.
    - According to the silvicultural practices adopted by the Forest Department in the mid-Himalayan regions, irrigation is never provided and further there is no source of water in the sloping hills (Working Plans of Forests and Silvicultural Manual of Government of Himachal Pradesh)
- If project activities are implemented on organic soils, drainage is not allowed and not more than 10% of the project area may be disturbed as result of soil preparation for planting
    - Observation of physical features of land indicates the absence of the problem of drainage
    - The project area is characterised by steep slopes, absence of water logging and further irrigation practice is not adopted, thus drainage issue is not relevant. Further, organic soils are absent in most of the districts of Himachal Pradesh.
- Nitrogen-fixing trees used in the A/R CDM project activity account for less than 10% of the total forest crown area, so greenhouse gas emissions from denitrification can therefore be neglected.
    - Less than 10% of the total project area or the total canopy cover at maturity is expected to be planted with nitrogen fixing species, therefore greenhouse gas emissions from denitrification are insignificant and can be neglected
    - Recent published scientific evidence suggests that N_2O emission from legumes is insignificant and further, the latest IPCC Guideline (2006) has excluded estimation of N_2O emission from leguminous crops.

C.3. Assessment of the selected carbon pools and emission sources of the approved methodology to the proposed CDM project activity:

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Decision 11/CP.7 requires parties to account for carbon stock changes in five pools: aboveground

biomass, belowground biomass, dead wood, litter and soil organic carbon[11]. This was reiterated in decision 19/CP.9[12]. The definitions for the five pools are given in the Good Practice Guidance for LULUCF[13]. The carbon pools selected for the project according to the AR-ACM0001/Version 02 methodology are given in Box C.3.1.

Box C.3.1: Carbon pools selected for project monitoring

Carbon Pools	Selected (answer with yes or no)	Justification / Explanation
Above ground	Yes	Major carbon pool subjected to the project activity
Below ground	Yes	Major carbon pool subjected to the project activity
Dead wood	No	As there are only a few pre-project living trees and the lands to be planted are degraded, degrading or in a low-level steady state, carbon stocks in dead wood in the baseline scenario can be expected to decrease more or increase less, relative to the project scenario. Therefore, this pool can be conservatively omitted as per the provisions of the methodology.
Litter	No	As the land to be planted are degraded and degrading or in a low-level steady state, carbon stocks in litter in the baseline scenario can be expected to decrease more or increase less, relative to the project scenario. Therefore, this pool can be conservatively omitted as per the provisions of the methodology.
Soil organic carbon	Yes	The sloping land selected for the A/R CDM project has been subjected to erosion and degradation over decades, leading to low soil organic matter status. The proposed reforestation activity is projected to increase the soil organic carbon density. The soil organic matter would be monitored and measured to assess its increase under the project scenario.

Aboveground biomass, belowground biomass and soil organic carbon are the three carbon pools selected for monitoring and reporting in the project. Carbon stocks in the pools dead wood and litter will not decrease more as a result of the proposed A/R CDM project activity than in the baseline, because the A/R activities will be implemented on degraded unclassed or undemarcated/demarcated protected forest land, degraded community land and degraded and abandoned private land. In other words, the carbon stocks in these pools are expected to increase relative to the baseline scenario, which otherwise would have degraded further or remained in a low steady state. However, this increase will be marginal during the initial years and communities will collect all the litter available in the form of fallen dry twigs for use as fuelwood during the subsequent years. In the case of dead wood, the likelihood of occurrence is very less in a growing forest for it takes 100-120 years for forests in Himachal Pradesh to reach maturity and for trees to senesce and die. Therefore, to be conservative, it is chosen to account only for aboveground biomass, belowground biomass and soil organic carbon pools in the proposed A/R CDM project activity.

[11] FCCC/CP/2001/13/Add.1, 54~63. http://unfccc.int/resource/docs/cop7/13a01.pdf

[12] FCCC/CP/2003/6/Add.2, 13~31, http://unfccc.int/resource/docs/cop9/06a02.pdf

[13] FCCC/CP/2003/6/Add.2, 13~31, http://unfccc.int/resource/docs/cop9/06a02.pdf

The greenhouse gases (GHG) that are expected to emit during the implementation of the proposed A/R CDM project activity are CO_2, and CH_4. They are expected to result from:

- Combustion of fossil fuels and
- Burning of biomass

Source	Gas	Included/ excluded	Justification / Explanation
Combustion of fossil fuels	CO_2	Included	Main gas of this source
	CH_4	Excluded	Potential emissions are negligibly small
	N_2O	Excluded	Potential emissions are negligibly small
Burning of biomass	CO_2	Excluded	Carbon stock decreases due to burning are accounted as a carbon stock change
	CH_4	Included	Non-CO_2 gas emitted from biomass burning
	N_2O	Excluded	Potential emissions are negligibly small

C.4. Description of strata identified using the *ex ante* stratification:

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The *ex-ante* stratification procedures outlined in Section II.3 of the approved methodology have been followed as described below:

The critical factors that will determine the stratification and the carbon stocks include the altitude, slope, soil depth and pre-existing vegetation conditions. The following stratification procedure is adopted for the project.

Step 1: Stratification according to pre-existing conditions

Survey of the records of the project area as well as field visits and observations revealed the following factors as critical in influencing the above-ground biomass, below-ground biomass and soil carbon pools.

Current land use, tenure and the location of the land categories included in the project with respect to the habitation are discussed below. The location of the three land categories with respect to habitation is likely to characterize carbon stocks:

- *Degraded forestland*: These lands are located at higher elevation in all the GPs where the grazing pressure is relatively less and these lands are farthest from habitation. This land category is largely without tree cover and is under the control of the state Forest Department.
- *Degraded community land:* These lands are under the control of the revenue department on which communities have rights of access to grazing and fuelwood collection. These lands are closer to habitation compared to degraded forestlands. As a consequence, these lands are subjected to intensive pressures of grazing and fuelwood collection.
- *Degraded and abandoned private land:* These lands are at lower elevation close to the valley and are close to human habitation. These lands were cultivated on slopes and partially terraced conditions in the past. The lands are abandoned for more than 10 years and are currently used for fodder collection and livestock grazing.

The above three land categories form the primary basis for stratification under the baseline scenario taking into account the factors of pre-existing vegetation, tenure, slope and biotic pressure.

Step 2: Stratification according to planned A/R CDM project activity

It is proposed to adopt the following stand models suitable to the three broad land categories and altitudinal sub-strata for each land category (Refer to Section A.5.3). The selected parcels for A/R activity would belong to one of the three sub-strata. It is likely that a given panchayat, no matter belonging to which division or district, can have all the three altitudinal sub-strata or two or only one of the sub-strata. Further, each of the reforestation models could belong to or occur at any of the three altitudinal strata. The three altitude based sub-strata are as follows:

- High – 1400 to 1800 m
- Medium – 1100-1400 m
- Low – 600-1100 m

Each of the three broad land categories are further stratified based on the altitudinal range due to the following rationale.

- The soil status is likely to vary across high, medium and low altitudes
- The species suitability varies with altitude
- The growth rate of biomass could vary with altitude
- The settlements are usually in the lower altitudinal strata.

Under the A/R project, the first stage stratification is restricted to the above three reforestation models, relevant to respective land categories for the following reasons.

- The vegetation study in randomly selected land parcels belonging to each land category showed that 50% of the parcels were without trees (>2 meters height) and the aboveground biomass was < 5 t/ha in 70% of the parcels (64% in degraded community land to 79% in degraded and abandoned private land). On land parcels classified as with trees, the biomass recorded is in the range of 1.0 to 16 t/ha.
- The species mix for each of the above models was evolved based on land suitability analysis and consultation process involving multiple stakeholders.
- The planting will be done in a phased manner over a period of five years where all the three reforestation models will be implemented in a systematic manner.
-

Year	FOREST				COMMUNITY				PRIVATE				YEAR WISE
	LOW	MEDIUM	HIGH	TOTAL	LOW	MEDIUM	HIGH	TOTAL	LOW	MEDIUM	HIGH	TOTAL	TOTAL
2006-07	254	62	_	316	16	46	4	66	_	_	_	0	382
2007-08	387	136	25	548	14	47	15	76	_	_	_	0	624
2008-09	790	179	143	1112	_	18		18	37	33	_	70	1200
2009-10	710	305	305	1320	247	267	101	615	490	470	105	1065	3000
2010-11	1000	596	409	2005	_	_	_	0	711	170	114	995	3000
2011-12	295	600	899	1794	_	_	_	0	_	_	_	0	1794
TOTAL	**3436**	**1878**	**1781**	**7095**	**277**	**378**	**120**	**775**	**1238**	**673**	**219**	**2130**	**10000**

- Further, there is no difference in the silvicultural practices, fertilizer or manure application in different parcels of land belonging to the different GPs, for a given stand model.
- The location of the three land categories described earlier, with respect to elevation and proximity to human habitation is nearly identical in all GPs, such as degraded forestland at a higher elevation farthest from habitation in all the GPs. This does not vary across watershed divisions and GPs.

- The soil carbon density across different sample plots in different GPs for a given land category is low and is in the range (7.40 to 34.42 tC/ha, for degraded forestland, 23.6 to 33.9 tC/ha, for degraded community land and 18.5 to 35.5 tC/ha, for degraded private land, refer to Table C.2.2).
- Carbon stock changes will be determined by species choice, their growth rates, survival and density of stocking and, apart from site class and topography.

Step 3: Final ex-ante stratification

The stratification adopted for the pre-existing vegetation under the baseline conditions is geographically delineated according to the three broad land categories as described earlier. The three reforestation models were further stratified based on the altitude of the parcels selected for reforestation. The following three stage final *ex-ante* stratification is adopted based on a combination of pre-existing conditions, reforestation model and altitudinal sub-strata (Figure C.4.1).

Stage 1: Pre-existing land categories namely; degraded forestland, degraded community land and degraded and abandoned private land
Stage 2: Reforestation models namely;

- restoration forestry on degraded forestland
- community forestry on degraded community land and
- farm forestry on degraded and abandoned private land

Stage 3: The final *ex-ante* A/R stratification consists of three altitudinal reforestation models under each of the reforestation models

- ***Restoration forestry***; high, medium and low strata
- ***Community forestry***; high, medium and low strata
- ***Farm forestry***; high, medium and low strata

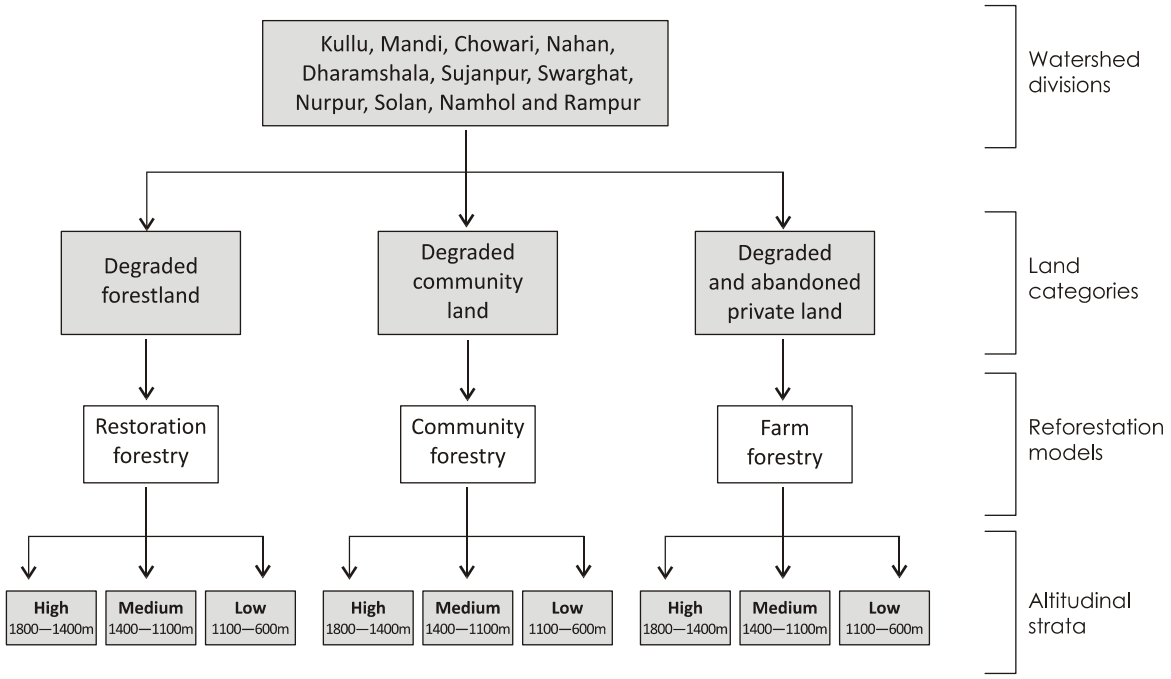

Figure C.4.1: Final *ex-ante* stratification of proposed reforestation activity

C.5. Identification of the baseline scenario:

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C.5.1. Description of the application of the procedure to identify the most plausible baseline scenario (separately for each stratum defined in C.4.):

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The most plausible baseline scenario has been determined using A/R Methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities"[14].

Step 1: Demonstration that the proposed A/R CDM project activity meets the conditions of the methodology AR ACM0001, and the relevance of the baseline approach 22 (a) – historical and existing land use can be demonstrated.

- The land categories - degraded forest and community lands have remained degraded (<10% tree crown) since 1989, as demonstrated in Section C.1 through satellite imageries, and remote sensing maps (Refer to Figure A.6.1).
- The survey of these land categories indicates that there are no standing trees or have very few scatted trees in the land categories selected for the project. Therefore, these lands are not forests as per the Government of India's definition of forest. The data of baseline study presents evidence of low biomass stock per hectare (Table C.2.2).
- The PRA exercise conducted in sample GPs shows that these lands did not have forests since 1989 and have not been temporarily unstocked due to anthropogenic interference during the period 1989 to 2006 (Refer to Section C.1). Similarly, the degraded and abandoned private lands have remained degraded fallows over the years. This has been demonstrated through household survey of the sample farmers whose land parcel has been considered for the project (Table C.5.1).

Table C.5.1: Percent gram panchayats and farmers reporting no conversion of land use based on PRA and household survey

Baseline stratum	Percent gram panchayats reporting no forest during 1989 on project land parcels	Percent farmers reporting no cropping on private land or current status since 1989
Degraded forestland	100	-
Degraded community land	100	-
Degraded and abandoned private land	-	92

- *Vegetation survey*: The vegetation study conducted to determine the status of vegetation under the baseline showed that the mean number of tree stems per ha >10 cm and >30 cm DBH respectively are 33 and 6 (Table C.5.2).

Table C.5.2: Average number of trees per ha above 10 cm and above 30 cm DBH, respectively in different land categories

Baseline stratum	Number of trees /ha	
	>10 cm DBH	>30 cm DBH*

[14] http://cdm.unfccc.int/EB/Meetings/035/eb35_repan19.pdf

Degraded forestland	30	5
Degraded community land	39	7
Degraded and abandoned private land	30	5

*Less than 50% of the sampled plots support trees with >30 cm DBH

- Vegetation study indicated very low levels of above-ground biomass in most gram panchayats (Table C.5.3), which translates into insignificant quantities of deadwood and litter in the baseline scenario.
    - The analysis of soil samples in the baseline study demonstrated low soil organic carbon density (in the range of 21.74 to 31.36 tC/ha) in all the three baseline strata. This quantity of soil carbon is about half of the soil organic carbon observed in the standing forests of the region.
    - The topography is an important indicator of soil status. The three land categories of the basline scenario reflect varied topography characterised by steep slope and shallow top soil, moderate slope and moderate soil depth, and valley region with good soil depth.

Table C.5.3: Distribution of total biomass (above+belowground) in the three land categories of 30 sample GPs

Baseline stratum	**Number of gram panchayats* with biomass**			
	<2 t	**2-5 t**	**5-10 t**	**>10 t**
Degraded forestland	6	6	4	2
Degraded community land	5	2	2	1
Degraded and abandoned private land	7	4	3	0
Total	**18**	**12**	**9**	**3**

*Total number of gram panchayats sampled is 30.

- *Assessment of the natural regeneration potential of the degraded lands:* The dominant mode of propagation and the potential for natural regeneration of species present in the three broad degraded land categories under the baseline conditions is presented in Table C.5.4. Pine, which is one of the dominant species of the project area requires specific conditions for regeneration and establishment. On degraded community land, this species accounts for nearly 20% and on degraded and abandoned private land it accounts or for about 10% of the vegetation. The next dominant species on degraded forestland and degraded and abandoned private land is *Dalbergia sissoo*. *Acacia catechu*, the dominant species on degraded community (23%) and degraded and abandoned private land (26%) also does not spread easily through seeds (Table C.5.4). This shows that there is no forest succession based on tree seed sources from nearby areas. In addition, livestock grazing may not allow natural regeneration.

Table C.5.4: Dominant species present under the degraded status in the baseline scenario conditions and their modes of propagation

	Species present under the degraded baseline conditions	**Baseline stratum**	**Dominant mode of propagation**	**Potential for natural regeneration**
1	*Acacia catechu*	Degraded forestland, degraded community land, degraded & abandoned private land	Nursery practice	Limited/none
2	*Albizzia chinensis*	Degraded & abandoned private land	Nursery practice	Limited/none

3	*Anogeissus latifolia*	Degraded community land	Natural	Limited/none
4	*Bauhinia variegate*	Degraded community land	Natural	Limited/none
5	*Cassia fistula*	Degraded forestland, degraded community land	Nursery practice	Limited/none
6	*Dalbergia sissoo*	Degraded forestland, degraded community land, degraded & abandoned private land	Nursery practice	Limited/none
7	*Emblica officinalis*	Degraded & abandoned private land	Nursery practice	Limited/none
8	*Ficus sp.,*	Degraded & abandoned private land	-	Limited/none
9	*Flacourtia sp.,*	Degraded community land	Natural	Limited/none
10	*Mallotus philippensis*	Degraded forestland, degraded & abandoned private land	Natural	Limited/none
11	*Mitragyna parviflora*	Degraded & abandoned private land	Nursery practice	Limited/none
12	*Pinus roxburghii*	Degraded forestland, degraded community land, degraded & abandoned private land	Nursery practice	Limited/none
13	*Pinus wallichiana*	Degraded forestland, degraded & abandoned private land	Natural	Limited/none
14	*Punica granatum(wild)*	Degraded community land	Nursery practice	Limited/none
15	*Pyrus pashia*	Degraded forestland, degraded community land, degraded & abandoned private land	Nursery practice	Limited/none
16	*Quercus semecarpifolia*	Degraded forestland, degraded & abandoned private land	Natural	Limited/none
17	*Ziziphus jujube*	Degraded & abandoned private land	Nursery practice	Limited/none

Step 2: Definition of project boundary
The procedure adopted for defining the project boundary involved the following steps:

- GPs were selected using the approach described in Section A.5.4. These GPs were marked on a map
- In each GP, the parcels belonging to degraded forest, community and abandoned private lands selected were identified and numbered on a map
- Detailed description of the project boundary and its delineation, geographically locating the identified land parcels belonging to the different land categories in the selected GPs is provided in Section A.5.4.

The project boundary is the area delineated for each parcel of land to be brought under one of the reforestation models of A/R project.

Step 3: Analysis of historical land use, local and sectoral land use policies or regulations and land use alternatives

The factors that determine the land use/land cover change over time are state and national policies which influence land use change, status of the land, in particular vegetation, and rate of A/R under various programmes.

The historical land use and local and sectoral policies and regulation and their likely implications for the A/R CDM project area are analysed using the following sources of data.

- *Data source 1:* Remote sensing maps with tree crown cover (<10%, 10-40%, etc) were obtained from the Forest Survey of India for the years 1989, 2000 and 2003 to demonstrate that the land considered for A/R CDM are not forests and have remained degraded over the period under consideration (atleast since 1989).
- *Data source 2:* Data and information on national and state policies on land use and A/R activities implemented on degraded lands in the past and lands proposed for A/R activities in the future in the absence of the proposed CDM A/R project was obtained from the State Forest Department. Further, information from the Forest Department in order to demonstrate that the lands proposed would continue to be in the existing land use reflecting the continuation of the baseline.
- *Data source 3:* Data from Forest Survey of India on the extent of land under different tree crown density classes at the state and district level was obtained for different periods to demonstrate that the forests are subjected to degradation. The increase in area under open forests and reduction in area under dense forest in the districts covered under the project highlights the continuing degraded status of carbon stocks (Forest Survey of India, State of Forest Reports)
- *Data source 4:* Data on area brought under A/R over the years was obtained from State Forest Department to demonstrate that the rate of A/R activity is declining in the recent years
- *Data source 5:* Wasteland statistics from the National Remote Sensing Agency was obtained to demonstrate that a large extent of wasteland is available in the state for A/R activities
- *Data source 6:* Data from vegetation surveys conducted in sample land categories was used to demonstrate the low biomass status, indicating the degraded status of lands and continued degradation of land
- *Data source 7:* Data from soil sampling and laboratory analysis showed low soil organic carbon reflecting the continuation of land degradation in the baseline scenario.
- *Data source 8:* Data and information from PRA was collected on the historical status of degraded forest and community land and plausible alternative uses for such lands. The analysis of information showed that no alternative options exist apart from *Status quo* or continued degraded state of lands and vegetation under the baseline scenario.
- *Data source 9:* Household survey of the sample farmers was conducted to establish that the degraded and abandoned private land being considered for the A/R CDM project are not suitable or profitable for conversion to cropland or horticulture.

Step 4: Stratification of A/R CDM project activity

Ex-ante stratification of the project area was described in Section C.4 and Figure C.4.1.

Step 5: Determine the baseline land use/land cover scenario for each stratum

Above-ground and below-ground tree biomass

- The aboveground biomass (in tonnes of dry matter) is low under the baseline scenario, (Refer to Table C.2.2)
  - Degraded forestland: 3.35 t/ha
  - Degraded community land: 1.93 t/ha
  - Degraded and abandoned private land: 2.28 t/ha

Since the aboveground biomass growing stock in the baseline is low (Table C.5.3), the accumulation of dead wood or litter is likely to be insignificant or absent. If 5% of the aboveground biomass is assumed as litter and deadwood, the annual accumulation rate will be around 0.2 t/ha/year.

Above-ground non-tree biomass

The assessment of non-tree aboveground biomass indicates that the grass productivity of degraded forest and community land categories is very low and ranges from 2 to 2.5 dry tonnes/ha/year (Table C.5.4). Even in degraded private land where there is comparatively less anthropogenic pressure, the grass productivity recorded is only 3 dry tonnes/ha/year.

Table C.5.4: Grass (herb layer) productivity (in dry tonnes/ha) in different land categories under baseline condition

Baseline stratum	Grass production (t/ha)
Degraded forestland	2.5
Degraded community land	2.0
Degraded and abandoned private land	3.0

C.5.2. Description of the identified baseline scenario (separately for each stratum defined in Section C.4.):

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Baseline scenario of degraded forest and community lands

These two land categories are owned by Government agencies and have similar tenurial condition. The only plausible alternative for the degraded forest and community land is continued degradation of the land categories.

i. The national and state policies ban conversion of degraded forest and community land for non-forestry purposes, particularly to cropland
ii. Forest lands are demonstrated to be getting degraded since the area under open forests (10-40% tree crown) is increasing (81.6% during the period 1997 to 2003)
iii. The current vegetation status is very poor with 4.22 t (degraded forestland) and 2.43 t (degraded community land) of biomass (total above and belowground biomass) per hectare (Table C.2.2)
iv. Soil organic carbon status of the soil is very low (around 26 tC/ha, refer to Table C.2.2)
v. Sloping hilly terrain of the bare land or poor vegetation cover leads to increased soil erosion and degradation and decrease in carbon stocks
vi. Absence of root stock and natural seed sources in the land categories selected for A/R project.
vii. The data indicates that forest and community lands have not been converted to cropland and the abandoned private lands have remained in that state for long periods
viii. Remote sensing analysis for the period 1989 and 2003 shows that the land considered have remained under <10% tree crown.

Baseline scenario of degraded private lands

In the case of degraded and abandoned private land, the only plausible option is to remain as abandoned and fallow, and subjected to further degradation or reforestation of these lands under CDM.

- These lands have been left abandoned for over 20 years
- These lands are on the hilly slopes, degraded and are not suitable for profitable cropping (Refer to Section C.6)
- Area under agriculture has declined in the Himachal Pradesh state over the last two decades, indicating no new area is brought under crops

- The biomass stock on degraded private lands is low at 2.88 t/ha (Table C.2.2)
- The soil organic carbon on the degraded and abandoned private lands is low at 27.60 tC/ha (Table C.2.2).

The land categories and the land parcels selected for the CDM A/R project are shown to be in a degraded state and further these land categories are subjected to continued degradation, as demonstrated in Section C.5. Further, the evidence from vegetation and soil studies, PRA, analysis of sectoral policies and regulations, current low rate of afforestation programmes, historical land use and observed land use change trends show that the only plausible baseline land use is *Status quo* or the current land use which is degraded or abandoned, and subjected to continued degradation. Alternatively these lands could be brought under A/R under the CDM project, as demonstrated below (Refer to Section C.6).

Three baseline strata represent the land categories namely, degraded forest, degraded community and degraded and abandoned private lands.

Baseline stratum	***Land use category***	***Description***	***Status***
Baseline stratum 1	Degraded forestland	- Current vegetation status poor - Low biomass of 4.22 t/ha - Low soil organic carbon of 21.74 tC/ha - Absence of root stock and natural seed sources - no vegetation regeneration has occurred - <10% tree crown as indicated by remote sensing maps	Continuation of existing land use under the baseline
Baseline stratum 2	Degraded community land	- Current vegetation status poor - Low biomass of 2.43 t/ha - Low soil organic carbon of 31.36 tC/ha - <10% tree crown as indicated by remote sensing maps - no vegetation regeneration has occurred	Continuation of existing land use under the baseline
Baseline stratum 3	Degraded private land	- Land abandoned for over 20 years - Low biomass stock of 2.88 t/ha - Soil organic carbon low at 27.60 tC/ha - No vegetation regeneration has occurred	Continuation of existing land use under the baseline

C.6. Assessment and demonstration of additionality:

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In this section, additionality of the proposed A/R CDM project is demonstrated using the step-wise approach outlined in the "*Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities*"[15].

[15]http://cdm.unfccc.int/EB/Meetings/035/eb35_repan19.pdf

Step 0: *Preliminary screening based on the starting date of the A/R project activity*

The starting date for the project is 1 July 2006. The need for the proposed CDM project activity is highlighted in the project implementation document of the Mid Himalayan Watershed Development Project (Project implementation Plan-HPMHWDP, 2006). The importance of financial incentive from the revenue generated from selling CERs from the reforestation activities was considered and documented in 'Environment and Social Assessment Report of the Mid-Himalayan Watershed Development Project' of HPMHWDP (2006). According to the project document, consideration of the CER revenue facilitates the implementation of the watershed development project.

Step 1: Identification of alternative scenarios

Alternatives to the A/R project activities consistent with existing laws and regulations are identified using the steps provided in the Combined Tool[16]".

Sub-step 1a: The alternative uses of the public lands (degraded forest and community lands) and the private lands (degraded and abandoned private lands) outlined below.

Public land (degraded forest and community land)

- Continuation of existing land use or *status quo*
- Proposed project not undertaken as an A/R CDM project

Degraded forestland: The State Forest Department has control over the degraded forestland. Currently, this land category is subjected to degradation due to unsustainable grazing. Another alternative is to implement the A/R activity not as a CDM project.

Degraded community land: The Revenue Department has control over community land. It is subjected to degradation due to unsustainable grazing. The panchayats or village communities cannot unilaterally take decisions on the utilization of this land. It is transferred to the Forest Departments for undertaking A/R activities. In such cases, village panchayats are involved in planning and implementing the plantation schemes. An alternative is to implement the A/R activity not as a CDM project.

Alternative uses of private land (degraded and abandoned private land) include

- Continuation of existing land use or *status quo*
- Naturally grown grassland with extremely low productivity
- Proposed project not undertaken as an A/R CDM project.

Private lands (degraded and abandoned private lands) are controlled by the individual farmers. These lands are currently used for collection of grass and for grazing livestock, which is likely to continue in the future. Avoiding grazing pressure could permit them to evolve them into natural grasslands of low productivity. However, considering the limited alternative use of such grasslands for households, they would continue to be used for fodder collection and grazing or would be in *status quo*. An alternative is to implement the A/R activity not as a CDM project.

Sub-step 1b. *Consistency of credible alternative land use scenarios with enforced mandatory applicable laws and regulations:* The mandatory laws and regulations and forest policy does not permit the use of

[16] http://cdm.unfccc.int/EB/Meetings/035/eb35_repan19.pdf

public lands for agriculture. The private lands although could be used for agriculture or horticulture, considering these lands have remained abandoned for more than a decade, it is unlikely that they will be used for agriculture. The implementation of A/R activity is not a mandatory requirement, the public and private lands would continue to be in the degraded state.

Step 2: Barrier analysis

The barrier analysis is used to demonstrate that the alternative use of public and private lands for A/R activity faces investment, technological, institutional barriers.

Sub-step 2a: *Identification of barriers that would prevent the implementation of at least one alternative land use scenarios:*

The barriers to implementation of the project activities are presented in Table C.6.3. Furthermore, how these barriers do not prevent the implementation of at least one of the alternatives is also presented in Table C.6.3.

a) Investment barriers

- *Lack of access to credit:* Commercial banks do not provide credit to A/R activities in case of private lands. The returns from private lands are low and involve long gestation periods as the lands are on hilly degraded slopes and have poor and shallow soils.
- *Access to international capital markets* is lacking for the proposed A/R CDM project activity on all three categories of land as returns are low and involve long gestation periods.

Status quo: No investment is required for maintaining the *Status quo*. No financial or technological or policy intervention is required to maintain the *Status quo*. Thus, *Status quo* is the most likely plausible alternative with no barriers.

b) Institutional barriers

There is a lack of institutional capacity at panchayat and individual farmer level to undertake silvicultural practices and management of the plantations. Institutional capacity required for raising nursery and carrying out some of the silvicultural practices is beyond the capacity of GPs and farmers. The implementation of capacity development and awareness programs require finances that are not available when A/R activity is implemented as not as a CDM project

Moreover, continuation of existing land use or *status quo* occurs within the prevailing institutional barriers as it has been happening for several decades.

c) Technological barriers

There are several technological barriers such as lack of access to quality planting material and lack of infrastructure for implementing reforestation practices. Significant investment in training, skill development and improved silvicultural practices is required, which would not be available for A/R activity if undertaken as a non-CDM project.

The technological barriers will not prevent the *Status quo* as no technological interventions are required to continue with the existing land use.

The other barriers are presented in Table C.6.1.

Table C.6.1: Barrier analysis

Barrier that would prevent the implementation of the type of proposed project activity from being carried out if the project activity was not registered as an A/R CDM activity.	Sub-step 3a. How it prevents the implementation of this type of proposed project activity. How it would prevent potential project proponents from carrying out the proposed project activity if it was not expected to be registered as an A/R CDM project activity.	Sub-step 3b. How it does not prevent the implementation of the alternative.	Source of transparent and documented evidence.	How CDM project implementation enables overcoming the barrier.
Investment barrier 1: Debt funding is not available for this type of project activity.	Debt funding is not available for funding A/R activities in public land	No investment required, thus not a barrier for maintaining *Status quo*	Government policy in India for Banking institutions	CDM revenue will meet the funding needs of project implementation
Investment barrier 2: No access to international capital markets due to real or perceived risks associated with domestic or foreign direct investment in the country where the project activity is to be Implemented.	Access to international capital market for A/R in community and forest land lacking, since these lands are under government control and subjected to several regulations. No direct investment is provided for A/R on public land.	No investment required, therefore not a barrier for maintaining *Status quo*	Government policy is not to permit direct investment in A/R in public land	CDM revenue will meet the investment cost requirement of the project
Investment barrier 3: Lack of access to credit	Commercial banks do not provide credit to afforestation in public land and Government funding is limited, since at current rate of A/R in Himachal Pradesh >200 years are required for covering the potential area	No investment required, therefore not a barrier for maintaining *Status quo*	State governments do not borrow from commercial sources for investment in A/R in public land by private or international agencies - Afforestation is not a commercially vilable activity since harvesting is banned in public lands (refer to Godavarman, Dec 202, 1996)	CDM revenue has helped MHWDP authorities to get funds for investment from the World Bank

Institutional barrier 1: Risk related to changes in government policies or laws	No risk of government policy for A/R	Forest Policy of Himachal Pradesh is very clear about the access and tenurial laws, thus *Status quo* likely to continue	Forest Policy of Himachal Pradesh	Government has agreed and signed the project MoU, detailing the policy towards this project, due to potential CDM revenue incentive
Technological barrier 1: Lack of access to planting/fencing materials	Presently a barrier since quality planting material in adequate numbers is limited for A/R	Not an issue since there is no planting involved under *Status quo*		CDM revenue helped MHWDP to raise and obtain quality planting material and protection fencing
Barrier related to local tradition 2: Traditional equipment and technology	Panchayats and farmers do not own equipments, etc., for raising nurseries and there is lack of access to water for nurseries	Not a barrier since people have adequate traditional knowledge of grazing and fuelwood gathering, which are the current practices		CDM project will facilitate MHWDP to procure the equipment and technology required for implementing the project
Barrier due to local ecological conditions 1: Degraded soil (e.g. water/wind erosion, salination, etc.)	The project land parcels are part of mid-himalayan altitude (range on 600 to 1600 m) with most land having a slope of 15-25 degrees. This requires higher investment for land preparation and other silvicultural practices. Land is highly degraded and cannot support any activity other than A/R	Not a barrier since no land preparation or silvicultural practices or planting is required	Working Plan of Forest Department and Compartment History files	CDM revenue will facilitate investment to implement soil quality improvement practices.
Barrier due to local ecological conditions 3: Biotic pressure in terms of grazing, fodder collection, etc.	Biotic pressure is a serious barrier for the reforestation reforestation models considered, which can adversely affect survival and growth of seedlings due to absence of strong institutional arrangements as well as lack of incentive for protection and management	Not an issue as grazing and fuelwood gathering is an ongoing activity	MHWDP Implementation Report	CDM revenue would motivate local communities to protect and manage the forest and regulate or overcome the biotic pressure barrier. Further, grass productivity and fuelwood supply is likely to increase under the project.
Barrier due to local social conditions 1:	Lack of technical skills for raising	Not an issue as grazing and fuelwood		CDM revenue provides resources

Lack of skills locally.	nursery and sustainable forest management limits the ability to undertake large-scale A/R	gathering are ongoing activities and do not require any skills		to overcome the skill barrier and MHWDP will also assist the project motivated
Barrier due to local social conditions 2: Grazing and fuelwood collection	Currently, all the land categories are used for grazing, grass collection and fuelwood gathering. In the absence of adequate financial incentives, A/R activities are unlikely to succeed due to these pressures	Grazing, fuelwood and grass collection is an ongoing activity	MHWDP Document	Under the CDM project, the grass and fuelwood production is projected to increase due to planting, protection, and management, thus overcoming the barrier
Barrier due to local social conditions 5: Lack of organisation of local communities.	Absence of strong and empowered decentralized sub-panchayat level institutions, which could enforce effective protection, prevent felling of trees, and regulate grazing and fuelwood collection	Not an issue since traditionally communities have been grazing and collecting fuelwood	MHWDP Document	CDM project includes formation of panchayats level institutions. CDM revenue is likely to motivate village communities to organize themselves with the help of MHWDP
Barriers relating to markets, transport and storage 1: Possibilities of large price risk due to the fluctuations in the prices of timber and non-timber products over the project period in the absence of efficient markets and insurance mechanisms.	Limited and unorganized market for non-timber forest products, which prevents adoption of reforestation models with non-timber products yielding species. Further there is lack of information on marketing channels for non-timber products	Not an issue, as there are no major marketing risks and traditional markets are adequate for sale of grass or fuelwood. Further, there are no significant non-timber products yielding trees and other species under status condition	MHWDP Document	Under the proposed CDM project, the main sources of revenue are carbon credit payment and non-timber forest products. CDM revenue will overcome the barriers arising from timber price and market uncertainties
	Private land: Absence of market for non-timber products and fruit products limits the implementation of models involving non-timber products and fruit yielding species			

Sub-step 2b: Elimination of land use scenarios that are prevented by the identified barriers.

The alternative land use scenario "proposed project not undertaken as an A/R CDM project" identified in *sub-step 1a* above can be eliminated from land use scenarios due to the barriers it faces. The three baseline strata have poor vegetation and soil carbon status and are in a degraded state. They are likely to get degraded further due to soil erosion and other biotic pressures. The analysis presented in Table C.6.2 shows that continuation of the existing land use or *status quo* is not prevented by the ecological, technical, financial, institutional, social, and cultural barriers as the three land categories selected have been in degraded state for several decades (Refer to Section C.5.1).

Sub-step 2c. Determination of baseline scenario (if allowed by the barrier analysis)

The plausible alternative scenarios, their feasibility and justification are provided in Table C.6.2. Step-wise description of the selection of baseline scenario was provided in Section C.5.2.

Table C.6.2: Current land use, alternative land use and feasibility

Current land use	Alternative land use	Feasibility of the alternative	Justification
Degraded forestland	1. Continuation of the existing land use or *status quo*	Yes	Has remained in this state for several decades and has not been brought under any plantation forestry schemes, possibly due to barriers. *Status quo* doesn't require any investment or any intervention and face no barriers
	2. Reforestation activity	No	Due to the barrier of non-availability of funds, these lands are unlikely to be brought under plantation forestry. At current rates of A/R it will take >200 years to afforest all the potential degraded land in Himachal Pradesh
Degraded community land	1. Continuation of the existing land use or *status quo*	Yes	Has remained in this state for several decades and has not been brought under any plantation forestry scheme, due to financial barriers. *Status quo* doesn't require any investment or any intervention and face no barriers
	2. Reforestation activity	No	Due to the barrier of non-availability of funds, these lands are unlikely to be brought under plantation forestry. At current rates of A/R it will take >200 years to afforest all the potential degraded land in Himachal Pradesh

Degraded and abandoned private land	1. Continuation of the existing land use or *status quo*	Yes	Has remained in this state for several decades and has not been brought under any plantation forestry scheme or agriculture or horticulture, due to financial and other barriers such as non-suitability of hilly slopes for commercial cropping. *Status quo* faces no barriers and no investment and intervention is required
	2. Grassland	No	These lands have remained abandoned for more than 20 years, with poor grass production and indicates unsuitability for profitable grass production.
	3. Reforestation activity	No	Due to the barrier of non-availability of funds, these lands are unlikely to be brought under plantation forestry.

Is reforestation activity not undertaken as an A/R CDM project included in the list of land use scenarios that are not prevented by any barrier?

→ no, then:

Does the list contain only one land use scenario?

→yes, the remaining land use is the baseline scenario, which is *status quo* in this case.

Step 4: Common practice analysis

Himachal Pradesh has been implementing afforestation programme since early 1980s, when social forestry programme was launched in India. The area afforested in the initial years ranged from 20,000 to 25,000 ha annually. The rate of afforestation which was around 30,000 ha during 1998 to 2000 has consistently declined since then. The rate of afforestation during 2003-04, the latest year for which data is available, is around 13,414 ha. The budget allocation of the state government to A&R programmes has declined over the years (State Budget) reflected by the reduction in area afforested in the recent years. The proposed A&R under CDM is being undertaken under different circumstances; Changes in state afforestation policies, reduction in budget allocation for A&R and intensification of forestry practices, compared to the normal A&R programme of the forest department. A comparative analysis of the previous and ongoing A&R activities with the proposed A/R CDM activity in Himachal Pradesh shows the following differences which make the proposed project is not common practice.

1. *Inclusion of private abandoned land:* State funded A/R programmes are not implemented on degraded private land. The land owners have little financial incentive to invest in afforestation programmes on their land, due to long gestation period and low economic reutrns.
2. *Lack of financial incentives for communities under the normal A/R programmes:* Given the low economic returns, panchayats do not have any financial incentive to undertake or participate in reforestation on degraded land.
3. *Incentive of carbon revenue for community participation for watershed protection, biodiversity conservation and carbon sequestration:* Carbon revenue would make the reforestation programme financially viable and attractive to the panchayats as well as individual farmers.
4. *Financial barriers to A/R programmes:* The budget allocation of the state government to afforestation programmes has declined.

5. *Species choice:* In Himachal Pradesh, the dominant species promoted under the A/R programmes include pines, oaks, *Acacia catechu*, etc. Conversely, the proposed A/R CDM project promotes multi-species forestry, economically useful to the communities. For example, native fruit yielding tree species are preferred on degraded abandoned private lands.
6. *Decline of external funding to forest management programmes:* Funding for forestry programmes has declined and currently, no programmes exist. The GTZ and DFID funded afforestation programmes in Himachal Pradesh have ended and currently and no state-wide externally funded afforestation programme exists.
7. *Improved silvicultural practices:* The proposed A/R CDM project aims to adopt planting of healthy seedlings, improved land preparation and protection measures. These practices increase the cost of planting per hectare beyond the norms of the state forest department[17] (Govt. norms). Raising seedlings and transportation of seedlings to the planting sites involves significant human effort and cost. Thus the area proposed for the A/R CDM project is unlikely to be planted under the normal A&R programmes.
8. *Difficult terrain:* The dominant area proposed for the A/R CDM project is degraded forestland accounting for over 70% of the total area to be reforested. This land is at a higher elevation, away from the settlements and with inadequate access. Normal afforestation programmes will occur in the easily accessible area in the lower reaches of the hills.

C.7. Estimation of the *ex ante* baseline net GHG removals by sinks:

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Under the applicability conditions of this methodology:

- Changes in carbon stock of above-ground and below-ground biomass of non tree vegetation may be conservatively assumed to be zero for all strata in the baseline scenario;
- It is expected that the baseline dead wood and litter carbon pools will not show a permanent net increase. It is therefore conservative to assume that the sum of the changes in the carbon stocks of dead wood and litter carbon pools is zero for all strata in the baseline scenario;
- Changes in carbon stock in soil organic carbon may be conservatively assumed to be zero for all strata in the baseline scenario.

Therefore the baseline net GHG removals by sinks will be determined as:

$$\Delta C_{BSL} = \Delta C_{BSL,tree} \quad (1)$$

where:

ΔC_{BSL}	Baseline net greenhouse gas removals by sinks; t CO_2-e
$\Delta C_{BSL,tree}$	Sum of the carbon stock changes in above-ground and below-ground biomass of trees in the baseline; t CO_2-e

As demonstrated in Section A.7, the baseline scenario is the continued degradation of carbon stocks or their maintenance in a steady state, under which the carbon stock changes in dead wood and litter are conservatively assumed to be zero. There are pre-project growing trees, thus the baseline net removals by

[17] June 2008 MHWDP Executive Committee proceedings

sinks are estimated as the sum of the carbon stock change due to the growth of pre-project growing trees. See Annex 3 for detail estimation. However, annual net CO_2 removals by pre-existing trees are not included in the projection of baseline carbon stocks as they will be measured and accounted as part of the project during monitoring. This is a conservative assumption, as trees will continue to grow.

The total growing stock under the baseline scenario for the proposed area to be reforested is 2.52 tons of biomass per hectare (Table C.7.1). According to the Forest Survey of India, the mean annual increment is 0.054 m^3/cu. m of growing stock (http://envfor.nic.in/nfap/chap05.html). In our study, the growing stock is 2.43 to 4.22 t/ha (a mean of 2.52 t/ha) and by assessing the growth rate by taking a value of 0.054 m^3/cu. m, the growing stock per ha is 0.046 cu. m /ha/year or 0.03082 t/ha/year. Thus, the increment in the baseline carbon stock of tree and non-tree biomass is likely to be insignificant and therefore not included in the ex-ante baseline net GHG removals by sinks (Table C.7.2).

The net GHG removals, which include carbon in above and belowground biomass, is estimated for the three land categories (degraded forest, community and private land) under the baseline scenario using plot method, involving harvest method for non-tree vegetation. The plot method is described in the Annex. The aboveground tree biomass of trees is determined by measuring DBH and height of trees and estimation of volume using species-specific biomass equations for the dominant tree species. Belowground biomass is estimated using the IPCC default conversion factor of 0.26 (GPG, 2003) fraction of above-ground biomass. The average biomass (AGB+BGB) on different land categories selected for the A/R CDM project, based on field studies is given in Table C.7.1. The non-tree biomass was estimated by adopting harvest method (Refer to Table C.7.1).

Table C.7.1: Average carbon stock per hectare in different land categories (includes above- and belowground biomass) in tC/ha under baseline conditions

Land category	Total tree biomass carbon (tC/ha)	Total non-tree biomass carbon (tC/ha)	Total biomass carbon (tC/ha)
Degraded forestland	1.68	1.42	3.10
Degraded community land	0.97	1.65	2.62
Degraded and abandoned private land	1.14	1.96	3.10
Mean	1.26	1.68	2.94

The ex ante baseline net GHG removal by sinks accounting for above and belowground biomass over a 20-year period is 14239 tCO_2-e (Table C.7.2).

Table C.7.2: Ex-ante baseline net GHG removals by sinks

Year	Below the ground Baseline net GHG removals by sinks (t CO_2 yr-1)	Above the ground baseline net GHG removals by sinks (t CO_2 yr-1)	Baseline net GHG removals by sinks (t CO_2 yr-1)	Cumulative baseline net GHG removals by sinks (t CO_2)
2006	6	22	27	27
2007	24	92	116	143
2008	68	260	328	471
2009	209	803	1011	1483
2010	297	1142	1439	2921

2011	279	1072	1351	4272
2012	147	565	712	4984
2013	147	565	712	5696
2014	147	565	712	6407
2015	147	565	712	7119
2016	147	565	712	7831
2017	147	565	712	8543
2018	147	565	712	9255
2019	147	565	712	9967
2020	147	565	712	10679
2021	147	565	712	11391
2022	147	565	712	12103
2023	147	565	712	12815
2024	147	565	712	13527
2025	147	565	712	14239
Total	2938	11301	14239	

The annual change in carbon stocks were calculated based on stock change method given by the approved methodology.

Year	**Annual estimation of baseline net anthropogenic GHG removals by sinks in tonnes of CO_2 e**
2006	27
2007	116
2008	328
2009	1011
2010	1439
2011	1351
2012	712
2013	712
2014	712
2015	712
2016	712
2017	712
2018	712
2019	712
2020	712
2021	712
2022	712
2023	712
2024	712
2025	712
Total estimated baseline net GHG removals by sinks (tonnes of CO_2 e)	**14239**

Total number of crediting years	**20**
Annual average over the crediting period of estimated baseline net GHG removals by sinks (tonnes of CO_2 e)	**712**

C.8. Date of completion of the baseline study and the name of person(s)/entity(ies) determining the baseline:

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The detailed baseline information is attached in Annex 3.
Date of completion of Baseline study: December 2007
Name of persons/entity determining the baseline:

- **Indian Institute of Science, Bangalore, India**

  Prof N H Ravindranath, ravi@ces.iisc.ernet.in

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- **MHWDP team**
- **World Bank Team**

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

D.1. Estimate of the *ex ante* actual net GHG removals by sinks:

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The *ex ante* net GHG removals by sinks is calculated for a crediting period of 20 years using the approach provided in the methodology AR-ACM0001 annually for different carbon pools and expressed as tonnes of CO_2-equivalent. The GHG emissions from fossil fuel burning during use of machinery for land preparation and other activities, and biomass burning during site preparation are estimated and deducted from the sum of the changes in carbon stocks of all the pools to obtain the actual net GHG removals by sinks. The procedure adopted for estimating the *ex ante* actual net GHG removals by sinks is given below:

Actual net greenhouse gas removals by sinks (C_{ACTUAL}): This is estimated by calculating the sum of changes in living biomass carbon stocks and soil carbon and deducting the sum of emissions by sources within the project boundary, as a result of project activities using the following formula (Equation 12 of AR-ACM0001):

$$C_{ACTUAL} = \Delta C_P - GHG_E$$

where:
C_{ACTUAL} = actual net greenhouse gas removals by sinks; t CO_2-e.
ΔC_P = sum of the changes in above-ground and below-ground biomass, dead wood, litter and soil organic carbon stocks in the project scenario; t CO_2-e

GHG_E = sum of the increases in GHG emissions by sources within the project boundary as a result of the implementation of an AR CDM project activity; t CO_2-e.

Step 1: Sum of the changes in above-ground and below-ground biomass and soil organic carbon stocks in the project scenario; t CO_2-e - ΔC_P

The verifiable changes in the carbon stock in above-ground biomass and below-ground biomass, and soil organic carbon within the project boundary are estimated using the following approach[18]:

$$\Delta C = \sum_{t=1}^{t*} \Delta C_t * \frac{44}{12} - E_{BiomassLoss}$$

Where:

ΔC_P: Sum of the changes in above-ground and below-ground biomass and soil organic carbon stocks in the project scenario; t CO_2-e

ΔC_t: Annual change in carbon stock in all selected carbon pools for year *t*; t C yr^{-1}

$E_{BiomassLoss}$: Increase in CO_2 emissions from loss of existing 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

*T: 1, 2, 3, .t** years elapsed since the start of the AR project activity; yr

44/12: Ratio of molecular weights of CO_2 and carbon; t CO_2 t^{-1} C

$E_{BiomassLoss}$ is estimated using the most recent version of the approved methodological tool: "Estimation of emissions from clearing, burning and decay of existing vegetation due to implementation of a CDM A/R project activity.

ΔC_t shall be estimated using the following equation:

$$\Delta C_t = \sum_{i=1}^{M_{PS}} (\Delta C_{AG,i,t} + \Delta C_{BG,i,t} + \Delta C_{DW,i,t} + \Delta C_{LI,i,t} + \Delta C_{SOC,i,t})$$

$\Delta C_{LI,i,t}$	Annual change in the litter carbon pool in stratum *i*, (possibly averaged over a monitoring period); t C yr^{-1}
$\Delta C_{SOC,i,t}$	Annual carbon stock change in the soil organic carbon pool[5] 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 carbon pools that are conservatively excluded from accounting shall be set equal to zero.

Carbon pools included: Estimates of actual net GHG removals by sinks include carbon stock changes in living biomass (above and belowground biomass) and soil organic carbon. The carbon stock changes in pools of dead wood and litter are excluded. The rationale for selecting these three pools and for excluding dead wood and litter is given in Section C.3.

[18] IPCC GPG-LULUCF 2003, equation 3.2.3

The change in living biomass and soil organic carbon that would be achieved by the proposed A/R CDM activity was estimated for the three reforestation models using the following approach.

- Area under each stand model was estimated
- Density of the trees to be planted according to species was obtained
- The dominant species in each of the stand model identified
- Mean annual aboveground biomass growth rates for each of the dominant species was obtained from published literature for the region
- Per hectare mean annual increment for aboveground biomass was estimated separately for each stand model
- Belowground biomass was calculated using the mean annual increment for aboveground biomass and the IPCC default factor of 0.26
- Soil organic carbon increment rates were estimated based on field sampling and laboratory analysis Decrease in carbon stocks resulting from loss of non-tree vegetation biomass stocks in the year of site preparation is not estimated since the land preparation practices in the A/R programmes of Himachal Pradesh involve insignificant slash and burn.
- The changes in living biomass carbon stocks and soil organic carbon of the three different land categories being planted with the three different models was computed independently and summed to obtain the total annual carbon stock change for the total project area.

Planting will be done in a phased manner over five years. Harvesting is not considered for the crediting period and for any of the tree species as the dominant species included in the three reforestation models are long rotation timber or NTFP yielding species, with long gestation periods of more than 20 years, which is the crediting period. No harvesting is envisaged during the crediting period.

Step 2: Sum of the increases in GHG emissions by sources within the project boundary as a result of the implementation of the A/R CDM project activity - GHG_E

$$GHG_E = \sum_{t=1}^{t^*} (ET_{FC,t} + E_{BiomassBurn,t})$$

where:

GHG_E	Increase in GHG emissions as a result of the implementation of the proposed A/R CDM project activity within the project boundary; t CO_2-e
$ET_{FC,t}$	CO_2 emissions from fossil fuel combustion during the year *t*; t CO_2-e
$E_{BiomassBurn,t}$	Non-CO_2 emissions due to biomass burning of existing vegetation as part of site preparation during the year *t*; t CO_2-e
t	*1, 2, 3, ... t^** years elapsed since the start of the A/R CDM project activity

The GHG emission sources considered according to Equation 33 of AR-ACM0001 methodology include the following:

- GHG emissions resulting from burning of fossil fuels within the project boundary from site preparation
  - The silvicultural practice related to site preparation in Himachal Pradesh involves use of only human labour. Therefore, there are no GHG emissions related to site preparation from use of fossil fuels in machinery.

- GHG emissions resulting from biomass burning within the project boundary during site preparation
    - The silvicultural practices adopted for A/R in Himachal Pradesh do not involve slash and burn practices during land preparation. However, in the proposed project, above ground non-tree vegetation would be cleared at about 0.158 m^2/plant, which accounts for about 1.7% of land area per hectare. Further, lantana the dominant shrub species is present in an area of about 20%. Thus, the total area with lantana cover that will be disturbed will account for only 0.035% of the area per hectare.
    - Thus, GHG emissions resulting from biomass burning is considered to be zero.
- Therefore GHG_E = Zero

Step 3: Estimation of actual net greenhouse gas removals by sinks – C_{ACTUAL}

The total actual net GHG removals by sinks calculated for the total project area over a 20-year crediting period is 5,058,103 tCO_2-e. This is about 505 tCO_2-e sequestered per hectare of land.

Actual net greenhouse gas removals by sinks (C_{ACTUAL}): This is estimated by calculating the sum of changes in living biomass carbon stocks and deducting the sum of emissions by sources within the project boundary, as a result of project activities. The actual net GHG removal by sinks is 5,058,103 tCO_2-e.

D.2. Estimate of the *ex ante* leakage:

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Leakage is the increase in GHG emissions by sources which occurs outside the boundary of an A/R CDM project activity which is measurable and attributable to the A/R CDM project activity. The two sources of leakage covered by AR-ACM0001 methodology include:

- Carbon stock decreases caused by displacement of pre-project agricultural crops, grazing and fuel-wood collection activities
- Carbon stock decreases caused by the increased use of wood posts for fencing.

$$LK = LK_{ActivityDisplacement} + LK_{Fencing}$$

i) Estimation of leakage due to activity displacement: The potential activity displacements include:

- Conversion of land for cropping
- Conversion of land for grazing
- Shifting of fuelwood collection activities

a) Conversion of land for cropping: In the proposed A/R CDM project, no conversion of the three land categories to cropland is considered and thus, no emissions are estimated due to the following, $LK_{cropping}$ = Zero.

- In Himachal Pradesh, according to the Forest Act, conversion of degraded forest and community land is banned
- PRA conducted in the sample GPs showed that there has been no conversion of degraded forest and community land (Table C.5.3). Further, no conversion is projected in the future
- The change in the area of cropland in Himachal Pradesh has been marginal in the past decades, indicating no new land conversion (Refer to Table C.5.2)
- The area under forest has remained stable or marginally increased in the recent past, indicating absence of any forest land conversion

- The degraded private lands under the control of the farmers fall in the category of cropland and these lands have been left fallow or abandoned for long periods (Table C.5.3). Thus, conversion of these lands categories to cropland is unlikely as indicated during household survey.

b) Conversion of land for grazing: Leakage due to conversion of land for grazing is set as zero ($LK_{grazing}= 0$) due to the following reasons based on the AR-ACM0001 methodology:

In the state of Himachal Pradesh and in the project area, grazing, fodder collection and stall feeding of livestock are practiced. The approach adopted for estimating leakage is as follows:

- The total livestock population belonging to different livestock groups was obtained through PRA in the sample GPs
- The number and percentage of different livestock groups grazing in different land categories selected for the project was obtained through PRA
- Leakage due to the displacement of animal grazing is set as zero due to the following reasons:
    - According to Table C.5.3, the grass productivity under the baseline conditions, in the control plot without fencing and protection is 2-3 dry t/ha in the three land categories
    - Grass productivity after fencing and protection under A/R activity is projected to increase by almost 100% according to a monitoring and evaluation report of the Integrated Watershed Development Project (Hills)-II in Himachal Pradesh (Refer to Table D.1.2)

Table D.1.2: Change in grass or fodder availability with implementation of A/R project (based on field studies)

Grass availability	Total quantity in tonnes
Baseline (in the absence of project)	1,10,000
Post A/R project implementation	2,18,000
Percent increase as a result of A/R project	***98.18%***

    - Under the proposed A/R CDM project, total grass available from the project area will be higher than under the baseline conditions (nearly double)
    - According to the AR-ACM0001 methodology, if the planned AR-CDM project activity produces more grass or fodder than the baseline activity, leakage due to conversion of land for grazing need not be accounted.

Table D.1.3: Livestock population trends in Himachal Pradesh

Livestock type	Livestock census			
	1987	**1992**	**1997**	**2003**
Cattle (Cows & Bulls)	2244815	2165034	2001826	2196538
Buffaloes	794991	703549	652373	773229
Sheep	1112768	1078940	908831	906027
Goats	1120139	1118094	946529	1115587
Total	**5272713**	**5065617**	**4509559**	**4991381**

- The degraded forestlands are located at the higher elevation,. Field measurements of grass productivity in the degraded forestland show that it is low at 2 dry t/ha/year (Refer to Table C.5.3). The degraded forestlands which are at a higher elevation and away from the settlement are not subjected to grazing compared to

cropland and community land. Finally, the degraded forestland account for 49% of the total project area.

- According to the household survey, there is a shift from rearing traditional breeds of milch animals to high-yielding cross-bred cows. Cross-bred cows are normally stall-fed. It was shown above that grass productivity increased, potentially leading to increased grass and fodder availability for harvest and stall-feeding.
- Further, the population of sheep and goats have declined in Himachal Pradesh, which indicates reduced grazing pressure (Table D.1.3)
- Grass harvesting and stall feeding practice is on the increase in the state, which further shows that there will be no shift of grazing pressure since more grass will be available post-project implementation, which may ultimately lead to reduction in the practice of grazing
- The Watershed Project has initiated activities to enhance fodder supply and improve the breed of cattle.

c) Displacement of fuelwood collection: Leakage due to displacement of fuelwood collection is set as zero ($LK_{fuelwood} = 0$) due to the following reasons based on the AR-ACM0001 methodology:

- The average pre-project annual volume of fuelwood gathering was estimated based on household survey
- Fuelwood is collected from all the three land categories considered for the A/R CDM project
- According to the household survey, 50% of households use LPG and about 1% of households use kerosene and further shift to improved fuels away from fuelwood is projected
- According to the A/R CDM project strategy, the households will be permitted to gather fuelwood from the area brought under A/R CDM project activities from the existing shrubs and trees. Further, the fallen twigs and branches from the trees planted under the A/R CDM project will also be available to the households as fuelwood
- Thus, the total quantity of fuelwood available from the project area is estimated to be higher than under the baseline or pre-project situation.

ii) Leakage due to increased use of wood poles for fencing: The plantation sites will be fenced using wood and bamboo poles. Of the total project area of 10,000 ha, 50% of the area that requires fencing will be fenced using wood posts (50% of area) and the remaining will be fenced with bamboo. Fencing is normally carried out one year prior to planting.

Wood poles; Wood poles will be used to fence about 50% of the total project area. The main source of wood poles is plantations raised in nearby GPs and obtained during pollarding of lops and tops. Since the source of wood poles is lops and tops, which regrow, it can be considered as sustainable not leading to any emissions or leakage. However, the leakage from use of wood poles is estimated using the following procedure:

- The number of poles required for the area to be fenced using wood poles during different years was estimated using the standard norm of 60 poles per ha, used by the State Forest Department
- The average size of the pole is a 0.3 m height and a diameter of 0.15 m with a total volume of 0.11 m^3 and a wood density of 0.6 is used for converting to biomass
- Even though most of the poles are obtained from lops and tops of existing plantations, 100% is considered for estimation of leakage
- Since lops and tops come largely from branches, biomass expansion factor is not necessary
- Carbon fraction of dry matter is taken as 0.5 (IPCC default value)

- Total leakage due to use of wood posts for fencing was calculated using the equation given in the AR-ACM0001 methodology (Equation 39).

Bamboo poles: Leakage due to use of bamboo poles as fence material is not considered since bamboo is extracted in a sustainable manner from nearby forests and plantations. Bamboo fencing will be encouraged and will be adopted wherever possible, in about 50% of the area to be fenced.

The total estimated leakage due to use of wood posts for fencing is 35,574 tCO_2-e, accounting for 0.7% of the actual net GHG removals by sinks. According to the guidance provided by EB22 (Annex 5) decision, the GHG emissions resulting from leakage due to increased use of wood posts for fencing can be excluded from the calculation of leakage if it is <5%[19] of actual net GHG removals by sinks.

Total leakage estimation and consideration in estimating net GHG removals by sinks

The leakage from the following sources is estimated and reported in Table D.1.4. According to the calculations, the total leakage from all the sources is 57,237.92 tCO_2-e.

i) Estimation of leakage due to activity displacement	-
a) Conversion of land for cropping	- Nil
b) Conversion of land for grazing	- 19997.00 tCO_2-e
c) Displacement of fuelwood collection	- 1219.95 tCO_2-e
ii) Leakage due to increased use of wood poles for fencing	*- 35574.00 tCO_2-e*
Total leakage from all the sources	**= 57237.92 t CO_2-e**

The actual net GHG removals by sinks is 5,058,103 tCO_2-e. Leakage estimated from all the sources listed above is 57,237.92 tCO_2-e. This is 1.1% of the actual net GHG removals by sinks. According to the AR-ACM-0001 methodology, the GHG emissions from leakage can be excluded if it is <5% of actual net GHG removals by sinks[20]. Therefore, GHG emissions from leakage are excluded from estimation of actual net GHG removals by sinks.

Table D.1.4: Estimates of leakage (tCO_2-e)

Year	Shifting of activity			Fencing poles	Total	Estimated Cumulative GHG Emissions t CO2-e
	Fuelwood	Grazing	Crops			
2006	406.65	6665.67		11858.00	18930.32	18930.32
2007	406.65	6665.67		11858.00	18930.32	37860.64
2008	406.65	6665.67		11858.00	18930.32	56790.96
2009						56790.96
2010						56790.96
2011						56790.96
2012						56790.96

[19]http://cdm.unfccc.int/EB/031/eb31_repan16.pdf

[20] http://cdm.unfccc.int/EB/031/eb31_repan16.pdf

2013						56790.96
2014						56790.96
2015						56790.96
2016						56790.96
2017						56790.96
2018						56790.96
2019						56790.96
2020						56790.96
2021						56790.96
2022						56790.96
2023						56790.96
2024						56790.96
2025						56790.96
Total	**1219.95**	**19997.01**	**0.00**	**35574.00**	**56790.95**	

SECTION E. Monitoring plan

E.1. Monitoring of the project implementation:

>>

E.1.1. Monitoring of forest establishment and management:

>>

Planting will be phased over five years, starting in 2006. Monitoring of forest establishment and management is done to ensure that the planting quality conforms to the technology and practices described in A/R CDM PDD. Monitoring will be conducted during the initial three years and activities include:

1.1.1 Site preparation practices: This is monitored to ensure that the practice prescribed in the PDD is what is being implemented and involves minimal disturbance to soil and does not involve slash and burn of pre existing vegetation as mentioned in the PDD

1.1.2 Species planted: A check of species planted in the different strata is conducted to ensure the species planting on different strata is in conformity with what is outlined in the PDD

1.1.3 Survival of seedlings: The survival rate of seedlings is accounted for and annual monitoring of survival of seedlings is conducted by the monitoring team and seedlings replanted if the survival rates are very low (less than 90% of planted).

1.1.4 Weeding: The weeding practice, if any will be checked so as to ensure its conformity with the practice described in the PDD.

ID number[21]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[22]	Recording frequency	Number of data points / Other measure of number of collected data.	Comment
1.1.1	Site preparation practices	-		Once	Qualitative visual assessment	
1.1.2	Species planted	-	M	Annual	Number of trees planted per species in a stratum	
1.1.3	Survival of seedlings	-	M	Annual	%	
1.1.4	Weeding	-		Annual	Qualitative visual assessment	

E.1.2. If required by the selected approved methodology, describe or provide reference to, SOPs and quality control/quality assurance (QA/QC) procedures applied.

>>

[21] Please provide ID number for cross-referencing in the PDD.

[22] Please provide full reference to data source.

Standard Operating Procedures (SOPs) will be developed for all field related activities. These SOPs would be adhered to at all times and all activities will be documented in detail for verification purposes as well as comparison of estimates over time. To ensure the collection of reliable field data; the following would be done:

- Training of field-team members so they are aware of all procedures and the importance of collecting data as accurately as possible
- Installation of test plots in the field to measure all pertinent components using the SOPs
- Checking of field measurements by a qualified person so as to correct any errors in techniques
- Documentation of all activities with a list of all members involved in field related activities and certification by the project leader that the team is trained
- Training of new staff recruited.

ID number[23]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[24]	Recording frequency	Number of data points / Other measure of number of collected data.	Comment

E.2. Sampling design and stratification

>>

The methodology procedures for monitoring strata and defining the sampling framework are outlined below for living biomass and soil carbon.

a) Stratification and sampling for ex-post calculations

i. Living biomass

To increase the accuracy and precision of measuring and monitoring in a cost-effective manner, stratification of the project area into relatively homogeneous units is done as follows. This is in accordance of the chosen methodology AR-ACM0001.

Step 1*:* Assessing the key factors influencing carbon stocks in the above and belowground biomass carbon pools, the project area has been stratified. This will increase the accuracy of measuring and monitoring in a cost-effective manner.

Step 2*:* Local information of key factors identified in Step 1 has been collected, e.g.:

- altitude, slope, soil depth and pre-existing vegetation conditions

[23] Please provide ID number for cross-referencing in the PDD.

[24] Please provide full reference to data source.

Data sources such as archives, records, statistics, study reports and publications of national, regional or local governments, institutes and/or agencies, and literature has been collected.

Step 3: ***Stratification according to pre-existing conditions:*** Survey of the records of the project area as well as field visits and observations revealed the following factors as critical and influencing the AGB and BGB carbon pools.

Current land use, tenure and the location of the land categories included in the project will characterize carbon stocks due to human pressure. Thus, the above three land categories - the baseline strata - form the basis for stratification under pre-existing conditions.

Step 4: ***Stratification according to planned A/R CDM project activity:*** It is proposed to adopt the following stand models suitable to the three broad land categories and altitudinal sub-strata for each land category (Refer to Section A.5.3). The three altitude based sub-strata are as follows:

- High – 1400 to 1800 m
- Medium – 1100-1400 m
- Low – 600-1100 m

Step 5: ***Final ex-ante stratification:*** The stratification adopted for the pre-existing vegetation under the baseline conditions is geographically delineated according to the three broad land categories as described earlier. The three reforestation models were further stratified based on the altitude of the parcels selected for reforestation. The following three stage final *ex-ante* stratification is adopted based on a combination of pre-existing conditions, reforestation model and altitudinal sub-strata (Figure C.4.1).

The final *ex-ante* A/R stratification consists of three altitudinal reforestation models under each of the reforestation models

- ***Restoration forestry***; high, medium and low strata
- ***Community forestry***; high, medium and low strata
- ***Farm forestry***; high, medium and low strata

ii. Soil carbon

Stratification: Soil carbon accumulation is likely to be determined by above and belowground biomass accumulation and litter fall. However, given the low rates of accumulation of soil carbon and low standard deviation, the stratification adopted for monitoring soil carbon stock changes will be restricted to the three broad land categories and the accompanying reforestation models. Further, the stratification is limited to the three categories due to the likely high cost involved in monitoring the small changes in soil carbon stocks. Thus stratification for soil carbon monitoring is as follows:

- Restoration forestry
- Community forestry
- Farm forestry

b) Sampling

- **Living biomass**

Permanent sample plots will be used for sampling over time to measure and monitor changes in carbon stocks of above- and below ground biomass. Permanent sample plots are statistically efficient and address the covariance between observations at successive sampling events. Plots will be treated in the same way as other land within the project boundary, e.g., during site and soil preparation, weeding, fertilization, irrigation, thinning, etc., therefore, differential treatment of sample plots and other land parcels will not be used. The staff involved in management activities will not be informed of the location of monitoring plots.

(i) Determining sample size

The number of plots depends on species variation, accuracy and monitoring interval. In this methodology the total sum of samples (n) will be estimated as per a criterion of Neyman of fixed levels of accuracy and costs, according to Wenger (1984) and given in the approved methodology.

$$n = \left(\frac{t}{E}\right)^2 \left(\sum_{h=1}^{L} W_h S_h \sqrt{C_h}\right)\left(\sum_{h=1}^{L} W_h S_h / \sqrt{C_h}\right)$$

$$n_h = n.\frac{W_h.S_h / \sqrt{C_h}}{\sum_{h=1}^{L} W_h S_h / \sqrt{C_h}}$$

Where:

L total number of strata

t t value for a confidence level (95%)

E allowable error (±10% of the mean)

s_h standard deviation of stratum h

n_h. number of samples per stratum that is allocated proportional to $W_h.S_h / \sqrt{C_h}$

W_h N_h/N

N number of total sample units (all stratum), $N = \sum N_h$

N_h number of sample units for stratum h, calculated by dividing the area of stratum h by area of each plot

C_h cost to select a plot of the stratum h

The allowable error on per-plot basis (±10%) of the expected mean biomass carbon stock per plot in living trees at the end of a rotation, which will be estimated as part of the ex-ante estimation of the actual net GHG removals by sinks described in the baseline methodology. It is possible to reasonably modify the sample size after the first monitoring event based on the actual variation of the carbon stock changes determined from taking the n samples.

The total number of sample plots to be selected for monitoring for each strata is given in Table E.2.1. This was estimated using the formula given above. The total number of sample plots to be selected for monitoring is 224.

Table E.2.1. Number of sample plots for each stratum for monitoring

Land category	Reforestation	Altitudinal	Area	Standard	Number of

	model	strata	(ha)	deviation	sample points
Degraded forestland	Reforestation	High	3436	5.16	126
		Medium	1878	1.26	17
		Low	1781	3.54	45
Degraded community land	Community forestry	High	277	5.16	10
		Medium	378	2.24	6
		Low	120	2.47	2
Degraded and abandoned private land	Farm forestry	High	1238	0.23	2
		Medium	673	2.80	13
		Low	219	1.56	3

(ii) Randomly locating sampling plots

To avoid subjective choice of plot locations, plot reference points, the permanent sample plots will be located systematically with a random start, which is considered good practice in GPG-LULUCF. This will be accomplished with the help of a GPS in the field. The geographical position (GPS coordinates), administrative location, stratum and sub-stratum series number of each plots will be recorded and archived. It will be ensured that the sampling plots are distributed evenly over the project strata.

The aboveground biomass and soil carbon sampling require separate monitoring frameworks. The permanent sample plots will be used for aboveground biomass monitoring. Each plot will have its coordinates recorded using a GPS. The plot corners of rectangular plots will be located and the GPS coordinates noted. Plot markers will not be prominently displayed to ensure that permanent plots do not receive differential treatment from forestry personnel.

(iii) Size of the plots
The size of plots will depend on the density of trees and variation in the vegetation. Since the species mix and density are nearly uniform for reforestation and community forestry models, accounting for 79% of the total area, the sample plot size to be adopted is 25x20 m.

(iv) Monitoring frequency
The monitoring frequency is determined based on the IPCC Good Practice Guidance (GPG, 2003) and it varies for different pools.

- Aboveground biomass; Once in 5 years
- Soil organic carbon; Once in 5 years

The first monitoring will be conducted during 2010 for the area planted during 2006-07, which is the fifth year after first planting.

- **Soil carbon**

Temporary sample plots will be used for monitoring changes in the soil carbon. It is not necessary that the same plots be revisited over time as soil carbon monitoring will focus on comparing the mean stocks of two *independent*, temporally-separated plots, temporary plots can be used. Thus, location of soil carbon plots will not be permanently marked.

During the sample plot establishment the field crew will follow a protocol in which all steps are recorded beginning with the starting point and surveying sample plots, recording azimuth, horizontal distance and polygonal layouts and fixed points in the surrounding are recorded.

(i) Determining sample size

The number of sampling points depends on variation in vegetation, accuracy and monitoring interval. The number of sampling points for monitoring soil carbon stock changes will be determined by using the methods and equations described for living biomass.

The allowable error on per-plot basis is ±10% of the expected mean soil carbon stock. The total number of sample plots to be selected for monitoring for each strata is given in Table E.2.2. The total number of sample plots to be selected for monitoring is 52.

Table E.2.2. Number of soil sampling points for each stratum for monitoring

Land category	Reforestation model	Area (ha)	Standard deviation	Number of sample points
Degraded forestland	Reforestation	7095	8.51	36
Degraded community land	Community forestry	775	12.05	6
Degraded and abandoned private land	Farm forestry	2130	8.41	11

(ii) Randomly locating sampling points

To avoid subjective choice of locating soil sampling points as well as to avoid the cost of establishing permanent plots and points and periodically locating them, temporary sampling point approach will be adopted. The sampling points will be randomly located using the grid approach. The grids will be randomly selected and the centre point of the sample grid will be sampled for soil carbon.

(iii) Depth of soil sampling

Soil samples will be collected from two depths namely 0-15 cm and 15-30 cm.

(iv) Monitoring frequency

The rate of accumulation of soil carbon is low at around 1.2 tonnes of C/ha/year, compared to over 5 tonnes of C/ha/year in living biomass. Thus, it is proposed to monitor soil carbon stock change once in 5 years to coincide with vegetation biomass measurement and verification.

E.3. Monitoring of the baseline net GHG removals by sinks, if required by the selected approved methodology:

>>

The baseline carbon stock changes need not be monitored on implementation of the project, because the accepted baseline approach 22(a) assumes continuation of existing changes in carbon pools within the project boundary from the time of validation. Further, as per the AR-ACM0001/Version 02 methodology, monitoring of baseline net GHG removals by sinks is not required.

E.4. Monitoring of the actual net GHG removals by sinks:

>>

The actual net greenhouse gas removals by sinks represent the sum of the verifiable changes in carbon stocks in the carbon pools within the project boundary, minus the increase in GHG emissions measured in CO_2 equivalents by the sources as a result of the implementation of an AR CDM project activity. The calculations will be performed as per the periodicity outlined in the monitoring plan.

E.4.1. Data to be collected in order to monitor the verifiable changes in carbon stock in the carbon pools within the project boundary resulting from the proposed A/R CDM project activity:

>>

ID number[25]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[26]	Recording frequency	Number of sample plots at which the data will be monitored	Comment
4.1.1.01	Stratum ID	Alpha numeric		Before the start of the project	100%	Based on land capability class as each stratum has a particular combination of soil type and landform
4.1.1.02	Sub- stratum ID	Alpha numeric		Before the start of the project	100%	Each sub-stratum will be a particular year to be planted under each stratum
4.1.1.03	Confidence level	%		Before the start of the project	100%	For the purpose of QA/QC and measuring and monitoring precision control
4.1.1.04	Precision level	%		Before the start of the project	100%	For the purpose of QA/QC and measuring and monitoring precision control
4.1.1.05	Sample plot ID	Alpha numeric		Before the start of the project	100%	Numeric series ID will be assigned to each permanent sample plot
4.1.1.06	Plot location		m	5 years	100%	Using GPS to

[25] Please provide ID number for cross-referencing in the PDD.

[26] Please provide full reference to data source.

						locate before start of the project and at time of each field measurement
4.1.1.07	Tree species			5 years	100%	As in PDD
4.1.1.08	Age of plantation	Year	m	5 years	100 % sample plot	Counted since the planted year
4.1.1.09	Number of trees	Number	m	Yearly & 5 years	100 %	- All trees based on PRA by cluster leader with the farmers - Counted in plot measurement at 5 years interval
4.1.1.10	Diameter at breast height (DBH)	cm	m	5 years	100 % trees in plot	Measuring at each monitoring time per sampling method
4.1.1.11	Mean DBH	cm	c	5 years	100 % sample plot	Calculated via 4.1.1.09 and 4.1.1.10
4.1.1.12	Tree height	m	m	5 years	100 % trees in plot	Measuring at each monitoring time per sampling method
4.1.1.13	Mean tree height	m	c	5 years	100 % sample plot	Calculated via 4.1.1.09 and 4.1.1.12
4.1.1.14	Allometric equations	M^3 hectare^{-1}	c/m	5 years	100 % sample plot	Calculated using equations (11)-(12) via 4.1.1.11 and 4.1.1.12
4.1.1.15	Wood density	t d.m.m^{-3}	e	5 years	100 % sample plot	Species specific
4.1.1.16	Biomass expansion factor (BEF)	dimensionless	e	5 years	100 % sample plot	Species specific
4.1.1.17	Carbon fraction	t C. (t.d.m)$^{-1}$	e	5 years	100 % sample plot	IPCC default value
4.1.1.18	Root- shoot ratio	dimensionless	e	5 years	100 % sample plot	Based on IPCC equation for tropical forests
4.1.1.19	Carbon stock in above ground biomass of	t C hectare^{-1}	c	5 years	100 % sample plot	Calculated using equation (14) via 4.1.1.14 and

	plots					4.1.1.17
4.1.1.20	Carbon stock in below ground biomass of plots	t C hectare^{-1}	c	5 years	100 % sample plot	Calculated using equation (15) via 4.1.1.18 and 4.1.1.19
4.1.1.21	Mean carbon stock in above ground biomass per unit area per stratum per species	t C hectare^{-1}	c	5 years	100 % strata and sub-strata	Calculated from 4.1.1.09 and 4.1.1.19
4.1.1.22	Mean carbon stock in below ground biomass per unit area per stratum per species	t C hectare^{-1}	c	5 years	100 % strata and sub-strata	Calculated from 4.1.1.09 and 4.1.1.20
4.1.1.23	Area of stratum and sum-stratum	hectare	m	5 years	100 % strata and sub-strata	Actual area of each stratum and sub-stratum
4.1.1.24	Carbon stock in above ground biomass of stratum per species	t C	c	5 years	100 % sample plot	Calculated using equation (8) via 4.1.1.21and 4.1.1.23
4.1.1.25	Carbon stock in below ground biomass of stratum per species	t C	c	5 years	100 % sample plot	Calculated using equation (9) via 4.1.1.22and 4.1.1.23
4.1.1.26	Carbon stock in above ground biomass of stratum per species	t C yr^{-1}	c	5 years	100 % strata and sub-strata	Calculated using equation (6) via 4.1.1.24
4.1.1.27	Carbon stock in above below biomass of stratum per species	t C yr^{-1}	c	5 years	100 % strata and sub-strata	Calculated using equation (7) via 4.1.1.25
4.1.1.30	Total carbon stock change	t CO_2-e yr^{-1}	c	5 years	100 % project area	Summing up carbon stock change 4.1.1.26 and 4.1.1.27 for all strata , sub-strata and tree

						species

E.4.2. Data to be collected in order to monitor the GHG emissions by the sources, measured in units of CO_2 equivalent, that are increased as a result of the implementation of the proposed A/R CDM project activity within the project boundary:

>>

E.5. Leakage:

>> Under the applied methodology AR-ACM0001, leakage will not be monitored for any of the activities

E.5.1. If applicable, please describe the data and information that will be collected in order to monitor leakage of the proposed A/R CDM project activity:

>>

E.5.2. Specify the procedures for the periodic review of implementation of activities and measures to minimize leakage, if required by the selected approved methodology:

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E.6. Provide any additional quality control (QC) and quality assurance (QA) procedures undertaken for data monitored not included in section E.1.3:

>>

The QA/QC procedures for the critical data or parameters, along with uncertainty estimate are presented in the following tables.

Data (Indicate ID number)	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Plantation parcel location	Low	Random plot verification using GPS to ensure consistent recording of the latitude and longitude values
Area planted	Low	GP-wise random verification of area planted using remote sensing data
Species planted	Low	Random verification over the project area to ensure each tree species is correctly identified and measured
Tree density	Low	Random plot verification
Girth (GBH) or Diameter at breast height (DBH)	Low	Random plot verification
Height of tree	Low	Random plot verification using multiple methods
Wood density	Low	Data that divert significantly from IPCC default value will be verified through laboratory measurements
Biomass of the tree	Low	Random verification of allometric equations and volume estimation using height, diameter and tree form
Merchantable volume	Low	Allometric equations used to calculate this data will be verified and direct volume will be estimated using DBH, height and tree form data
Biomass Expansion Factor (BEF)	Low	IPCC default value will be verified with national biomass expansion factor, where available
Carbon fraction	Low	Data that divert significantly from IPCC default value will be verified

Root-shoot ratio	Low	Root: Shoot value obtained from national sources verified with IPCC defaults

E.7. Please describe the operational and management structure(s) that the project operator will implement in order to monitor actual GHG removals by sinks and any leakage generated by the proposed A/R CDM project activity:

>>

The project will be implemented and managed by the MHWDP till 2013, and subsequently the State Forest Department will manage the project. The MHWDP project directorate will coordinate all the monitoring activities. The institutional arrangements for monitoring of the GHG removals by sinks and leakage are presented in Figure E.7.1. The project directorate will prepare the monitoring plan and delegate responsibility to different institutions and coordinate the monitoring exercise. The key institutions that will be involved in monitoring are;

- Project authorities
- Research institutions and universities
- Gram panchayats

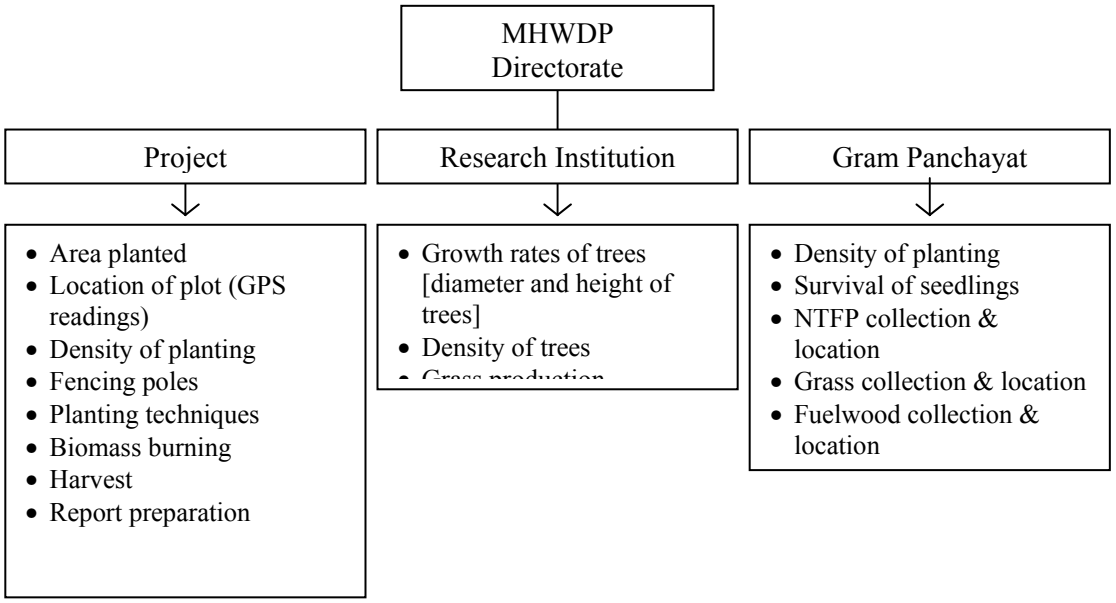

Figure E.7.1: Institutional framework for monitoring

E.8. Name of person(s)/entity(ies) applying the monitoring plan:

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1. MHWDP: Chief Project Director, Solan
2. Universities / Research Institutes: Department of Forests, Department of Horticulture, Solan Agricultural University, Solan
3. Gram Panchayats

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

F.1. Documentation on the analysis of the environmental impacts, including impacts on biodiversity and natural ecosystems, and impacts outside the project boundary of the proposed A/R CDM project activity:

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The project aims at protecting the watersheds, enhancing tree cover, conserving biodiversity and promoting livelihood in addition to enhancing carbon sinks in 10,000 ha of degraded sloping hilly areas of mid-Himalayan region. Some of the potential environmental benefits are presented in this section.

Overview of Environmental Analysis: The PDD outlines a detailed environmental analysis and mitigation measures. The PDD itself is an outcome of the detailed environmental analysis undertaken in 30 GPs (as the sample size - out of 602 project GPs). Necessary technical specifications including a detailed monitoring mechanism are mentioned in this PDD. It also describes an institutional accountability required during the implementation process.

The CDM Project is proposed as an additional component of the Mid-Himalayan Watershed Development Project (MHWDP). The focus of the projects is different and implemented on different lands – at the same time complement each other in all respects. The MHWDP focuses on soil and moisture conservation in arable agriculture land and in village common land through field bunding, terracing, check dams, gully plugging, development of grass-lands and providing support for high value agriculture production with forward and backward market linkage support. However, reforestation work did not become an integral part of MHWDP because villagers in MHWDP areas neither received any cash incentive for reforestation work nor timber rights. Whereas in CDM project, the focus is only on reforestation for which the farmers will receive cash incentive (by being a potential seller of carbon credit) on three types of lands; (i) non-arable agriculture wasteland referred to as abandoned farm land, (ii) degraded forestland, and iii) degraded common property land. In brief, MHWDP supports soil and moisture conservation work and grassland development, and the CDM project intends to support reforestation programme. The CDM project can be perceived as an environmental mitigation project for the ongoing land degradation and loss of forest problem in HP.

The project will follow the Environmental Social Guidelines (ESG) and Environmental Social Management Framework (ESMF) already developed as safeguard measures under the MHWDP.

1. Within the Project area:

Carbon revenue as an incentive for watershed protection

The watersheds, particularly the catchment areas of watersheds, in the hilly terrain of Himachal Pradesh are highly vulnerable to land degradation, soil erosion and excessive water runoff. The state has been implementing a number of watershed development programmes with adequate budgetary support. Watershed projects with activities such as soil and water conservation and re-vegetation measures provide long-term benefits to the farmers and the community. There is need for incentives to village communities and farmers to protect and regenerate watersheds.

The proposed A/R CDM project activity aims to provide financial incentives to farmers and communities in the form of CDM revenue from the sale of CERs to motivate them to protect and regenerate the

catchments of the watersheds (Table F.1.1). The potential revenue from the sale of CERs is given in Table F.1.1.

Table F.1.1: Revenue from sale of CERs

	CERs (tCO2-e)	CERs/year (tCO_2-e)	CER revenue (Rs./year) at US$ 4/tCO_2	CER revenue (Rs./year) at US$ 10/tCO_2
Total for the whole project area	5,058,103	252,905	40,464,827	101,162,068
Average per hectare	505.81	25.29	4,046	10,116

The financial incentive from the sale of CERs could provide a very critical incentive to the stakeholders to protect, regenerate and manage the watersheds. This is particularly important to the state, which is a catchment for major rivers of north India such as Ravi and Beas. This project demonstrates the role of forest carbon sinks to conserve, protect and to regenerate watersheds and highlights the synergy between global environmental benefits and local environmental benefits (e.g., watershed protection).

Biodiversity
The plant biodiversity index of the baseline scenario is low as shown below:

- Degraded forestland – 1.16
- Degraded community land – 1.22
- Degraded and abandoned private land – 1.11

A/R activity will involve planting of native tree species on degraded land largely from indigenous gene pool. About 1000 trees comprising 10 to 20 tree species will be planted per hectare. Therefore, A/R would have positive impacts on the vegetation and biodiversity. The biodiversity of flora and fauna will be promoted due to planting of native species, protection and promotion of natural regeneration. Apart from planting, largely indigenous tree species, 10,000 ha will be brought under protection from unregulated grazing, fire and fuelwood collection, leading to natural regeneration of large number of tree, shrub and herb species.

Suppression of invasive alien species
The unregulated grazing and fire have contributed to the spread of invasive species such as Lantana, Parthenium and Eupatorium (Table F.1.2). Protection and management (controlled grass harvesting practices) will suppress the germination and growth of invasive alien species. It is also proposed to eliminate invasive plants through weeding and other management practices.

Table F.1.2: Dominant invasive alien species found in the degraded lands of Himachal Pradesh

Invasive species	Tree/Herb/Shrub
Lantana camara	Shrub
Parthenium sp.	Shrub
Eupatorium odoratum	Shrub

Hydrology and watershed protection
The entire project is located in the Mid-Himalayan watershed area. The rate of soil erosion from these steep slopes is estimated to be 50 t/ha of soil annually. Thus, soil erosion will be reduced by 70-80 % with A/R activities. A number of streams and rivers originate in the area and feed major northern Indian rivers. These streams and springs are likely to increase their discharge rate with the intervention under the A/R

activities. While in short span of time it may not show these positive impacts, but in long run, A/R activities will help in source sustainability of these springs and streams.

A/R activity would enable protection and improvement of soil on these lands and facilitate rainwater percolation. Tree cover increases soil moisture. Hence, it would enhance the productivity of these lands along with recharging of ground water.

Biomass flow
Planting and protection will lead to growth and regeneration of multiple plant forms (trees, grass, shrubs, etc), leading to increase in biomass supply to the community. This will include supply of fuelwood, grass, medicinal plants, gum, seeds etc**.,** as a result of the A/R CDM project. For example, grass productivity under protection is likely to be nearly double (Table D.1.2).

NTFPs (Non-Timber Forest Products)
People collect resin from *Pinus roxburghii*, fruits from *Emblica officinalis*, seeds from *Terminalia chebula*, *Acacia catechu* etc. These trees are almost absent on land proposed for A/R CDM activities. Reforestation models developed for planting under the project include a combination of many species of trees that yield non-timber forest produce. Thus, A/R activity would increase the availability of NTFPs (Table F.1.3). In addition, local community could generate additional income by processing the NTFPs and marketing them. This would provide an opportunity for setting up of NTFP processing industry, creating employment and generating income through value addition at the local level.

Table F.1.3: Commercial and subsistence NTFPs from A/R CDM reforestation models

Reforestation model	Tree species	NTFPs for subsistence use	Commercial NTFPs for processing
Restoration model	Willow, Poplar, Ailanthus, Toon, Chuli, Robinia, Walnut, Aesculus, Ash, Maple, Deodar, Ban oak	Ritha, Dheoun, Mango, Jamun, Jack fruit	Amla, T. Arjuna, Neem, Behera
Community forestry model	Drek, Silver Oak, Willow, Poplar, Robinia, Ailanthus, Chil, Toon, Shehtoot, Grewia, Celtis, Dhauri, Walnut, Ban oak, Kakkar	Shehtoot, Walnut	Walnut
Farm forestry model	Bamboo, Siris, Ohi, Shehtoot, Pongamia, Neem, Khair, Kachnar, Shisham, Toon, Amla, Willow, Grewia, Celtis, Karial, Teak, Ritha, Kakkar, Jamun, Mango, Harar, Bahera, Pecanut, Aegle, Jack fruit, Arjun, Dheoun	Jack fruit, Ritha, Jamun, Behera	Juglans, Pecanut, Amla, Pongamia, Harar, Behera

Grass production
Average grass production of lands in the baseline ranged from to 2 to 3 tonnes per ha/year. An increase in grass production by almost 100% (Refer to Table D.1.2) is observed when grazing land is protected

(Monitoring and evaluation report of the Integrated Watershed Development Project (Hills)-II in Himachal Pradesh). CDM plantations would be protected from fire and grazing, facilitating an increase in grass production. Local communities will be permitted to harvest grass periodically from the plantations, thus enhancing the availability of grass from the project area. This increased grass availability would improve the health of livestock and milk production.

Fuelwood
Fuelwood is the main source of cooking energy in the project area. Households collect this fuelwood from forests, community land and private land. Land selected for the project support very few trees (30-39 trees/ha with >10 cm DBH). Hence, households do not collect any significant quantity of fuelwood from these lands. People go to natural forests situated at long distances from the villages even outside the village boundary. Under the project, about 1000 tress will be stocked in each hectare of plantation. It is estimated that about 1 to 2 tonnes of dry woody matter per hectare would be available to the community in the form of small twigs and branches and would ensure the availability of additional fuelwood on a sustainable basis.

Soil fertility
Land selected for CDM A/R plantation support poor soils due to erosion and lack of organic matter. Soil organic carbon in these soils range from 22 to 32 tC/ha whereas in the forests the mean stock was 123.79 tC/ha (Table C.2.2). CDM plantations would arrest soil erosion and add organic matter to soils during the project period. This would increase soil organic matter of the project area.

Reduction of vulnerability of mountain forest ecosystem
According to the reports of IPCC (Working Group II) the forest ecosystems and the hilly mountainous ecosystems are highly vulnerable to climate change. A study (Ravindranath et al. 2006) on impact of climate change and forest ecosystems in India has shown that most the forested grids of Himachal Pradesh are highly vulnerable to climate change and are projected to experience change in forest types, before the end of the current century.

A/R activity which includes planting of multiple species would reduce the vulnerability since different species have different temperature tolerance. Thus, the mountain forest ecosystems including degraded forests will be less vulnerable to impacts of climate change.

Reduction of the threat of pest attack
Monoculture plantations are known to be more vulnerable to pests and diseases. Plantations included in the A/R CDM project have multi-species, which reduces the threats of major pest attacks. The risk of pest infestation is also likely to be insignificant in the project considering the field observation of the plantations implemented in the previous decades.

Carbon sink enhancement
Carbon sink enhancement in degraded forest, community and private land due to A/R project activities in nearly 10,000 ha will lead to net removal of 5,058,103 tCO_2-e during the project period of 20 years. This will contribute to addressing the climate change problem through removal of CO2 from the atmosphere and storing it in vegetation and oils.

2. Benefits outside the project area

Reduced pressure on forests

- The rural communities in the project area collect a large percent of their fuelwood requirement for cooking from the nearby forests and plantations. They collect it largely from forests and plantations nearest to their GP, outside the project boundary. The project area covers a population of 4,35,918. Even assuming an average of 1 to 2 tonne of fuelwood in the form of woody litter and dried branches, the total fuelwood supplied from the project area will be about 10,000 to 20,000 tonnes per year, on a sustainable basis.
- Thus, sustainable and additional fuelwood supply from CDM plantations, in the form of woody litter and deadwood will reduce the pressure on the natural forests that are outside the project area. This will have a positive impact on conservation of forests outside the project area.

Reduced flooding

- Lower elevation areas of Himachal Pradesh and neighboring states of Punjab, Haryana experience floods during monsoon from rivers flowing from higher regions of Himachal Pradesh. CDM plantations in the hilly catchment of rivers such as Ravi and Beas and their tributaries will enhance the harvest and percolation of rainwater in the plantation area. This will reduce the surface runoff of rainwater that normally causes floods.

Demonstration effect of watershed protection and carbon revenue incentives

- Large-scale implementation A/R CDM project activities, covering 10,000 ha and the flow of CER revenues and other benefits such as increased grass and fuelwood supply, enhanced NTFP availability will have a demonstration effect on the neighboring villages and GPs.
- The neighboring GPs and farmers may also wish to undertake reforestation activities for protection of watershed as well as creation of carbon sinks.

Reduce landslides

- Occurrence of landslides is a common phenomenon in the hilly regions of Himachal Pradesh during the rainy season. The state has about 2.4 million hectare of wasteland without any vegetation cover. Furthermore, about 0.53 million hectare are open forests. These lands are vulnerable to landslides.
- CDM A/R plantations on degraded land will stabilise these lands and help to reduce their susceptibility to landslides, outside the project boundary.

3. Project risks and proposed mitigation measures

- **Fire**
  - **Risks**: Incidence of fire in forests and grassland are reported in selected pockets of the Himachal Pradesh. At the same time reported case of fire in proposed project areas (degraded land) is insignificant. However, there could be a possibility of fire spreading to the A/R CDM project area.
  - **Mitigation**: Regeneration of degraded land in multiple discrete parcels with multiple species is likely to make these lands less vulnerable to fires. GP level user groups would be involved in managing the project plantations. An effective watch and ward especially during the summer would prevent the fire accidents. Large-scale fire is unlikely in the project area. The institutional arrangements, improved management and distribution of carbon revenues to the local communities would limit the fire risk.

- **Grazing**

- **Risks:** Livestock graze in forest, community and private land. There is a risk of grazing by these animals in the CDM plantation areas and thereby damaging the planted or regenerated seedlings.
- **Mitigation:** The risk of grazing to planted areas would be avoided or minimized due to the following;
    - CDM plantation will be protected by physical measures like fencing.
    - Stall feeding is being promoted under the MHWDP project in the same area
    - Increased grass production from the project plantations is likely to encourage more livestock owning households to shift to grass harvesting and stall feeding.
    - Formation of participatory institutions for protection and management of CDM project plantations will stop the practice of livestock grazing and promote stall feeding.
    - Reduction in livestock population and shift to improved breeds that require stall feeding will reduce the grazing demand, and this is being promoted under the watershed project.

o **Invasive species**
- **Risks:** Invasive species spread widely because of their ability to disperse and establish aggressively in new areas.
- **Mitigation:** Majority of the species selected for planting in the CDM plantations are indigenous or locally adapted species. The mix of species considered for the reforestation models do not include any profusely spreading exotic tree species. Large-scale colonisation by any invasive weed species is unlikely due to the silvicultural management.

o **Site preparation**
- **Risks:** Raising of forest plantations involve operations such as digging pits for planting and filling the pits etc. There is a risk of disturbance to soils during these operations if machines are used that could lead to GHG emissions.
- **Mitigation:** Site preparation for the plantations would not involve use of machines. Site preparation would be carried out using only manual labour. Site preparation and disturbance of top soil is restricted to less than 1% of the top soil surface area. Thus, there is no risk of GHG emissions due to soil preparation.

o **Low productivity of reforestation models**
- **Risks:** Land selected for CDM plantations is eroded and have shallow soils. Soils are characterised by low fertility and low soil organic matter (about 25tC/ha). Moderate biomass growth rates are used in the calculation of the net GHG removals. There is a risk of low biomass productivity and carbon accumulation. Thus, there is a risk that the projected net carbon removals may not be achieved.
- **Mitigation:** Package of practices for high yields will be followed in raising the plantations. High quality seed material will be obtained and healthy seedlings will be selected for planting. . Adoption of good silvicultural package of practices, selection of high quality seed material and protection is likely to ensure the projected rates of growth of biomass and carbon accumulation.

o **Pest attack and use of pesticide**
- **Risks:** There is a risk of pest attack on reforestation models raised under the A/R CDM project.

- **Mitigation:** There is no evidence of any serious pest attack on the A/R programmes implemented in the state of Himachal Pradesh. There is no example of use of pesticides in any A/R programme. Furthermore, watershed project has a component for promoting integrated pest management systems in all the watershed divisions it is implemented. Thus there is minimal risk of pest infestation in the A/R CDM project

F.2. If any negative impact is considered significant by the project participants or the host Party, a statement that project participants have undertaken an environmental impact assessment, in accordance with the procedures required by the host Party, including conclusions and all references to support documentation:

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No significant negative impacts due to implementation of A/R CDM activity are projected. However, A/R activity could result in temporary loss of grazing land for the livestock.

- **Temporary loss of grazing land**: Land selected for A/R activities under the project include degraded forest, community and private abandoned land. These lands are currently partially used for grazing. When these lands are brought under CDM project and protected from grazing, there would be a reduction in the area available for grazing in the project scenario. This issue was investigated and the results are as follows;
    - All the evidence available shows that grass production and availability of grass or fodder will increase in the project area, due to protection and management. Refer to Table D.1.2 for the data which shows that grass production nearly doubled with protection and management.
    - Harvesting grass and stall feeding is a common practice adopted in the GPs (as shown by the Household Survey). So shifting from grazing to grass harvest and stall feeding will not be a major change in their traditional practice.
    - The evidence on the livestock population trends shows that in Himachal Pradesh firstly, the livestock population is declining and secondly, that there is a shift from local breeds to improved breeds, which are stall-fed and not grazed.
    - Watershed project has a programme to promote stall feeding and improving the quality of breeds and these high yielding cross-breed cows are stall-fed and not grazed.
    - Thus all the evidence shows that there will be no negative impacts due to regulation of grazing and in fact there will be positive impacts on the ecology (soil conservation) and economics (such as improved milk production).

F.3. Description of planned monitoring and remedial measures to address significant impacts referred to in section F.2. above:

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It is proposed to monitor all the potential risks and any adverse impacts on local environment using the following framework (Table F.3.1); which involves monitoring field issues as well as management and institutional issues.

Table F.3.1: Monitoring of risks and any negative impacts

Parameter or variable	Filed monitoring issues	Monitoring frequency for field issues	Institutional arrangement for monitoring

-Loss of grazing land -Reduction in access to grass production	-Number of livestock owning families grazing -Locations of grazing -Number of households harvesting grass -Quantity of grass harvested -Number of families practicing stall feeding	Monthly during cropping season on the field issues listed	MHWDP will organize monitoring; involving GPs and external research institutions
-Pest incidence and pesticide use	-Name of pest attacking the trees -Name and quantity of pesticide used in different land categories and reforestation models -Extent of adoption of IPM	During the cropping season, after the rains - monthly	
Loss of biodiversity	- Species planted under different models -Species regenerating	Annually till five years	
Site preparation leading to GHG emissions	- Extent of use of machinery	During land preparation season during the first 3 years	
Invasive alien Species occurrence	-Species name and number in sample plots	Once in 2 years	
Occurrence of fire	-Number of times of occurrence of fire -Area affected -Severity of fire attack	During summer months	

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

G.1. Documentation on the analysis of the major socio-economic impacts, including impacts outside the project boundary of the proposed A/R CDM project activity:

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Agriculture is the main occupation and source of income to the rural communities in the project area. However, agricultural production is suffering for various reasons and the income is unpredictable and is becoming low in recent years (MHWDP). Implementation of CDM project activities is expected to provide multiple socio-economic benefits to the local communities. One of the main economic benefits is the flow of CER carbon revenues to GPs and individual families. Some of the potential socio-economic benefits are presented in this section.

G.1.1. Within the project area

i) Flow of CDM CER revenues

Implementation of A/R CDM project will generate CDM CERs. The CER revenue from degraded forest and community land will be shared with the GPs and in turn with the individual families. CER revenue from the degraded private land will be fully transferred to the respective farmers. The MHWDP will manage the fund flow initially till 2012 and Forest Dept will manage the fund flow later from CERs to the GPs and farmers, under a signed agreement involving all the stakeholders. The extent of CDM CER revenue is a conservative estimate at a carbon price of US$ 4/tCO_2. The flow of revenue per hectare is quite significant compared to the per capita income in rural Himachal Pradesh (Rs. 14,682/capita).

ii) Changes in land use pattern and implications

Under the A/R CDM project three reforestation stand models involving multiple tree species will be planted in degraded forest, community and private abandoned land, leading to changes in land use and land cover with the following potential economic benefits:

- Protection of watersheds leading to positive impacts in terms of soil and moisture conservation
- Increased fodder or grass supply to livestock leading to increase in milk production
- Supply of NTFPs from planted forests
- Increase in employment due to improved fodder production
- Increase in household incomes from improved diary breeds, stall feeding, NTFP production and improvements in crop production

- Some of these socio-economic impacts are presented in detail in the following sections

iii) Increase in employment opportunity

Employment generation is one of the objectives of all A/R projects and it results from the following activities under the A/R CDM project

- Establishment of forest plantations would involve activities such as nursery, land preparation, planting, silvicultural practices and protection. These activities would generate employment to local population. On an average 343 person days of employment are generated per hectare of reforestation. Additional employment generated from these activities is provided in Table A.2.1.
- Doubling of grass production will require labour for harvesting and stall feeding
- Planting of NTFP yielding species will lead to supply of multiple NTFPs, whose collection and processing will generate additional employment.
- Activities implemented to support agriculture production, watershed protection and soil and water conservation.

*iv) **Women empowerment***

- CDM CER revenue will contribute to empowerment of women groups (such as Self Help Groups) and institutions
- It is proposed to form Carbon Management Committee or CDM User groups, where women will have a major role in managing the CDM revenue.
- GPs where women are significantly represented under the regulations will have a major role in all decisions related to A/R CDM project as well as sharing the CDM CER revenue.
- In the project area Self Help Groups are functioning and will continue to play a key role in protecting and managing the CDM A/R activities.
- Under the watershed programme several institutional arrangements and capacity building programmes are being planned to involve and empower women.

v) NTFP availability and income generation

- Currently the flow of NTFPs from land categories selected for the A/R activities is marginal or absent. The list of NTFP yielding species to be planted under the project will provide several NTFPs.
- Many of the species included in the A/R activities; yield commercially important NTFPs such as *Acacia catechu, Pinus roxburghii, Emblica officinalis* etc.
- Additional income is likely to be generated by processing and marketing of NTFPs such as amla, ritha, jamun, mango, pecanut, etc. (Table F.1.3)

vi) Fuelwood supply

Fuelwood is a major source of energy for cooking in the project area. Currently fuelwood is collected from several sources including natural forests, plantations and farms. Under the CDM project, the local communities will be permitted to collect dead and fallen twigs and branches form the pre-existing trees as

well as the planted trees. Out of above ground biomass productivity of about 6-8 tonnes/ha/yr expected from the project activities, about 1 to 2 t/ha/year of woody biomass could be considered as available as fuelwood for gathering by the local communities. Felling of green branches and stems will be banned by the GPs from the project areas. Further assured supply of fuelwood from CDM plantations will reduce the time taken for fuelwood collection and the associated drudgery, particularly for women.

vii) Financial benefits to landless and the poor
Agriculture is the main occupation and source of income for farmers. Landless or the poor depend on farm wages for their living. Their economic status would increase with carbon revenue and empower them to participate in the panchayat or other village / ward level institutions.

G.1.2. Outside the project area

i) Supply of NTFPs and employment in processing industry
- Supply of NTFPs from CDM plantations on a sustainable basis would create new processing industries and ensure raw-material supply to these industries. These could be located outside the project area and create new jobs.

ii) Reduction in migration
- Flow of carbon revenue in the long-term could have a negative impact on migration of rural population to the urban areas in search of employment. Carbon revenue, a new income source along with creation of large-scale reforestation and NTFP based industry may create new jobs and reduce migration.

G.1.3 Potential socio-economic risks

i) Indigenous people
- **Risks:** Himachal Pradesh has few migratory herders or trans-human community. They migrate along with their livestock in search of fodder during summer months. They travel regularly through different parts of the state with their livestock. The reduction in area of grazing land because of the A/R CM project could affect fodder resources for this community.
- **Mitigation:** Area proposed for the CDM project of about 10,000 ha accounts for 0.5% of the total wasteland or degraded land and 0.83% of forest area of the districts. Thus the area dedicated for A/R activities is unlikely to have any significant adverse implications for the indigenous Gujjar community. Further, the State Forest Department has clear guidelines regarding the grazing rights of Gujjars and the project will adhere to these regulations. Care has been taken to select areas or land parcels where migratory rights do not exist. There is already a tribal action plan of the MHWDP.

iv) Loss of cultural and religious sites
No land with cultural and religious importance, for the local communities in the project area is proposed under the CDM project.

viii) Access to grass, fuelwood and NTFP
- **Risk:** Reforestation, fencing and regulations may lead to loss of access and supply to the local communities to the pre-existing grass, fuelwood and NTFPs.
- **Mitigation:** Firstly, there will be no reduction in access to pre-existing grass, fuelwood and NTFPS, though regulated to ensure sustainable extraction. Secondly, reforestation and planting of multiple of tree species will ensure incremental grass, fuelwood and NTFP production and

supply. Thirdly, there will be no restriction on harvesting and collection of enhanced grass production, NTFPs and fallen and dead dry woody litter and branches. Thus, there will be no reduction in access to fuelwood and NTFPS, indeed there will be increased supply with clearly defined access rules.

G.2. If any negative impact is considered significant by the project participants or the host Party, a statement that project participants have undertaken a socio-economic impact assessment, in accordance with the procedures required by the host Party, including conclusions and all references to supporting documentation:

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No significant negative socio-economic impacts are expected due to the implementation of A/R CDM project activities. As explained earlier there will be several positive socio-economic impacts due to the implementation of the project.

G.3. Description of planned monitoring and remedial measures to address significant impacts referred to in section G.2 above:

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Since, there is no significant negative impact because of the A/R CDM project, monitoring and remedial measures are not necessary. However, the project management will organize monitoring of some of the potential risks (Table G.3.1).

Table G.3.1: Monitoring of the risks and any negative socio-economic implications

Parameter or variable	Filed monitoring issues	Monitoring frequency for field issues	Institutional arrangement for monitoring
Loss of access to indigenous people for grass production	- Passage of Gujjar community in the project areas - Locations of grazing by the Gujjars in and around the project GPs	Monthly, monitoring during the migration periods	MHWDP will organize monitoring; involving GPs and external research institutions
Access to grass, fuelwood and NTFPs	-Quantity of fuelwood, grass and NTFP collected by the local households -Number of households visiting the project areas for collection	During the rainy season for grass production, and monthly for fuelwood and NTFPs	

SECTION H. Stakeholders' comments:

H.1. Brief description of how comments by local stakeholders have been invited and compiled:

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The comments were collected from primary as well as secondary stakeholders

Primary stakeholders: The primary stakeholders are the village communities, represented by the GP, farmers and the State Forest Dept. The methods involved the following;

- PRA for the GP members as well as with the whole village community of 30 GPs representing all the watershed divisions

- Questionnaire survey with the individual sample households form all 30 GPs

In fact, the consultation process was initiated between the village community and MHWDP authorities in the context of watershed development programme. This process was continued further during the design of the CDM project and the PDD.

Details of consultation process with primary stakeholders
Detailed discussion was held with the primary stakeholders in the selected 30 GPs through PRA to inform and elucidate their interest for implementing A/R Project. During the discussion stakeholders were made aware of the issues such as the objectives of the project, implementation process, species choice, protection needs and arrangements, cost sharing mechanism, benefits from the flow of forest produce, biomass yield, CDM and carbon revenue. Their comments on these issues were recorded and compiled.

Primary stakeholders who participated in the discussion included the GP President, landless families, marginal farmers, small farmers, large farmers and other people residing in the village.

Following issues were raised during the PRA and discussion with communities.

i) Selection of species for planting
Comment: Stakeholders raised many questions about the species choice and they wanted fast growing species as well as tree species which provided multiple products. They had these doubts due to their experience with other afforestation programmes, where some times largely exotic species were planted.

ii) Grazing
Comment: The village community wanted to know about the access to grass and grazing, after the tree plantations were raised. Since they feared about loss of access to grass once the plots are fenced

iii) Access to fuelwood and NTFPs
Comment: The village communities wanted to know about the access to fuelwood and NTFPs that will be available to the families of the village and GP from the tree plantations to be raised under the project.

iv) Carbon revenue flow
Comment: The GP members as well as the farmers wanted to know how the income from the sale of CERs will be shared with them. What percent of the revenue will reach them? How it will be credited to them, as members of a GP or as individual farmers?

Secondary stakeholders: Secondary stakeholders in the project include MHWDP and Forest Department. The views and comments of the secondary stakeholders were obtained through workshops, meetings and circulation of draft PDD.

i) Flow of Carbon credits
Comment: The State Forest Dept wanted to know how the CDM CER revenues will flow, and the share that would accrue to the Forest Department.

H.2. Summary of the comments received:

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The key comments were related to the flow of CDM CER revenue and access to land, grass, fuelwood and NTFP from the plantations once the A/R CDM project was implemented.

H.3. Report on how due account was taken of any comments received:

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i) Selection of species for planting: The CDM A/R project developers have prepared a large basket of species for each model based on suitability to the location, flow of multiple products and rate of growth. The GPs and farmers will make the final choice from the basket of suitable list of species. Thus, the primary stakeholders will make the species choice; village GP members will make the final selection for the degraded forest and community land and individual farmer for the respective plot of land.

ii) Grazing: The GP members or the village community will have full access to grass produced. Evidence is available to show that the grass production will double with protection and management. Thus, the village community will obtain double the quantity of grass. The village community will be encouraged to shift to grass harvesting and stall feeding, which is already being practiced by many farmers. The watershed project authorities also have programmes to enable livestock owners to shift to high yielding cow breeds, which are normally stall-fed.

iii) Access to NTFPs: The community will have full access to all NTFPs produced from the tree reforestation models. Under the Participatory Forestry Programme guidelines, the communities will have full access to all NTFPs, including grass, dead and fallen and dry wood and NTFPs.

iv) Carbon revenue flow: MoU or agreement is prepared according to which all the revenue from the degraded forest and community land will flow to the village GPs and revenue from private land will flow to the individual farmers. Only a small administrative cost will deducted from the carbon revenue. The agreement is being signed between the MHWDP project authorities and the GPs and the individual farmers. The State government will endorse the agreement.

All the stakeholders appreciated the afforestation and reforestation project activities on the degraded forest, community and private land. They welcomed the A/R activity in villages and panchayats. Primary stakeholders gave many positive comments, which would give a strong impetus for a successful implementation of project. They appreciated the objectives of project and showed interest in management of the plantations and are ready to share the responsibilities and enjoy the benefits including carbon revenue.

Annex 1

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Annex 3

BASELINE INFORMATION

Baseline vegetation and soil carbon as well as socio-economic information were collected using the following approach and methodology.

Step 1: Selection of region
The Mid Himalayan Watershed project consists of two broad regions namely Bilaspur and Dharamshala. These regions are characterized by sloping topography, degraded status of lands devoid of vegetation, and subjected to grazing. These factors influence the vegetation and soil carbon stocks and their rates of change. Thus, the project area is distributed in two broad administrative regions namely Bilaspur and Dharamshala.

Step 2: Selection of watershed division
Further these two regions are sub-divided into watershed divisions and all the divisions have been selected.

- *Bilaspur region:* Nahan, Swarghat, Namhol, Solan , Kullu, Rampur
- *Dharamshala region:* Dharamshala, Mandi, Chowari, Nurpur, Sujanpur

Step 3: Selection of GPs
From each of the 10 watershed divisions, sample GPs were selected for baseline survey of vegetation as well as soil sample collection and for PRA and household survey. Three sample GPs each were selected from 10 of the 11 watershed divisions, excluding Rampur.

Step 4: Selection of land categories

Of the three land categories included in the project, namely degraded forestland, degraded community land and degraded and abandoned private land are identified as the baseline strata.

- *Degraded forestland*: These lands are located at a higher elevation and grazing pressure is relatively less as these lands categories are farthest from the habitation.
- *Degraded community land:* These lands are under the control of the revenue department and communities have right of access to grazing and fuelwood collection. These are in the vicinity of village habitation.
- *Degraded and abandoned private land:* These lands categories are at lower elevation close to the valley and are closest to human habitation. They were cultivated under sloping or partially levelled and partially terraced condition. The lands included under the project have been abandoned for more than 10 years and are currently used for grass harvest and livestock grazing.

Step 5: Baseline vegetation survey

Sample plots were laid randomly in each of the land categories present in a GP within a watershed division. Plots were laid for studying trees as well as non-trees. The dimensions of the tree and non-tree quadrats are as follows:

Tree
Dimension – 20 X 25 m

Number of plots - 5

Non-tree
Dimension – 5 X 5 m
Number of plots – 5

Land category	No. of GPs sampled
Degraded forestland	19
Degraded community land	13
Degraded and abandoned private land	21

Step 6 Tree measurements

After laying a tree quadrat of above mentioned dimensions, all stems of height >1.5 m were identified and the girth or diameter (GBH/DBH) of the tree and height were measured and estimated, respectively. DBH is the most critical parameter required for estimating the above-ground biomass, as shown by the box in Step-7, where the majority of allometric equations require only DBH data.

GBH/DBH Measured using tapes for large trees and slide calipers for smaller trees

Height of the tree Trees below 3 m height were measured and the height of the taller trees was visually estimated. The height data however is not used in calculations of aboveground biomass since all the allometric equations used require only diameter (DBH) data.

Step 7 Estimation of biomass of non-trees

For estimating the biomass of shrubs or non-trees, the harvest method was adopted. All the grass and shrub biomass present within the non-tree quadrat were clipped and harvested. The fresh weight of the harvested biomass was taken. The weight of grass and shrubs within this quadrat were taken separately in order to estimate the grass and woody biomass separately.

Step 1: Species name and number in each shrub plot recorded.
Step 2: The shrub and herb biomass was harvested in each plot.
Step 3: Fresh weight of the biomass was estimated.
Step 4: Dry weight of the biomass was estimated by taking a small quantity and drying it in an oven.
Step 5: The dry biomass expressed as dry tones is extrapolated to per ha from the sample area

Step 8 Calculation of tree biomass

There is very limited literature on the allometric equations for estimating the above-ground biomass stocks for tree species occurring in India (Murali et al, 2005). The only major source of allometric equation is the report published by Forest Survey of India (FSI, 1996). Biomass of trees was estimated using DBH (D) and height (H) data in species-specific allometric equations. Some equations of the dominant species are:

Acacia catechu	V=0.041849-0.552715 D+2.952186D^2
Acacia catechu	V=0.042189-0.552715D+2.952186D^2+0.114508D^2
Acacia spp.	V^2/2=-0.00242+2.62922D-0.54701D^2/2
Albizzia lebbeck	V=((-0.014)+(0.292(D*H^2)))

Albizzia lebbeck	V=-0.014+0.292 D^2H
Anogeissus latifolia	V=0.289-2.651 D+22.772D^2
Anogeissus latifolia	V/D^2=(-0.022051/D^2)+(0.087428/D)+2.545702+4.7662*D
Anogeissus spp	V=(0.099-2.229*D)+8.2*D^2
Artocarpus hirsuta	V=(0.026+((0.126)* (D^2)*H)
Bauhinia spp	V=-0.04262+6.90492 D^2
Bombax ceiba	V/D2H=0.002994/D^2H+0.457281-0.00054*D^2H
Boswellia serrata	V^2/2=-0.255126+2.724875D
Buchnania latifolia	V=0.02475+0.2982 D^2 H
Careya arborea	V=-0.0210.+279D^2H
Cassia fistula	V=0.066+0.287 D^2H
Cassia siamea	V=0.05259-0.51112 D+1.46026 D2+20.28471 D1
Cassia siamea	V=0.05259-0.51112D+1.46026D^2
Cinnmomum zeylanicum	V=0.089-2.242D+9.712 D^2
Dalbergia latifolia	V=0.28945-2.46225D+20.54462 D ^2
Dalbergia sissoo	V=-0.2168+0.00128+0.02424H
Dalbergia spp	V^2/2=0.76896+7.12777D-4.02951D^2/2
Dillinea pentagyna	V=0.070-2.295+9.429D^2
Diospyros malabaricum	V^2/2=0.2158+4.20022D-2.27165D^2/2
Diospyros melanoxylon	V=0.02456+0.12621 D^2 H
Diospyros melanoxylon	V=0.042+0.246D^2H
Diospyros spp	V^2/2=0.92625+7.86462D--4.67222D62/2
Dipeterocarpus indica	V=0.0101+0.4444 D ^2 H
Dipterocarpus macrocarpus	V^2/2=0.10528+5.89511D-2.24269D^2/2
Dipterocarpus spp	V=0.4721-0.0227D+0.00208D^2
Dysoxylum malbaricum	V=0.288-2.921D+21.869D^2
Embelica officinalis	V=-0.018+0.144D^2H
Erythrina spp	V=-0.07801+2.70258D-9.26280D^2+11.92455D^1
Eucalyptus spp	V=0.02894-0.89284D+8.72426D^2
Eugenia spp	V=0.22468-2.42186D+9.74541D^2
Ficus	V^2/2=0.01629+1.95189D-0.8422D^2/2
Ficus spp	V^2/2=0.01629+1.95189D-0.8422D^2/2
Hardwickia binata	V=-0.021581+0.279452 D^2 H
Holarrhena antidysentrica	V=-0.021581+0.279452D^2H
Lagerostomia lanceolata	V=0.21819-2.48072 D +20.24206 D^2
Lagerostomia spp	V=0.2270-2.58942D+9.76464D^2
Madhuca latifolia	V=-0.002557+0.260224 D^2 H
Mallotus phillipnensis	V=0.24749-2.82501D+29.62977D^2
Melia azadirach	V=-0.01520+5.12982D^2
Messua ferrea	V=0.09252-2.95224D+21.52055D^2
Michelia champaka	V^2/2=0.17242+5.64284D-2.27448D^2/2
Myristica malabarica	V=0.79212-20.40159D+45.56029D^2-17.82922D^2
Phyllantus embelica	V=0.02244+0.14122 D^2 H
Pterocarpus marsupium	V=0.70-2.295D+9.429D^2
Semecarpus anacardium	V^2/2=2.67477+24.81747D-9.41186D^2/2
Spondias pinnata	V^2/2=0.49487+6.28662 D-2.95076 D^2/2
Sterospermum personatum	V=2.18792-22.52719 D+10.52466 D^2-9.65242 D ^1
Syzygium cuminii	V=-0.002041+0.162117 D^2 H

Tectona grandis	V=0.086+5.642D^2
Terminalia bellerica	V=-0.042471+6.996762D^2+0.217468D^2H
Terminalia chebula	V/D^2H=-0.00652/D^2H+0.42169
Terminalia paniculata	V=0.21200-2.87212D+9.47862D^2
Terminalia paniculata	V=0.21200-2.87212D+9.47862D^2
Terminalia spp	V=0.50601-6.64201D+25.21882D^2
Terminalia tomentosa	V=0.06527-0.2218D+1.96894D^2+4.61954D^1
Local volume equation of *Cedrus deodar* for Chamba, Lahaul Spiti and Kanpur District. Also used for Shimla, Rohur and Chopal districts	$V/D^2 = 0.2421/D^2$—2.68191/D+14.77955

The biomass of the sample area was then extrapolated to per ha and biomass expressed as dry tonnes per ha.

Step 9 Estimation of total living biomass and total carbon

In order to estimate the total biomass, the following steps were adopted.

- Above-ground biomass was estimated using the DBH (and in some cases height) values measured in sample plots in the Allometric equations for each species. The biomass of each tree according to species was estimated and summed for the plots and extrapolated to per hectare value from sample plot area
- Using IPCC default conversion factor, the belowground biomass estimated as a fraction of aboveground biomass (0.26% of aboveground biomass)
- Total biomass is a sum of above and belowground biomass

$$\text{Total Biomass} = \sum (\text{Aboveground biomass} + \text{Belowground biomass})$$

- According to IPCC, carbon fraction default value is 0.5 and therefore living biomass carbon is estimated by multiplying total living biomass with carbon fraction

$$\text{Total living biomass carbon} = \text{Total living biomass} \times \text{carbon fraction (0.5)}$$

Step 10 Estimation of soil organic carbon

Soil carbon density (tC/ha) was estimated based on stratified random sampling for the three broad land categories selected for A/R activities. Soil samples were collected at a depth of 30 cm from all land categories included in the A/R CDM project in a selected GP. Samples were collected in replicates and a composite sample prepared for analysis. Soil organic carbon was estimated in the laboratory using the Walkley Black method. The three broad land categories as well as the number of sample points selected for soil carbon estimation is given below.

Land category	No. of sample points/GPs
Degraded forestland	
Degraded community land	
Degraded and abandoned private land	

Selection of sample point: The GPs and the land categories selected for vegetation sampling (for tree biomass estimation) were used for locating soil sampling points. The total number of sampling points selected for the three land categories are given above. The number of GPs and land categories selected for baseline soil carbon estimation is lower than that for tree biomass estimation due to the high cost involved in determining the soil carbon stocks. Thus, one GP per division was selected compared to 3 GPs per division for tree biomass estimation.

Field sampling for soil carbon: The following procedure was adopted;

- One GP and the land categories occurring in this GP were selected randomly from the 3 GPs in each division. Thus, ten GPs were selected for soil sampling
- The centre point of each of the baseline tree plots was marked
- The soil surface was scraped to remove the litter
- Soil was dug to a depth of 30 cm
- Thus, soil was collected from each of the 5 tree plots as replicates
- Soil from these five plots was mixed to obtain a composite sample
- The soil was collected in a polythene bag and transferred to laboratory for analysis

Laboratory analysis: The Walkley-Black method was used for estimating soil organic carbon content.

Bulk density estimation: Bulk density was estimated by collecting soil from 30 cm depth and filling it into a bottle and obtaining the weight and volume of the soil in the bottle.

Bulk density (grams/cc) = Weight of the soil/volume of the soil

Calculation of soil carbon stocks: The content of organic carbon in soil estimated in percentage terms can be converted to tonnes per hectare using bulk density, depth of soil and area (10,000 m^2).

Soil organic carbon (t/ha) = [soil mass in 0-30 cm layer x soil organic carbon concentration (%)]/100

Soil mass (t/ha) = [area (10,000 m^2/ha) x depth (0.3 m) x bulk density (t/m^3)]

Step 11: Estimation of total carbon

Total Carbon = [Total Living Biomass Carbon + Total Soil Organic Carbon]

Step 12: Assessment of degraded state of baseline strata based on field studies

Degraded lands were defined based on the tree crown and, biomass and soil carbon status of the land categories selected. The detailed approach for selecting land categories and parcels that are in a degraded state is given in Section A.7.

- Tree crown obtained from remote sensing maps for the land parcels selected for the project, where only parcels with <10% tree crown were selected
- Soil organic carbon (tC/ha) estimated using the methods described above (Step 10) for the land categories and land parcels selected and compared with adjoining forests
- Vegetation status (tonnes of biomass/ha) determined using the methods described above (Steps 1-9)
- The soil carbon and vegetation biomass carbon is compared with that of values obtained for adjacent forests as well as the literature values for Himachal Pradesh.

- Further, the topography of the land categories and parcels is characterized by a slope of about 15-20%, which enhances soil erosion.

Annex 4

MONITORING PLAN

Monitoring methods along with the indicators for estimating the GHG emissions and removals, according to the methodology AR-ACM0001, were described in Section E. The monitoring plan for the proposed A/R CDM project activity involves the following elements:

1. Monitoring of forest establishment and management
2. Stratification and sampling for monitoring
3. Selection of carbon pools for monitoring and frequency of monitoring
4. GHG measurement and calculation of carbon stock changes
5. Monitoring of GHG emissions
6. Monitoring of leakage
7. Estimation of net GHG removal by sinks
8. Archiving and storage of data
9. QA/QC plan

1. Monitoring of forest establishment and management

The details of methods and indicators to be monitored for assessing forest establishment and management practices are presented in this section. The monitoring methods also aim to ensure that the management practices are implemented in accordance with the PDD.

a. Area and species planted annually

Watershed Division: _____ GP: _____

Land category: _____ Reforestation model: _____

Parcel ID: _____

Area planted (ha)					
Year 1	Species	Year 2	Species	Year 3	Species

b. Survival rate

Watershed Division: _____ GP: _____

Land category: _____ Reforestation model: _____

Parcel ID: _____

Year 1			Year 2			Year 3		
Species	Number	Number	Species	Number	Number	Species	Number	Number

	planted	surviving		planted	surviving		planted	surviving

The activities to be monitored for monitoring of forest establishment were described in Section E.1.1. The parameters to be monitored are as follows:

c. Cleaning and site preparation measures

Division: _____ GP: _____

Land category: _____ Reforestation model: _____

Parcel ID: _____

Year 1				Year 2				Year 3			
Date	Area (ha)	Quantity of biomass removed (kg)	Other measures	Date	Area (ha)	Quantity of biomass removed (kg)	Other measures	Date	Area (ha)	Quantity of biomass removed (kg)	Other measures

Note: Only 0.007% *of the total planted area will be disturbed as pitting method of planting is adopted traditionally in Himachal Pradesh*

d. Details of planting
Refer to section on monitoring of forest establishment Table a.

e.. Fuelwood collection

Division: _____ GP: _____

Land category: _____ Reforestation model: _____

Parcel ID: _____

Year 1				Year 2				Year 3			
Date	Area (ha)	Species	Quantity of biomass removed (kg)	Date	Area (ha)	Species	Quantity of biomass removed (kg)	Date	Area (ha)	Species	Quantity of biomass removed (kg)

2. Stratification and sampling for monitoring

Preliminary stratification procedure is described in Section C. The final *ex ante* stratification of the project will be decided after implementation of project activities. The details of the methods for sampling and the sample size (number and size of plots) for monitoring are described in Section E.

3. Selection of carbon pools for monitoring and frequency

The carbon pools selected to be monitored as per the methodology AR-ACM0001 adopted are i) above ground biomass ii) below ground biomass or roots, and iii) soil organic carbon

a. Aboveground biomass: This pool includes both tree and non-tree vegetation and monitoring will be carried out once in 3 years.

Table 4.1 Parameters to be monitored for aboveground biomass carbon pools

Carbon pool	Plant form	Parameters monitored	Frequency
Aboveground biomass	Tree	- Species name - DBH - Height	5 years
	Shrub	- Species name -Density (number/ha) - Fresh weight - Dry weight	5 years
	Grass	- Fresh weight - Dry weight	5 years

b. Belowground biomass: Root biomass is an important carbon pool for A/R CDM projects. Root biomass will not be measured directly as the method is complex requiring digging of trees and enormous effort and cost. Instead, root:shoot ratio or conversion factor will be used to estimate root biomass, based on shoot biomass data. Default values of root:shoot ratio or conversion factors as given by the IPCC or any locally or nationally available root:shoot ratios will be adopted.

4. GHG measurement and calculation of carbon stock changes

Measurement and calculation of carbon stock changes involves the following steps for estimation of aboveground biomass stocks as illustrated in Figure 4.1.

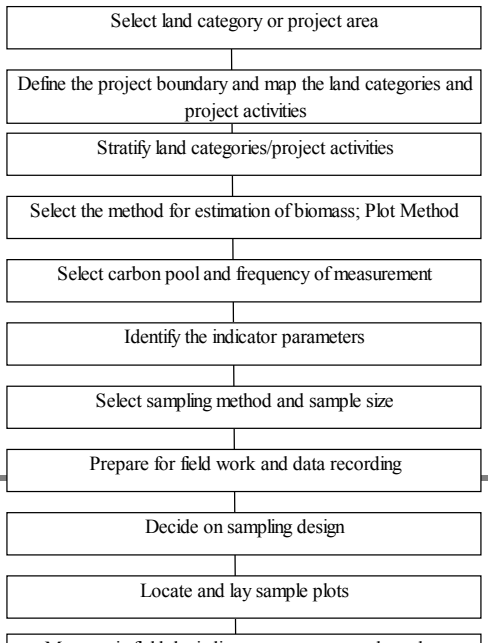


Figure 4.1: Steps in measurement and estimation of aboveground biomass stock

Steps 1 to 3 are described in previous sections.

Step 4: Selection of permanent plot method

The permanent sample plots will be used for estimation of aboveground biomass of tree and non-tree vegetation. The plot method involves selection of an appropriate size and number of plots, laying them randomly in the strata selected and measuring the indicator parameters (e.g., tree DBH, height or grass production) and using different approaches such as allometric functions to calculate the biomass, and converting the sample plot estimate to per hectare and for the total project area. Permanent plot method enables monitoring of carbon stock changes or gains and losses on a periodic basis.

Steps 5 & 6: Selection of carbon pool, frequency of measurement and identification of indicator parameters

The selection of carbon pools and frequency of measurement of carbon pools was described earlier in this Section. The indicator parameters for measurement are also listed in Table 4.1. A description of the parameters to be monitored and measurement procedure is given below:

i) *Name of the species* Vegetation type such as tree, shrub or herb will be recorded, followed by the species name. Among the trees, different species have different shape, size, rate of growth and wood density. Species name is important even for non-tree plant forms such as shrubs, herbs and grass. Biomass for tree species is estimated as volume or weight per tree, which can be extrapolated to per hectare based on the density and distribution of each species. While recording the species name and number, it is proposed to record other features such as

- *Status of tree crown* percent damaged or full crown
- *Dead or living tree* living, or dead and standing, or dead and fallen

ii) DBH (Diameter at Breast Height) or GBH (Girth at Breast Height) for trees This is one of the most important parameters, which represents the volume or weight of the trees, which can be converted to biomass estimates per unit area (tonnes/ha or tonnes/ha/year). DBH values along with the height parameters can be used for estimating the volume of the tree by simple equations. DBH values can also be used in allometric functions, where volume or biomass per tree or per hectare can be estimated. DBH is easy to measure in the field and also it facilitates repeated measurements, by marking the plot as well as the tree. DBH will be measured at a height of 137 cm above ground.

iii) Height of trees It is the most important indicator apart from DBH, used for measuring the volume or weight of the tree. Height parameter will be used in the allometric functions to estimate the volume or weight of the tree along with the DBH values.

iv) Parameters for non-tree species DBH and height parameters are not measured for non-tree species such as herbs and grasses. The biomass for non-tree species is estimated in terms of weight per unit area for each species, by actually harvesting and weighing all the herbs and grasses in the sample plots.

Step 7: Selection of sampling method and sample size
Sampling includes selection of the number of plots, size of the plots and shape of the plots. Carbon inventory will be estimated based by adopting a sampling design method. Stratified random sampling will be adopted for monitoring**.**

Stratified random sampling: The random sampling approach involves locating the plots in the field in an unbiased way. Stratified random sampling approach to be adopted involves the following steps and the stratification procedure adopted and sample size is described in Section E.

Step 1: Stratify the land categories and project activity area, namely high altitudinal strata of reforestation model

Step 2: A grid map of the project area, demarcating each land use category and reforestation model and parcels and a grid size of 25 m X 20 m will be adopted

Step 3: Each grid for the project reforestation models will be marked

Step 4: The sample grid numbers will be randomly picked, using random table or lottery system.

Step 5: Permanent tree plots will be located in the grids selected in the field with respect to some permanent visible land mark and the boundary of each tree plot will be marked using a GPS

Step 7: The map prepared with all the details, including the location of sample plots marked on it will be stored in a computer on a GIS platform.

Location of sample plots in the field will be achieved by overlaying the reforestation model map over the grid scale map, using GIS, and marking the plots in the selected grids. GPS measurements of the corner points of quadrats or plots will be recorded on the map for revisits and periodic measurements. For long-term monitoring the plots will be marked in the field as well as on the map using GPS readings and with reference to some permanent landmark, for easy identification on the ground.

Statistical approach to sampling: This approach involves selecting the size and number of plots based on the variability of vegetation and areas of the sampling strata. It involves conducting preliminary sample study to estimate the variance of the variable selected, which is the biomass stock in each land use system. The method also requires estimation of the cost of sampling. The sample size is estimated using a formula, which requires variance in each land use system, area, desired precision, and error estimate. The sampling procedure was presented in Section E.

Trees: Trees or stems above 5 cm DBH will be included in the tree plots. The dimension of plots is likely to be 25 X 20 m, finalize size will be determined after plantations are raised.

Shrubs: Shrub plots include trees below 5 cm DBH and perennial shrub species but with height above 1.5 m. For every tree plot two shrub plots will be selected. Shrub plots will be located inside the tree plots, at the rate of one per tree plot. Shrub plot size would be 5 m X 5 m.

Herbs and grass: The dimensions of the herb layer plots will be 1 m X 1 m and the number is double that of shrub plots.

Step 8 Field measurements and data recording
Estimation of biomass carbon stock or growth rate requires measurement of indicator parameters such as tree height and GBH. These parameters will be measured in the field through a sampling design. Above ground biomass is estimated for trees, shrubs and herbs/grasses. The biomass of trees, shrubs and herbs will be measured using the following steps:

Step 1: Select the sample size, locate, and mark the sample plots for trees, shrubs and herbs on the ground
Step 2: Select the parameters for tree, shrub and herb biomass and procure all the materials required for field studies
Step 3: Measure the parameters for trees; species, height, DBH and status or features of tree
Step 4: Measure the parameters for shrubs; height, DBH and weight of the woody and non-woody biomass
Step 5: Measure parameters for herbs/grass; species, number of plants, weight of the plants in the sample plots
Step 6: Record all the parameters in the standard formats for trees, shrubs and herbs/grass

Steps 1 and 2 have already been described in earlier sections. Steps 3 to 6 are described in the following section. These largely focus on measurement of different parameters as indicators for estimating the plant biomass stock.

Aboveground biomass of trees

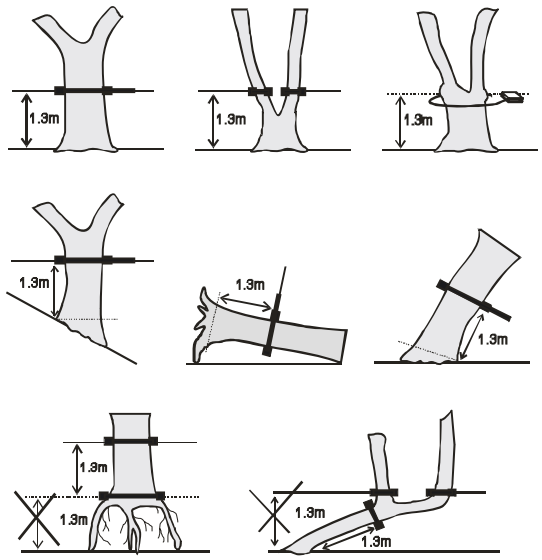
Trees are woody perennial plants having a single, usually elongated main stem with few or no branches on its lower part. Trees could be large or mature (>30 cm DBH) medium sized or growing (10–30 cm DBH) or regenerating seedlings (<10 cm DBH). Plants belonging to a tree species will be considered for measurement in tree quadrats, if the height of the plant is over 1.5 m and with a DBH of >5cm (a girth of about 15cm).

Parameters to be measured include species, number of stems, DBH, height, status of regeneration, dead and standing tree and extent of damage to the tree.

DBH DBH is easy to measure and verify. It requires only a measuring tape or a caliper and a marker. DBH is measured using the following procedure:

- Mark 137 cm above ground on tree trunk
- Place the calipers/tape at 137 cm
- Measure and record the DBH or GBH in cm
    - If a tree has multiple shoots count and measure GBH/DBH for all shoots
    - If the tree is large normally girth is measured using a measuring tape
    - If the tree is young and has girth lesser than the prescribed, measure DBH using a slide caliper
    - If the tree is on the border line, and if >50% of the girth is inside the plot include it for the measurement in the sample plot

A tree could have multiple and/or crooked shapes, could be slanting, and could be on a sloping hill. Measurement technique for irregularly shaped trees and under different land conditions is illustrated in the following figure.



Measuring DBH or GBH for trees of different shapes and forms

Height Tree height normally refers to total tree height defined as the vertical distance from the ground level to the upper most point. Tree height is also often referred to as the merchantable height, since many allometric equations are derived for this height. Height is measured for all the tree stems for which DBH is measured. Measurement of tree height is difficult for tall trees, unlike DBH, especially, in a dense forest or plantation, with dense tree stems and overlapping tree crowns.

Tree height can be measured using various instruments or even a simple tape. However, measuring the height of individual trees with overlapping tree crowns and trees in a dense forest or plantation, poses a challenge for measurement even using instruments. Trees <3 meters will be measured using a graduated height stick, by holding a stick against the side of the tree. Clinometer is one of the instruments used for measuring the height of the trees. Mark out a horizontal distance of 10 meters from the tree from where the tree can be viewed using a clinometer, if necessary increase the horizontal distance by moving away from the tree beyond 10 meters. If the tree plot is located on a steep slope, view the tree from across the slope to obtain the horizontal distance. Sighting the tree through the clinometer, align the centre line with the base of the tree (ground level on the upside slope) and record the reading on the percent scale (base angle %). Next aim the clinometer to the top of the tree and record the reading on a percentage scale. Calculate the height using the following equation

$$\text{Height (m)} = \frac{\text{Top angle (\%)} - \text{Base angle (\%)} \times \text{Horizontal distance}}{100}$$

Tagging of trees The trees, which are perennial, will have to be measured periodically over a number years. Thus, to enable location of tree species and number, it is desirable to mark or tag the trees. This is achieved by fixing aluminium or other metallic tags to the tree.

Location: GPS reading: Parcel ID:		Land use system: Stratum:						Plot no: Size of the plot		Investigators: Date:
S. No	Species name	Tree number	GBH (cm)					Planted or regenerated	Height (m)	Status of crown[1]
			Stem1	Stem2	Stem3	Stem4	Stem5			

1										

[1] indicate the percentage crown cover present or damaged

Shrubs Shrubs are woody plants of relatively low height often less than five meters, having several stems arising from the base and lacking a single trunk. Shrub plots include shrub species as well as younger trees with DBH lower than what is defined for the trees in the tree plots. Shrub plots are located inside the tree plots.

Parameters to be measured include species, number of stems, DBH, height and weight of the shrub biomass from the sample plot.

Demarcation of the shrub plots and the boundary The method of laying the shrub plots was described in the earlier section. The shrub plots will be located at one of the randomly selected corners of the tree plot. If a shrub is on the boundary line of the plot, it will be included into the plot if >50% of the shrub crown is within the plot.

Procedure for measuring trees in shrub plots The following steps will be adopted to measure the parameters in the shrub plots:

Step 1: The shrub plots will be located in the tree plots
Step 2: Start from one corner of the shrub plot and record indicator parameters and mark the plants after measurement, with a chalk or paint
Step 3: Record the species and the number of shrub plants under each species
Step 4: Measure the height of the tree using methods described for trees
Step 5: Measure DBH of all tree plants of >1.5 m in height in the shrub plot and if multiple shoots are present, record DBH for all
Step 6: Record the name, height, DBH and other features for each shrub plant in the formats.

Procedure for measuring non-tree vegetation This could include annual or perennial shrubs as well as very young tree seedlings (of height <1.5m). Estimation of non-tree biomass in shrub plots will be based on harvest method for annual as well as perennial shrubs. Tree seedling could be excluded from harvest procedure.

Biomass of annual shrubs will be estimated by clipping the shrubs according to each species in the shrub plot and taking fresh weight of the plants. Dry weight of the biomass can be estimated by taking a known quantity (of 0.5 to 1.0 kg) of sample and drying it in the oven.

Biomass of perennial shrubs is estimated by harvesting the perennial shrubs and estimating the fresh and dry weight of the shrubs. However, if a shrub species is yielding an economically valuable product, such species need not be harvested or a few representative shrub plants could be harvested to get a mean weight of a shrub plant. The mean weight of sample shrubs harvested can be extrapolated to the whole plot.

Location: GPS reading: Parcel ID:		Land use system: Stratum:			Tree plot no: Shrub plot no: Size of the plot:	Investigators: Date:
S. No.	Species	Diameter (cm)			Height (m)	Biomass – Fresh weight (kg)
		DBH1	DBH2	DBH3		

1						

Herbs Herbs are non-woody plants that usually die at the end of the season. Herb layer biomass includes all annual plants, regenerated saplings and grass biomass. Herb layer plots of size (1x1m) will be selected. Herb layer biomass is part of the annual carbon cycle and estimated through harvest method during the peak growth period.

Parameters Species name, number of plants and fresh weight of standing herb biomass are the parameters to be recorded.

Demarcation of the herb plots and the boundary The herb plots are usually 1x1 m in size and are marked at the two opposing corners of each shrub plot.

Measurement of the herb vegetation This includes recording of the species name and harvesting the herb biomass to determine the weight. The following steps could be adopted.

Step 1: Recording of the species name and number in each herb plot. The percent ground cover of the herb in the plot would also be recorded according to species based on visual observation.
Step 2: The herb plants will be harvested according to species in each herb plot.
Step 3: Next the fresh weight of the herb biomass according to species would be estimated
Step 4: Dry weight of the fresh herb biomass would be estimated by taking a small quantity and drying it in an oven.

Step 9 Data recording and compilation

Data recording formats have been developed for tree, shrub and herb species in sample plots. These formats are largely for use in the field. The data entered in these formats in the field would be verified and entered into a database for analysis. Some of the following precautions and steps would be followed to ensure correct recording in the field and its compilation in a computer for obtaining accurate estimates of the biomass are as follows:

- Use of the appropriate data entry format for trees, shrubs and herbs
- Ensure to enter the location name, date, plot number, vegetation type and name of the field investigator
- Enter and verify the GPS readings of the plots
- Enter and verify the units of height, DBH and weight
- Ensure all the relevant data recording cells in the formats are entered, before departing from the field location
- Verify the data recording formats as quickly as possible, after returning from the field, for any corrections or conversion of traditional units of measurement to the standard units such as metric system
- Codify if any entry requires the use of codes, by converting the qualitative information using the codes
- Develop a user friendly data entry system for computer analysis and for archiving of data
- Verify all the data entered and store in the database

Step 10 Calculation of aboveground biomass

Aboveground biomass would be estimated using biomass estimation equations for the dominant species raised in the reforestation models. These equations are available. The following steps would be adopted for estimating above ground biomass:

i) Select the biomass equation relevant to the region, plantation species and age of the stand
ii) Tabulate and enter the tree number, DBH and height (H) data into a computer data analysis package such as Excel or SPSS for each sample plot
iii) Enter the biomass equation in the data file or worksheet for estimating the weight of the individual tree (kg/tree) for a given DBH
iv) Estimate and add the weight of each tree derived using the DBH values from the sample plot selected
v) Add up the values of total weight of the trees in each of the sample plot to obtain the total weight of all the trees in the sample plots selected for the land category, reforestation model and stratum
vi) Extrapolate the biomass of trees from the sampled area to per hectare (tonnes/ha)
vii) The biomass equations provide volume (in m^3) estimates. These will be converted to biomass by multiplying the volume by the wood density of the tree species in the reforestation model. Wood density would be assessed from the sample plots of reforestation model for different species or collected from the research studies.

Step 11 Calculation of belowground biomass

Belowground biomass will be estimated using the IPCC default value of 0.26 of aboveground biomass. The aboveground biomass values obtained in Step-10, will be multiplied by the default value of 0.26, to obtain the belowground biomass value. Efforts will be made to obtain local aboveground and belowground biomass ratios, for the dominant species of the reforestation models raised in the project.

Step 12 Calculation of total biomass stock for species in a reforestation model

Total biomass carbon stock per hectare will be estimated by adding the aboveground and belowground biomass values calculated for each species belonging to the reforestation model.

Step 14 Calculation of biomass carbon stock values

The biomass values estimated per hectare for each reforestation model will be converted to tonnes of carbon per hectare using the IPCC default value of 0.5. Efforts would be made to obtain local conversion values for the dominant tree species.

Methods for monitoring soil organic carbon

Making an inventory of soil carbon involves estimating the quantity of organic carbon present in the soil of a given land-use category or strata in the A/R CDM project activity at a given depth. Soil organic carbon is less frequently estimated compared to above-ground biomass, since the annual rate of change is low. A soil carbon inventory involves

- Estimation of bulk density of the soil at the specified depth
- Estimation of the concentration of organic carbon content in the soil sample
- Conversion of organic carbon content to tonnes of carbon per unit area (tC/ha) for a given depth of soil, using the bulk density.

The broad steps involved in inventory of soil carbon are as follows:
Step 1: Select the three land categories along with reforestation models as described in Section C.4.
Step 2: Determine the frequency of measurement; once in 5 years

Step 3: Select the method for estimating bulk density; clod method
Step 4: Randomly locate sampling points in the field using the grid method (refer to Section 4 of living biomass)
Step 5: Collect soil samples for laboratory analysis (refer to Annex 3 describing baseline estimation method of soil organic carbon
Step 6: Measure bulk density parameters in the field using clod method (refer to any standard Soil Chemistry textbook or Ravindranath and Ostwald, 2007)
Step 7: Analyse the soil samples in the laboratory using Walkley Black method (refer to any standard Soil Chemistry textbook or Ravindranath and Ostwald, 2007)
Step 8: Enter field data and laboratory results into the database
Step 9: Calculate the quantity of soil organic carbon (tC/ha).
Step 10: Calculation procedure

Calculation of soil carbon density (tC/ha) involves calculation of bulk density of the soil and soil organic matter content. The equations for calculating bulk density and soil organic carbon are given below:

a. Bulk density: Calculate the bulk density (g/cc) by dividing the weight of the oven dry soil by the volume of the tin.

Bulk density (g/cc) = (weight of dry soil with tin – weight of empty tin)/volume of the tin

b. Soil organic carbon: The content of organic carbon in soil estimated in percentage terms can be converted to tonnes per hectare using bulk density, depth of soil and area (10,000 m^2).

Soil mass (t/ha) = [area (10,000 m^2/ha) x depth (0.3 m) x bulk density (t/m^3)]

Soil organic carbon (t/ha) = [soil mass in 0-30 cm layer x soil organic carbon concentration (%)]/100

5. Monitoring of GHG emissions

6. Monitoring of leakage
a)Activity shifting

The potential activity displacements options due to the implementation of project activities include:
- Conversion of land for cropping
- Conversion of land for grazing
- Shifting of fuelwood collection activities

Conversion of land for cropping In the proposed A/R CDM project, no conversion of land to cropland is likely to occur as the degraded forest and community land considered for the project is degraded and not fit for cropping. Furthermore, conversion these lands categories to cropland is banned under the law. Currently no conversion is occurring. Therefore emissions from conversion of land for cropping purposes, is not likely to occur. The abandoned private fallow lands are also in degraded state and abandoned for long periods.

Conversion of land for grazing Conversion of land outside the project boundary is unlikely due the factors explained in earlier sections.

Grass production is projected to increase due to protection and management of reforestation models. Local communities will be permitted to harvest grass and feed to the livestock. Grass production in the project area will be estimated by adopting plot method. Further, control plots will be laid next to the project area, not subjected to plantation activities. The method for estimating grass production is similar to annual herb biomass estimation and the following steps could be adopted:

Step 1: Select the land category or project activity and stratify the land area
Step 2: Adopt sampling procedures and select size and number of plots and locate them in the field using the procedure described for herb plots
Step 3: Select 4-5 quadrats, similar to selection of tree or shrub quadrats
Step 4: Divide the shrub or tree quadrat into 12 sub plots of size 1m x 1m to represent 12 months of a year and mark, and fence the plots
Step 5: Select a month and harvest the grass by clipping aboveground biomass in plot-1 (of size 1 x 1 m) of quadrat-1 and determine the fresh and dry weight of the grass biomass harvested
Step 6: Repeat the harvest procedure for plot-1 of all the quadrats during the month selected and estimate the fresh and dry weight of grass biomass (grams/m^2) and convert to per hectare estimate of grass production (grams/ha) in dry weight terms
Step 7: Repeat the harvest and biomass estimation method in plot-2 of each of the 4 or 5 quadrats and estimate fresh and dry weight during the next month, and finally estimate the grass production for the second month in terms of grams/ha
Step 8: Compile the monthly production of grass biomass (grams/ha) and calculate the average biomass for all the grass growing months and select the month for which the grass production is highest as the production for that grassland category.

Household survey will also be conducted to monitor the collection of grass from the project area

Household survey for monitoring grass collection from the project area

Household survey will be conducted in 10% of the households per GP and survey will be conducted once a month.

	Location 1			Location 2			Location 3		
	Number of trips	Frequency of trips per week	Quantity per trip (kg)	Number of trips	Frequency of trips per week	Quantity per trip (kg)	Number of trips	Frequency of trips per week	Quantity per trip (kg)
Farmer 1									
Farmer 2									
Farmer 3									
Farmer 4									
Farmer 5									

Shifting of fuelwood collection activities

Extraction of fuelwood will be estimated GP-wise and land category wise using the following steps.

Step 1: Select 10% of GPs from each watershed division
Step 2: Local investigator will monitor fuelwood removed from the project area using the following formats
Step 3: Monitoring will be conducted for one week every month, covering all the project area in the given GP
Step 4: The quantity of fuelwood extracted, normally in the form of head loads will be weighed using field spring balance
Step 5: Extrapolate the quantity of fuelwood extracted during the sample week to the remaining three weeks of the month
Step 6: Estimate the annual total fuelwood extracted based on the monthly data calculated

Field survey

Division: _____ GP: _____

Land category: _____ Reforestation model: _____

Parcel ID:

Year 1				Year 2				Year 3			
Date	Area (ha)	Species	Quantity of biomass removed (kg)	Date	Area (ha)	Species	Quantity of biomass removed (kg)	Date	Area (ha)	Species	Quantity of biomass removed (kg)

b) Fencing poles

GP	Land category	Reforestation model 1	Area (ha)	Source of poles	Land category	Reforestation model2	Area (ha)	Source of poles	Land category	Reforestation model2	Area (ha)	Source of poles	Average dimensio of pole (DBH & height)

Wood posts will be used in only about 50% of the total project area

7. Calculation of net GHG removal by sinks

Actual net greenhouse gas removals by sinks (CACTUAL): This is calculated as the sum of changes in living biomass carbon stocks and deducting the sum of emissions by sources within the project boundary, as a result of project activities using the following formula (Equation 13 of AR-ACM0001):

$C_{ACTUAL} = \Delta CP_B - GHG_E$

where:
C_{ACTUAL} = actual net greenhouse gas removals by sinks; tCO_2-e.
$\Delta CP_{,B}$ = sum of the changes in carbon stocks of all the pools (above- and below-ground and soil); tCO_2-e.
GHG_E = sum of the increases in GHG emissions by sources within the project boundary as a result of the implementation of an AR CDM project activity; t CO_2-e.

8. Archiving and storage of data

Documentation and archiving procedures for the A/R CDM project will focus on the following issues:

- Documentation of the consistency of time series data and methods for interpolating between samples and years
- Documentation on land-use categories
- Because of the complexity of data and models, providing thorough documentation allows internal QC checks and investigations and external QA reviews to operate effectively:
    - Archives will contain documentation on the assumptions, data sources, and other information

9. QA/QC plan

Quality control (QC), quality assurance (QA) and verification procedures are very important components of carbon inventory process, particularly to reduce the uncertainty involved in the estimation of carbon stock and changes. IPCC (2003 and 2006) provide the definitions and procedures for QA, QC and verification to enhance transparency and accuracy of the estimates of carbon inventory.

- *Quality Control* is a system of routine technical activities to measure and control the quality of the inventory as it is being developed, and is designed to:
    - Provide routine and consistent checks to ensure data integrity, correctness and completeness
    - Identify and address errors and omissions
    - Document and archive inventory material and record all QC activities.
- *Quality Assurance* is a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process.

QA/QC procedures will be developed and adopted particularly for the following activities;

- Field measurements
- Sample preparation and laboratory measurements
- Data entry and analysis
- Data storage and management

Quality control procedures: General QC procedures include quality checks related to calculations, data processing, completeness, documenting, and archiving procedures. Examples of QC activities and procedures involve the following:

- Check the assumptions used in the models
- Check the sampling procedure
- Check for transcription errors in data inputs
- Check the calculation procedures of carbon stocks and changes and units and conversions
- Check the time trends in long-term monitoring for any outliers
- Review internal documentation and archiving
- Check the suitability of use of any default data or coefficients
- Check the integrity of database files
    - Confirm the appropriate data processing steps are correctly represented in the database
    - Confirm the data relationships are correctly represented in the database
    - Ensure that data fields are properly labeled and have the correct design specifications
    - Ensure adequate documentation of database and model structure

Quality assurance review procedures: QA comprises activities outside the actual carbon inventory processes. The estimates of carbon stocks and changes may be reviewed by external agencies in an unbiased way. It is important to involve experts or reviewers who were not involved in the carbon inventory estimations. This requires an expert review to assess the quality of the carbon inventory and to identify areas where improvements are necessary. QA procedure involves expert peer review, involving:

- Review of calculations and assumptions
- Review, if the major models used have undergone peer review
- Assessment of documentation of models, input data and other assumptions.

Annex 5

SOCIAL SAFEGUARD MANAGEMENT FRAMEWORK

This carbon finance project will be operationalized as a part of the Himachal Pradesh Mid-Himalayan Watershed Development Project (MHWDP) and will consequently be adopting all the provision that were approved by the World Bank and that have thus been addressed as part of project implementation. As such, no separate social assessment and safeguard procedures have been deemed necessary. The CDM component will be implemented following the sub-project process that has been established, with a number of appropriate modifications which will be defined in the community operations manual (COM) and project implementation manual following successful negotiation. As such, it is expected that the CDM component will act to strengthen the existing social processes and implementation frameworks that aim towards pro-poor inclusion and livelihood improvements.

The existing recommendation of the ESMF will be applied in the implementation of the CDM component. However the following key additional steps are integrated into the overall project design:

- Adequate processes are developed to ensure that the poorest of the poor and vulnerable groups are given the opportunity to participate in the CDM component
- Adequate information is provided, in an appropriate format, to ensure that participation in this component is based on full, prior, informed consent of the risks and potential benefits

- That steps are made to ensure that the closing of parcels of land for CDM component in no way affects existing users (formal and informal) or that alternative sources of fodder, grazing, forest produce collection etc are made available
- That a strategy is put in place to ensure sustainability of CDM component management after the close of the MHWSDP.

Further, it has been agreed that the CDM component of the project will be assessed independently for performance in terms of pro-poor inclusions and tribal development, and will thereby aim to extend the overall projects achievements in terms of social development objectives. In addition, strategies will be developed to ensure that these implementation principles and practices are maintained following the closure of the MHWSDP.

This note summarized the social safeguard framework of the MHWSDP, outlines the key areas that will be addresses in the CDM component and sets out areas where implementation and management of the latter will be developed in light of these considerations.

In this note, reference to the 'project' refers to the World Bank assisted MHWSDP, and the CDM component to the activities to be supporting through carbon finance.

Context

The HPMHWSD project has been effective since January 15th 2006 and has an expected closing date of March 31st 2012. The primary objective of the project is to reverse the process of degradation of the natural resource base and improve the productive potential of natural resources and income of the rural households in the project area. The secondary objective is to support policy and institutional development to harmonize watershed development projects and policies across the state in accordance with best practices. The project has three main components: institutional strengthening, watershed development and management, and enhancing mountain livelihoods. Building on the experience of previous watershed development projects (IWDP 1 and 2) this project has been designed with a view to entrusting responsibility for most project implementation with local governments (GPs) rather than with village development committees, which were created as part of precursor projects.

The **Indigenous People (OP/BP 4.20) safeguard is triggered in the MHWSDP**. The PAD states that indigenous people are among the intended beneficiaries and the Project is likely to improve their situation through targeted interventions. For this purpose a tribal and transhumant plan was developed by the project (see below). Safeguard policy on Involuntary Resettlement (OP4.12) is not triggered on the agreement that there will be **no land acquisition in specific subproject areas proposed under the project and the project does not involve any involuntary resettlement.** These agreements over the application of safeguard policies will be applied in the implementation of the CDM component.

Tribal Development Plan – Summary and Status

The social assessment, which was carried out as part of the preparation of the MHWSDP, underlined the importance and challenges of ensuring that nomadic tribal groups avail of the benefits of the project in terms of enhanced livelihoods. As such a specific plan has been developed that aims to ensure that the needs of transhumant population along the migratory route including ensuring access to grazing lands, breed improvement, and mobile veterinary and medical and education facilitates etc. One of the key

challenges in terms of implementing this Plan relates to the challenge of ensuring effective consultations with the migratory populations at appropriate times in the year for needs identification and feedback[27].

As tribal development components of the project are focused on migratory groups, there is very limited application of these provisions to the CDM component of the project, as it has been agreed that land parcels that are eligible for CDM funding do not lie along the migratory route. The design of the project has consciously excluded notified grazing routes followed by transhumants.

The recommendations of the Social Assessment

Inclusion of Poor and Vulnerable Groups
The second aspect of the tribal development plan is the objective of ensuring the integration of tribals and migrants into watershed committees at the GP level and organizing them into groups to ensure their coverage within the project. However, the tribal development plans offer no explicit provision for settled tribes, or their settled family members. These aspects of tribal development have been included as part of the project implementation provisions for poor and vulnerable groups.

The ESMF refers sets out a Strategy for '*Equity, Inclusiveness, Participation and Transparency*' a part of the implementation cycle. This included specific recommendations to include the participation of women. The main component of this strategy that related to the CDM component are (*selected excerpts from ESMF*):

- Preliminary Consultations:
  - Identification of poor and vulnerable groups through wealth ranking (based on established criteria of land holding, assets ownership, house type, and women headed HH etc).
  - Budgetary provisions commensurate with needs of the poor population (minimum of 30% for poor and vulnerable groups)
  - Creation of opportunities for marginalized groups to participate in decision making process
- Groups formation
  - Creation of specific UGs for the inclusion of vulnerable and disadvantaged groups
  - The Executive of PWC shall have a minimum of 40% women and representatives from different castes, hamlets, including landless, SCs, Gaddis and Gujjars wherever applicable
  - At least two chairpersons of UG should be from vulnerable groups
  - One woman should be co-signatory of the project accounts at Panchayat level
- Planning
  - All poor and vulnerable members are listed in GPWSDP
- Sub-project screening
  - Does the activity have any adverse impacts on the indigenous people/ vulnerable families in terms of displacement?
  - Does the activity deprive vulnerable families in having share in the benefits accrued out of the common property resources
  - Does the activity restrict participation of women and marginalized groups

[27] This issue was raised during the implementation support mission November 2007.

- Does the activity affect natural resource-based livelihoods of the poor and other disadvantaged

- Awareness
  - An appropriate and effective IEC strategy plays a major role in the recommendation for social inclusion and transparency
- Transparency Measures
  - Social Audit - Operationalize social audit by constituting a social audit team comprising of four members – one woman, one ward member, one member from general house and one member from poor or vulnerable community. The audit report to be presented in Gram Sabha and summary be pasted on walls/notice boards etc
  - Right to Information – it is recommended that project level transparency mechanism should be linked to provision of the Right to Information Act to enhance effectiveness of transparency mechanisms.
  - Legal Literacy – due to the number of acts and legal agreements that impact on the project (forest act, land rights acts etc) a program of legal awareness was recommended.

The project has progressed well in terms of implementing these strategies, however it has been suggested that targeting process for the poorest and vulnerable groups need to be revisited periodically (as part of annual planning) as a mean of ensuring community awareness of this component and assessing its effectiveness[28].

Strengthening the capacity of institutions

The decision to implement this project through the GP is one of the most significant departures in this project, one that will yield important dividends especially in terms of sustainability. However politicization, limited capacity, limited equity and participation were identified as some of the key constraints to this approach. As such, the institutional development component of MHWSDP aims to redress some of these potential institutional weaknesses through training, capacity building and implementation support. Moreover, it is noted that the project is in the process of internalizing implementation experiences and developing new approaches to strengthen local institutions. One of the key issues has been the sharing of operations and maintenance funds between the GPs and the UGs – lessons of which has fed into the design of the CDM component.

Monitoring of Social Issues

The monitoring indicators needed for social compliance are already an integral part of the MHDWP. However, special attempt is made to extrapolate some of the key social indicators that may require additional attention under the CDM project. The project is currently in the process of reviewing and strengthening the M E and L system, with a particular focus on PME tools.

Public Accountability and Grievance Redressal

The project has established a web-site that regularly updates the status of various components of the project. This also includes a grievance redressal mechanism for stakeholders in general.

Status of Project Implementation and Quality Ratings

The project was rated 'satisfactory' on the key indicators during the November 2007 implementation support mission. Progress on the tribal development plan (social safeguards) it was noted that 42 tribal actions plans have been 'completed' and that a separate plan for transhumants and tribal groups has been

[28] This recommendation was recorded in the aide-memoire of the November 2007 Implementation Support Mission.

integrated into the micro-planning process. The mission notes that some of the newer field staff lacked clarity on the objectives of this component, especially in terms of promoting inclusiveness of the tribals in the project and integration of tribal development in the watershed development plan and other departmental programs.

Bio-Carbon Component – Safeguard Application and Social Management Framework

The implementation of the CDM component will follow the sub-project model that has been developed and implemented as part of the MHWSDP. As such, the project has not been assessed as an independent entity from a safeguards perspective and no specific social safeguards plan has been deemed necessary.

Bio-carbon activities adopted the same implementation strategy that has been developed for sub-components in the project whereby activities will be identified by the gram sabha and tri-partite agreements will be made between the GP, user groups and the project. In the case of the CDM component, revenue sharing between the GP and the user group has been decided in advance (20/80 split) with the understanding that GPs will use CDM funds for maintenance work that support watershed development and natural resource protection relating to the areas identified for the bio-carbon component.

While the existing project structure provided a relatively robust framework for implementation is notes that carbon credits offer a significant potential revenue flow to project beneficiaries and will substantially contribute toward the objective of reversing the process of degradation of the natural resource base and improving the productive potential of natural resources and income of the rural households in the project area. Furthermore, the CDM component will ensure a revenue stream for beneficiaries over a twenty year period. Hence, implementation plans need to ensure that sustainable systems are in place for the management of this component following the close of the MHWSDP.

Three types of lands will be covered under the CDM component – private lands, (government) forest lands and community lands. The implementation mechanism is similar for the latter two types of land which will follow the PFM 2001 regulations with slight modifications. User groups will be selected / formed to undertake plantation and protection and the carbon revenue will be shared on a 20/80 basis between GP and user groups respectively.

In all case, parcels of land that are eligible for the CDM component have been identified as part of project preparation based on technical assessment of size and natural resource quality. Implementation of the project in terms of reforestation is spread over 5 years, starting 2006. Total coverage under the CDM component is around 10,000 ha. Out of this, private land coverage is around 2,000 ha, with remainder being government or community lands.

In the case of private lands, the project will not support any investment in fencing or plantation; however eligible farmers will be able to receive 90% of the carbon credits (the remaining 10% goes to MHWDP for overhead charges) on the basis of assessment of verifiable emissions reduction (VER). The project will **exclude absentee land lords** from the CDM component, in the interests of equity. One of the underlying objective of CDM project is to provide cash which will start flowing starting 2009. In lieu of this, the project may encounter series of demands from various stakeholders. This may pose additional pressure on PMU for inclusion under this project. Considering this is a pilot initiative of the GoHP, adequate information and communication strategy are built into the project to explicitly mention that the current initiative is a pilot one and cannot include the entire command area of the mid Himalayan watershed. In addition, CDM guidelines may or may not qualify majority of the project command areas.

In the case of community and government lands, it is expected that around 500 or more user groups will be formed to manage these parcels. Identification of these groups will be done during the gram sabha. However, in the interests of equity, emphasis will be given to ensure that women, tribal and identified poorest and vulnerable groups are given the opportunity to participate in this component.

The **tri-partite agreements** between MHWDP, GP and user groups have been finalized and approved by GoHP.

Guidelines for the use of the carbon revenue accruing to the GP have been developed. At present the CDM component is envisaging these funds to be used to finance activities relating to the Gram Panchayat Watershed Development Plan, the planning period of which is limited to the MHWSDP. In view of the 20 year project cycle of the CDM component, a clause in agreement has been incorporated that specifies that these funds will be used only for activities relating to the protection of NR, planning for which will be done on an annual basis with the agreement of the CDM user groups and the GP through a decision passed in the Gram Sabha.

Involvement of the poorest of the poor and settled tribes

Beneficiary selection and community participation required under the CDM project are already envisaged in the COM of the MHWDP. This also includes extensive community mobilization process, GP level participation and community mobilization processes.

The COM also supports the following interventions:

- Development of a clear set of guidelines for the CDM component which will be documented as an addition to the existing COM setting out the eligibility criteria for the CDM component and beneficiary selection process
- Training for front line WDC staff regarding pro-poor identification process as part of the CDM component implementation
- Verification of the wealth ranking and tribal and vulnerable groups modules of the GPWSDP
- Development of monitoring systems for social inclusion in CDM component based on the above targets
- At least 40% of the GS is present at the general meeting to agree on the formation of user groups for CDM component.
- The current web site of the MHDWP has a grievance redressal mechanism outlined.

Strengthening Institutions and Sustainability

By the mid-term review of the MHWSDP, an institutional sustainability plan for the CDM component will be drafted. This will include the following:

- Proposed implementation structure for the CDM component after the end of the MHWSDP
- Transition plan to maximize the potential of a smooth transition
- Funding arrangement to ensure management of the CDM component, include maintenance of M and E systems, grievance redressal systems, staffing and training/capacity enhancement needs.

Screening Process

Closing parcels of land for the CDM component will entail the denial of grazing which will be adequately compensated through doubled grass production for cut and carry. On the basis of the sub-project recommendation of the ESMF of the MHWSDP, measures have been put in place to ensure that no adverse effects on poor, vulnerable and other marginalized groups. Under the terms of the CDM

component, where full closure of land parcels is involved, a more stringent screening process needs to be developed to ensure that all existing users of the land are informed of the terms of the tri-partite agreement. Where possible, alterative sources of natural resources need to be agreed on. Where not possible, there is a need to ensure benefit sharing arrangement between the user groups and the land users. One means to achieve this is to ensure that all users are made part of the NR protection groups.

The passing of resolutions in gram sabha will form the basis of this agreement, however sufficient mechanism will be put in place for prior consultation with formal and informal users of land parcels in order to make these provisions effective.

Informed consent and risk mitigation

As per the agreement with the World Bank, the value of the carbon credits will not fall below certain norms that have been established in advance of project implementation. Therefore, the potential risks associated with changing livelihood options for carbon based revenue is likely to be limited. However, in order to ensure that participation in this sub-component is based on free, prior and informed consent of the risks and revenues, the project needs to develop a special component of the community operations manual (COM) that describes the requirements and guaranteed returns that will accrue from taking up these activates. This component needs to be developed in conjunction with the community to ensure that the information is conveyed in a way that is understandable to low-literate groups.

Annex 6

LIST OF LAND PARCELS UNDER THE PROJECT

Eligibility report of Land Parcels-Pilot areas (FSI Report), will be sent by Arvind

Annex 7

CALCULATION OF NET ANTHROPOGENIC GHG REMOVALS BY SINKS

TARAM enclosed as a separate file

Annex 8

LEAKAGE ASSESSMENT

Enclosed as a separate file

Annex 9

LIST OF PARTICIPATING GRAM PANCHAYAT AND PRIVATE LAND OWNER STAKEHOLDERS

a. List of participating GPs, three excel sheets - one giving abstract, two others giving district wise and divison wise GPs with Codes for each region – enclosed as a separate file

b. List of Private land owners is very elaborate – Will be provided at the time of validation

Annex 10

CONTRACTURAL AGREEMENT ON CARBON REVENUE SHARING WITH COMMUNITIES

There are three agreements each for three land categories, considered in the project – enclosed as a separate file.

Annex 11

DOCUMENTARY EVIDENCE ON THE NON-DIVERSION OF ODA

Documentary evidence will be provided during Validation.