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

CONTENTS

Annexes

PROJECT DESIGN DOCUMENT FORM
FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD) - Version 02

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

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

>> Bagepalli CDM Reforestation Programme
Version 1
August 06 2006

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

>> The purpose of the proposed A/R CDM project activity "Bagepalli CDM Reforestation Programme" is to implement a reforestation activity on the degraded land of 5 taluks of North Kolar District of Karnataka, India. These lands are currently uncultivable lands, fallow lands or marginal croplands. They are all highly degraded. The majority of the lands are uncultivable or their productivity is very low due to scarcity of water resources and poor soil conditions for agriculture. The lands belong to the poorest farmers and agricultural labourers in the region who have had to make do with the worst kind of lands. Seasonal conditions have been the major factor causing fluctuation in the area under cultivation. The periodic drought and recurring scarcity have made any kind of land-based activity including agriculture very difficult.

The proposed reforestation activity on such degraded lands is of great promise. It will generate income to the marginal farmers, not only from the products but mainly from the sale of carbon credits. The proposed project activity will thus play a vital role in poverty alleviation. The project is thus designed to create long-term secure income for marginal farmers in the Bagepalli, Chickaballapur, Chintamani Gudibanda and Siddalaghatta taluks of Kolar District, as well as creating a lasting tree cover in the region.

Kolar District is a very dry region. The rainfall is scanty, and the nominal forest area is just 9% of the total area of the district (FSI,2003)[1]. Many of the forests are also themselves very degraded. The proposed project is essential for a district like Kolar. But the project proponents are not taking up any activities on Forest Department lands. The reforestation is only taking place on either marginal private lands of members of the Bagepalli Coolie Sangha organised by the Project Proponents and which is categorised as degraded land (wasteland) by the Government, or on Gram Panchayat wasteland under the control of the members of the Bagepalli Coolie Sangha and also organised by the Project Proponents. The title deeds to all the lands being reforested are available, and are pledged to the project, either for guaranteeing tCERs or project loans.

Apart from producing fruits, small amounts of timber, firewood, fodder, and materials required for agricultural implements, the indirect benefits of the "Bagepalli CDM Reforestation Programme" will be by way of moisture conservation in the soil, prevention of soil erosion, improvement of soil fertility by the addition of organic manure, reduction of flood havoc, and maintenance of the regular flow of water in the steams.

The view of the project participant is that this A/R CDM project activity provides a substantial contribution to sustainable development.

- It will generate income and improve the environmental well-being of local marginal farmer families.

[1] Source: State of Forest Report, Forest Survey of India, 2003, Dehra Dun, India.

- It will improve the soil and provide water erosion control: the production of litter and nutrient recycling enrich the soil with organic matter and essential nutrients, and the trees act as a barrier to water run-off and roots hold the soil in place.
- It will sequester carbon dioxide (CO_2) and generate emission reductions in greenhouse gases (GHG) that can be measured, monitored and certified.
- Decreases vulnerability to current climate change and climatic variability
- It will engage in capacity building through training and technical assistance.
- It will reforest 18,181 ha with local mixed species trees on degraded lands in 5 taluks of Northern Kolar district namely Bagepalli, Chickaballapur, Chintamani, Siddalaghatta and Gudibanda.
- It will monitor and assess the project's environmental and socio-economic impacts.
- It will sell temporary Certified Emission Reductions (tCERs)

The A/R CDM project activity is proposed on marginal farmer's lands that have land holdings of 0.2-1 ha and on Gram Panchayat land under the control of the participating members in the project. These farmers do not have the financial wherewithal to invest in planting activities and wait for several years for the financial benefits to accrue. Without the pre-project investment from carbon credits, it is not an economically feasible proposition. With the sales of carbon credit however, and with the collection of non-timber forest products (NTFPs), timber, firewood and fodder in the first few years, farmers will have enough benefits to make the A/R CDM project activity sustainable.

The species for planting were chosen by participating local families who selected local species, in consultation with Indian Institute of Science to maximise biomass growth based on 10 year field trials; the species are suited for the agro-climatic zone and to meet multiple local needs. The main species and numbers on one ha are:

Leucaena Leucocephala (Subabool)	175
Dalbergia sissoo (Sissoo)	280
Azadirachta indica (Yapa, Hevu)	40
Moringa oleifera (Nugekai)	170
Eucalyptus tereticornis (Nilgiri)	200
Gmelina arborea (kulimavu, kumbuda, kumulu)	280
Tamarindus indica (Chintamanu, Hunse)	40
Glyricidia maculata (Glyricidia)	450
Sesbania grandiflora (akace, agace, agase, agise)	660
Albizzia lebbek (Kala Siris, Bhander, Sarsaoda, Koko, Kalbage)	170
Madhuca indica (Ippa)	40
Bauhinia purpurea (Kachna, Chameli, Pasau)	340
Casuarina equisetifolia (Sarvemara)	175
Albizzia odoratissima (Siris, Pullivage, Nellivega, Hiharu, Bilwara, Chamkoroi)	170
Pongemia pinnata (kanniga)	40
Prosopis spicigera (Kabanni, Banni)	40
Acacia Auriculiformis (Auriculiformis)	625
Cassia siamea (Minjiri, Nellatangedu)	170
Sapindus laurifolus (soapnut)	20
Grevillea robusta (Silver oak)	175
Acacia tortalis (Mulvara, Barnei, Muglimara)	170
Phyllanthus emblica (nelli)	15

Albizia richardiana (Pachali)	25
Acacia Auric.(auriculiformis)	140
Acacia nilotica (Karijali, Nellatumma)	30
Tectona grandis (teak)	60
Swietenia mahagonia (Puttikai, Mahogani)	30
Terminalia tomentosa (Karimaradu, Thambavu)	20
Pterocarpus marsupium (Honne)	20
Hardwickia binnata (Anjan, Vereppa)	20
Artocarpus fraxinifolius (Jackfruit, Panasa)	10
Populus ssp,	10
Abrus ssp (Coral pea; galaganji, gul-ganji, gunja, gunji guruganji, gurugunji, haga, jeshtamadhu, madhuka madhukavalli, gulaganji, gunja, haga, kempu kannu beeja, guruganji, guruganji, gulagangi)	35
Feronia limonia (Balnvalgida)	20
Ziziphus jujube (Ber)	10
Ceiba pentadra (Seemeburga, Silk cotton, Seauel)	10
Annona squamosa (Sitaphal).	20
Eugeania jambolana (Nerale)	10
Ficus ssp (Ala etc)	5
Pithecellobium dulce (Seemahunse)	10
Artocarpus heterophyllus (Panasa)	5
Dalbergia latifolia (Shisham)	5
Babusa arundinacea (Kanta, Banas, Budit bans, Bamboo, Hollow bans, Velu)	10
Terminalia bellerica (Behera, Behdo, Gowa, Phomra, Kamia, Tharala, Thani, Thannia, Thavale, Hela, Vehela)	10
Samania saman (raintree)	5
Michelia Champaka (Champa, Titasopa, Sampige)	10
Aegle marmelos (Bel, Billi, Bil, Belpatra, Belphas)	10
Acacia ferruginea (Banni).	5

A.3. Project participants:

>>

Name of the party involved	Private and/or public entity project participants	Kindly indicate if the party involved wishes to be considered as project participant (Yes/No)
India (Host)	CER India Pvt. Ltd. E-mail : anandi@cerindia.com Site Internet : www.cerindia.com	No

A.4. Technical description of the A/R CDM project activity:

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

>> The proposed A/R CDM project activity is located as dispersed parcels of degraded lands belonging to Members of the Coolie Sangha and registered with Agricultural Development and Training Society in Bagepalli, Chickaballapur, Chintamani, Gudibanda and Siddalaghatta taluks of Kolar District, Karnataka, India.

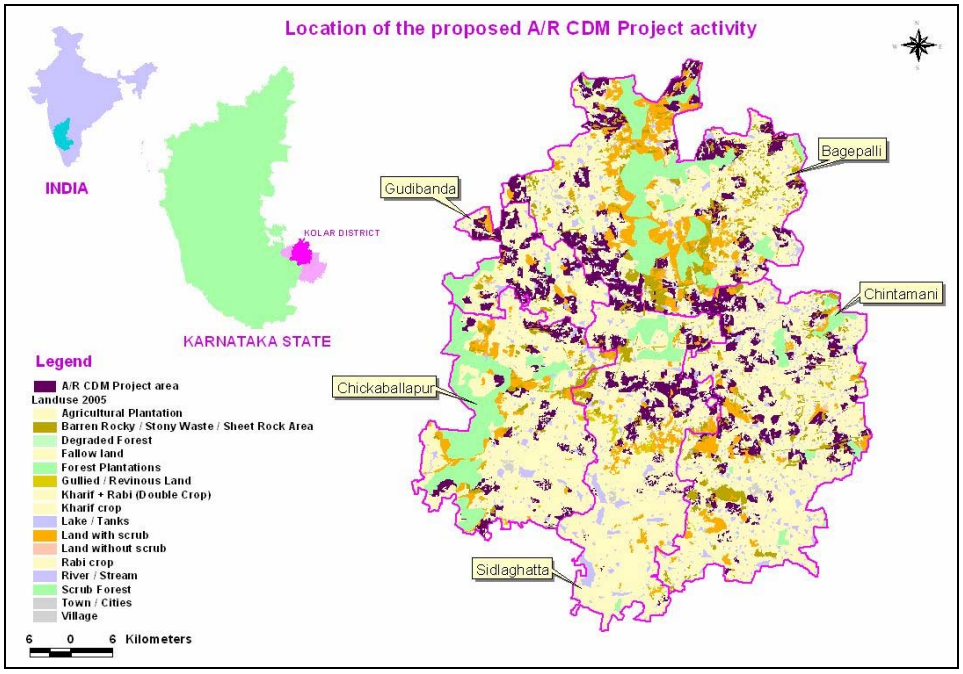


Fig A-1: Location of the proposed A/R CDM project activity

A.4.1.1. Host Party(ies):

>> India

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

>> Bagepalli, Chickaballapur, Chintamani, Gudibanda and Siddalaghatta taluks of Kolar District, Karnataka state.

A.4.1.3. City/Town/Community etc:

>> Villages in Bagepalli Taluk

Code	Cluster No.	Village	Hobli	Gram Panchayat
029	C001	Sakulavarapalli	Bagepalli Kasaba	Paragodu
033	C001	Devareddipalli	Bagepalli Kasaba	Paragodu
183	C001	Adepalli	Bagepalli Kasaba	Gantamvaripalli
184	C001	Puttaparthi	Bagepalli Kasaba	Gantamvaripalli
006	C003	Lagumaddepalli	Bagepalli Kasaba	Yellampalli
008	C003	Shankavarampalli	Bagepalli Kasaba	Yellampalli
008	C003	Neeragantapalli	Bagepalli Kasaba	Somnathpura
056	C003	Seegalapalli	Pathapalya	Somnathpura
014	C005	Nakkalapalli	Pathapalya	Somnathpura
015	C005	Somnathpura	Pathapalya	Somnathpura

016	C005	Gotlapalli	Pathapalya	Billur
032	C005	Billur MV	Pathapalya	Billur
020	C006	Billur HC	Pathapalya	Billur
021	C006	Mekalavaripalli	Pathapalya	Tholapalli
022	C006	Kallipalli HC	Pathapalya	Billur
057	C006	Upparlapalli	Pathapalya	Billur
094	C006	Mallepalli	Pathapalya	Billur
169	C006	Vangarlapalli	Pathapalya	Billur
191	C006	Goravanlapalli	Pathapalya	Marganku nte
720	C006	Pichilavarapalli	Gulur	Kothakota
173	C007	Honnampalli	Gulur	Kothakota
174	C007	Pesalaparthi HC	Gulur	Marganku nte
177	C007	Gunakalavaripalli	Gulur	Kothakota
179	C007	Madepalli	Gulur	Kothakota
186	C007	Maddakavaripalli	Gulur	Kothakota
187	C007	Kothakota	Gulur	Palyakere
787	C007	Banalapalli	Chellur	Palyakere
041	C011	Palyakere MV	Chellur	Palyakere
042	C011	Abravarapalli	Chellur	Palyakere
095	C011	Masanapalli	Chellur	Palyakere
154	C011	Chowdampalli	Chellur	Nallagutlapalli
194	C011	Peddarajapalli	Chellur	Nallagutlapalli
196	C011	Pedduru	Chellur	Nallagutlapalli
043	C012	Beerangavanlapalli	Chellur	Nallagutlapalli
045	C012	Pasupalavarapalli	Chellur	Nallagutlapalli
046	C012	Gundlapalli	Chellur	Nallagutlapalli
048	C012	Venkatapuram	Chellur	Nallagutlapalli
050	C013	Iddilavaripalli	Chellur	Puligal
051	C013	Bajjapuram	Chellur	Chelur
052	C013	Nallasanampalli	Chellur	Chelur
078	C013	Sherkhankote	Chellur	Naremaddepalli
160	C013	Byrappanapalli	Chellur	Naremaddepalli
189	C013	Shivapuram	Pathapalya	Naremaddepalli
066	C017	Gadivanlapalli	Pathapalya	Naremaddepalli
067	C017	Besthalapalli	Pathapalya	Rascheruvu
068	C017	Doddivaripalli	Pathapalya	Rascheruvu
071	C017	Rascheruvu HC	Chellur	Rascheruvu
090	C019	Rascheruvu MV	Chellur	Rascheruvu
091	C019	Ramasamipalli	Chellur	Rascheruvu
096	C019	Kondoripalli	Chellur	Thimmampalli
192	C019	Somakapalli	Chellur	Thimmampalli
195	C019	Egava Maddalakhane	Gulur	Thimmampalli
117	C024	Chencharayanapalli HC	Gulur	Thimmampalli
118	C024	Chencharayanapalli MV	Gulur	Thimmampalli
119	C024	Bommaiagaripalli	Gulur	Thimmampalli
120	C024	Gundlapalli	Gulur	Gorthapalli
121	C024	G. Maddepalli HC	Gulur	Gorthapalli
123	C025	Jeekavanlapalli	Gulur	Gorthapalli

134	C025	G. Cherulopalli	Gulur	Gorthapalli
135	C025	D. Kothapalli	Gulur	Gorthapalli
139	C028	Donnakonda	Gulur	Gorthapalli
140	C028	Sajjapalli MV	Gulur	Gorthapalli
141	C028	Sajjapalli HC	Gulur	Gorthapalli
142	C028	Egava D. Kothapalli	Gulur	Gulur
155	C028	Gorthapalli	Gulur	Gulur
193	C028	Siddapalli Thanda	Gulur	Gulur
110	C029	Saddapalli Digava Thanda	Gulur	Gulur
145	C029	Saddapalli	Gulur	Gulur
146	C029	Saddapalli Egava Thanda	Gulur	Marganku nte
151	C029	Koigutta Thanda	Gulur	Marganku nte
190	C029	Maraganakunte MV-A	Gulur	Marganku nte
170	C030	Maraganakunte MV-B	Gulur	Marganku nte
171	C030	Maraganakunte HC	Gulur	Marganku nte
172	C030	Narayanaswamykote	Gulur	Julapalya
180	C030	Pokamakalapalli	Gulur	Julapalya
198	C030	Gajilakothapalli	Mittemari	Julapalya
724	C031	Cheruvumundarapalli	Mittemari	Julapalya
703	C032	Julapalya A	Mittemari	Julapalya
708	C032	Julapalya B	Mittemari	Julapalya
709	C032	Julapalya C	Mittemari	Julapalya
710	C032	Bodikadirepalli	Mittemari	Julapalya
711	C032	Bandakindapalli	Mittemari	Julapalya
712	C032	Pedda Nagarlu	Mittemari	Julapalya
735	C035	Polanayakanapalli HC	Mittemari	Julapalya
740	C035	Polanayakanapalli MV	Mittemari	Julapalya
741	C035	Bathalapalli	Mittemari	Julapalya
742	C035	Poolakuntlapalli	Mittemari	Julapalya
743	C035	Bommasandra	Mittemari	Julapalya
744	C035	Kuntlapalli	Mittemari	Julapalya
745	C035	Sridharavarapalli	Mittemari	Julapalya
713	C036	Vadigiri	Mittemari	Julapalya
715	C036	Bandolapalli	Mittemari	Julapalya
716	C036	Nadimpalli	Mittemari	Julapalya
717	C036	Paipalya-A	Mittemari	Somnathpura
746	C036	Paipalya-B	Mittemari	Somnathpura
747	C036	Egava Netkuntlapalli	Pathapalya	Palyakere
088	C037	Digava Netkuntlapalli	Pathapalya	Palyakere
089	C037	Gollapalli	Pathapalya	Palyakere
092	C037	Gownavaripalli	Chellur	Julapalya
181	C037	Mandyampalli	Chellur	Mittemari
036	C038	Hosahudya	Mittemari	Mittemari
723	C039	Chinnarapalli	Mittemari	Mittemari
816	C040	Gwallapalli	Mittemari	Mittemari
817	C040	Surappalli	Mittemari	Mittemari
818	C040	Chinnampalli	Mittemari	Kanagamakalapalli
820	C040	Gubbolapalli	Mittemari	Kanagamakalapalli

821	C040	Muguchinnapalli	Mittemari	Kanagamakalapalli
005	C041	Vardaiagaripalli	Mittemari	Kanagamakalapalli
799	C041	Vanaganapalli	Mittemari	Kanagamakalapalli
801	C041	Buttavarapalli	Mittemari	Yellampalli
802	C041	Patrolapalli	Mittemari	Yellampalli
804	C041	Saprampalli	Mittemari	Kanagamakalapalli
805	C041	Solamakalapalli	Mittemari	Kanagamakalapalli
808	C042	Giripalli	Mittemari	Kanagamakalapalli
809	C042	Chinna Giripalli	Mittemari	Kanagamakalapalli
810	C042	Hanumantharayanapalli	Mittemari	Kanagamakalapalli
814	C042	Patlopalli	Mittemari	Kanagamakalapalli
815	C042	Jeeganapalli	Mittemari	Mittemari
794	C043	Appaswamy Thanda	Mittemari	Mittemari
795	C043	Kempaiah Thanda	Mittemari	Kanagamakalapalli
796	C043	Mittemari A	Mittemari	Mittemari
797	C043	Mittemari B	Mittemari	Mittemari
798	C043	Mittemari C	Mittemari	Mittemari
819	C043	Malligurki	Mittemari	Mittemari
826	C043	Papnepalli	Mittemari	Mittemari
827	C043	Merupalli	Mittemari	Kanagamakalapalli
824	C044	Nallamallepalli	Mittemari	Kanagamakalapalli
828	C044	Kothakota	Mittemari	Kanagamakalapalli
811	C045	Dommirigudisulu	Mittemari	Kanagamakalapalli
812	C045	Pillagutta	Mittemari	Kanagamakalapalli
822	C045	Kanagamakalapalli	Mittemari	Kanagamakalapalli
825	C045	Kodipalli	Mittemari	Kanagamakalapalli

Villages in Chickballapur villages

Code	Cluster No.	Village	Hobli	Gram Panchayat
301	C101	Susaipalya	Chickballapur Kasaba	Thippenahalli
302	C101	Badaganahalli	Chickballapur Kasaba	Thippenahalli
303	C101	Ankanagondhi	Chickballapur Kasaba	Thippenahalli
304	C101	Hanumanthapura	Chickballapur Kasaba	Thippenahalli
375	C102	Byreganahalli	Mandikal	Dodda Peyalagurki
307	C103	Hariharpura	Chickballapur Kasaba	Avalagurki
311	C103	Vadrepalya	Chickballapur Kasaba	Avalagurki
312	C103	Kavaranahalli	Chickballapur Kasaba	Avalagurki
313	C103	Kurlahalli	Chickballapur Kasaba	Avalagurki
318	C103	Sadenahalli	Chickballapur Kasaba	Gollahalli
320	C104	Kariganapalya	Chickballapur Kasaba	Gollahalli
322	C104	Beeraganahalli	Chickballapur Kasaba	Dodda Peyalagurki
323	C104	Ramaganaparthy	Chickballapur Kasaba	Dodda Peyalagurki
354	C109	Kadiridevarapalli	Mandikal	Peresandra
355	C109	Yelagalahalli	Mandikal	Peresandra
357	C109	Haleperesandra	Mandikal	Peresandra
360	C109	Korenahalli	Mandikal	Peresandra
363	C110	Shettivarahalli	Mandikal	Peresandra

364	C110	Boyanahalli	Mandikal	Peresandra
365	C110	Dommarigudisalu	Mandikal	Peresandra
366	C110	Tumakunta	Mandikal	Peresandra
404	C121	Udigiri Nallapanahalli	Mandikal	Kammaguttahalli
405	C121	Vantur	Mandikal	Kammaguttahalli
416	C122	Renumakalahalli	Chickballapur Kasaba	Kammaguttahalli
418	C123	Gowdanahalli	Chickballapur Kasaba	Dodda Peyalagurki
421	C123	Haristhala	Mandikal	Dodda Peyalagurki
305	C124	Kothanur	Nandi	Kuppahalli
477	C124	Kuppahalli	Nandi	Kuppahalli
482	C124	Thirnahalli	Nandi	Kuppahalli
484	C124	Byranayakanahalli	Nandi	Nandi
430	C125	Devasthanada Hosahalli A	Chickballapur Kasaba	Harobande
432	C125	Soppahalli	Chickballapur Kasaba	Harobande
433	C125	Inminchenahalli	Chickballapur Kasaba	Dodda Peyalagurki
434	C125	Gundlugurki A	Chickballapur Kasaba	Manchanabale
435	C125	Gundlugurki B	Chickballapur Kasaba	Manchanabale
436	C128	Pathuru	Chickballapur Kasaba	Angarekhanahalli
445	C128	Marlakunte	Chickballapur Kasaba	Angarekhanahalli
446	C128	Honnapanahalli	Chickballapur Kasaba	Angarekhanahalli
450	C128	Angarekanahalli	Chickballapur Kasaba	Angarekhanahalli
452	C128	Seemanahalli	Chickballapur Kasaba	Angarekhanahalli
453	C128	Avulahalli	Chickballapur Kasaba	Angarekhanahalli
458	C129	Dodda Kirugambi	Nandi	Ajjavara
460	C129	Ajjivara	Nandi	Ajjavara
463	C130	Thimmanahalli	Nandi	Kondenahalli
464	C130	Kadiseeganahalli	Nandi	Kondenahalli
465	C130	Sreerampura	Nandi	Agalagurki
467	C130	Kanithahalli	Nandi	Kondenahalli
468	C130	Kondenahalli	Nandi	Kondenahalli
470	C131	Kuduvathi	Nandi	Kuppahalli
471	C131	Erenahalli	Nandi	Kuppahalli
472	C131	Angatta	Nandi	Kuppahalli
478	C132	Seegatenahalli	Nandi	Muddenahalli
479	C132	Gantiganahalli	Nandi	Muddenahalli
480	C132	Bandahalli	Nandi	Muddenahalli
481	C132	Bachalli	Nandi	Muddenahalli
489	C132	Suddahalli	Nandi	Muddenahalli
485	C133	Kanganahalli	Nandi	Muddenahalli
486	C133	Madirenahalli	Nandi	Muddenahalli
487	C133	Naskunte Hosur	Nandi	Muddenahalli
488	C133	Gowchenahalli	Nandi	Muddenahalli

Villages in Chintamani Villages

Code	Cluster No.	Village	Hobli	Gram Panchayat
501	C201	Korlaparthi HC	Chilakalnerpu	Korlaparthi
503	C201	Gajalavaripalli	Chilakalnerpu	Korlaparthi
505	C201	K. Devaganahalli	Chilakalnerpu	Korlaparthi

506	C201	Bachaganahalli	Chilakalnerpu	Korlaparthi
518	C201	Masanahalli	Chilakalnerpu	Korlaparthi
563	C201	K. Gollahalli	Chilakalnerpu	Korlaparthi
514	C203	Kadirepalli Cross	Chilakalnerpu	Korlaparthi
515	C203	Papathimmanahalli HC	Chilakalnerpu	Korlaparthi
516	C203	Rampamthoti	Chilakalnerpu	Korlaparthi
517	C203	Bandepalli	Chilakalnerpu	Korlaparthi
519	C203	Papathimanahalli MV	Chilakalnerpu	Korlaparthi
521	C204	Nandanahosahalli	Chilakalnerpu	Mittehalli
522	C204	Chikka Kattigenahalli	Chilakalnerpu	Mittehalli
523	C204	Dodda Katigenahalli MV	Chilakalnerpu	Mittehalli
524	C204	Dodda Katigenahalli HC	Chilakalnerpu	Mittehalli
526	C204	Peddagutlapalli	Chilakalnerpu	Mittehalli
561	C204	Yerramareddipalli	Chilakalnerpu	Korlaparthi
940	C204	Seegalagudam	Chilakalnerpu	Korlaparthi
527	C205	Mittehalli MV	Chilakalnerpu	Mittehalli
529	C205	Appasanahalli	Chilakalnerpu	Mittehalli
531	C205	Basavapura	Chilakalnerpu	Burudugunta
566	C205	Kodegandlu	Chilakalnerpu	Kencharlahalli
533	C206	Shettinayakanahalli HC	Chilakalnerpu	Kencharlahalli
534	C206	Shettinayakanahalli MV	Chilakalnerpu	Kencharlahalli
537	C206	Marabanahalli	Chilakalnerpu	Kencharlahalli
554	C206	Kancharlapalli	Chilakalnerpu	Kencharlahalli
557	C206	Rasapalli	Chilakalnerpu	Mittehalli
565	C206	Kommepalli	Chilakalnerpu	Mittehalli
601	C221	Kethanayakanapalli	Ambasadurga	Shettihalli
604	C221	Mohammedpura A	Ambasadurga	Konapalli
605	C221	Mohammedpura B	Ambasadurga	Konapalli
615	C221	Kanganahalli	Ambasadurga	Kathriguppa
616	C221	Batharahalli	Ambasadurga	Kathriguppa
617	C221	Hussainpura	Ambasadurga	Kathriguppa
618	C223	Bommaikal MV	Ambasadurga	Upparpet
619	C223	Bommaikal HC	Ambasadurga	Upparpet
620	C223	Dodda Gutlahalli	Ambasadurga	Masthenahalli
621	C223	Thinnakallu	Ambasadurga	Upparpet
623	C223	Burugamakalapalli	Ambasadurga	Upparpet
625	C223	Yerraseeganahalli	Ambasadurga	Kathriguppa
627	C224	Dodda Kondarahalli	Ambasadurga	Upparpet
629	C224	Mailapura HC	Kaivara	Peramachanahalli
632	C224	Kendenahalli MV	Kaivara	Peramachanahalli
635	C224	Nallagutlapalli	Kaivara	Chinnasandra
636	C224	Chikka Kondarahalli	Kaivara	Upparpet
637	C224	Narayanapalli	Kaivara	Chinnasandra
661	C224	Kendanahalli HC	Kaivara	Peramachanahalli
662	C224	Mailapura MV	Kaivara	Peramachanahalli
547	C225	Kariyapalli	Munganahalli	Raguttahalli
553	C225	Gudipapanahalli	Munganahalli	Raguttahalli
634	C225	Seemanagutta	Munganahalli	Kadadalamari

958	C225	Yasagalahalli	Munganahalli	Raguttahalli
959	C225	Kodigal A	Munganahalli	Kadadalamari
960	C225	Kodigal B	Munganahalli	Kadadalamari
962	C225	Egava Nagarajahosahalli	Munganahalli	Raguttahalli
647	C227	Thippanahalli	Ambasadurga	Kotagal
648	C227	Veerapalli	Ambasadurga	Kotagal
650	C227	Chowdadepalli	Ambasadurga	Shettihalli
651	C227	Raguttahalli	Ambasadurga	Kotagal
936	C227	Gopalapura	Ambasadurga	Kotagal
652	C228	Burudagunte HC	Chilakalnerpu	Burudugunta
656	C228	Ulebale	Chilakalnerpu	Enegadale
657	C228	Deshwarapalli	Chilakalnerpu	Burudugunta
658	C228	Gadigavaripalli MV	Chilakalnerpu	Burudugunta
664	C229	Nimakailapalli	Murugamalla	Nandiganahalli
665	C229	Digavapalli	Murugamalla	Peddur
666	C229	Muddalahalli	Murugamalla	Nandiganahalli
667	C229	Gownicherlapalli	Murugamalla	Peddur
668	C229	Kothapalli	Murugamalla	Peddur
669	C229	Bodigundlapalli	Murugamalla	Peddur
670	C229	Korakanapalli	Murugamalla	Peddur
928	C244	Kotagal B	Ambasadurga	Gudisalapalli
930	C244	Gudisalapalli	Ambasadurga	Bhoomishettihalli
934	C244	Doddipalli	Ambasadurga	Kotagal
939	C244	Kurumarlapalli	Ambasadurga	Kotagal
568	C246	Vyjakooru	Kaivara	Santhekalahalli
680	C246	Byalahalli	Kaivara	Hirekattigenahalli
684	C246	Madabahalli	Kaivara	Peramachanahalli
986	C246	Virupakshapura	Kaivara	Santhekalahalli
991	C246	Beerajenahalli	Kaivara	Santhekalahalli
663	C248	Nallagutlapalli	Munganahalli	Raguttahalli
691	C248	Seetharamapuram	Munganahalli	Irigampalli
900	C248	S. Raguttapalli	Munganahalli	Raguttahalli
964	C248	Brahmanahalli	Munganahalli	Raguttahalli
966	C248	Madamangala	Munganahalli	Raguttahalli
569	C249	Siddepalli Cross	Murugamalla	Bhoomishettihalli
672	C249	Chilamkota	Murugamalla	Murugamala
967	C249	Yerrakota	Murugamalla	Murugamala
970	C249	Gudarlahalli HC	Murugamalla	Murugamala
971	C249	Gudarlahalli MV	Murugamalla	Murugamala
972	C249	Gudamarlahalli	Murugamalla	Bhoomishettihalli
567	C250	Krishnapuram	Munganahalli	Kadadalamari
600	C250	Hanumaiagaripalli	Munganahalli	Kadadalamari
696	C250	Soonappagutta HC	Munganahalli	Kadadalamari
697	C250	Soonappagutta	Munganahalli	Kadadalamari
926	C250	C. Gundlapalli	Chilakalnerpu	Enegadale
956	C250	Vangamala	Chilakalnerpu	Enegadale
698	C251	Seethahalli	Munganahalli	M. Gollahalli
952	C251	Digava Devappalli	Munganahalli	M. Gollahalli

953	C251	Egava Devappalli	Munganahalli	M. Gollahalli
975	C251	Munganapalli HC	Munganahalli	M. Gollahalli
976	C251	Munaganapalli MV	Munganahalli	M. Gollahalli
979	C251	Talarolapalli	Munganahalli	Batlahalli
981	C251	Bodampalli	Munganahalli	Batlahalli
645	C252	Pathakotha	Murugamalla	Peddur
687	C252	Egavakota	Murugamalla	Egavakota
688	C252	Hosahudya	Murugamalla	Egavakota
689	C252	Vempalli	Murugamalla	Peddur
690	C252	Digavakota	Murugamalla	Peddur
692	C252	Kondavenakapalli	Murugamalla	Egavakota
646	C253	Talagavara	Kaivara	Talagavara
683	C253	Nagendrahalli Colony	Kaivara	Peramachanahalli
912	C253	Peramachanahalli	Kaivara	Peramachanahalli
982	C253	Vaddahalli	Kaivara	Talagavara
984	C253	Mallikapura	Kaivara	Talagavara
989	C253	Kothur B	Kaivara	Masthenahalli
990	C253	Marappanahalli	Kaivara	Masthenahalli
572	C260	Y. Kapalli	Murugamalla	M. Gollahalli
923	C260	Palligadda	Munganahalli	M. Gollahalli
944	C260	Chowdareddipalya	Munganahalli	Peddur
945	C260	Lakkepalli	Munganahalli	M. Gollahalli
946	C260	Venkatarayanakote	Munganahalli	M. Gollahalli
947	C260	Guttapalya	Munganahalli	M. Gollahalli
951	C260	Kondliganahalli HC	Munganahalli	M. Gollahalli

Villages in Gudibanda villages

Code	Cluster No.	Village	Hobli	Gram Panchayat
201	C071	Somalapuram	Gudibanda Kasaba	Ullodu
203	C071	Karaganathamanahalli	Gudibanda Kasaba	Ullodu
208	C071	Ullodu	Gudibanda Kasaba	Ullodu
210	C071	Chowtathimannahalli	Gudibanda Kasaba	Ullodu
269	C071	Poovalamakalapalli	Gudibanda Kasaba	Ullodu
215	C073	Chikkathamenahalli	Gudibanda Kasaba	Beechaganapalli
216	C073	Koppukatenahalli	Gudibanda Kasaba	Beechaganapalli
217	C073	Sadashivanahalli	Gudibanda Kasaba	Beechaganapalli
218	C073	Eereddipalli	Gudibanda Kasaba	Beechaganapalli
219	C073	Giddapannahalli	Somenahalli	Varlakonda
227	C073	Balepalli	Gudibanda Kasaba	Beechaganapalli
224	C075	Singanapalli	Somenahalli	Thirumani
230	C075	Ganganapalli	Somenahalli	Somenhalli
231	C075	Jambigemaradahalli	Somenahalli	Somenhalli
232	C075	Chintakayalapalli	Somenahalli	Somenhalli
234	C075	Mallenahalli	Somenahalli	Somenhalli
237	C076	Kalvagaddapalli	Somenahalli	Thirumani
238	C076	Katenahalli	Somenahalli	Somenhalli

285	C076	Thirumani	Somenahalli	Thirumani
244	C077	Korepalli	Kasaba	Hampasandra
245	C077	Dhoomakuntapalli	Gudibanda Kasaba	Beechaganapalli
246	C077	Gandhamanagenahalli	Gudibanda Kasaba	Beechaganapalli
247	C077	Thattapalli	Gudibanda Kasaba	Hampasandra
258	C079	Pulasanavoddu	Gudibanda Kasaba	Hampasandra
260	C079	Yerrapalli	Gudibanda Kasaba	Yellodu
228	C080	Bandarlahalli	Gudibanda Kasaba	Beechaganapalli
263	C080	Ramaganahalli	Gudibanda Kasaba	Beechaganapalli
264	C080	Chikka Kurubarahalli	Gudibanda Kasaba	Beechaganapalli
265	C080	Gavikuntapalli	Gudibanda Kasaba	Beechaganapalli
267	C080	Dapparrthy	Gudibanda Kasaba	Beechaganapalli
268	C080	Beechaganapalli	Gudibanda Kasaba	Beechaganapalli
270	C080	Bathalapalli	Gudibanda Kasaba	Ullodu
252	C081	Gadacharlapallii	Gudibanda Kasaba	Hampasandra
266	C081	Kondavulapalli	Gudibanda Kasaba	Ullodu
271	C081	Lakkepalli	Gudibanda Kasaba	Hampasandra
272	C081	Pasupallodu	Gudibanda Kasaba	Hampasandra
273	C081	Kondireddipalli	Gudibanda Kasaba	Hampasandra
274	C081	Machapalli	Gudibanda Kasaba	Hampasandra
259	C082	Gundlahalli	Gudibanda Kasaba	Yellodu
275	C082	Nilugumba	Gudibanda Kasaba	Yellodu
278	C082	Yellodu	Gudibanda Kasaba	Yellodu
279	C082	Ambapura	Gudibanda Kasaba	Yellodu
280	C082	Kambalapalli	Gudibanda Kasaba	Yellodu
202	C083	Chinnapalli	Gudibanda Kasaba	Ullodu
204	C083	Brahmanahalli	Gudibanda Kasaba	Ullodu
209	C083	Ninchinabandapalli	Gudibanda Kasaba	Ullodu

Villages in Siddalaghatta Villages

Code	Cluster No.	Village	Hobli	Gram Panchayat
429	C307	Pendlavarahalli	Busetihalli	Busettihalli
758	C307	Valasahalli	Busetihalli	Busettihalli
760	C307	Ammorathimmanahalli	Busetihalli	Busettihalli
776	C307	Ammagarahalli	Busetihalli	Busettihalli
777	C307	Busetihalli	Busetihalli	Busettihalli
884	C307	Dodda Gummanahalli	Busetihalli	Busettihalli
765	C309	Tharabahalli	Busetihalli	Pallicherlu
766	C309	Pallicherla HC	Busetihalli	Pallicherlu
767	C309	Pallicherla MV	Busetihalli	Pallicherlu
768	C309	Kanapanahalli	Busetihalli	Pallicherlu
770	C309	Saddahalli	Busetihalli	Pallicherlu
771	C309	Devappanagudi	Busetihalli	Abloodu
772	C309	Byreganahalli	Busetihalli	Pallicherlu
773	C309	Kotahalli	Busetihalli	Abloodu
507	C311	Venkatapura	Busetihalli	Dibburahalli
512	C311	Thalakayalakonda	Busetihalli	Dibburahalli

		Digava		
560	C311	Thalakayalakonda	Busetihalli	Dibburahalli
778	C311	Bayapanahalli	Busetihalli	Dibburahalli
882	C311	Marlappanahalli	Busetihalli	Thimmanayakanahalli
761	C312	Mummenahalli	Busetihalli	Pallicherlu
762	C312	Marihalli	Busetihalli	Dodda Tekuhalli
763	C312	Chowdireddihalli	Busetihalli	Dodda Tekuhalli
849	C312	Somanahalli	Busetihalli	Pallicherlu
831	C321	Kadirinayakanahalli	Siddalaghatta Kasaba	Kothanur
834	C321	Chennahalli	Siddalaghatta Kasaba	Y. Hunasenahalli
835	C321	Hosahalli	Siddalaghatta Kasaba	Kothanur
840	C321	Chikka Dasenahalli	Siddalaghatta Kasaba	Y. Hunasenahalli
779	C322	Devaramallur	Siddalaghatta Kasaba	Devara Mallur
780	C322	Marappanahalli	Siddalaghatta Kasaba	Y. Hunasenahalli
782	C322	Sonnenahalli	Siddalaghatta Kasaba	Devara Mallur
838	C322	Varahunsenahalli A	Siddalaghatta Kasaba	Y. Hunasenahalli
839	C322	Varahunsenahalli B	Siddalaghatta Kasaba	Y. Hunasenahalli
500	C323	Egava Ganjigunta	Busetihalli	Ganjigunte
502	C323	Digava Ganjigunta	Busetihalli	Ganjigunte
511	C323	Alagurki	Busetihalli	Thimmanayakanahalli
846	C323	Chokkanahalli	Busetihalli	Ganjigunte
847	C323	Gonemardahalli	Busetihalli	Thimmanayakanahalli
848	C323	Bapanehalli	Busetihalli	Ganjigunte
851	C323	Gangahalli	Busetihalli	Ganjigunte
855	C324	Nallojapalli	Busetihalli	Thimmanayakanahalli
857	C324	Dadamghatta	Busetihalli	Thimmanayakanahalli
895	C324	Kudupukunte	Busetihalli	Thimmanayakanahalli
899	C324	Thimmanayakanahalli	Busetihalli	Thimmanayakanahalli
509	C325	Hale Ganjigunta	Busetihalli	Ganjigunte
541	C325	Lakkepalli	Busetihalli	Ganjigunte
544	C325	Pedda Bandaragatta	Busetihalli	Ganjigunte
545	C325	Chinna Bandaragatta	Busetihalli	Ganjigunte
558	C325	Vemagal	Busetihalli	Ganjigunte
788	C326	Subbarayanahalli	Sadali	Thimmasandra
793	C326	Byraganahalli	Sadali	Thimmasandra
866	C326	Thimmasandra A	Sadali	Thimmasandra
868	C326	Eegaletapalli	Sadali	Thimmasandra
869	C326	Thimmasandra B	Sadali	Thimmasandra
876	C326	Halehalli	Sadali	Thimmasandra
872	C327	Shettikere A	Sadali	Thimmasandra
874	C327	Kommasandra	Sadali	Thimmasandra
878	C327	Varasandra	Sadali	Thimmasandra
879	C327	Turukeshanahalli	Sadali	Thimmasandra
880	C327	Kondarasanahalli	Sadali	Thimmasandra
510	C329	Madepalli	Busetihalli	Ganjigunte
893	C329	Poolakuntlapalli	Busetihalli	Ganjigunte
897	C329	Nakkalahalli	Busetihalli	Thimmanayakanahalli
898	C329	Buduguvarapalli	Busetihalli	Thimmanayakanahalli

807	C331	Gandlachinte	Sadali	Dibburahalli
830	C331	Rappamalahalli	Sadali	Dibburahalli
833	C331	Nallacheruvapalli	Sadali	Dibburahalli
865	C331	Nakkalapalli	Sadali	Thimmasandra
867	C331	Karipalli A	Sadali	Thimmasandra
871	C331	Karipalli B	Sadali	Thimmasandra
800	C334	Iragappanapalli	Sadali	S. Devaganahalli
841	C334	Gadiminchenahalli	Sadali	S. Devaganahalli
859	C334	Niluvarathapalli	Sadali	Sadali
864	C334	Egava Jarugahalli	Sadali	Dibburahalli
894	C334	S. Kurubarahalli	Sadali	S. Devaganahalli
858	C335	Nallapalli	Sadali	Sadali
889	C335	Sonaganahalli	Sadali	Sadali
890	C335	Kotagal	Sadali	Sadali
891	C335	Kamannahalli	Sadali	Sadali
892	C335	Bandarlahalli	Sadali	Sadali

A.4.1.4. Detail of geographical location and project boundary, including information allowing the unique identification(s) of the proposed A/R CDM project activity:

>> Geographical location: Kolar is the easternmost District of Karnataka. It is bounded in the north by Ananthapur District of Andhra Pradesh, in the east by Ananthapur, Chittoor and Cuddapah Districts of Andhra Pradesh and North Arcot District of Tamil Nadu, in the west by Bangalore Rural and Tumkur Districts of Karnataka and in the south by Chittoor District of Andhra Pradesh and Dharampuri District of Tamil Nadu. The division is situated between 12° 46' and 13° 58' north latitudes and between 77° 21' and 78° 35' east longitudes. It spans over a distance of about 135 kilometres from north to south and over roughly similar distance from east to west. The taluks are situated between the following latitudes and longitudes.

Taluk	Latitude	Longitude
Bagepalli	13°35' and 13°58' North	77°4' and 78°05' East
Chickaballapur	13°2' and 31°39' North	77°33' and 77°5' East
Siddlaghatta	13°13' and 13°4' North	77°45' and 77°58' East
Gudibanda	13°36' and 13°47' North	77° 35' and 77°49' East
Chintamani	13°15' and 13°21' North	78° 51' and 78°1' East

Project boundary: The A/R CDM project contains more than one discrete area of land. It encompasses 15,339 parcels of lands in 471 villages. In all, the A/R CDM project involves 12,397 families on 18,181 ha of land. The details of each parcel of land – unique geographical identification, the farmer's name, and the survey number of the land are enclosed in Appendix 1A-1E. A summary of the details are as follows:

	Area (Ha)	No. of Villages	Member Families	Number of parcels
Bagepalli	6,395	163	3,910	5,011
Chickballapur	1,441	69	1,301	1,576

Chintamani	5,062	125	3,810	4,410
Gudibanda	1,471	30	1,144	1,264
Siddalaghatta	3,811	84	2,232	3,078
Total	**18,181**	**471**	**12,397**	**15,339**

Appendix 2 shows the cadastre maps of each of the village with survey numbers of plots in which planting will be done.

AR-AM0001/VERSION 2 further states:

> The discrete parcels of lands may be defined by polygons, and to make the boundary geographically verifiable and transparent, the GPS coordinate for all corners of each polygon shall be measured, recorded, archived and listed as an attachment of the CDM-AR-PDD. Furthermore, the project boundary includes the emission sources and gases listed in the table below.

Appendix 1A-1E provides details of all the parcels of land. Appendix 2 shows the cadastre maps of villages with boundary of each of the parcel of land and the survey numbers which matches with the details given in Appendix 1. The project boundaries and geographical locations are indicated in Fig A2a-e.

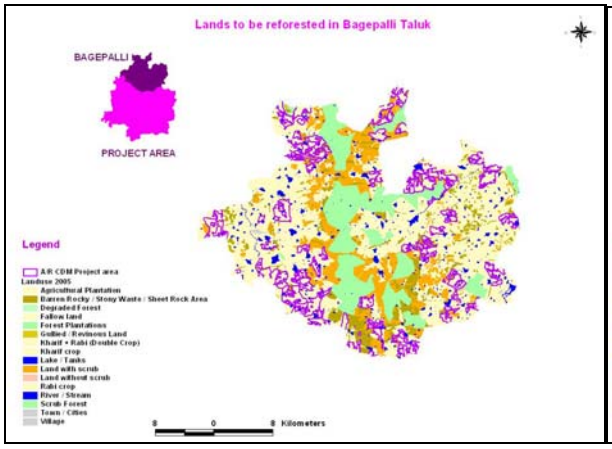


Fig A-2a Map showing land use/land cover (2005), and the lands to be reforested in Bagepalli taluk

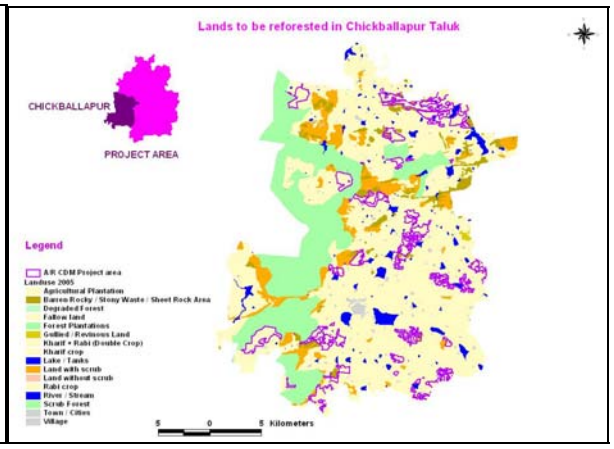
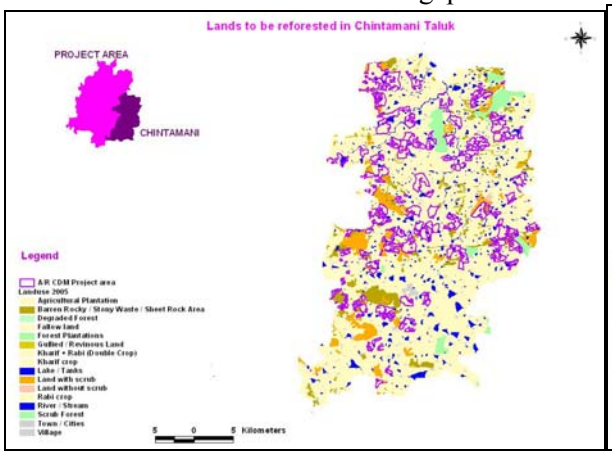


Fig A-2b Map showing land use/land cover (2005), and the lands to be reforested in Chickballapur taluk



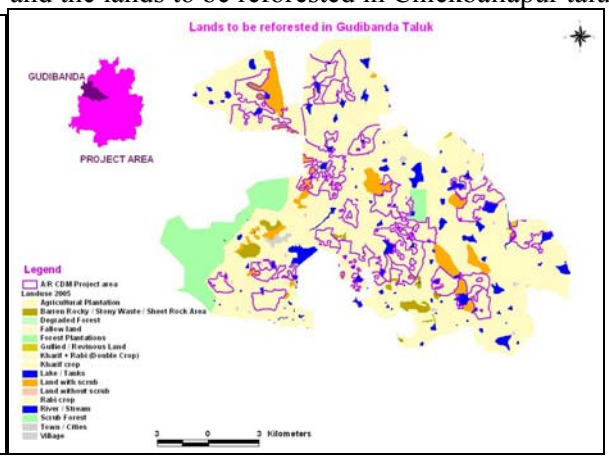


Fig A-2c Map showing land use/land cover (2005), Fig A-2d Map showing land use/land cover (2005), and the lands to be reforested in Chintamani taluk and the lands to be reforested in Gudibanda taluk

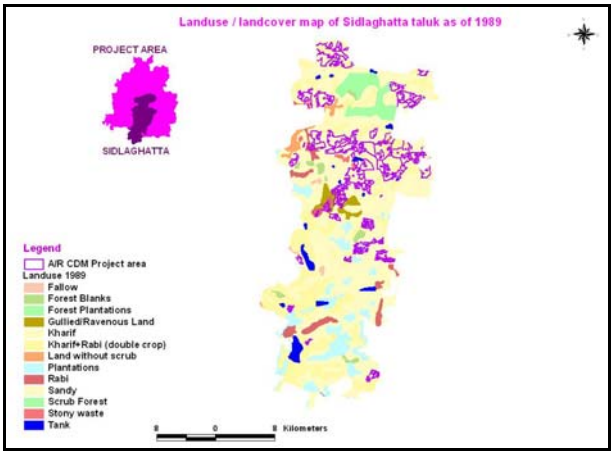


Fig A-2e Map showing land use/land cover (2005), and the lands to be reforested in Siddlaghatta taluk

A.4.1.5. A description of the present environmental conditions of the area, including a description of climate, hydrology, soils, ecosystems, and the possible presence of rare or endangered species and their habitats:

>> **Climate:** Kolar district has a hot climate. The year may be divided into four seasons. The dry season with clear bright weather is from December to February. The period from March to May constitutes the hot season and the south-west monsoon season is from June to about end of October. November is the retreating monsoon season. The average rainfall of the region is 786 mm and the maximum temperature of the district is 36° C and minimum is 16-18° C.

Table A-1: Average climate conditions in the taluks of project area

Taluk	Annual Rainfall* (mm)
Bagepalli	**679.2**
Chintamani	**690.1**
Chickaballapur	**771.2**
Gudibanda	**808.3**
Siddalaghatta	**753.0**

*** - last 50 years average**

Hydrology and geology: There are no perennial rivers in the district. Most of these are small and carry water only during the rainy season. Three important rivers, namely, Palar, North Pinakini or North Pennar and South Pinakini or South Pennar and several of their tributaries take their birth in the district and flow in different directions receiving the drainage of the intermediate tracts of the district. The project area consists of immense expanse of peninsular gneisses rocks (Fig A-3). The schistose rocks in this region are poor aquifers and yield poor quality water in very less quantity. In the absence of major sources of water like rivers, the district depends heavily on groundwater. But the groundwater table has receded beyond

600 feet depth. This has resulted in failure of most tubewells and has led to high fluoride content in drinking water, causing bone, dental and other physical deformities (Raju *et al*., 2004)[2].

Soils: The soils of Kolar district are divided into three types, viz., red, clay loam and laterite. Some black soil patches are also seen here and there. The red loam region extends from south to north of the district comprising of Chickaballapur, major parts of Siddalaghatta taluk. The water table in this type of soils is between 400 to 500 feet deep. The gravelly soil region is found in parts of Gudibanda and Chintamani taluks. The water table in these types of soils is between 500 to 600 feet deep. The clay loam soil is found in Chickaballapur and parts of Siddalaghatta and Bagepalli. Around Siddalaghatta, lateritic masses occur irregularly distributed in disconnected patches in the form of flat topped hills. The soils in Kolar district have a normal soil reaction and here and there they tend towards alkalinity. Due to land degradation many lands are uncultivable and may only improve after intensive soil treatment. The A/R CDM project activity will improve the soil by providing additional mulching material to the soil and providing shading, water retention capacity and prevention of soil erosion and surface soil runoff. As can be seen from the Fig A-3, most of the areas in the proposed project area situated in the Northern part of Kolar is classified as severe problem soils.

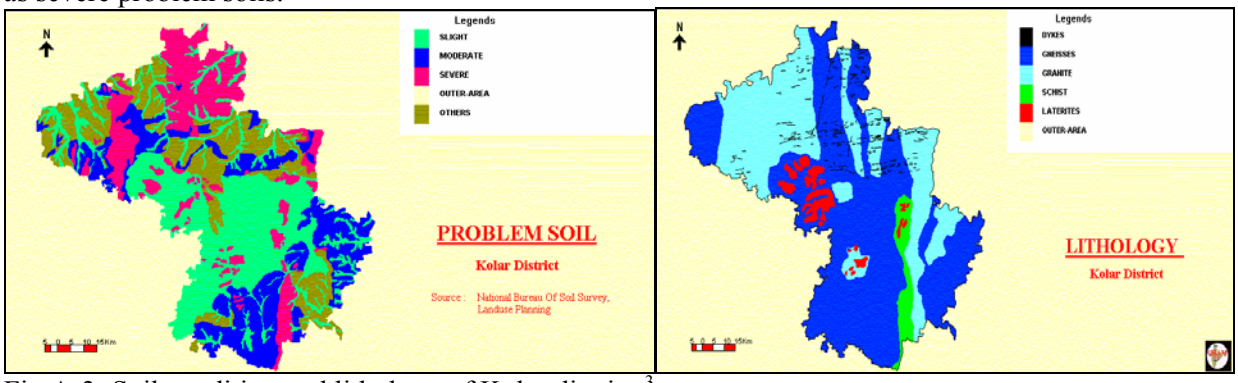


Fig A-3: Soil condition and lithology of Kolar district.[3]

Ecosystems

Composition of forests in the project area: The forests of Kolar are typical of the plain tracts of Karnataka. The stocking of the forests is poor. The trees are stunted and branchy, with diffused crown. The soil is poor and shallow and rains are scanty. Such conditions support only stunted growth. There are large extents of thorn forests. The forests have been heavily exploited in the past for extracting firewood and for manufacturing charcoal. Large extents of thorny, scrubby and deciduous forests were also cleared to plant mostly Eucalyptus hybrid under various schemes. The forests on inaccessible steep slopes, however, remain unworked. Even in the unexploited areas the vegetation is mostly stunted (Working plans, Kolar District, 2002).

The species commonly met with are *Albizzia amara (*Chigare or Thugali*), Dalbergia paniculata* (Pachali), *Gardenia resinifera (*Bikke*), Cassia fistula (*Indian Laburnum, Kakke*),Acacia catechu or Acacia chundra (*Kagli, Kaggali*), Anogeissus latifolia (*Dindiga*),* Naviladi, *Santalum album* (Srigandha), *Dysoxylum malabaricum (*Devadari*),* Kukarthi, *Pterocarpus marsupium* (Honne), *Terminalia paniculata* (Hunaal), *Azadiracta indica (*Bevu*), Pongemia pinnata* (Honge), *Diospyros*

[2] K.V. Raju, N. Praveen, B.K. Anand,. 2004. Groundwater in Urban Market: Can it Sustain? A case study of Kolar city in south India. http://www.cerna.ensmp.fr/cerna_globalisation/Documents/Raju-paris.pdf

[3] Source: http://www.csre.iitb.ac.in/adi/maps/prob-s.gif; http://www.csre.iitb.ac.in/adi/maps/litholog.gif

*montana (*Jagalaganti*), Terminalia chebula (*Alale, Aralaikai*), Shorea laccilera* (Jalari), *Terminalia tomentosa (*Mathi*)* etc. Small bamboo (Medri) is found growing in some of the areas in valleys. Big bamboo (Dowga) is seen along the banks of rivers and streams at some places. The undergrowth mostly consists of grasses known locally as Lantana, Badabakka, Devavare, Uelachi, and various Grasses. *Dendrophthoe falcata* (Bandarike) which infects teak trees, alos occurs. The forest types recognized in Kolar division as per the classification of Champion and Seth (1968) are as under:

5A / C3: Southern Tropical Dry Mixed Deciduous Forests: In this type of forests, dry deciduous species occur and tend to become thorny with increased heavy grazing. Poor quality bamboos are present in some pockets. Grass is conspicuous, herbs are scattered and climbers are few. The approximate extent of such forest is around 20 % of total forest area of Kolar Forest Division. The most common and characteristic trees found are *Anogeissus latifolia* (Dindiga), *Terminalia tomentosa* (Mathi), *Chloroxylon swietenia* (Hurugalu), *Santalum album* (Srigandha), *Melia composita* (Hebbevu), *Acacia catechu* (Katha), *Hardwickia binata* (Kamara), *Cassia fistula* (Kakke), *Diospyros montana* (Jagalaganthi), *Diospyros melanoxylon* (Thupra).

5A / DS 1 Southern Tropical Dry Deciduous Forests: In this type, low broken cover of shrubby growth of 1 to 3 metres in height, is found. The trees usually develop branches from the base. The grass occurs throughout the tract. The approximate extent of such forest is around 45% of total forest area of Kolar Forest Division. The floristic composition are *Acacia leucophloea* (Bilijali), *Albizzia amara* (Chigara, Thugali), *Dalbergia paniculata* (Nayibeete, Pachali), *Azadiracta indica* (Bevu), *Euphorbia antiquorum* (Pirukalli, Mundukalli), *Pterolobium indicum* (Badubukalu), *Cassia fistula* (Kakke), *Lantana camara* (Lantana), *Opuntia dillenii* (Papaskalli).

6A / C1 Southern Tropical Thorn Forests: These are low open forests with thorny, xerophytic species. *Acacia* species are characteristic of this type. The trees usually have short boles with low branching crowns. The lower canopy is made up of shrubs, mostly spiny and xerophytic. Climbers are few. The herbs and grass make up the lowest level. *Acacias* are met in combination with *Zizyphus* species and stunted *Anogeisus latifolia*. Patches of fleshy *Euphorbias* are not infrequent. The approximate extent of such forest is around 15% of total forest area of Kolar Forest Division. The floristic composition is *Acacia catechu* (Kaggali), *Acacia leucophloea* (Bilijali), *Acacia nilotica* (Jali), *Flacourtia indica* (Devadari), *Euphorbia nivulia*, *Chloroxylon swietenia* (Hurugalu), *Ixora arborea* (Chiligida),, *Strychnos potatorum* (Chittadamara), *Cassia auriculata* (Thangadi), *Dodonea viscosa* (Kanagalu), etc.

6A / DS 1 Southern Thorn Scrub: In this type there is further degradation due to biotic and edaphic factors, resulting in the formation of almost thorny bush, with surviving trees seen here and there. Spiny, xerophytic climbers are met with. In further degraded areas grasses are more abundant. The approximate extent of such forest is around 20% of total forest area of Kolar Forest Division. The floristic composition is *Albizzia amara* (Chujjulu, Thugali), *Chloroxylon swietenia* (Hurugalu), *Wrightia tinctoria* (Hale), *Randia dumetorum* (Kare, Maggare), etc.

6A / DS 1 Southern Thorn Scrub: In this type there is further degradation due to biotic and edaphic factors, resulting in the formation of almost thorny bush, with surviving trees seen here and there. Spiny, xerophytic climbers are met with. In further degraded areas grasses are more abundant. The approximate extent of such forest is around 20% of total forest area of Kolar Forest Division. The floristic composition is *Albizzia amara* (Chujjulu, Thugali), *Chloroxylon swietenia* (Hurugalu), *Wrightia tinctoria* (Hale), *Randia dumetorum* (Kare, Maggare), etc.

General condition of the forests: The rainfall being scanty and the rivers and streams remaining dry for a large part of the year, the area is for the most part, devoid of vegetation, and scarcity conditions are very common. Extensive plantations have been raised in the division since many years. However, because of relatively hostile conditions and inadequate post-planting cultural operations, indigenous species have generally not done well. Some of the exotic species introduced in these plantations such as *Eucalyptus* species (Karpuradagida or Nilgirigida), *Prosopis juliflora* (Ballari jali), *Cassia siamia* (Sime thangadi), *Dalbergia sisso* (Sissoo), and *Casuarina equisetifolia* (Sarvemara) have fared better in relatively favourable sites.

Repeated illicit felling of plants and even of coppice shoots have rendered the forests of the district almost barren. The soil is exposed to sheet and gully erosion, except in the areas where coppice and bushy growth still survives. *Lantana* has spread gregariously over the area. This weed, together with *Prosopis Juliflora*, has now become the major source of fuel in the absence of better species. Xerophytic condition prevails with its characteristic species. Several pure patches of *Shorea talura* (Jalari) occur in some state forests, like that of Sambar kaval. *Buchanania angustifolia* (Maradi) predominates yielding an important minor forest produce (Working Plan, Kolar district,2002).

Fauna: Owing to the absence of thick forests, there is not much cover for wild animals. Wild game is practically unknown in the district. In the Nandi hill ranges, occasional visitations of panthers are known. Black bucks and deer are found, though in small number, in the unfrequented parts, which have a little forest growth. In the hill slopes and valleys, several kinds of reptiles are found, cobras being very common. The district has no sanctuary or national park. The wild animals and birds found in the district are, The Indian Gerbill, Mongoose, Blackbuck, Blacknaped Hare, The Fourhorned Antelope, Palm squirrel, The Leopard, The Indian Wild Boar, Jackal, Indian Pangolin, Fox, Indian Otter, Jungle Cat, Ratel, Small Indian Civet, Slender Loris, The Common Palm civet, Porcupine, Striped Hyena, white tailed wood rat, Bonnet Macaque, Indian Bush Rat and Sloth bear.

A.4.2. Species and varieties selected:

>>

Tier 1		Tier 2		Tier 3		Tier 4	
Spacing 0.75 x 2 m		**Spacing 1 x 2 m**		**Spacing 2 x 2 m**		**Spacing 0.5 x 2 m**	
Tree species	**Nos/ha**	**Tree species**	**Nos/ha**	**Tree species**	**Nos/ha**	**Tree species**	**Nos/ha**
Leucaena Leucocephala (Subabool)	175	Dalbergia sissoo (Sissoo)	280	Azadirachta indica (Yapa, or Hevu)	40	Moringa oleifera (Nugekai)	170
Eucalyptus tereticornis (Nilgiri)	200	Gmelina arborea (Kulimavu, or Kumbuda, or Kumulu)	280	Tamarindus indica (Chintamanu)	40	Glyricidia maculata (Glyricidia)	450
Sesbania grandiflora (Agise)	660	Albizzia lebbek (Kala Siris, or Kalbage)	170	Madhuca indica (Ippa)	40	Bauhinia purpurea (Kachna, Chameli, Pasau)	340
Casuarina equisetifolia (Sarvemara)	175	Albizzia odoratissima (Siris, Pullivage, Nellivega, Hiharu, Bilwara,	170	Pongemia pinnata (kanniga)	40	Prosopis spicigera (Kabanni, or Banni)	40

		Chamkoroi)					
Acacia Auriculiformis (Auriculiformis)	625	Cassia siamea (Minjiri, Nellatangedu)	170	Sapindus laurifolus (Soapnut)	20		
Grevillea robusta (Silver oak)	175	Acacia tortalis (Mulvara or Muglimara)	170	Phyllanthus emblica (Nelli)	15		
Albizia richardiana (Pachali)	25	Acacia Auric. (Auriculiformis)	140	Acacia nilotica (Karijali, Nellatumma)	30		
		Tectona grandis (teak)	60	Swietenia mahagonia (Puttikai, Mahogani)	30		
				Terminalia tomentosa (Karimaradu, Thambavu)	20		
				Pterocarpus marsupium (Honne)	20		
				Hardwickia binnata (Anjan, Vereppa)	20		
Artocarpus fraxinifolius (Jackfruit), Populus ssp, Abrus ssp (Coral pea; galaganji, gul-ganji, gunja, gunji, guruganji, gurugunji, haga, jeshtamadhu, madhuka, madhukavalli, gulaganji, gunja, haga, kempu kannu beeja, guruganji, guruganji, gulagangi)	55	Feronia limonia (Balnvalgida), Ziziphus jujube (Ber), Ceiba pentadra (Seemeburga, Silk cotton, Seauel) and Annona squamosa (Sitaphal).	60	Eugeania jambolana (Nerale), Ficus ssp (Ala etc), Pithecellobium dulce (Seemahunse), Artocarpus heterophyllus (Panasa), Dalbergia latifolia (Shisham), Babusa arundinacea (Kanta, Banas, Budit bans, Bamboo, Hollow bans, Velu), Terminalia bellerica (Behera, Behdo, Gowa, Phomra, Kamia, Tharala, Thani, Thannia, Thavale, Hela, Vehela) , Samania saman (raintree),	85		

				Michelia Champaka (Champa, Titasopa, Sampige), Aegle marmelos (Bel, Billi, Bil, Belpatra, Belphas) and Acacia ferruginea (Banni).			
TOTAL trees	2100		1500		400		1000

This planting arrangement has been tested in field trials over 10 years.[4]

A.4.3. Specification of the greenhouse gases (GHG) whose emissions will be part of the proposed A/R CDM project activity:

>> The GHGs whose emissions will be part of the proposed A/R CDM project activity are CO_2 and N_2O. The choice is based on the methodology AR-AM0001/VERSION 2 .

Emission sources and gases included in the project boundary:

The gases considered from emissions by sources other than resulting from changes in carbon pools, and justification of the choice, are the following:

Sources	Gas	Included/ Excluded	Justification/Explanation
Burning of biomass	CO_2	Excluded	Site burning before planting is not a practice
	CH_4	Excluded	
	N_2O	Excluded	
Use of fertilizer	CO_2	Excluded	Not applicable
	CH_4	Excluded	Not applicable
	N_2O	Included	
Combustion of fossil fuels used in on-site vehicles and water pumping	CO_2	Included	
	CH_4	Excluded	Potential emission is negligibly small
	N_2O	Excluded	Potential emission is negligibly small

Burning of biomass: The degraded lands which are being reforested under this A/R CDM reforestation activity have hardly any biomass cover. If some grasses or shrubs are present on the land they are not burnt but are browsed by animals or used for firewood. These practices may continue in the project

[4] Shailaja et al.

scenario at about the same level. There is never any burning of biomass of the kind which could cause GHG emissions.

Use of fertilizer: Organic fertilizer will be applied in the initial year of planting for each of the pit. The N_2O emissions from the application of farmyard manure will be calculated.

Combustion of fossil fuels used in on-site vehicles and water pumping: Fossil-fuels will be used for transportation for management staff, for seedlings and NTFPs, resulting in CO_2 and non-CO_2 emissions. CH_4 and N_2O will not be counted as it is negligible. Bore-wells which pump groundwater from around 100 metres depth by diesel generators during summer months during the initial 4 years consume large amounts of either grid electricity or diesel. As the families participating in this A/R CDM project activity do not own such bore-wells however, and the water supplied to the project is only a small and negligible part of the water coming from these borewells, these emissions from water pumping will not be accounted. Transportation of saplings will be accounted.

Other potential activities which cause emissions will not be practiced: Tillage (this will not be employed during site preparation), and site burning before planting (this is not a common practice). Machinery will also not be used for site preparation, planting, weeding, thinning, harvesting and other management practices.

A.4.4. Carbon pools selected:

>> In accordance with the "Approved afforestation and reforestation baseline methodology AR-AM0001/VERSION 2 ", only aboveground biomass and below ground biomass carbon pools have been chosen for the proposed A/R CDM project activity.

Only the carbon stock changes in above-ground and below-ground biomass (in living trees) are estimated. The omission of the other pools (soil organic matter, dead wood and litter) is considered to be conservative because it can be justified that these other pools would decrease more or increase less in the absence of the proposed A/R CDM project activity, relative to the project scenario. The loss of non-tree living biomass on the site due to competition from planted trees or site preparation is accounted as an emission within the project boundary, in a conservative manner.

Carbon stocks in soil organic matter, litter and deadwood can be expected to increase by a relatively small amount in the proposed A/R CDM project activity. Clearly the choice will not increase the expected net anthropogenic GHG removals by sinks. Not accounting for the possible changes in these carbon pools as a result of the implementation of the proposed A/R CDM project activity also avoids the risk of double counting.

Carbon Pools	Selected	Justification/ Explanation
Aboveground	Yes	In accordance with "Approved afforestation and reforestation baseline methodology AR-AM0001/VERSION 2 ", this is a significant pool and should be accounted for.
Below ground	Yes	In accordance with "Approved afforestation and reforestation baseline methodology AR-AM0001/VERSION 2 ", this is a significant pool and should be accounted for.
Dead wood	No	- As per the approved 'afforestation and reforestation baseline methodology AR-AM0001/VERSION 2 ', dead wood is not included .As the plantations will be established on degraded lands, dead wood

		will be an insignificant pool.
Litter	No	- As per the 'Approved afforestation and reforestation baseline methodology AR-AM0001/VERSION 2 ' litter is not accounted. As the farmers may also be using some litter for composting, mulching, fodder etc, litter will be an insignificant pool.
Soil organic carbon	No	- As per the approved afforestation and reforestation baseline methodology AR-AM0001/VERSION 2 , soil organic carbon is not accounted. As the soil in the project activity area is very degraded, soil organic carbon will be an insignificant pool.

A.4.5. Assessment of the eligibility of land:

>> To comply with the definition of afforestation or reforestation and eligibility of the land, the present A/R CDM project activity provides evidence that the land within the planned project boundary is eligible as an A/R CDM project activity by demonstrating that the land at the moment the project starts is not a forest. This is done first by showing that the land is below the forest national threshold (crown cover, tree height and minimum land area) for forest definition under decisions 11/CP.7 and 19/CP.9 as communicated by the respective DNA. AR-AM0001/VERSION 2 provides that:

The eligibility of land as an A/R CDM project activity is demonstrated using archives and/or maps of land use/cover and/or satellite image around 1990 and for a recent date before the start of the A/R CDM project activity, as well as a supplementary survey of land use in cases where land cover alone is not sufficient to distinguish between forest and non-forest (e.g., bare land that may be forest due to forest regeneration under way).

As per the host party India, forests are defined as (http://cdm.unfccc.int/DNA/ARDNA.html?CID=101)

- a single minimum tree crown cover value of 30 per cent
- a single minimum land area value of 0.05 ha
- a single minimum tree height value of 5 m

The present A/R CDM project activity in fact has two sources of evidence that demonstrate that the current land use pattern on the lands under this A/R CDM project activity are not forests.

The first source is the recent 2005 land use maps for 5 taluks. For each of the taluk, the land use maps were overlaid on the project area. The source of these digitized satellite imagery maps is the Karnataka State Remote Sensing Application Centre. From the output, it can be seen that the project area is predominantly marginal croplands, fallow lands or wastelands (A-2a-e).

Secondly, the DLDP Database also acts as Participatory Rural Appraisal evidence: The lands which are being brought under the present A/R CDM project activity are degraded and are being treated under a Dry Land Development Programme. Under the programme so far, 26,615 ha of land has been treated. The local Participatory Rural Appraisal evidence based on our Dry Land Development Database thus also more than adequately confirms the GIS based evidence. Studies conducted also show that most of the area are degraded and not suitable for agriculture (Fig A-4).

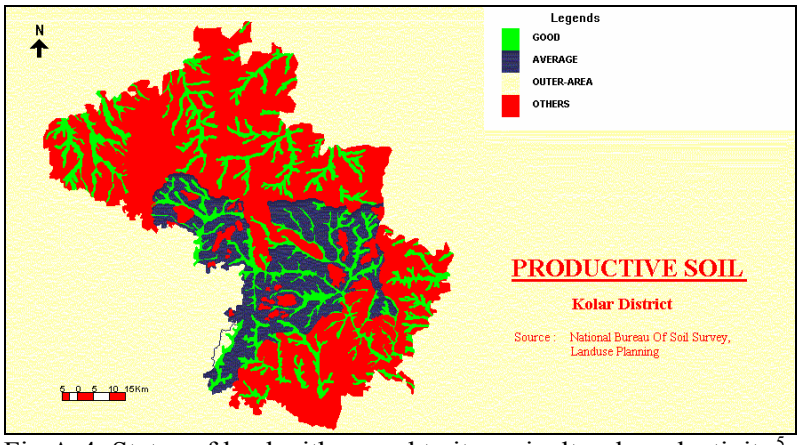


Fig A-4: Status of land with regard to its agricultural productivity[5]

The initial objective of the Dry Land Development Programme (DLDP) is to enable agricultural labourers to cultivate their scattered patches of marginal land and become subsistence farmers in the absence of any other source of income what so ever. The further objective is to engage in sustainable land use practices. The DLDP is a pluralistic programme comprising a whole range of indigenously conceived soil & water conservation measures. Each individual land owner decides on the type of labour input needed on each separate field. The collective output of the labour of 20-25 determined persons in a work gang converts the marginal lands into productive fields. The DLDP works carried so far are as follows:

Description	2002	2003	2004	2005	Total
New Stone Contour Bunds (mts)	196,853	327,550	235,969	250,143	1,010,515
Strengthen Existing Bunds (mts)	19,952	26,850	34,894	38,478	120,174
Ravine & Gully Check	234	1,323	435	410	2,402
Clear Boulders (acres)	2,032	2,948	3,743	2,053	10,775
Field Bunds (mts)	32,750	68,773	51,703	27,538	180,764
Retention Walls *(Kanji)* (mts)	17,236	34,958	38,805	38,775	129,774
Diversion Channels (mts)	24,784	13,122	10,879	13,512	62,297
Cattle Walls (mts)	1,291	5,268	9,254	7,822	23,635
Deepen Open Wells	13	47	31	29	120
Farm Ponds	17	10	36	12	75
Pit for trees(acres)	-	-	4	84	88
Paths & Roads (mts)	548	520	280	849	2,197
Wasted Works (acres)	-	21	12	4	37

ADATS implements DLDP from the 3rd or 4th year of Coolie Sangha formation. Labour capital is made available for each Coolie Sangha Unit (CSU) to collectively work on their patches of dry land for 100 days every year. These person-days are divided according to land holding and the condition of each patch of land. The entire CSU then descends on each holding to do various labour intensive works from March to June every year. They split themselves into work gangs and descend on each person's holding to do labour intensive works. One person from each Member family goes to work. Each land owner decides on the actual soil and water conservation work needed on her or his land. ADATS Staff give technical advice and monitor the actual works. After that, Accounts Staff pay DLDP wages to the actual persons who work on the lands - i.e. the land owner does not receive any direct monetary benefit.

[5] Source: NBSSLUP; http://www.csre.iitb.ac.in/adi/maps/prod-s.gif

Soil & water conservation works: For the first 3-4 years, land is cleared of pebbles and boulders, and Soil & Water Conservation Works like stone contour bunding, ravine and gully check, diversion channels, etc. are taken up. Shrubs and grasses are allowed to grow on them. These soil and water conservation works are once again implemented, after a gap of 2-3 years, in order to tackle the new contours of erosion that would, in the meantime, have chequered the terrain.

In this manner, over a period of about 8 years, all the Coolie lands are cleared, levelled and bunded. Rain water is retained for a moment, moisture in the soil is increased, and soil erosion prevented. This makes the holdings cultivable, and yields as well as holdings dramatically increase.

The DLDP was started in 1986. Over the past 20 years (not every village implemented DLDP works every single year), Rs 85,890,420 worth of soil and water conservation works have been carried out on a total of 26615 ha of Coolie owned lands. The work carried out so far is as follows:

Area (ha)	Percent of area	Years work done	Rs.
6052	23%	1	6,808,311
7059.2	27%	2	15,883,285
5859.2	22%	3	19,767,537
3305.2	12%	4	14,872,752
2179.2	8%	5	12,256,942
1185.2	4%	6	7,998,912
588.4	2%	7	4,634,973
263.6	1%	8	2,371,212
91.2	-	9	925,425
28.4	-	10	321,075
4	-	11	49,995
26615.6	100%		85,890,420

Land Survey: The established practice of Coolie Sangha is that as soon as a Coolie family joins the village CSU, all their landholdings are immediately surveyed and entered into the database. This data includes the extent of area, title in whose name the land stands, source of water if any, gradient, quality of contour bunds, number of years of soil and water conservation works already carried out on the holding, and an estimate of the number of years of further work needed. ADATS and the Coolie Sangha need to implement an additional Rs 39,942,010 worth of soil and water conservation works on 17,833 ha of Coolie owned lands over the next 5 years. About 4854 ha (i.e. 27% of Coolie owned lands) are completely cleared of boulders, contour bunded and levelled, and another 3744 ha (21%) need just 1 more year of labour investment.

The DLDP also includes silt hauling onto coolie lands from the beds of irrigation tanks, compost making, seed treatment, promoting kitchen gardens, training women masons to build Smokeless *Chullas* (fuel efficient wood stoves), assisting sweeper women to set up vermicompost units to make manure from earthworms, and a host of other activities (http://www.adats.com).

From this it can be seen that land cover alone is sufficient to distinguish between forest and non-forest. Thus it can be seen that that proposed A/R CDM activity is on lands that are currently degraded land and not forests and that the land is below the forest national thresholds (crown cover, tree height and

minimum land area) for forest definition under decisions 11/CP.7 and 19/CP.9 as communicated by the Indian DNA.

This is also decisive evidence that (ii.) 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.

In addition, the A/R CDM project activity must demonstrate that the activity is a reforestation or afforestation project activity. The present proposed A/R CDM project is a reforestation activity.

Reforestation is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.
… For reforestation project activities, the A/R CDM project activities must demonstrate that on 31 December 1989, the land was below the forest national thresholds (crown cover, tree height and minimum land area) for forest definition under decision 11/CP.7 as communicated by the respective DNA.

The project area of the proposed A/R CDM activity was overlaid on the 1989 satellite imagery maps. The source of these digitized satellite imagery maps is the Karnataka State Remote Sensing Application Centre. The land use maps were overlaid over the project area to show the exact land use/land cover of the project area. It can be seen that none of the parcels of land coming under the Bagepalli CDM reforestation programme are forests and thus the proposed project area were not forested around 1990. The output for each of the taluk is provided in Fig A-5a-e. As can be seen, none of the project area was forests during 1989. Thus the proposed project area is a reforestation activity.

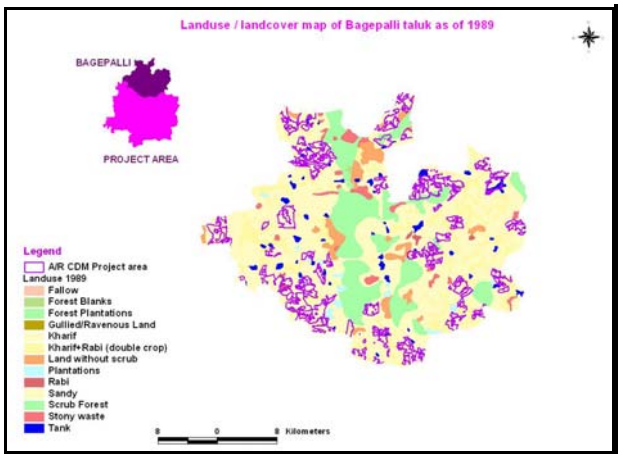


Fig A-5a Land use/land cover map of Bagepalli taluk of Kolar district in Karnataka in 1989

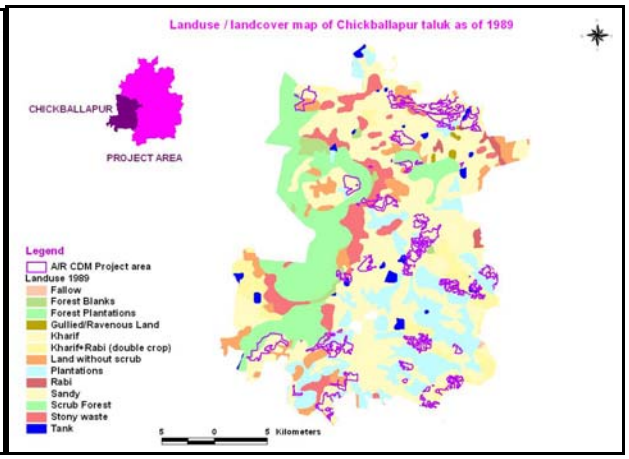


Fig A-5b Land use/land cover map of Chickballapur taluk of Kolar district in Karnataka in 1989

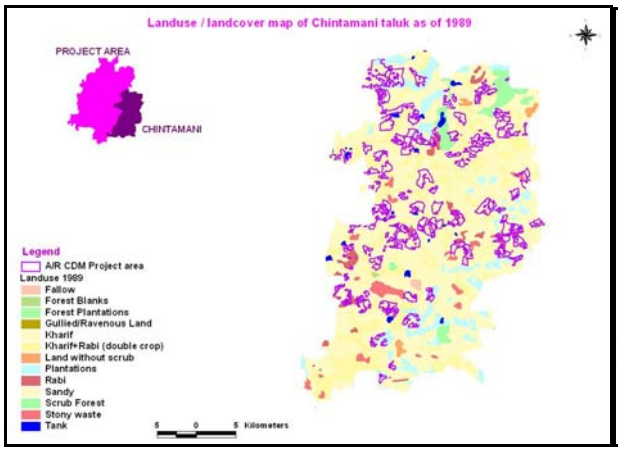


Fig A-5c Land use/land cover map of Chintamani taluk of Kolar district in Karnataka in 1989

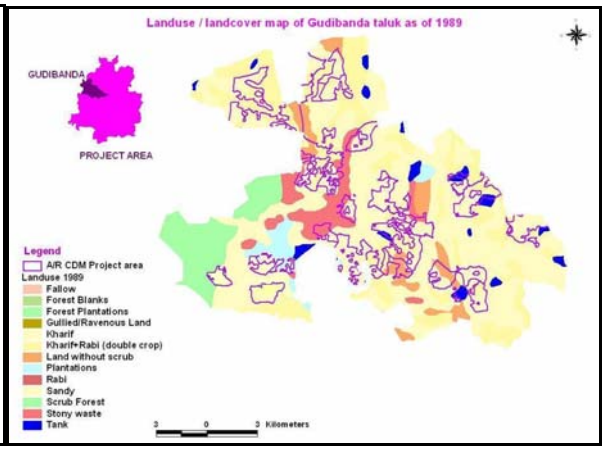


Fig A-5d Land use/land cover map of Gudibanda taluk of Kolar district in Karnataka in 1989

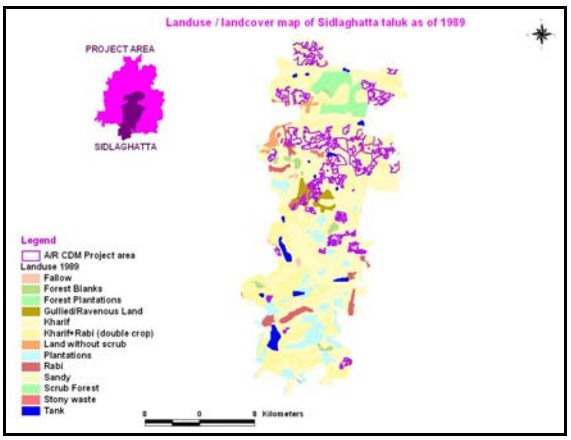


Fig A-5e Land use/land cover map of Siddalaghatta taluk of Kolar district in Karnataka in 1989

Subsequently the DLDP work going on since 1986 on these lands is also sufficient evidence to show that these lands were not forests during 1989 (Fig B-1).

Village level cadastre maps showing the parcels of land with survey numbers were prepared during 1890-60s by the Land Records and Settlement Department, Government of Karnataka. These lands show the private holdings of the farmers. The maps show the lands owned by the farmers, the contours of hills, water bodies, etc (Appendix 2). The maps show the survey numbers and these match the list of lands and survey number of the participating farmers. The maps show clearly that the land was below the forest national thresholds (crown cover, tree height and minimum land area) for forest definition under decision 11/CP.7 as communicated by the Indian DNA, in the sense that all the lands coming under this A/R CDM project activity are outside the Forest department area, and are listed as private lands.

Thus the satellite imagery complemented by ground reference data is available to show beyond doubt that the proposed CDM A/R project area was not forests from 1989 till date.

Additional written testimony produced by following a participatory rural appraisal methodology is not required as this evidence provided is sufficient. As DLDP has been carried out since 1986 however, the

DLDP Database acts as written testimony to back up this evidence from the satellite imagery. Thus to summerise: To demonstrate that the A/R CDM project activity is a reforestation activity the verifiable information provided is as follows:

- These lands have been uncultivable and barren. Dryland Development is being carried out on these lands since 1986 (Fig B-1). These records are available at the ADATS office. The work done by ADATS in the 5 taluks of Kolar can also be seen at the website http://www.adats.com
- The cadastre maps showing the parcel of privately owned farmer's lands with survey numbers, on which the A/R CDM project activity will be carried out, are available. These maps were prepared during 1890-1960s. Each parcel of land is registered with the land registrar (*Tahsildar*). Each plot of land has a survey number. Copies of these land registry documents (*pahanis*) are available at the taluk office. None of the plots are listed as being forest, nor are any trees mentioned on any of them.
- The integrated maps of land use and the project boundary as shown in Fig A-2 and Fig A-5 also show that these lands have not been forests currently and since 1989 respectively.

Thus it can be concluded without doubt that these lands have not been forests and are degraded drylands since 1989 and are undergoing dryland development programme. The approved methodology 'Approved afforestation and reforestation baseline methodology AR-AM0001/VERSION 2 ' can be applied for this project.

A.4.6. A description of legal title to the land, current land tenure and land use and rights of access to the sequestered carbon:

>> **Legal title to the land:** The land category is private land. The legal title of the parcels of land is held with individual farmers. The membership to the Coolie Sangha and the relationship to the legal title of the land is shown in Appendix 1. These farmers have legal title deeds to their lands with survey number and cadastre maps showing the boundaries. Copies of these *pahanis* and maps are available with the Tahsildar.

Current land tenure: All the participating private farmers have absolute title to the land.

Land use: Currently the private farmer's lands are uncultivable barren lands, fallow lands or marginal croplands.

Rights of access to the sequestered carbon: The individual farmers have assigned the right of access to the sequestered carbon to CER India Pvt. Ltd.

A.4.7. Type(s) of A/R CDM project activity:

>> The type of A/R project activity is

'Approved afforestation and reforestation baseline methodology AR-AM0001/VERSION 2 – Reforestation of degraded land'.

For information regarding the methodology and its consideration by the Executive Board refer to ARNM0001": http://cdm.unfccc.int/methodologies/ARmethodologies/approved_ar.html.

A.4.8. Technology to be employed by the proposed A/R CDM project activity:

>> The reforestation activity is categorised as dense mixed tree plantation to meet the biomass needs of villagers with extraction of NTFPs. The aims are a) to meet the biomass needs of villagers by planting a variety of trees; b) to recycle nutrients through a rich litterfall and c) provide a sustainable biomass generation and yield through high biomass productivity. The following criteria were used in selecting the

trees. a) The trees used must provide for some local need. The major needs considered are fuel, fodder, green manure, timber and medicine. b) Local and exotic trees, adapted to the semi-arid region and possessing moderate to fast growth characteristics, are considered. c) A small number of trees belonging to species not grown in Ungra region are introduced. d) A mix of leguminous and non-leguminous trees is considered. All the trees to be planted are classified into four tiers depending on expected growth characteristics. The trees belonging to any specific tier are all planted along a line. About 5,000 trees are planted in an area of 1 hectare. Table 1 provides a list of the trees planted in the various tiers along with the number of specimens in each species. The pattern of four-tier planting is also shown in a schematic diagram in Figure 1. 90% of the trees are to be found in Tiers 1, 2 and 4. The rest 10% are in Tier 3. The trees in the third tier had either timber value or yielded minor forest produce. 70% of the trees are leguminous. The saplings will be raised on suitable plots belonging to participating members in the project, using seeds from trees in the region. The seeds of *Eucalyptus tereticornis, Albizzia odoratissima, Acacia auriculiformis,Pterocarpus marsupium* will be obtained from the (State Government) Forest Department at Pathpalya and other local nurseries in all the taluks. A small number of seedlings of species like *Gmelina arborea, Albizzia richardiana* and *Cassiasiamea* will also be obtained from the nursery of the Forest Department. The land preparation consisted of digging parallel trenches of depth 0.4 m and width 0.3 m. The spacing between rows of trenches is 2.0 m. This operation will be carried out during April-May 2007. The planting will be done in 2007, in July – August, when the region receives rather heavy rainfall. In the case of fast-growing species the saplings will be 12 months old at the time of planting. The slow-growing species will be 18 months old when planted.

The tree species may be arranged according to their purpose, though some have multiple use:
Fruit and medicinal: *Moringa oleifera* (Nugekai), *Tamarindus indica* (Chintamanu, Hunse), *Phyllanthus emblica* (Nelli), *Artocarpus fraxinifolius* (Jackfruit, Panasa), *Feronia limonia* (Balnvalgida),*Aegle marmelos* (Bel, Billi, Bil, Belpatra, Belphas), *Ziziphus jujube* (Ber), *Annona squamosa* (Sitaphal),*Terminalia bellerica* (Behera, Hela), *Pithecellobium dulce* (Seemahunse) *Abrus* ssp (Coral pea; galaganji, gulagangi etc), *Artocarpus heterophyllus* (Panasa), *Eugeania jambolana* (Nerale), *Azadirachta indica* (Yapa, Hevu), *Sapindus laurifolus* (soapnut), *Terminalia tomentosa* (Karimaradu, Thambavu)
Small timber and fodder: *Leucaena Leucocephala* (Subabool), *Dalbergia sissoo* (Sissoo), *Eucalyptus tereticornis* (Nilgiri), *Gmelina arborea* (kulimavu, kumbuda, kumulu), *Glyricidia maculata* (Glyricidia), *Sesbania grandiflora* (akace, agace, agase, agise), *Albizzia lebbek* (Kala Siris, Kalbage etc), *Madhuca indica* (Ippa), *Bauhinia purpurea* (Kachna, Chameli, Pasau), *Casuarina equisetifolia* (Sarvemara), *Albizzia odoratissima* (Siris, Pullivage, Nellivega, Hiharu, Bilwara, etc), *Pongemia pinnata* (Kanniga, Honge), *Prosopis spicigera* (Kabanni, Banni), *Acacia Auriculiformis* (Auriculiformis), *Cassia siamea* (Minjiri, Nellatangedu), *Grevillea robusta* (Silver oak), *Acacia tortalis* (Mulvara, Barnei, Muglimara) *Albizia richardiana* (Pachali), *Acacia nilotica* (Karijali, Nellatumma), T*ectona grandis* (teak), *Swietenia mahagonia* (Puttikai, Mahogani), *Pterocarpus marsupium* (Honne), *Hardwickia binnata* (Anjan, Vereppa), *Populus* ssp, *Ceiba pentadra* (Seemeburga, Silk cotton, Seauel), *Ficus ssp* (Ala etc), *Dalbergia latifolia* (Shisham), B*abusa arundinacea* (Kanta, Banas, Budit bans, Bamboo, Hollow bans, Velu), *Samania saman* (Raintree), *Michelia Champaka* (Champa, Titasopa, Sampige), *Acacia ferruginea* (Banni).

Some of the more important species are described in more detail below.

Tamarindus indica belongs to Caesalpinoideae of the Leguminosae family, and is commonly referred to as Tamarind. The Tamarind tree is much loved throughout the semi-arid regions for its deep, cool shade and for its valuable pungent fruits. Less well known are its excellent leaf fodder and high quality timber. It can be grown on a wide range of soils, including slightly saline or alkaline; has a deep tap root and is drought-hardy. The species requires 500 mm annual rainfall to do well, but can be grown with 350 if

watered for establishment. It propagates easily by direct sowing, seeding, cutting; it is frost-tender, and relatively slow-growing. The Tamarind is a large tree (height 30m, dbh 1.6m) with a spreading crown up to 12m in diameter. It is a light demander, and grows best in the open. It is deep rooted, wind-firm, very sensitive to frost, and seedlings and saplings require special protection. It is drought resistant, and starts flowering at the age of about 10 years. It is grown on the soils ranging from gravely to deep alluvial, and thrives best in deep loam which provides optimum conditions for development of its long tap root. It tolerates slightly alkaline or saline soil, and tolerates temperatures up to 47^0 C but is very sensitive to frost and fire. It can be raised by direct sowing in lines behind the plough or in patches of $45cm^2$ dug 30cm deep. The depth of sowing should be about 1.5 cm.
Nursery technique: Seeds have been sown in large size poly bags in March – April in 2006. Germination starts within a week and takes about a month to complete. Seedlings attain plantable size, 30cm and above, in the following rains when they are 14 months old. They need to be protected against frost during winter and drought in summer.
Planting practices: Tamarind will be raised in Tier 3 at spacing of 2 x 2 m. Seedlings will be planted out in July or August when the soil is well soaked by monsoon rains. The entire plot will also be fenced against cattle damage. Regular weeding is essential for good growth. The rate of growth of seedlings is moderate to slow. Trees start bearing fruit at 8-9 years and continue for 200 years or so. Well grown trees of 20 years may yield as much as 200 kg/tree/yr. 40 trees will be planted per ha.

Syzygium cumini (Eugenia jambolana) (L.) is in the Myrtaceae family and is sometimes referred to as Indian plum. It is high valued for its fruit and as a fodder tree, and produces strong, heavy timber. It grows in moist condition and tolerates water logging, but also survives and is productive, though may be stunted in semi-arid conditions on gravely and stony sites. It is a large tree growing up to 30 metres in height and attaining 1.3 metres dbh. The tree inhabits a variety of soils from clayey to loamy sands, including swampy conditions. It is found under a wide range of sub tropical and tropical climates with temperature extremes of $2\text{-}45^0$ C and mean annual rainfall of 500-5000 mm.

Planting will be through nursery raised seedlings or stumps. Fruits are produced in abundance every year. Ripe fruits are collected from existing mature trees or swept from the ground in June to August. No pre-treatment is required for germination. The sowing will be done in the nursery beds in June to July in 2006. The germination % of fresh seed is high i.e. 90%. Planting out of entire transplants is done in July to August of the following year. For stump planting the stumps are prepared from 2-3 old plants depending upon their growth. The growth of seedlings is slow during the first year and comparatively fast during the subsequent years. In farmers field it is often planted on bunds. In this case it acts as windbreak around orchards. Syzygium will be planted on bunds at a spacing of 2x2 m in Tier 3. Thus approximately 10 trees will be planted per ha.

Tectona grandis: Tectona grandis, commonly called Teak, is a tall, deciduous timber tree, of the verbena family. The tree, which attains a height of about 30 m (about 100 ft), is native to India and the Malay Archipelago. The bluish to white flowers are arranged in terminal panicles, or clusters. The fruit is a drupe. Because of its durability and strength, teakwood is used throughout the world as lumber in shipbuilding and construction of furniture; outdoor teak furniture or garden products has been known to resist the attacks of insects and the corrosive effects of weather for hundreds of years. Planting material of teak will consist of seedlings or stumps. Seedlings will be raised in nurseries and grown until they reach 30–40 cm in height. The seedlings are left to grow in the germination beds until they reach about 15–20 mm in diameter, then they are prepared for planting by pruning off both the shoot and root. These seedlings will be planted into the field after the first rains. Generally 25–50 mm of shoot is retained and about 150–200 mm of the root is left intact. This remaining material is known as a stump and is the most common planting method, because it can be stored for a period of time before planting, and gives more

even height when planted in the field. Teak in its natural state grows on a variety of geological formations but the quality of growth depends on the depth, structure, porosity, drainage and moisture holding capacity of the soil. Teak thrives best on soils that are neutral, or slightly alkaline, so the most favourable soils for growth and development usually have a pH of 6.5–7.5. Waterlogged, shallow and compacted soils will be avoided. On laterite soils, even if partly disintegrated, teak will always be stunted. Teak is a calcicolous species and requires a relatively large amount of calcium / lime in the soil for growth and development. The teak seedlings will be planted in Tier 2 at a spacing of 1 m x 2 m. Approximately 60 trees/ha will be planted.

All the trees will be raised in the project nurseries and planted out in the trenches and rows. There will be no thinning and extraction will be limited to NTFPs and small timber. Gap filling will be done every year.

All the participants will plant around 5000 trees/ha, with a typical plot of 1 ha consisting of the following trees in the following numbers:

Leucaena Leucocephala (Subabool)	175
Dalbergia sissoo (Sissoo)	280
Azadirachta indica (Yapa, Hevu)	40
Moringa oleifera (Nugekai)	170
Eucalyptus tereticornis (Nilgiri)	200
Gmelina arborea (kulimavu, kumbuda, kumulu)	280
Tamarindus indica (Chintamanu, Hunse)	40
Glyricidia maculata (Glyricidia)	450
Sesbania grandiflora (akace, agace, agase, agise)	660
Albizzia lebbek (Kala Siris, Bhander, Sarsaoda, Koko, Kalbage)	170
Madhuca indica (Ippa)	40
Bauhinia purpurea (Kachna, Chameli, Pasau)	340
Casuarina equisetifolia (Sarvemara)	175
Albizzia odoratissima (Siris, Pullivage, Nellivega, Hiharu, Bilwara, Chamkoroi)	170
Pongemia pinnata (kanniga)	40
Prosopis spicigera (Kabanni, Banni)	40
Acacia Auriculiformis (Auriculiformis)	625
Cassia siamea (Minjiri, Nellatangedu)	170
Sapindus laurifolus (soapnut)	20
Grevillea robusta (Silver oak)	175
Acacia tortalis (Mulvara, Barnei, Muglimara)	170
Phyllanthus emblica (nelli)	15
Albizia richardiana (Pachali)	25
Acacia Auric.(auriculiformis)	140
Acacia nilotica (Karijali, Nellatumma)	30
Tectona grandis (teak)	60
Swietenia mahagonia (Puttikai, Mahogani)	30
Terminalia tomentosa (Karimaradu, Thambavu)	20
Pterocarpus marsupium (Honne)	20
Hardwickia binnata (Anjan, Vereppa)	20
Artocarpus fraxinifolius (Jackfruit, Panasa)	10
Populus ssp,	10

Abrus ssp (Coral pea; galaganji, gul-ganji, gunja, gunji guruganji, gurugunji, haga, jeshtamadhu, madhuka madhukavalli, gulaganji, gunja, haga, kempu kannu beeja, guruganji, guruganji, gulagangi)	35
Feronia limonia (Balnvalgida)	20
Ziziphus jujube (Ber)	10
Ceiba pentadra (Seemeburga, Silk cotton, Seauel)	10
Annona squamosa (Sitaphal).	20
Eugeania jambolana (Nerale)	10
Ficus ssp (Ala etc)	5
Pithecellobium dulce (Seemahunse)	10
Artocarpus heterophyllus (Panasa)	5
Dalbergia latifolia (Shisham)	5
Babusa arundinacea (Kanta, Banas, Budit bans, Bamboo, Hollow bans, Velu)	10
Terminalia bellerica (Behera, Behdo, Gowa, Phomra, Kamia, Tharala, Thani, Thannia, Thavale, Hela, Vehela)	10
Samania saman (raintree)	5
Michelia Champaka (Champa, Titasopa, Sampige)	10
Aegle marmelos (Bel, Billi, Bil, Belpatra, Belphas)	10
Acacia ferruginea (Banni).	

The overall technology to be employed consists of:

- Technically assessing the plot including soil type, water availability and interest and ability of the family to maintain the orchard
- Preparing the land including levelling, removing of boulders, bunding if necessary
- Making watering arrangements for supplementary watering as necessary in the fields and arranging for watering the plants for one month during initial planting and doing some supplementary watering if possible depending on water availability in summer months i.e. March-June (4 months) depending on the rains in that year. Arrangement for payments for water sharing from bore wells will be done if required.
- Digging of trenches for 5000 trees per ha in lines 2 m apart, for mixed species planting in four tiers alternating regularly.
- Applying of farmyard manure and red sand to the trenches
- Joint raising and procurement of saplings along with other project participants
- Planting and maintenance
- Annual sapling replacement if necessary
- Mapping the plot to be reforested: Using the GPS reading for each of the parcel of land, it will be integrated with GIS. Other details such as species planted, number of trees, year of planting, survival rate, permanent plots for each strata will be integrated. This will ensure transparency and aid in monitoring, verification and certification.
- Joint sale of tCERs.
- Joint marketing of produce as necessary.

No environmentally safe and sound technologies and know-how employed by the project are being transferred to the host Party under international technology transfer. The technology is indigenous and known to the project A/R CDM project activity participant.

A.4.9. Approach for addressing non-permanence:

>> In accordance with section K paragraph 38 (a) of the CDM A/R modalities and procedures[6], the following approach is selected to address non-permanence of the A/R CDM activity:

(a) Issuance of tCERs for the net anthropogenic greenhouse gas removals by sinks achieved by the project activity since the project start date….

AR-AM0001/VERSION 2 provides formula 28 for calculating t-CERs.

t-CERs reflect the *existing stock change at the time of verification* minus project emissions minus leakage at the previous time of verification (t CO_2).

A.4.10. Duration of the proposed A/R CDM project activity / Crediting period:

>>3 x 20 years

A.4.10.1. Starting date of the proposed A/R CDM project activity and of the (first) crediting period, including a justification:

>> The first crediting period shall begin at the start of the A/R CDM project activity. The starting date of the proposed A/R CDM project activity is 1st July 2006. We expect that tCERs will be bought in advance by a buyer.

A.4.10.2. Expected operational lifetime of the proposed A/R CDM project activity:

>>100 years.

A.4.10.3. Choice of crediting period and related information:

>>3 x 20 years

A.4.10.3.1. Renewable crediting period, if selected:

>> 3 x 20 years

A.4.10.3.1.1. Starting date of the first crediting period:

>> 1st July 2006

A.4.10.3.1.2. Length of the first crediting period:

>> 20-y-0-m

A.4.10.3.2 Fixed crediting period, if selected:

>>N/A

A.4.10.3.2 .1. Starting date:

>> N/A

[6] Decision 19/CP.9 - Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol.

A.4.10.3.2.2. Length:

>> N/A

A.4.11. Brief explanation of how the net anthropogenic GHG removals by sinks are achieved by the proposed A/R CDM project activity, including why these would not occur in the absence of the proposed A/R CDM project activity, taking into account national and/or sectoral policies and circumstances:

>> The lands to be reforested are degraded lands, and will continue to be abandoned and degrade without the proposed A/R CDM project activity. The project activity of reforestation will sequester carbon by the process of photosynthesis removal of carbon dioxide from the atmosphere by planted trees including *Tamarindus indica* (Tamarind), *Syzygium cumini* (Jamun), *Tectona grandis (*Teak*)*, *Grevillea robusta (*Silver Oak*)*, *Pterocarpus* spp. (Hardwoods), *Artocarpus* spp. (Jackfruit), *Terminalia* spp., *Dalbergia* spp, *Pongamia pinnata* etc. The planting arrangement is dense mixed species planting. As the trees mature, sequestration in different pools (living biomass above and below ground) will increase to a theoretical maximum. In practice, silvicultural and horticultural interventions and small timber harvesting to meet sustainable development objectives will establish an average level of carbon sequestration in the sum of the reforested parcels. Under the A/R CDM project activity vegetation cover will dramatically improve. Initially the faster growing trees will show stronger growth. Establishment of Tamarind trees in the third Tier will be slow, since the lands are very dry and the soils are very poor. However, as interest and commitment by the farmers is high, and planting spacing and arrangement is done to maximise growth, there will be fast growth of all the trees early. They will further put on substantial biomass in the post-establishment phase. Reforestation of this area without availability of financial revenues from tCER sales will certainly not be possible, since there are too many barriers to reforestation without tCER income. In the absence of the A/R CDM project activity the Government of India would not be in a position to step in and provide the resources to reforest the degraded land which is being covered under this A/R CDM project activity. This is apparent from the lack of planting in 2005 and 2006. In the absence of the project activity neither the GOI nor the private farmers will have the resources to support forestry on their lands either individually or as a group. Hardly any reforestation is taking place compared to the potential in Kolar District. Kolar forest division has 1039.41 km^2 of forest area constituting 9% of the geographical area of the district. Of this only 3% has crown cover of more than 10%. Basically there has been no increase in forest cover over the last 15 years and no improvement in the quality of the forest. The baseline net greenhouse gas removals by sinks is the sum of the changes in carbon stocks in the carbon pools within the project boundary that would have occurred in the absence of an A/R CDM project activity[7]. The current and past land use pattern in Bagepalli, Chickaballapur, Chintamani, Gudibanda and Siddlaghatta taluks for the period 1988-89 to 2005 and the rate of afforestation – past and projected on degraded forestland in Bagepalli, Gudibanda, Chintamani, Siddlaghatta and Chickaballapur taluks show that there has been a very low rate of afforestation in the taluks covered by this A/R CDM project activity. The brief explanation of how net anthropogenic GHG removals by sinks are to be achieved is given in AR-AM0001 VERSION 2.

The proposed A/R CDM project area is stratified based on local site classification map/table, the most updated land use/cover maps and/or satellite image, soil map, vegetation map, landform map as well as supplementary surveys, and the baseline scenario is determined separately for each stratum. For strata without growing trees, this methodology conservatively assumes that the carbon stock in above-ground and below-ground biomass would in the absence of the project activity remain constant, i.e., the baseline net GHG removals by sinks are zero. For strata with a few growing trees, the baseline net GHG removals

[7] Decision 19/CP.9, http://unfccc.int/resource/docs/cop9/06a02.pdf

by sinks are estimated based on methods in GPG-LULUCF. Only the carbon stock changes in above-ground and below-ground biomass (in living trees) are estimated. The omission of the other pools (soil organic matter, dead wood and litter) is considered to be conservative because it can be justified that these other pools would decrease more or increase less in the absence of the proposed A/R CDM project activity, relative to the project scenario. The loss of non-tree living biomass on the site due to competition from planted trees or site preparation is accounted as a emission within the project boundary, in a conservative manner.

This is covered in section B-2. The estimate of the anticipated total net anthropogenic GHG removals by sinks in tonnes of CO_2 equivalent as determined in section E is 6,934,013 tCO_2 tonnes of CO_2 equivalent during the first crediting period.

A.4.11.1. Estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period:

>>

Year	Annual estimation of net anthropogenic GHG removals by sinks in tones of CO_2 -e
2006	82,855
2007	217,418
2008	319,420
2009	370,620
2010	362,136
2011	355,399
2012	350,056
2013	349,885
2014	349,697
2015	349,490
2016	349,263
2017	349,012
2018	348,737
2019	348,434
2020	348,101
2021	347,735
2022	347,332
2023	347,104
2024	347,104
2025	347,104
2026	347,104
2027	347,104
Total estimated net anthropogenic GHG removals by sinks (tonnes of CO_2)	**6,934,013**
Annual average over the crediting period of estimated net anthropogenic GHG removals by sinks (tonnes of CO_2 e)	**346,701**

A.4.12. Public funding of the proposed A/R CDM project activity:

>> No public funding from parties included in Annex 1 is involved.

SECTION B. Application of a baseline methodology

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

>> The approved A/R CDM baseline methodology is

'Approved afforestation and reforestation baseline methodology AR-AM0001/VERSION 2 – Reforestation of degraded land'.

B.1.1. Justification of the choice of the methodology and its applicability to the proposed A/R CDM project activity:

>> The 'Approved afforestation and reforestation baseline methodology AR-AM0001/VERSION 2 – Reforestation of degraded land',

….applies approach 22(a) as a general baseline approach for the proposed A/R CDM project activity, taking into account historic land use/cover changes, national, local and sectoral policies that influence land use within the boundary of the proposed A/R CDM project activity, economical attractiveness of the project relative to the baseline, and barriers for implementing project activities in absence of CDM finance.

The applicability of this approach to the proposed A/R CDM project activity is as follows:

- The project activity CDM A/R does not lead to a shift of pre-project activities outside the project boundary, i.e. the land under the proposed A/R CDM project activity can continue to provide at least the same amount of goods and services as in the absence of the project activity. This condition is applicable in the case of the present A/R CDM project activity as the proposed project area is currently degraded lands providing very little or no goods and services. Any level of reforestation on this degraded land would lead to an increase in goods and services. There will be no change in right of access to the plots or other management changes which for example would bar families with the right to their own land from using any part of it. As none of the land is common land there is no chance of landless families being prevented from using the land and thus being deprived of the goods and services they are getting.

- Lands to be reforested have to be severely degraded with the vegetation indicators below thresholds for defining forests, as communicated by the DNA consistent with decision 11/CP.7 and 19/CP.9, and the lands are still degrading. According to the baseline survey carried out for this A/R CDM project activity, this condition is applicable. The average aboveground biomass in the project area has been monitored and is 0.006 t/ha. Other parameters which define degraded land are: low soil carbon, low organic content of soil, lack of biomass growth and lack of water retention on the land. All these conditions apply as can be seen from Fig A-3 and A-4. As seen from the taluk maps in Fig A-2 and Fig A-5 and as shown in the DLDP Database, these lands are devoid of vegetation, and are below the thresholds defining forests as communicated by the DNA, which is a single minimum tree crown cover of 30%; minimum land area of 0.05 and minimum tree height of 5 meters.

- Environmental conditions and human-caused degradation do not permit the encroachment of natural forest vegetation. This condition also applies. The project area is wasteland which has been taken up for development under a Dry Land Development Programme (DLDP). The land is being treated by removing boulders and stones and creating bunds for soil and water conservation (Fig B-1). According to the State of Forest Report, the Kolar division has 1039.41 km^2 of forest area constituting 12.64% of the geographical area of the district. The reserved forests constitute 877.93 km^2, the protected forests 43.31 km^2, the unclassified forests 61.56 km^2 and the village forests 56.61 km^2.Kolar District has 7% of geographic area under forests accounting for 58200 ha. Of them, 86% constitute open forests, which have a crown cover between 10-40%. The status of forests in Kolar has not changed since 1980s. The increase in area of forests of 1% has been due to plantations done on degraded forest lands under the social forestry projects. Thus it is seen that soil and degraded land conditions do not permit encroachment of natural forest vegetation and generally the environmental conditions and human-caused degradation of the parcels of land under this A/R CDM project activity do not permit natural regeneration or encroachment of natural vegetation.
- Lands will be reforested by direct planting and seeding of multiple mixed species of mainly leguminous trees. Long rotation species such as *Tamarindus indica* and *Syzygium cumini* will be planted in Tier 3 which yield NTFPs along with Tectona grandis (Teak).

- Site preparation does not cause significant longer term net emissions from soil carbon. The only site preparation that is taking place is the Dry Land Development Programme, where the boulders are being removed and bund prepared for soil and moisture conservation.

- Carbon stocks in soil organic matter, litter and deadwood should be expected to decrease more due to soil erosion and human intervention or increase less in the absence of the project activity, relative to the project scenario. This condition is also applicable. Being a very dry area and with a huge scarcity of biomass, the dry and fallen litter will be collected by the families as fuelwood. Thus litter will not form a major source of carbon stock. The increment in soil organic carbon will also be meagre in such dry arid land.

- Grazing will not occur within the project boundary in the project case.

In addition AR-AM0001/VERSION 2 lays out the procedure for determining the baseline scenario in section II.4., 'procedure for selection of most plausible baseline scenario'. This is addressed below. It leads to the conclusion that the baseline approach 22(a) (existing or historical changes in carbon stocks in the carbon pools with the project boundary) is indeed the most appropriate choice for determination of the baseline scenario and that the land will remain degraded in the absence of the project activity.

B.2. Description of how the methodology is applied to the proposed A/R CDM project activity:

>> The methodology applied to the proposed A/R CDM project activity is according to the

'Approved afforestation and reforestation baseline methodology AR-AM0001 – Reforestation of degraded land'.

The methodology, based on the following step-wise approach, is transparent and conservative.

A. The proposed A/R CDM project activity meets the conditions under which the proposed methodology AR-AM0001 is applicable, and thus applies approach 22(a) as a general baseline approach

…taking into account historic land use/cover changes, national, local and sectoral policies that influence land use within the boundary of the proposed A/R CDM project activity, economical attractiveness of the project relative to the baseline, and barriers for implementing project activities in absence of CDM finance.

The procedure for selection of the most plausible baseline scenario given in AR-AM0001 is followed:

Step 1: Identify and list plausible alternative land uses including alternative future public or private activities on the degraded lands such as any similar A/R activity or any other feasible land development activities, considering relevant national and or sectoral land-use policies that would impact the proposed project area, and land records, field surveys, data and feedback from stakeholders, and other appropriate sources.

a) The National Forest Policy of India (1988) envisages 33% of land area under forest/ tree cover. In the approach paper of the Tenth Five Year Plan a monitorable target has been fixed to increase forest/tree cover to the extent of 25% by 2007 and 33% by 2012.

b) The Indian Constitution has been amended to include forestry under concurrent list. Article 48-A states "The State shall endeavour to protect and improve environment and safeguard the forests and wildlife of the country." Article 51- A (G) enshrined as fundamental duty of each citizen "to protect and improve the natural environment including forest, lakes, rivers and wildlife, and to have compassion for living creatures". Similarly 73rd and 74th amendments of the Constitution authorized Panchayats and Urban local bodies to promote social forestry and urban forestry and tree plantations on vacant lands.

c) The National Forest Policy 1988 was adopted with the objectives to: i.) have a symbiotic relationship between the tribal and forest, and to associate the forest dwellers in protection, regeneration and development of forests as well as sharing of benefits, ii.) promote/popularise non-wood forest products and development of medicinal plants and bamboos, iii). increase productivity through adoption of clonal forestry, application of biofertilizers, adoption of IPM system and efficient forest product development, processing, utilisation and marketing and iv. Carry out detailed investment studies, harmonisation of demand and supply of forest products, and environmental impact analysis to rationalize and improve utilisation.

d) The National Agriculture Policy 2000 was adopted with the following objectives:

   a. Areas of shifting cultivation will receive special attention for their sustainable management
   b. Integrated and holistic development of rainfed areas will be promoted by conservation of rainwater through vegetative measures on watershed basis and augmentation of biomass production through agro and farm forestry with the involvement of the watershed committee.
   c. Agroforestry and social forestry that are prime requisites for maintenance of ecological balance and augmentation of biomass production in the agricultural systems will receive a major thrust for efficient nutrient cycling, nitrogen fixation, organic matter addition and for improving drainage. Farmers will be encouraged to take up farm/agroforestry for

higher income generation by evolving technology, extension and credit support and removing constraints to development of agro and farm forestry.

d. Creation of National Wasteland Development Board to afforest 5 million hectares of wasteland every year. The National Afforestation and Ecodevelopment Board set up by the Ministry of Environment and Forests will regenerate degraded forest land.
e. Formulation of a number of externally aided social forestry projects and their implementation in States.
f. Concrete efforts are to be made to cover 15 million ha of degraded forests under JFM (Joint Forest Management (JFM) was started for regenerating, protecting and equity sharing of forest resource. So far, 44,943 JFM Committees have been formed covering an area of about 11.629 m ha of degraded forest land). vii. Private forestry development has to be encouraged by providing various inputs and legal & policy supports for increasing production and improving ecology and economy of the region.

e) **Target for Greening Programme**

Around 300 m ha is the available productive land out of 328.27 m ha total geographical area of the country. Actual forest cover is 63.73 m ha of which only 37.73 m ha are good forests. About 20 m ha is covered under tree plantations (agroforestry, farm forestry, social forestry and other plantations). Thus, in order to achieve one-third area under forest/ tree cover, (100-37.73-20= 42.27, say 43) 43 m ha of area is proposed to be covered under Greening programme in 10-year period as under:

i) 15 m ha of degraded forest land to be covered under JFM.
ii) 10 m ha of irrigated area to be brought under commercial agroforestry.
iii) 18 m ha of rainfed area to be brought under subsistence agroforestry.

Greening India Programme aims at achieving increased productivity, employment and income generation and food security to poverty stricken people.

Though there are a large number of policies, programmes and amendments to the Constitution for reforestation, implementation depends on the availability of funds. In India, the budgetary outlays under the forestry and wildlife sector in State Plans are around 1 per cent. This amount includes overseas development aid. The financial requirement for greening programme would be of the order of Rs.48,000 crores in 10 years. The annual requirement would be Rs. 4,800 crores against the current availability of Rs.1601 crores. There is shortage of funds to undertake such programmes. Additional funds requirement will have to be met from the plan budget of Central and State Governments and externally aided projects. It was envisaged that the external aid would come as an additional amount, but the domestic support was consequently reduced[8]. Thus funding for afforestation and reforestation is lacking in the country though there are ambitious policies and plans to cover a large area under tree cover as described above.

The funds for afforestation and reforestation in Kolar region were allocated for planting on forest lands under the Joint Forest Management. On an average, annually, during 1991-2005, 500 ha has been planted in each of the taluks. Funding for planting on farmers lands from the programmes are limited. The overseas funding from JBIC for planting on forest lands under the JFM programme and

[8]Source: http://planningcommission.nic.in/plans/planrel/fiveyr/10th/volume2/v2_ch9_1.pdf. Tenth five year plan 2002-07. Forests and Environment, Planning commission. Govt. of India.

the Forest Development Fund from the Central Government has come to an end. There are no funding for planting activities in Kolar district under any of the schemes in the coming years either on forest lands or on private lands. In addition, farmers do not get loans from banks for the purpose of reforestation activities as compared to agricultural activities. According to the mid term appraisal by the Planning Commission, the states have not been able to realize the full potential of this sector, particularly the poverty alleviation focus of the 1988 Indian Forest Policy. The strategy of the Forestry Sector should be two pronged – one, producing market oriented products on farms and two, protecting forests for environmental benefits and for sustaining the livelihood of the forest dwellers[9]. Lack of funds has been the major deterrent to promote forestry activities.

Thus business as usual is the only plausible alternative land uses including alternative future public or private activities on the degraded lands. There is no other similar A/R activity or any other feasible land development activities that would impact the proposed project area. The relevant national and sectoral land-use policies, listed above, and the land records, field surveys, data and feedback from stakeholders, already described above as being practiced by ADATS under DLDP, all demonstrate that without the proposed A/R CDM project activity, the project area will not be reforested and will continue to remain in a degraded state.

Step 2: Demonstrate that under the plausible scenarios identified in Step 1, the most plausible scenario is that the project areas would remain abandoned and degrading in absence of the project activity, by assessing the attractiveness of the plausible alternative land uses in terms of benefits to the project participants, consulting with stakeholders for existing and future land use, and identifying barriers for alternative land uses. This can be done in at least one of the following ways:
•**Generally**: By demonstrating that similar lands, in the vicinity, are also not, and are not planned to be used for these alternative land uses. Show that apparent financial and/or other barriers, which prevent alternative land uses can be identified;
•**Specifically for any agricultural alternative land use**s: Demonstrate that the project lands are legally restricted to forestry purposes only, and that these restrictions are generally complied with in the vicinity of the project area. Alternatively, use step 2 of the A/R "Tool for the demonstration and assessment of additionality" to demonstrate that alternative agricultural land uses are financially non-viable.

As we have chosen the barrier approach from the A/R "Tool for the demonstration and assessment of additionality" to demonstrate additionality, we will not use step 2 of A/R additionality tool here, but instead we demonstrate that the project areas would remain abandoned and degrading in absence of the project activity, by assessing the attractiveness of the plausible alternative land uses in terms of benefits to the project participants, consulting with stakeholders for existing and future land use, and identifying barriers for alternative land uses. We do this by showing generally that similar lands, in the vicinity, are also not, and are not planned to be, used for these alternative land uses. We show that apparent financial and/or other barriers, which prevent alternative land uses can be identified.

The most plausible scenario is thus that the project areas would remain abandoned and degrading in absence of the project activity. The attractiveness of the plausible alternative land uses in terms of the benefits to the project participants is very low indeed. This is evidenced by the fact that the agricultural labourer families who are participating in this A/R CDM project activity have to work on other people's

[9]Report of the task force on greening India for livelihood security and sustainable development. Planning Commission, Government of India, July 2001. http://planningcommission.nic.in/aboutus/taskforce/tk_green.pdf

lands often in other states as daily agricultural wage labourers, as their own land which they will be reforesting under this A/R CDM project activity is so degraded. Similar lands in the vicinity, which are not under DLDP, are also simply left as degraded lands and are also not cultivated or reforested. The financial and other barriers which prevent these alternative land uses is the lack of investment capital. The only incentive to doing this reforestation activity is the funds which can be mobilised through registration as a A/R CDM project activity.

Based on stakeholders interview, the only alternative to the project activity for the lands would be marginal agricultural cultivation. However the crop productivities are low as these areas have low fertility and are dependent on rainfall (Fig A-3&A-4). Uncertain rainfall and continuous droughts in the area would cause financial loses to these marginal farmers. The project areas would thus remain as barren and uncultivable lands, as it would not be feasible to engage in even marginal cropping or planting in the absence of the project activity. The relative attractiveness of cropping in terms of benefits to the local economy and communities' subsistence is too low. A stakeholder's consultation for existing and future land use shows that the communities do not find cropping profitable or attractive on these degraded lands. At the same time there is no financial wherewithal to implement a reforestation programme on these degraded lands in the hope of creating a perennial crop which is more capable of withstanding the vagaries of the weather and climate. Thus whilst the project activity is in the long run more attractive than continuing , this must be seen as a relative gain as it will be a 10 year struggle to establish the trees at any decent level of productivity. This will not be possible without CDM revenues.

The description of the DLDP works above also demonstrate amply that the barriers to alternative land use are too high. The DLDP cannot get families into reforestation activities. At the most some soil conservation work and levelling can be achieved for some marginal cultivation activities. There has only been one other programme around.

The World Bank aided social forestry programme in the eighties had contributed considerably to the supply of seedlings to farmers through decentralized nurseries for planting on revenue lands. In Southern and Eastern Kolar District, *Eucalyptus* was extensively planted on the mounds/ bunds as well as in the agricultural wastelands (Fig B-2). In the Northern Kolar district comprising the project area, the area covered was negligible as seen in Fig B-2 and Fig A-5. Plantations account for 0.18-5% of the taluk area (Table B-1). These programs were aided by overseas developmental agencies, while domestic funds for such programmes were minimal. A study by Shiva *et al*., (1981)[10], concluded that the primary objective of social forestry had not been achieved, i.e. the subsistence forest product requirements of the poorest rural communities were not being met. Instead, social forestry had been successful in motivating medium and large farmers to plant trees on their lands. The establishment of Eucalyptus plantations on private land is argued to have adversely affected landless agricultural labourers and marginal farmers by reducing local employment opportunities as well as fuel and fodder availability. The authors assign the failure of social forestry primarily to: 1) promoting tree cultivation without sufficient attention to species and the capacity of different socio-economic groups to grow these; and 2) assuming that increasing production of a commodity in a particular locality will also ensure increased local availability. The large-scale planting of Eucalyptus has caused severe decrease in the water table of the region. A survey of the various stakeholders for choice of species in the project area show that they do not prefer Eucalyptus, as they opine that it will further deteriorate the lands. The choice of species has been horticulture species.

[10] Shiva, V., Sharatchandra, H.C. & Bandyopadhyay, J. 1981. Social, Economic and Ecological Impact of Social Forestry in Kolar. Indian Institute of Management, Bangalore, India. http://www.odifpeg.org.uk/publications/greyliterature/socialforestry/shiva/ Shiva.pdf

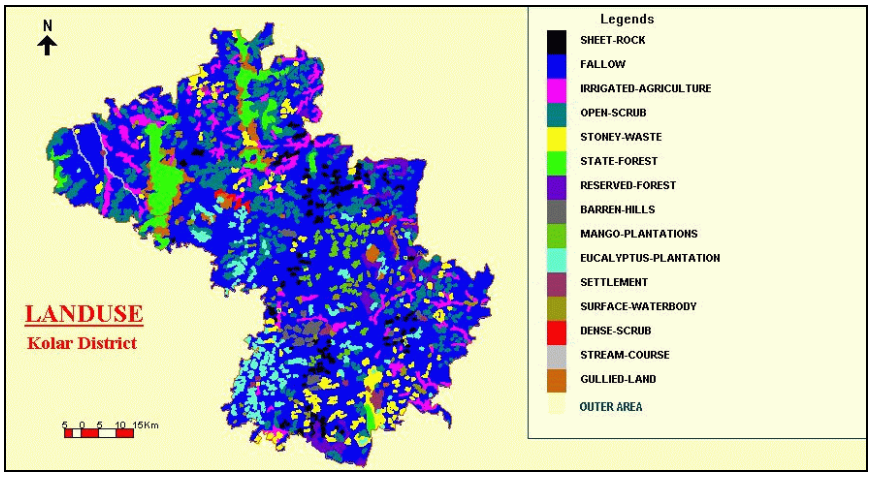


Fig B-2: Land use map of Kolar district

Thus under the plausible scenarios, the most plausible scenario is that the project areas would remain abandoned and degrading in absence of the project activity. The assessment of the attractiveness of two plausible alternative land uses in terms of benefits to the project participants (having consulted with stakeholders for existing and future land use, and identifying barriers for alternative land uses) is that similar lands, in the vicinity to the proposed project activity parcels of land, are not planned to be used for these alternative land uses. There are barriers which prevent the alternative land use as described above. The proposed A/R CDM activity is different from the earlier social forestry programmes in the following way:

- Reforestation under this A/R CDM project activity is on degraded lands belonging to marginal farmers and agricultural labourers in the five Northern taluks of Kolar District. These taluks have worse soil conditions than Southern and Eastern taluks, and do not lend themselves to the programmes described above.
- The species are selected by the participating families and the emphasis is on NTFP and local species.
- The aim is to establish long rotation farm forests, and not engage in short rotation cash crop plantations.
- There will be greater biodiversity benefits from this A/R CDM project activity as bund planting and mixed species will contribute to creating small protected habitats for flora and fauna.

Currently afforestation and reforestation is being done under the externally aided JBIC programme. The activity is limited to forest lands. The benefit of planting is to the Joint Forest Committees (JFMCs) and the forest department. Planting on degraded private lands are not being done. As mentioned above, even in the agroforestry model, only a few big farmers (with large land holding) were benefited while the marginal and poor farmers are not being benefited. The species planned for this proposed A/R CDM project activity are NTFP species which are indigenous to the region and will yield long-term benefit to the farmers. The scale of the A/R CDM project activity also means that some benefit may accrue to the local climate and ecological conditions, and precipitation in the local area may even increase. These kinds of scales of planting on private marginal lands has not been done before. Thus the proposed CDM is different from the on-going forestry projects promoted by the forest department.

Step 3: To support the findings above, demonstrate that the lands to be planted are really "degraded": Analyze the historical and existing land use/cover changes in a social-economic context and identify key factors that influence the land use/cover changes over time, using multiple sources of data including archives, maps and/or satellite images of land use/cover around 1990 and before the start of the proposed A/R CDM project activity, supplementary field investigation, land-owner interviews, as well as collection

of data from other sources. The historical degradation feature can be indicated by assessing one of the following indicators:
•Vegetation degradation, e.g.,
- The crown cover of non-tree vegetation has decreased in the recent past for reasons other than sustainable harvesting activities;
•Soil degradation, e.g.,
- Soil erosion has increased between two time points in the recent past;
- Soil organic matter content has decreased between two time points in the recent past.
In addition, demonstrate that no natural encroachment of trees would occur by,
•Demonstration of lack of on-site seed pool that may results in natural regeneration;
•Demonstration of lack of external seed sources that may result in natural regeneration;
•Demonstration of lack of possibility of seed sprouting and growth of young trees;
•Demonstration of lack of possible natural regeneration activity, by use of supplementary surveys on the project areas as well as similar surrounding areas for two different years that cover a minimum time period of ten years;
•Any other evidence that demonstrates the impossibility of natural encroachment in a credible and verifiable way.
Demonstrate that national and/or sectoral land-use policies or regulations that create policy driven market distortions which give comparative advantages to afforestation/reforestation activities and that have been adopted before 11 November 2001 do not influence the areas of the proposed A/R CDM project activity (e.g., because the policy is not implemented, the policy does not target this area, or because there are prohibitive barriers to the policy in this area, etc. If the policies (implemented before 11 Nov 2001) significantly impact the project area, then the baseline scenario cannot be "degraded land" and this methodology cannot be used. This methodology is not applicable if project proponents can not clearly show in the application of Steps 1 to 3 that the baseline approach 22(a) (existing or historical changes in carbon stocks in the carbon pools with the project boundary) and the scenario "lands to be planted are degraded lands* and will continue to degrade in absence of the project" is the most appropriate plausible baseline scenario. To ensure transparency regarding the condition of degraded lands, all information used in the analysis and demonstration shall be archived and verifiable.

* For meaning of "degraded" see AR-AM0001 Version 2 section II.4. Footnote to Step 3.

The historical and existing land use/cover changes in their social-economic context are best observed by analyzing the DLDP records going back to 1986, looking at the satellite images of land use/cover from around 1990 and by drawing on the local knowledge of the project participants who have lived and worked in this area for 30 years. The key factor that influences the land use/cover changes over time in this region is climate change. The project area is a semi arid drought prone region. The project area skirts the southern border of the Rayalaseema desert belt and shares the same language, culture and social structure, as also the stark poverty that afflicts southern Andhra Pradesh. The region receives an annual rainfall of around 650 mm and is facing imminent desertification, with severely degraded soils. The dust brown rocky terrain is severely undulating, with small hill ranges and outcrops that stud the topography. There is no mineral wealth and only a very thin and fragile soil cover. Slopes in the region are not terraced and rainfall is not retained. This is an even bigger problem than low precipitation and erratic, spatial showers. Soil erosion is a definite problem (Fig A-3&A-4) and the age-old network of small and large irrigation tanks is getting visibly choked. These areas are undergoing soil and water conservation works under the DLDP. These lands are currently barren and uncultivable land, fallow land or marginal cropland, soil erosion is continuously increasing and soil organic matter content is decreasing.

The degradation of the vegetation is clear in that the crown cover of the non-tree vegetation has decreased in the recent past for reasons other than sustainable harvesting activities. Basically climate change is causing rapid desertification. Soil degradation has occurred as erosion has increased continuously and no soil and water conservation works have really been able to stop it; soil organic matter content has decreased (see study by Ravindranath et al), and no natural encroachment of trees would occur as there are no on-site seed pools that may result in natural regeneration. Based on the baseline study (section B), the density of naturally occurring trees in the region is <1 tree/ha. There are no external seed sources that may result in natural regeneration; and there is no possibility of seeds sprouting and the growth of young trees occurring. As DLDP has been going on since 1986, this provides the required evidence of supplementary surveys on the project areas as well as similar surrounding areas for two different years covering a minimum time period of ten years. There are no national and/or sectoral land-use policies or regulations that create policy driven market distortions which give comparative advantages to afforestation/reforestation activities and that have been adopted before 11 November 2001. As can be seen from Table B-1, plantations in the taluks account for only 0.18-5% of the land use. No policies (implemented before 11 Nov 2001) significantly impact the project area, and therefore there is no reason why the baseline scenario should not be considered degraded land. Thus the methodology can be used. The scenario "lands to be planted are degraded lands* and will continue to degrade in absence of the project" is the most appropriate plausible baseline scenario. To ensure transparency regarding the condition of degraded lands, all information used in the analysis and demonstration is archived at the ADATS head office in Bagepalli.

Table B-1: Percent of land use in the taluks of project area based on satellite imagery

Taluk	Built-up	Agriculture	Plantation	Forest	Wasteland	Waterbody
Bagepalli	8.33	32.21	0.18	0.96	57.60	0.72
Chickballapur	2.82	49.16	2.42	4.78	39.47	1.36
Chintamani	5.65	47.74	0.56	0.12	45.60	0.33
Gudibanda	3.07	44.30	3.28	2.82	45.74	0.79
Siddlaghatta	5.05	47.64	5.23	0.70	41.08	0.31

Source: Mapping of fuel wood trees in Kolar district using remote sensing data and GIS. http://ces.iisc.ernet.in/energy/paper/fuelwood/fuelwood.html

B) Stratification of the A/R CDM project area

According to AR-AM0001 Version 2

The proposed A/R CDM project area is stratified based on local site classification map/table, the most updated land use/cover maps and/or satellite image, soil map, vegetation map, landform map as well as supplementary surveys, and the baseline scenario is determined separately for each stratum. For strata without growing trees, this methodology conservatively assumes that the carbon stock in above-ground and below-ground biomass would in the absence of the project activity remain constant, i.e., the baseline net GHG removals by sinks are zero. For strata with a few growing trees, the baseline net GHG removals by sinks are estimated based on methods in GPG-LULUCF. Only the carbon stock changes in above-ground and below-ground biomass (in living trees) are estimated. The omission of the other pools (soil organic matter, dead wood and litter) is considered to be conservative because it can be justified that these other pools would decrease more or increase less in the absence of the proposed A/R CDM project activity, relative to the project scenario. The loss of non-tree living biomass on the site due to competition from planted trees or site preparation is accounted as a emission within the project boundary, in a conservative manner.

Stratification of the A/R CDM project activity is as follows:

- The proposed A/R project activity lands to be reforested are located in Kolar District which has 3 types of soils – red, clay loam and laterite.
- The project area is located in 5 taluks of Kolar – Bagepalli, Chickaballapur, Siddalaghatta, Chintamani and Gudibanda. These taluks have the same climate, landform and vegetation type. Representative samples covering all the 5 taluks have been taken.
- The stratification is based on land capability classified by the NBSSLUP (Fig B-3). These were deduced from the soil map of Kolar district. Land capability classification is an interpretative grouping of soils based on inherent soil characteristics, external land features and other environmental factors that limit the use of the land. The soil characteristics considered are soil type, water availability, soil depth and soil erosion status (Table B-2).
- The stratification is based on all these parameters and plots are allocated to one of the strata (Table B-2). Overall 14 type of land capability classes are present in the project area, of which 34% of the area is having moderately shallow, well drained, clayey soils on undulating interfluves with moderate erosion followed by 21% area under very deep, moderately well drained, clayey soils of valleys, with problems of drainage and slight salinity in patches and 13% area under very deep, well drained, gravely loam soils, strongly gravely in the subsoil on rolling lands. with moderate erosion.
- Field details of each parcel of land has been collected to record the vegetation, soil conditions, slope condition and erosion status.
- Sampling survey of representative land parcels were carried to determine the vegetation status, land use type and land cover. The vegetation parameters recorded were: vegetation cover (tree, shrubs, herbs).
- For trees, Girth at Breast Height (GBH), Height of the tree, crown cover and age of the tree were recorded.

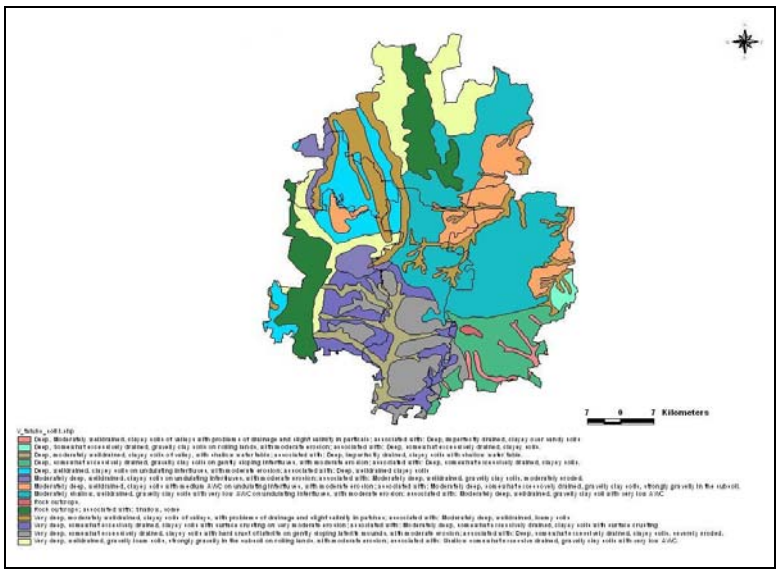


Fig B-3: Stratification of the project area based on land capability class

C) Determine the baseline scenario for each stratum

- The boundary of each of the parcel of land of the proposed CDM A/R project was determined and represented by the following:

a) the survey number of the parcel of land. Copies of these land registry documents (*Pahanis*) have been provided by the local land registrar office (Tahsildar) to the farmers. Copies of these land registry documents (*Pahanis*) are available with the Tahsildar.

b) Each parcel of land has been given a unique reference number, which has the code of the village and the farmer. The maps are available for all the parcels.

c) Field survey as part of DLDP was done to study soil conditions, gradient and erosion status of 100% of the lands. The gradient of the land and the bund condition is recorded for each parcel of the land.

- Sampling surveys on representative land types were done which includes the crown cover, mean height of shrubs, herbs and trees, biomass stock sampling and soil type.
- These areas are degraded and are under different stages of DLDP. Ground survey shows that these lands are highly degraded and there is no possibility of natural encroachment. The soil conditions are hostile for natural regeneration. Currently these lands are barren uncultivated lands, fallow lands or marginal croplands. These lands have been non-forested since 1989.

Table B-2: Stratification of the proposed A/R CDM project area based on land capability class

Sl No.	Description	Bage -palli	Chicka-ballapur	Chinta-mani	Gund-ibanda	Siddala -ghatta	Total
1	Deep, moderately welldrained, clayey soils of valley, with shallow water table		296			300	596
2	Deep, somewhat excessively drained, gravely clay soils on gently sloping interfluves, with moderate erosion			728		176	904
3	Deep, somewhat excessively drained, gravely clay soils on rolling lands, with moderate erosion			378			378
4	Deep, welldrained, clayey soils on undulating interfluves, with moderate erosion	762	428		533	84	1807
5	Moderately deep, welldrained, clayey soils on undulating interfluves, with moderate erosion		80				80
6	Moderately deep, welldrained, clayey soils with medium AWC on undulating interfluves, with moderate erosion	489	78	153		137	857
7	Moderately shallow, welldrained, gravely clay soils with very low AWC on undulating interfluves, with moderate erosion	1505		2997		1688	6190
8	Moderately shallow, welldrained, gravely clay soils with very low AWC on undulating interfluves, with moderate erosion ,	12					12
9	Rock outcrops	181	98				278
10	Very deep, moderately welldrained, clayey soils of valleys, with problems of drainage and slight salinity in patches	1005	168	753	881	991	3796
11	Very deep, somewhat excessively drained, clayey soils with surface crusting on very moderate erosion		108	54		274	436
12	Very deep, somewhat excessively drained, clayey soils with hard crust of laterite on gently sloping laterite mounds, with moderate erosion					161	162

13	Very deep, welldrained, gravely loam soils, strongly gravely in the subsoil on rolling lands. with moderate erosion	2200	186		58		2443
14	Very deep, welldrained, gravely loam soils, strongly gravely in the subsoil on rolling lands. with moderate erosion,	242					242
	Grand Total	6395	1441	5062	1471	3811	18181

D) Estimation of baseline net GHG removals by sinks

AR-AM0001 Version 2 requires that:

To determine the baseline net GHG removals by sinks, the following steps are necessary:
a) Determination of the sum of carbon stock changes for each stratum:
•For those strata without growing trees, the sum of carbon stock changes in above-ground and below-ground biomass is set as zero;
•For those strata with growing trees, the sum of carbon stock changes in above-ground and below-ground biomass is determined based on the projection of their number and growth, based on growth models (yield tables), allometric equations, and local or national or IPCC default parameters (detail below in this section).
b) Sum the baseline net GHG removals by sinks across all strata.

The baseline is determined ex-ante and remains fixed during the subsequent crediting period. Thus the baseline is not monitored.

The proposed project area was stratified according to the land capability class as shown in Fig B-3. The carbon stock change in aboveground biomass and below ground biomass was estimated. The other carbon pools, dead wood, litter and soil organic matter was omitted. Aboveground biomass and below ground biomass for all the strata was calculated and determined at the taluk level.

- For Siddalaghatta taluk, the growing trees are zero and are hence set as zero (Table B-3).
- For other taluks, Bagepalli, Chickballapur, Chintamani and Gudibanda, the sum of carbon stock changes in above-ground and below-ground biomass was determined based on the projection of their number and growth, based on growth models (yield tables) and allometric equations.

- Baseline analysis was done in each of the taluk based on the land capability class. They were analyzed at the taluk level as shown in Table B-3.

The baseline net greenhouse gas removals by sinks was calculated by:

$$\Delta C_{BSL,t} = \sum_i \sum_j \Delta C_{ij,t}$$

Where
i = strata, taluk level
j = tree species,
$\Delta C_{BSL,t}$ = the sum of the changes in carbon stocks in the living biomass of trees for year t
$\Delta C_{ij,baseline,t}$ = average annual carbon stock changes in living biomass of trees for stratum i species j in the absence of the project activity, in tonnes $CO_2 yr^{-1}$ for year t.
t = 1 to length of crediting period

Table B-3: Baseline carbon stock as determined by conduct of field studies in the proposed project area

Taluk	Total Project Area (Ha)	Baseline survey (Ha)	Aboveground biomass (t B/ha)*	No. of trees in project area*	Average Age	MAI/tree (t/ha/yr)***
Siddalaghatta	3811.18	38.6	0	0	0	0.0000
Chintamani	5062.41	48.4	0.2920	3870	9	0.0325
Bagepalli	6394.68	63.2	0.0014	101	9	0.0002
Gudibanda	1471.36	16.8	0.0100	88	10	0.0010
Chickaballapur	1441.00	16.8	0.0009	257	6	0.0001
Total	**18180.64**	**183.8**	**0.0609**	**4316**		

* Total trees in project area based on sample survey conducted in 183 ha.
** Based on equations developed for Indian tropical forests ($0.079+0.4149D^2H$). Source: Rai, S.N., 1980
*** The mean annual increment was determined based on the study conducted in the study area by stock change method.

In the baseline survey, 6 species were recorded, of which Pongamia pinnata was the dominant species accounting for 72% of the trees, followed by Tamarind with 17% of the trees. About 98% of the trees were found on the bunds, which will not be harvested. The average age of the trees is 10 years with a mean DBH of 22 cms and a mean height of 8 mts. The species recorded were Pongamia pinnata (71%), Tamarind (17%), Azadirachta India (4%) and Artocarpus indica, Eucalyptus and Tumbe (2% each). Biomass equation for Indian tropical forest was used for to estimate the standing biomass. The allometric equation used for estimating the aboveground biomass is

$V = (0.079+0.4149D^2H)$[11]

Wood density of 0.7 was used to convert volume (cum) to biomass (t) (Ravindranath *et al.*, 2006)[12]

Below ground biomass was determined by using the IPCC equation for tropical forests given by:
$Y = \exp[-1.0587+0.8836*\ln(ABD)]$; Where ABD is aboveground biomass[13]

Approximately 4125 trees are there in the project area based on the sample study conducted. The taluk, Siddalaghatta was without trees and the baseline carbon pool was set to zero. The carbon stock change of growing trees in each of the taluk trees was estimated separately. The annual change in carbon stocks were calculated based on stock change method given by the approved methodology (Table B-3). The average carbon increment of trees was taken as the increment in the next 30 years.

B.3. Description of how the actual net GHG removals by sinks are increased above those that would have occurred in the absence of the registered A/R CDM project activity:

[11] Source: Rai, S.N. Regional volume tables for some tropical rain forest tree species of Karnataka, India, Karnataka Forest Department and Government of Karnataka, 1980

[12] Ravindranath N H., Murthy I. K., Sudha, P., Ramprasad V., Nagendra, M.D.V., Sahana, C.A., Srivathsa, K.G. and Khan, H. Methodological Issues In Forestry Mitigation Projects A Case Study Of Kolar District. Submitted for publication in Mitigation And Adaptation Strategies For Global Change.

[13] Table 4.A.4, GPG LULUCF, IPCC, 2004

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Explanation of how and why this project is additional and therefore not the baseline scenario in accordance with the selected baseline methodology. Include 1) a description of the baseline scenario determined by applying the methodology, 2) a description of the project scenario, and 3) an analysis showing why the baseline net GHG removals by sinks scenario would likely lie below actual net anthropogenic GHG removals by sinks in the project scenario.

1. Land eligibility

The proposed project area is a collection of parcels of degraded land owned by marginal private farmers in the 5 taluks of Kolar District. The DLDP has been in place since 1986. As can be seen in Fig A-5, these lands have not been forests since 1989 according to the definition of forests given by India. Also currently these lands are not forests as shown in Fig A-2. These lands are degraded private lands and no natural regeneration will take place.

Additionality test

The steps as outlined in the EB additionality tool[14] may be followed to demonstrate that a proposed A/R CDM project activity is additional and not the baseline scenario, taking into account the conditions under which AR-AM0001 is applicable. The chosen approach is:

- Step 0: Preliminary screening based on the starting date of the project activity
- Step 1: Identification of alternatives to the A/R project activity (the possible baselines);
- Step 3: Barriers analysis; and
- Step 4: Impact of registration of the proposed afforestation or reforestation (A/R) project activity as an A/R CDM project activity.

STEP 0: Preliminary screening based on the starting date of the project activity

This step is not applicable. The crediting period will begin after registration in 2006.

STEP 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Define alternatives to the project activity

The project area being a semi-arid drought prone region receiving an annual rainfall of 650 mm, is facing desertification and soil degradation. The region has rocky terrain which is severely undulating, with small hill ranges and outcrops. There is only a very thin and fragile soil cover. Slopes in the region are not terraced and rainfall is not retained due to which soil erosion is a severe problem in this area. The proposed project area is undergoing soil and water conservation works under DLDP and the only alternative to this would be continued degradation of the land and continued barren conditions. Alternatively cropping could in some circumstances be taken up by the families. But neither DLDP nor marginal cropping is economically viable as the crop productivities are very low due to poor soil conditions and scarcity of water resources (Fig A-4). There has been a decrease in agricultural and pasture

[14] (cdm.unfccc.int/EB/Meetings/016/eb16repan1.pdf)

land, and there has been an increase in fallow degraded land (Kolar land use statistics, 2005)[15]. Seasonal conditions and climate change have been the main factor for decrease in cultivation area. The Employment Guarantee Act is very important in this region as unemployment is very high. The periodic drought and the recurring scarcity conditions have reduced the cultivated areas. To reap better benefits, slightly richer farmers install submersible borewells and cultivate some lands, and like marginal farmers, they leave the degraded unproductive lands fallow. This has led to overall collapse of the water table and further decrease in acreage under cultivation. The extent of all these types of degraded land during the years has not shown the most significant variation in the increase in the extent of fallow land. This is an indicator of increased degradation. Thus the lands to be reforested are severely degraded, with the vegetation indicators below thresholds for defining forests, and the lands are still degrading. As proved by the fact that DLDP works have to continue to be carried out on all these lands, these lands are economically unattractive as croplands. At the same time there is no financial wherewithal to take up alternatives. Thus the continuation of the current situation represents the only baseline alternative.

Sub-step 1b: Enforcement of applicable laws and regulations

The alternative described above is in compliance with all applicable legal and regulatory requirements. These laws and regulations have mixed objectives other than only land-use and related regulations, and include conservation of biodiversity, soil and water resources protection / conservation, cooking fuel security, and provision of basic minimum livelihood through granting of land title to agricultural labourers who have squatted the lands and obtained title to the land. National and local policies that have been implemented since the adoption of the modalities and procedures for the CDM are not taken into account.

National policies and programmes were launched in India for afforestation and reforestation in India, of which social forestry and the Joint Forest Management (JFM) order of 1990 are the major activities. According to the 10th Five years plan for the forestry sector by the Planning Commission, Government of India, the thrust for forestation especially on farm lands should be encouraged[16]. The following plans are suggested:

Promotion of forestry on private farmers' land: The National Forest Policy (1988) stressed that forest farming should be encouraged for meeting forest based industrial raw-material requirements. By avoiding duplication of species unhealthy competition may disappear between forestry and agroforestry sectors and farmers can start forest farming for their economic gains.

Poverty alleviation, tribal development and women's empowerment schemes to focus on private farm land: Forestry on agricultural lands has a potential to optimise production in the rainfed and semiarid regions. However, this has neither been stressed nor monitored in poverty alleviation, tribal development and women's empowerment schemes under implementation. Such programmes should be encouraged under the 10th five year plan.

Integrated watershed development programme: There is a serious problem of ecological deterioration in watershed areas. An integrated approach is needed for conserving, upgrading and using the natural resource base of land, water, plant, animal and human resources. Forestry on farm lands can play a dominant role in promoting livelihood opportunities and has to be taken up in the 10th five year plan.

[15] Chitraranjan, H. Kolar district Gazetteer, karnataka Gazetteer, 2005

[16] Report of the task force on greening India for livelihood security and sustainable development, Planning commission, Government of India, July-2001. http://planningcommission.nic.in/aboutus/taskforce/tk_green.pdf

These plans are not legally binding and meeting the goals and objectives of these programs depend on availability of funds. Funds from government have been limited for such programs. The national JFM program and social forestry concentrates on the forest areas rather than on such private degraded lands where the proposed A/R CDM activity takes place. Thus the baseline scenario is entirely in compliance with applicable legal and regulatory requirements but at the same time the fact that the legal requirements are in place does not mean that enough is being done.

STEP 3: Barrier Analysis

Determine whether the proposed project activity faces barriers that: - Prevent the implementation of this type of proposed project activity; and - Do not prevent the implementation of at least one of the alternatives.

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 evidence Transparent and documented;**
Investment barrier 1: Debt funding is not available for this type of project activity.	Perennial trees cost 87000 Rs/ha to establish. Agricultural banks do not give loans for these project activities as the marginal farmers do not have any collateral security to offer. The gestation period for tree crops is so long that these kinds of loans are not attractive to banks.	Annual cropping of marginal lands costs 1000 – 3000 Rs/ha. This level of borrowing is available more readily from informal sources where collateral is not needed. Gestation periods are short and money that has been borrowed informally can be returned more quickly to the lender. (However, it should be pointed out that as the project activity land is	Written documentation from ADATS who is developing and implementing the A/R CDM project activity, such as minutes from Board meetings, correspondence, feasibility studies, financial or budgetary information, etc; (www.adats.com) http://planningcommission.nic.i

		highly degraded, borrowing for planting on the project activity lands is not practiced.)	n/reports/wrkpapers/wp_lease.pdf
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.	It is not possible to raise funds on the international or domestic capital markets for investments on marginal farmer's own private lands where the financial returns from planting activity are too low to allow the farmers to repay any loans. - Funding is generally not adapted to the long-term nature of forestry; - inappropriate policies, poor institutional capacity and difficult procedures, whether on the part of aid recipient countries or donors. - the low business orientation of forestry administrations, bureaucratic delays and unsuitable tenure policies, laws and practices	Local funds are sufficient for the baseline level of activity on highly degraded lands where people do not have time, skill or money to look for other sources.	http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/w3247e/w3247e04.htm
Investment barrier 3: Lack of access to credit	If credit were available over say 5 year periods, with loan moratorium for 4 years until the trees start yielding, then these kinds of project activities would come up. But this form of finance is not available. - The credit is by banks has high transaction cost, complex procedure, corruption, one-time credit, poor recovery; overcrowding of lending in certain projects such as dairy; poor targeting and selection of non-poor.	Informal credit is available for low level of activities on degraded lands.	http://planningcommission.nic.in/plans/planrel/appdraft.pdf

	- Beyond the reach of poor farmers to take credit.		
Institutional barrier 1: Risk related to changes in government policies or laws	This kind of activity can only be taken up on land where title to the land is secure as carbon rights need to be clearly defined.	Can also be taken up on any degraded land even where the title has not yet been obtained.	Zeeuw, 1997; Kirk, 1999
Institutional barrier 2: Lack of enforcement of forest or land-use-related legislation.	Though 18 million ha of rainfed area is to be brought under subsistence forestry on private farmlands, lack of budget prevents it from implementation.	Business as usual is therefore for land to remain degraded with no tree cover.	Planning commission
Technological barrier 1: Lack of access to planting materials	The planting material has to be arranged a year in advance. If there is no fund security the nursery order cannot be given. There is also no pre-existing technological base from which to establish own nurseries.	For the baseline marginal crops like millet and groundnut there is no lack of planting material. It is available from local markets.	
Technological barrier 2: Lack of infrastructure for implementation of the technology.	This kind of project activity needs a well organised infrastructure for raising and/or distributing saplings, making watering arrangements, digging the pits, and maintaining the trees as it is degraded lands. This infrastructure can only be built up with adequate funds.	The infrastructure required in the baseline activity is family based. The activity can be carried out with family labour and there is no need for transport, technical and other inputs.	Documents prepared by ADATS in the context of the proposed project activity. www.adats.com
Barrier related to local tradition 1: - Traditional knowledge or lack thereof, laws and customs, market conditions, practices.	The educational level of rural youngsters cannot match the know-how and finesse of urban youth. A clever alliance with the middle-class like an NGO or local extension officers or private entrepreneurs is required for this kind of project activity to be taken up. Lack of knowledge of how to do CDM project	Superior knowledge of how to eke a living from degraded land does not result in adequate livelihood. Traditional knowledge is useless in the face of climate change and desertification. Lack of knowledge of how to implement a CDM project activity does obviously not prevent business as usual continuing.	

	activities is a barrier.		
Barrier related to local tradition 2: Traditional equipment and technology.	Lack of the vital technical advice prevents implementation of the type of project such as is being proposed as a CDM project activity.	Only technically proven and tried and tested crops are used – millet and groundnut on degraded lands are relatively pest-resistent and no additional technical support is required to get a marginal crop.	
Barrier due to prevailing practice: - The project activity is the "first of its kind": No project activity of this type is currently operational in the host country or region.	Prevailing practice is to take the path of least resistance and let marginal farmers on marginal parcels of land continue slowly abandoning degraded lands. A huge effort by the marginal farmers and the NGO is required to overcome prevailing practice.	By definition the business-as-usual scenario is the easiest to do.	
Barrier due to local ecological conditions 1: Degraded soil (e.g. water/wind erosion, salination, etc.)	A great amount of effort has to be made to establish trees.	Though this barrier also affects marginal cropping on degraded lands too, it does not affect it as strongly.	
Barrier due to local ecological conditions 2: Catastrophic natural and / or human-induced events (e.g. land slides, fire, etc)	This barrier does not affect the types of project such as this proposed project activity.	This barrier does not affect the baseline case.	
Barrier due to local ecological conditions 3: Unfavourable meteorological conditions such as drought.	Drought is a major barrier to the implementation of this project activity. Drought due to global climate change which causes increased desertification means that the proposed type of project activity has to overcome major barriers to see that the trees establish and flourish.	Though this barrier also affects marginal cropping on degraded lands too, it does not affect it as strongly, as the monetary loss in case of a drought is less.	
Barrier due to local ecological conditions 5: Biotic pressure in terms of grazing, fodder collection, etc.	Trees will have to be very well protected. Full time watch and ward is required for this type of project activity. Given that	Marginal annual crops on degraded lands give a small income within 3 months. This is an incentive to protect the crop during its	

	the harvest will not mature until the 4th or 5th year this is a major barrier to implementation of this type of project activity in the absence of additional financial incentives in the first years.	growth phase.	
Barrier due to social conditions 1: Demographic pressure on the land (e.g. increased demand on land due to population growth)	This barrier affects the planned type of project activity as land prices are going up despite continued degradation. This is due to scarcity of land and the perception that land is an asset over and above its productive value. Some parcels of land but not all thus face the barrier that reforestation will conflict with the aim of keeping the land in degraded condition with minimum investment and selling it at an opportune moment.	This barrier does not apply to marginal annual cultivation. The crop matures in three months and no major investment is lost if the land is sold.	
Barrier due to local social conditions 2: Social conflict among interest groups in the region where the project takes place.	The class/caste structure of rural society makes it difficult for this type of project activity to be taken up. This type of project activity faces a barrier due to social conflict between castes/classes which makes it very difficult to unite the various marginal farmers with their individual parcels of land in order to create a viable CDM project activity.	This barrier is not as intense for marginal cropping on degraded land. It helps families if they are organised, but there is no need for bundling as there is in a CDM project activity and so marginal cropping can be carried out even without working class unity.	http://www.epw.org.in/showArticles.php?root=2000&leaf=05&filename=1286&filetype=html
Barrier due to local social conditions 4: Lack of skills locally.	The project activity requires well organised and trained people to implement it; the training has to come as part of the pre-project phase. The lack of trained people amongst the implementing	Cropping on marginal degraded land does not need new skills; traditional practices suffice.	

	farmers is a barrier.		
Barrier due to local social conditions 5: Lack of organisation of local communities.	The project activity requires a very well organised community infrastructure. The lack of an organised community structure is a barrier.	For cropping on degraded land in individual parcels, no community organisation is required.	http://www.unu.edu/unupress/unupbooks/80a03e/80A03E0c.htm
Barriers relating to markets, transport and storage 3: 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.	There are yearly variations in price of NTFP products based on yield of the produce and yield of substitute products. The nearest informal local market and lack of any insurance for fluctuations, the financial returns to farmers is uncertain.	The produce from the land is sold in the nearby town.	http://www.deccanherald.com/deccanherald/jan252005/s2.asp
Barriers relating to markets, transport and storage 4: Absence of facilities to convert, store and add value to production from CDM activities limits the possibilities to capture rents from the land use under A/R CDM project activity."	The market for processed produce from the CDM activity would fetch higher returns to the farmers. An organized facility for processing, storage and value addition is currently not in place and is a barrier.	The produce from the land use will not be stored and sold immediately or used for subsistence.	

STEP 4: Impact of CDM registration

The approval and registration of the project activity as a A/R CDM project activity, and the attendant benefits and incentives derived from this registration, will alleviate the economic and financial and other identified barriers and thus enable the project activity to be undertaken.

The benefits and incentives are:

- The project will sequester CO_2. In the absence of the A/R CDM project activity, the land being private farmer's land will continue to remain degraded and no net GHG removals by sinks will take place.
- These farmers will be able to undertake reforestation activities on their marginal degraded lands which they will not be able to do without the CDM money which will flow after approval and registration. Loans for forestry activities for marginal farmers and agricultural labourers owning degraded land are not available as they cannot provide collateral security. Only the proposed A/R CDM activity will allow the project financing for the proposed reforestation activity by marginal farmers to be arranged, by creating the opportunity for ADATS to enter into an off-take contract with the proposed Annex 1 project participant on the basis of the lCERs to be generated by the project activity.

- The benefit of the reforestation programme is also that soil loss will be less as soil erodibility, surface slope gradients are less pronounced and shorter, soil cover increased, and conservation practices are adopted. The stock of soil affected by substantial erosion rate would otherwise over time, be converted to degraded soil and, if not restored, eventually result in a desert. As a consequence of the erosion process, sediment material would be further deposited in other parts of the landscape, water infiltration diminished, and runoff increased. Forests are one of the most protective types of soil covers that can help soil loss reduction. Thus approval and registration as a CDM project activity will overcome existing barriers to allow these benefits to flow.
- The successful implementation of this project and demonstrative effect may promote such activities in other parts of semi-arid region of the country and the region.
- New players who bring the capacity to implement a new technology/practice are attracted through a new kind of financing instrument.
- Ideas which were on paper can be implemented in practice and a proposed A/R CDM activity which was first conceived in 1995 can become reality.

B.4. Detailed baseline information, including the date of completion of the baseline study and the name of person(s)/entity(ies) determining the baseline:

>> See Section B 2 for detailed baseline information. Date of completion – 08-02-2006.

Name of person/entities determining the baseline:
CER India Pvt. Ltd.

The entity is a project participant listed in Annex 1.

SECTION C. Application of a monitoring methodology and of a monitoring plan

C.1. Title and reference of approved monitoring methodology applied to the project activity:

>>

'Approved afforestation and reforestation baseline methodology AR-AM0001 – Reforestation of degraded land'.

C.2. Justification of the choice of the methodology and its applicability to the proposed A/R CDM project activity:

>> The approved methodology provides the methodology for measuring, monitoring and estimating elements relevant to precisely estimate the net anthropogenic GHG removals by sinks for a proposed A/R project activity on degraded land. The monitoring will cover:

- Overall performance of the proposed A/R CDM project activity, including the project boundary, forest establishment and forest management activities;
- Actual net GHG removals by sinks including changes in carbon stock in above- and belowground biomass, increase in GHG emissions within the project boundary due to nitrogen fixation;
- Leakage due to vehicle use for transportation of seedlings, timber and non forest products, as a result of the implementation of the proposed A/R CDM project activity;
- Guidance for the implementation of a Quality Assurance/Quality Control plan, including field measurements, data collection verification, data entry and archiving, as an integral part of the monitoring plan of the proposed A/R CDM project activity to ensure the integrity of data collected and improve the monitoring efficiency.

The baseline net GHG removals by sinks do not need to be measured and monitored over times because, as per the conditions for the methodology, the lands to be reforested are degraded and are still degrading without possibility of natural encroachment of trees. Such removals are set to zero for lands without growing trees and projected carbon stock changes in above- and below-ground biomass of existing trees for lands with a few growing trees.

To be conservative and make the monitoring cost-effective, only carbon stock changes in above- and below-ground biomass are proposed to be measured and monitored because others pools are unlikely to decrease or decrease more than the baseline.

The stratification of the project area is based on local climate, existing vegetation, site class, land capability class and tree species to be planted under the aid of land use/cover maps, satellite image, soil map, GPS and field survey. The proposed methodology will use permanent sample plots to monitor carbon stock changes in above- and below-ground biomass pools. The sample frame to determine the number of plots needed in each stratum/sub-stratum will be to reach the targeted precision level of about ±5% of the mean at the 95% confidence level in a cost-effective manner. GPS located plots ensure the measuring and monitoring consistently over time.

All equations for estimating carbon stock changes, GHG emissions and leakage, actual net GHG removals by sinks and net anthropogenic removals by sinks will be through a step-wise approach.

The proposed A/R CDM project activity and its context meet the conditions under which the proposed methodology is applicable, as follows:

- The project activity CDM A/R does not lead to a shift of pre-project activities outside the project boundary, i.e. the land under the proposed A/R CDM project activity can continue to provide at least the same amount of goods and services as in the absence of the project activity. The proposed project area is currently uncultivable lands, fallow or marginal croplands.
- Lands to be reforested are severely degraded with the vegetation indicators below thresholds for defining forests, as communicated by the DNA consistent with decision 11/CP.7 and 19/CP.9, and the lands are still degrading. According to the baseline survey, the average aboveground biomass in the project area is 0.06 tB/ha. These lands as seen from the map in A-2 is below the thresholds of defining forests as communicated by DNA, which is a single minimum tree crown cover of 30%; minimum land area of 0.05 and minimum tree height of 5 meters.
- Environmental conditions and human-caused degradation do not permit the encroachment of natural forest vegetation. The project area is dryland which has been taken up for Dry Land Development Programme (DPDP). The land is being treated by removing boulders and creating bunds for soil and water conservation. There is a lack of natural seed source near by to result in natural regeneration.
- Lands will be reforested by direct planting and seeding of multiple long rotatuin species such as *Tamarindus indica*, *Syzygium cumini* and *Tectona grandis*.
- Site preparation does not cause significant longer term net emissions from soil carbon. The only site preparation that is taking place is the dry land development, where the boulders are being removed and bund prepared for soil and moisture conservation.
- Carbon stocks in soil organic matter, litter and deadwood can be expected to decrease more due to soil erosion and human intervention or increase less in the absence of the project activity, relative to the project scenario. Being a very dry area and scarcity of biomass, the dry and fallen

litter will be collected by the communities as fuelwood. Thus litter will not be a major source. The increment in soil organic carbon will also be meagre in such dry arid land.

- Only above- and belowground biomass will be monitored.
- Grazing will not occur within the project boundary in the project case.
- Each stratum based on species type, planting year, management regimes, soil type and soil capability class will be homogeneous is relatively homogeneous in terms of genetics, tree species, planting year and management regimes. The strata do not differ very much.
- The approved A/R CDM baseline methodology 'Afforestation and reforestation baseline methodology AR-AM0001 – Reforestation of degraded land' is chosen for determining the baseline.

C.3. Sampling design and stratification:

a) Stratification and sampling for ex-post calculations

To increase the accuracy and precision of measuring and monitoring in a cost-effective manner, stratification of the project area into relatively homogeneous units will be done as follows. This is in accordance of the chosen methodology AR-AM0001

Step 1*:* Assessing the key factors influencing carbon stocks in the above- and below-biomass pools, the project area has been stratified according to land capability classes. 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.:

- local site classification maps and/or tables;
- the most updated land use/cover maps and/or satellite images / aerial photography;
- Soil types, parent rocks and soil maps;
- landform information;
- soil erosion intensity;

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: Preliminary stratification: The preliminary stratification based on land capability class has been conducted using the GIS platform by overlaying information/maps collected, and hence in this case the hierarchical order is not necessary.
Step 4: A supplementary sampling survey on site specifications for each preliminary stratum, e.g.:

- Existing trees if any: species, age class, number of trees, mean diameter at breast height (DBH) and height by measuring randomly selected plots with an area of 400 m^2 will be conducted with at least 3 plots for each preliminary stratum;
- Non-tree vegetation: crown cover and mean height for herbaceous vegetation and shrubs by measuring randomly selected plots with an area of 4 m^2 (at least 10 plots for each preliminary stratum). For stratum with growing trees, the plots will be sub-plots of plots for measuring trees;
- Conducting variation analysis for key factors investigated above. If the variation is large within each preliminary stratum, more intense field investigation will be conducted and further stratification shall be considered in step 5.

Step 5: A further stratification will be done based on supplementary information collected from step 4 above, by checking whether or not each preliminary stratum is sufficiently homogenous or the difference among preliminary strata is significant. The degree of homogeneity will be assessed based on stratum size, the degree of natural variability and the significance of the variability to the project and baseline scenarios. A stratum within which there is a significant variation in any of vegetation type, soils and human intervention shall be divided into two or more strata. On the other hand, strata with similar features shall be merged into one stratum. Distinct strata should differ significantly from each other in terms of their baseline and/or project carbon calculation.

Step 6*:* Sub-stratification: Sub-strata will be created for each stratum based on tree species to be planted and/or on planting year described in CDM-AR-PDD.
Step 7*: S*tratification map will be created, by using a Geographical Information System (GIS). The GIS will be useful for integrating the data from different sources which can then be used to identify and stratify the project area. In addition, post stratification will be considered after the first monitoring event, because there are possible changes of project boundaries, tree species arrangement and planting year in comparison to the CDM-AR-PDD. The following factors shall be considered in the post-stratification:

- Data from monitoring of forest establishment and project boundary, e.g., actual project boundary, site and soil preparation, tree species and planting year;
- Data from monitoring of forest management, e.g., actual thinning and fertilization;
- Variation in carbon stock changes for each stratum and substratum after the first monitoring event.
- Strata or substrata shall be grouped into one strata or substrata if they have similar carbon stock, carbon stock change and spatial variation.

b) Sampling

Permanent sampling 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 generally regarded as statistically efficient in estimating changes in forest carbon stocks because there is typically a high covariance between observations at successive sampling events. Plots will be treated in the same way as other lands within the project boundary, e.g., during site and soil preparation, weeding, fertilization, irrigation, thinning, etc., will not be destroyed over the monitoring interval. 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.

(ii) Randomly locating sampling plots

To avoid subjective choice of plot locations (plot centres, plot reference points, movement of plot centres to more "convenient" positions), 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 coordinate), administrative location, stratum and sub-stratum series number of each plots will be recorded and archived. The size of plots will depend on the density of trees. Also, it will be ensured that the sampling plots are distributed as evenly spread as possible.

C.4. Monitoring of the baseline net GHG removals by sinks and the actual net GHG removals by sinks:

The monitoring of the baseline GHG removals by sinks and the actual net GHG removals by sinks will be according to the approved methodology

'Approved afforestation and reforestation baseline methodology AR-AM0001 Version 2 – Reforestation of degraded land'.

1. Monitoring of the baseline net GHG removals by sinks

The proposed A/R CDM project activity aims to reforest degraded private farmers land. The baseline scenario for degraded lands has been established using the approved methodology, i.e., "Afforestation and reforestation baseline methodology AR-AM0001 – Reforestation of degraded land'(section B).

The baseline net GHG removals by sinks are set to zero for the lands with no growing trees in Siddalaghatta taluk and the carbon stock change in the other taluks. In addition, the 30 year fixed crediting period is chosen as the crediting period. Hence, the baseline net GHG removals by sinks need not be monitored, because baseline approach 22(a) is chosen which "freezes" the baseline at the time of project validation.

2. Monitoring the boundary of the proposed A/R CDM project activity

- Field surveys on the actual boundary of each parcel of land where the reforestation CDM project activity will be occurring will be undertaken.
- The survey number of the parcel of land, the ownership to land and marking the unique reference number will be monitored annually by the ADATS team.
- The geographical positions (latitude and longitude of each corner of land parcel) will be marked on the GIS platform.
- The actual boundary will be cross-checked to verify whether it is consistent with the description in section A, Appendix 1 and 2.
- If the actual boundary falls outside of the designed boundary in section A, Appendix 1 and 2, additional information for the part of lands that are beyond the designed boundary in section A will be provided; the eligibility of these lands as a part of the A/R CDM project activity will be justified; and the projected baseline scenario will be demonstrated to be applicable to these lands. Otherwise, these lands will not be accounted as a part of the proposed A/R CDM project activity. Such changes in boundary will be informed to the DOE and subject to validation during the project.
- The measured geographical positions will be input into the GIS system and the eligible area of each stratum and sub-stratum will be calculated.
- The project boundary will be monitored periodically through the crediting period. If the boundary is changed during the crediting period, for instance, deforestation occurs on the project area, the specific location and area of the deforested land will be identified, the boundary will be modified and reported to DOE for subsequent verifications, the deforested area will be excluded from the project, and the lCERs resulting from that will subsequently be retired. Similarly, if the planting on certain lands within the project boundary fails, and other land uses take the place, these lands will be documented.

3. Monitoring of the forest establishment

To ensure the planting quality and confirm the practice described in section A is well-implemented, the following monitoring activity will be conducted in the first three years after planting:

- Confirm site and soil preparation are implemented based on practice documented in section A.
- Survival checking
- The initial survival rate of planted trees will be counted within three months after the planting, and re-planting will be conducted if the survival rate is lower than 90% percent.
- Annual check of survival rate will be done by the team. Replanting will be done in the subsequent year if the plants have not established during the first year.
- Final checking will be done three years after the planting.
- The checking of the survival rate will be conducted using permanent sample plots.

- Also 100% check will be done by having self monitoring system by farmers. These will be recorded at each plot level and record maintained at the ADATS office.
- Weeding checking: check and confirm that the weeding practice is well-implemented.
- Survey and check the area of planted species and planting year for each stratum and sub-stratum.

4. Monitoring of the forest management

Forest management practices that will be monitored are as follows:

- Thinning: specific location, area, tree species, thinning intensity, biomass removed
- Harvesting: harvested location, area, tree species, biomass removed
- Fertilization: tree species, location, amount and type of fertilizer applied, etc.
- Checking and confirming that harvested lands are re-planted or re-sowed immediately after harvesting if direct planting or seeding is used
- Checking and ensuring that good conditions exist for natural regeneration if harvested lands are allowed to regenerate naturally.

C.4.1. Actual net GHG removals by sinks data:

C.4.1.1. Data to be collected or used 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, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
4.1.1.01	Stratum ID	Stratification map	Alpha numeric		Before the start of the project	100%	Electronic and paper	Based on land capability class as each stratum has a particular combination of soil type and landform
4.1.1.02	Sub- stratum ID	Stratification map	Alpha numeric		Before the start of the project	100%	Electronic and paper	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	100%	Electronic and paper	For the purpose of QA/QC and measuring and monitoring

					project			precision control
4.1.1.04	Precision level		%		Before the start of the project	100%	Electronic and paper	For the purpose of QA/QC and measuring and monitoring precision control
4.1.1.05	Sample plot ID	Project and plot map	Alpha numeric		Before the start of the project	100%	Electronic and paper	Numeric series ID will be assigned to each permanent sample plot
4.1.1.06	Plot location	Project and plot map and GPS locating		m	5 years	100%	Electronic and paper	Using GPS to locate before start of the project and at time of each field measurement
4.1.1.07	Tree species	Project design map			5 years	100%	Electronic and paper	As in PDD
4.1.1.08	Age of plantation	Plot measurement	Year	m	5 years	100 % sampling plot	Electronic and paper	Counted since the planted year
4.1.1.09	Number of trees	All project area and also Plot measurement	Number	m	Yearly & 5 years	100 %	Electronic and paper	- 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)	Plot measurement	cm	m	5 years	100 % trees in plot	Electronic and paper	Measuring at each monitoring time per sampling method
4.1.1.11	Mean DBH	Calculated via 3.1.1.10	cm	c	5 years	100 % sampling plot	Electronic and paper	Calculated via 3.1.1.09 and 3.1.1.10
4.1.1.12	Tree height	Plot measurement	m	m	5 years	100 % trees in plot	Electronic and paper	Measuring at each monitoring time per sampling method
4.1.1.13	Mean tree height	Calculated via 3.1.1.12	m	c	5 years	100 % sampling plot	Electronic and paper	Calculated via 3.1.1.09 and 3.1.1.12
4.1.1.14	Allometric equations	Calculated using equation	$M^3 ha^{-1}$	c/m	5 years	100 % sampling plot	Electronic and paper	Calculated using equations (11)-(12) via 3.1.1.11 and 3.1.1.1t

		(11)- (12)						
4.1.1.15	Wood density	National inventory for LULUCF	t d.m.m^{-3}	e	5 years	100 % sampling plot	Electronic and paper	Species specific
4.1.1.16	Biomass expansion factor (BEF)	National inventory for LULUCF	dimensionless	e	5 years	100 % sampling plot	Electronic and paper	Species specific
4.1.1.17	Carbon fraction	IPCC	t C. (t.d.m)$^{-1}$	e	5 years	100 % sampling plot	Electronic and paper	IPCC default value
4.1.1.18	Root- shoot ratio	GPG, LULUCF, 2003	dimensionless	e	5 years	100 % sampling plot	Electronic and paper	Based on IPCC equation for tropical forests
4.1.1.19	Carbon stock in above ground biomass of plots	Calculated from equation	t C ha^{-1}	c	5 years	100 % sampling plot	Electronic and paper	Calculated using equation (14) via 3.1.1.14 and 3.1.1.17
4.1.1.20	Carbon stock in below ground biomass of plots	Calculated from equation	t C ha^{-1}	c	5 years	100 % sampling plot	Electronic and paper	Calculated using equation (15) via 3.1.1.18 and 3.1.1.19
4.1.1.21	Mean carbon stock in above ground biomass per unit area per stratum per species	Calculated from plot data	t C ha^{-1}	c	5 years	100 % strata and sub-strata	Electronic and paper	Calculated from 3.1.1.09 and 3.1.1.19
4.1. 1.22	Mean carbon stock in below ground	Calculated from plot data	t C ha^{-1}	c	5 years	100 % strata and sub-strata	Electronic and paper	Calculated from 3.1.1.09 and 3.1.1.20

	biomass per unit area per stratum per species							
4.1.1.23	Area of stratum and sum-stratum	Stratification map and data	ha	m	5 years	100 % strata and sub-strata	Electronic and paper	Actual area of each stratum and sub-stratum
4.1.1.24	Carbon stock in above ground biomass of stratum per species	Calculated using equation (8)	t C	c	5 years	100 % sampling plot	Electronic and paper	Calculated using equation (8) via 3.1.1.21and 3.1.1.23
4.1.1.25	Carbon stock in below ground biomass of stratum per species	Calculated using equation (9)	t C	c	5 years	100 % sampling plot	Electronic and paper	Calculated using equation (9) via 3.1.1.22 and 3.1.1.23
4.1.1.26	Carbon stock in above ground biomass of stratum per species	Calculated using equation (6)	t C yr^{-1}	c	5 years	100 % strata and sub-strata	Electronic and paper	Calculated using equation (6) via 3.1.1.24
4.1.1.27	Carbon stock in above below biomass of stratum per species	Calculated using equation (7)	t C yr^{-1}	c	5 years	100 % strata and sub-strata	Electronic and paper	Calculated using equation (7) via 3.1.1.25
4.1.1.30	Total carbon stock change	Calculated using equation (5)	t CO_2-e yr^{-1}	c	5 years	100 % project area	Electronic and paper	Summing up carbon stock change 3.1.1.26 and 3.1.1.27 for all strata , sub-strata and tree species

C.4.1.2. Data to be collected or used 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, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
4.1.2.01	Amount of organic fertilizer N applied per unit area	Monitoring activity	Kg N ha^{-1} yr^{-1}	m	Annually	100%	Electronic and paper	
4.1.2.02	Area of land with N applied	Monitoring activity	ha yr^{-1}	m	Annually	100%	Electronic and paper	
4.1.2.03	Amount of organic fertilizer N applied	Calculated using equation (17)	t N yr^{-1}	c	Annually	100%	Electronic and paper	Calculated using equation (17) via 3.1.2.01 and 3.1.2.02
4.1.2.04	Fraction that volatilizes as NH_3 and NOx for organic fertilizers	GPG 2000, IPCC Guideline	Dimensionless	e	Before start of monitoring	100%	Electronic and paper	IPCC default value (0.2) is used
4.1.2.05	Emission factor for	GPG 2000, IPCC	N_2O-N (tones N input)$^{-1}$	e	Before start of	100%	Electronic and paper	IPCC default value (1.25%) is used

	emission from N input	Guideline			monitoring			
4.1.2.06	Direct N_2O emission of N input	Calculated using equation (18)	t CO_2-e yr^{-1}	c	Annually	100 %	Electronic and paper	Calculated using equation (18) via 3.1.2.04and 3.1.2.08

C.4.1.3. Description of formulae and/or models used to monitor the estimation of the ex-post actual net GHG removals by sinks:

The formulae and/or models that will be used to monitor the estimation of the ex-post actual net GHG removals by sinks is based on the approved methodology AR-AM0001 Version 2.

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 that are increased as a result of the implementation of an A/R CDM project activity, while avoiding double counting, within the project boundary, attributable to the A/R CDM project activity. Therefore,

$$C_{ACTUAL} = \sum\sum\sum \Delta C_{ijk} - GHG_E$$

Where:
C_{ACTUAL} = actual net greenhouse gas removals by sinks, tonnes CO_2-e yr^{-1}
ΔC_{ijk} = verifiable changes in carbon stock change in carbon pools for stratum i sub-stratum j species k, tonnes CO_2 yr^{-1}.
GHG_E = increase in GHG emissions by the sources within the project boundary as a result of the implementation of an A/R CDM project activity, tonnes CO_2-e yr^{-1}.

C.4.1.3.1. Description of formulae and/or models used to monitor the estimation of the verifiable changes in carbon stock in the carbon pools within the project boundary (for each carbon pool in units of CO_2 equivalent):

>> Based on the approved methodology, carbon stock changes in pools of soil organic matter, litter and dead wood are ignored. The verifiable changes in carbon stock equal to the carbon stock changes in aboveground biomass and belowground biomass within the project boundary, will be estimated using equation

$$\Delta C_{ijk} = (\Delta C_{ABijk} + \Delta C_{BBijk}).{}^{44}\!/_{12}$$

$$\Delta C_{AB\,ijk} = (\Delta C_{ABi,t_2\,jk} + \Delta C_{ABt_1 ijk})./T$$

$$\Delta C_{BB\,ijk} = (\Delta C_{BBi,t_2\,jk} + \Delta C_{BBt_1 ijk})./T$$

where:

ΔC_{ijk}	=	verifiable changes in carbon stock in living biomass for stratum i sub-stratum j species k, tonnes CO_2 yr^{-1} in year t
ΔC_{ABijk}	=	changes in carbon stock in aboveground biomass for stratum i sub-stratum j species k, tonnes C yr^{-1} in year t
ΔC_{BBijk}	=	changes in carbon stock in belowground biomass for stratum i sub-stratum j species k, tonnes C yr^{-1} in year t
$\Delta C_{ABi,t_2\,jk}$	=	carbon stock in aboveground biomass for stratum i sub-stratum j species k, calculated at monitoring point t_2, tonnes C
$\Delta C_{ABi,t_1\,jk}$	=	carbon stock in aboveground biomass for stratum i sub-stratum j species k, calculated at monitoring point t_2, tonnes C
$\Delta C_{BBt_2 ijk}$	=	carbon stock in belowground biomass for stratum i sub-stratum j species k, calculated at monitoring point m_2, tonnes C
$\Delta C_{BBt_1 ijk}$	=	carbon stock in belowground biomass for stratum i sub-stratum j species k, calculated at monitoring point m_1, tonnes C
44/12	=	ratio of molecular weights of carbon and CO_2, dimensionless
T	=	number of years between monitoring point t_2 and t_1, which is 5 years.

The total carbon stock in living biomass for each stratum and sub-stratum in each monitoring point (t) is calculated from the area of each stratum and sub-stratum and mean carbon stock in aboveground biomass and belowground biomass per unit area, given by:

$$C_{AB,t,ijk} = A_{ijk}.MC_{AB,t,ijk}$$

$$C_{BB,t,ijk} = A_{ijk}.MC_{BB,t,ijk}$$

Where:

A_{ijk} = area of stratum i sub-stratum j species k, hectare (ha)

$MC_{AB,t,ijk}$ = mean carbon stock in aboveground biomass per unit area for stratum i sub-stratum j species k, tonnes C ha^{-1}

$MC_{BB,t,ijk}$ = mean carbon stock in belowground biomass per unit area for stratum i sub-stratum j species k, tonnes C ha^{-1}

The mean carbon stock in aboveground biomass and belowground biomass per unit area will be estimated based on field measurements on permanent plots. The aboveground biomass will be estimated using allometric equations method.

Allometric method

Step 1: The diameter at breast height (DBH) of trees at 1.3 metres above ground will be measured. The height of the trees will also be measured in the permanent sample plots.

Step 2: Allometric equations will be developed for *Tamarindus indica* sps and other species as local specific equations are not available. A sample of trees representing different size classes will be destructively harvested and its total biomass determined. The allometric equations will be constructed relating the biomass with values from measured variables, the DBH and total height. For syzygium and Teak species, volume equation are available, which will be used for estimating the aboveground biomass.

For syzygium cumini (Rai, 1980)[11]

$V= 0.0238 + 0.41681\ D^2H$; $R^2 = 0.81191$

For Tectona grandis (FSI, 1996)[17]

$V= 0.01103+0.31458D^2H$; where $R^2 = 0.9403$

Where D=DBH and H=height of the tree

To convert volume to aboveground biomass, the following equation will be used:

[17] FSI (1996) Volume Equations for Forests of India, Nepal and Bhutan, Forest Survey of India, Ministry of Environment and Forests, Government of India, 1996.

$$MC_{AB} = V.D.BEF.CF$$

The default value of biomass expansion factor of 1.5 will be used as given by the GPG for LULUCF, IPCC 2003.

To estimate belowground biomass the following equation will be used:

$$MC_{BB} = MC_{AB}.R$$

Where
C_{AB} = mean carbon stock in aboveground biomass, tonnes C ha^{-1}
C_{BB} = mean carbon stock in belowground biomass, tonnes C ha^{-1}
V = merchantable volume, m^3 ha^{-1}
D = volume-weighted average wood density, tonnes d.m.m^{-3} merchantable volume
BEF = biomass expansion factor for conversion of biomass of merchantable volume to aboveground biomass, dimensionless.
CF = carbon fraction, tonnes C (tonne d.m)$^{-1}$, IPCC default value = 0.5.
R = Root-shoot ratio, dimensionless

The root-shoot ratio will be determined based on the IPCC equation

$Y=\exp[-1.0587 + 0.8836 \bullet \ln(ABD)]$

Where Y= root biomass in Mg ha^{-1} of dry matter; ln = natural logarithm; exp = "e to the power of"; ABD = aboveground biomass in Mg ha^{-1} of dry matter
Source: Table 4.A.4 in GPG Good practice guidance

Step 3: The carbon stock in aboveground biomass will be estimated as follows:

$$MC_{AB} = B_{AB}.CF$$

Where
CF =Carbon fraction, tones C (tonne d.m)$^{-1}$; default value = 0.5.

To estimate the below ground biomass the IPCC default value will be used (GPG IPCC, 2004)

Allometric equations for estimating belowground or root biomass of forests

Tropical forests, ABD Y=exp[–1.0587 + 0.8836 • ln(ABD)] [18]

Where Y= root biomass in Mg ha^{-1} of dry matter; ln = natural logarithm; exp = "e to the power of"; ABD = aboveground biomass in Mg ha^{-1} of dry matter

C.4.1.3.2. Description of formulae and/or models used to monitor the estimation of 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 (for each source and gas, in units of CO_2 equivalent):

>> According to the approved methodology AR-AM0001 Version 2 the various GHG emissions by sources are burning of fossil fuel, decrease in carbon stock in living biomass of existing non-tree vegetation, biomass burning and nitrous oxide emissions from nitrogen fertilization practices. In the present project area, farm yard manure will be applied during the year of planting which leads to GHG emissions. Thus only direct N_2O emissions from nitrogen fertilization will be estimated as follows:

Step 1: Monitoring and estimating the amount of nitrogen in organic fertilizer used within the project boundary;

$$N_{ON-Fert,t} = \sum_k A_k . N_{ON-Fert,k,t} . 0.001$$

where:

$N_{ON\text{-}Fert,t}$ = total use of organic fertiliser within the project boundary, tonnes N yr-1 in year t
A_k = area of tree species k with fertilization, ha yr-1
$N_{ON\text{-}Fert,k,t}$ = use of organic fertiliser per unit area for tree species k, kg N ha-1 yr-1 in year t
0.001 = conversion kg N to tonnes N

Step 2: To calculate the direct N_2O emissions from nitrogen fertilization the following equation will be used:

$$N_2O_{direct-N_{fertilizer}} = [(F_{ON}).EF_1].44/28.310$$

$$F_{ON} = N_{ON-Fert}.(1 - Frac_{GASM})$$

[18] Source: Table 4.A.4 in GPG Good practice guidance,2004

where:

$N_2O_{direct-N_{fertilizer}}$ = the direct N_2O emission as a result of nitrogen application within the project boundary during monitoring interval, tonnes CO2-e yr^{-1} in year t

F_{ON} = Annual amount of organic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_X, tonnes N yr^{-1}

$N_{ON-Fert}$ = Amount of organic fertilizer nitrogen applied, tonnes N yr^{-1}

EF1 = Emission Factor for emissions from N inputs, tonnes N_2O-N (tonnes N input)$^{-1}$, IPCC default value = 1.25%

$Frac_{GASF}$ = the fraction that volatilises as NH3 and NOX for synthetic fertilizers, dimensionless; IPCC default value = 0.2;

44/28 = ration of molecular weights of N_2O and nitrogen, dimensionless

310 = Global warming potential for N_2O

Decrease in carbon stock from non-tree vegetation would occur in the project area for areas with shrubs. The decrease in shrub biomass due to project activity was estimated as follows:

The above-ground biomass and below ground biomass of shrubs was harvested for 20 parcels of land in 5 taluks. The dry weight was determined by over-drying at 280° C. The decrease in carbon stock of existing non-tree vegetation was determined as follows:

$$E_{biomassloss,t} = \sum_i Ai.B_{non-tree,i}.CF_{non-tree}.44/12 \qquad \forall t = 1$$

$$E_{biomassloss,t} = 0 \qquad \forall > 1$$

where:

A_i area of stratum i, ha

$B_{non-tree,i}$ average biomass stock of non-tree vegetation on land to be planted before the start of a proposed A/R CDM project activity for stratum I, tonnes d.m.ha^{-1}

$CF_{non-tree}$ the carbon fraction of dry biomass in non-tree vegetation, tonnes C (tonne d.m)$^{-1}$

44/12 ration of molecular weights of CO_2 and carbon, dimensionless

For the project area, the area of stratum with shrubs were determined based on the baseline survey. The percent of area with shrubs in the baseline survey was considered as the area with shrub for the project area. The details of the survey is as follows:

Table C-1: Details of shrub area in the project area

	Area to be planted yearly (ha)				% of sampled area with shrubs	Area with shrubs that will be planted (ha)			
Area of planting	Year 1	Year 2	Year 3	Year 4		Year 1	Year 2	Year 3	Year 4
Bagepalli	1087	1769	1769	1769	15%	162	263	263	263
Chickballapur	245	399	399	399	21%	52	85	85	85
Chintamani	861	1401	1401	1401	64%	555	903	903	903
Siddalaghatta	648	1054	1054	1054	62%	403	656	656	656
Gudibanda	250	407	407	407	0%	0	0	0	0
Total	3091	5030	5030	5030		1172	1907	1907	1907

The average biomass stock of non-tree vegetation on lands to be reforested is 0.055 t/ha. The moisture content was 30%. Hence the average dry biomass in non-tree vegetation is 0.039 t/ha. The carbon fraction of dry biomass in non-tree vegetation was taken as 0.5. Thus from the project area the annual loss of non-tree vegetation CO_2 loss is as given in Table C-2. The total CO_2 stock decrease due to existing non-tree vegetation is 486.5 tCO_2.

Table C-2: The decrease in CO_2 stock of existing non-tree vegetation from the project area (tCO_2)

Decrease in stock	**2006**	**2007**	**2008**	**2009**
Biomass	45.1	73.4	73.4	73.4
Carbon	22.6	36.7	36.7	36.7
CO_2	**82.7**	**134.6**	**134.6**	**134.6**

C.4.2. As appropriate, relevant data necessary for determining the ex-post baseline net GHG removals by sinks and how such data will be collected and archived, if required:

ID number ***(Please use numbers to ease cross-referencing to D.3)***	**Data variable**	**Source of data**	**Data unit**	**Measured (m), calculated (c) or estimated (e)**	**Recording frequency**	**Proportion of data to be monitored**	**How will the data be archived? (electronic/ paper)**	**Comment**
NA	*NA*							

C.4.2.1. Description of formulae and/or models used to monitor the estimation of the ex-post baseline net GHG removals by sinks (for each carbon pool, in units of CO_2 equivalent), if required:

>> In the baseline scenario, the baseline GHG removals are set to zero for degraded lands without growing trees and the projected increase in carbon stock of aboveground and below ground biomass for land with growing trees. As the crediting period is fixed, monitoring of the ex-post baseline net GHG removals by sinks will not be required.

C.5. Treatment of leakage in the monitoring plan:

>> Leakage represents the increase in GHG emissions by sources which occurs outside the boundary of an A/R CDM project activity which is measurable attributable to the A/R CDM project activity.

The proposed A/R CDM project area is presently under soil and water conservation under the dryland development programme by ADATS. Land used for reforestation is degraded and uncultivable private farm land unfit for productive cultivation. The economical unattractive land currently does not support agriculture, grazing, and is not a major source for fuelwood. PRA exercises at village level show that nearby forests and common lands are the main sources of fuelwood. In addition, family level biogas plants are being installed in this region under CDM activity, which will further reduce fuelwood requirement. Local farmers will be able to collect fuel within the project boundary without compromising growth of trees established under the proposed A/R CDM project activity, but this will be restricted to dead wood and branches. Thus, as the result of the proposed A/R CDM project activity, local farmers will in fact have fallen twigs and branches as fuelwood and will not have to collect fuelwood on lands outside the project boundary. However, in the context of A/R activities, fossil fuel combustion from vehicles use to the transportation of seedling, and NTFP products, to and/or from project sites, as a result of the proposed A/R CDM project activity, emits greenhouse gases. This will be monitored and estimated using IPCC approach.

C.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:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
5.1.01	Number of each Vehicle type used	Monitoring of project activity	Number		annually	100%	Electronic and paper	Monitoring number of each Vehicle type used

5.1.02	Emission factor for road transportation	GPG 2000, IPCC Guideline, national inventory	kg CO_2-e L^{-1}	e	annually	100 %	Electronic and paper	National or local value as the priority
5.1.03	Kilometers travelled by Vehicle	Monitoring of project activity	km	m	annually	100%	Electronic and paper	Monitoring Kilometers of each Vehicle type and fuel type used
5.1.04	Fuel consumption per km	Local data, National data, IPCC	Litre km^{-1}	e	5 years	100 %	Electronic and paper	Estimated for each Vehicle type and fuel type used
5.1.05	Fuel consumption for road transportations	Calculated using equation (22)	Litre	c	annually	100 %	Electronic and paper	Calculated using equation (22) via 4.1.07and 4.1.03, 4.1.04
5.1.06	Leakage due to vehicle use for transportation	Calculated using equation (21)	t CO_2-e yr^{-1}	c	annually	100 %	Electronic and paper	Calculated using equation (21) via 4.1.02and 4.1.07

C.5.2. Description of formulae and/or models used to estimate leakage (for each GHG, source, carbon pool, in units of CO_2 equivalent:

>> The formulae used to estimate leakage will be according to the approved methodology AR-AM0001.

Leakage due to fossil fuel combustion from vehicles will be estimated using following steps and formula
Step 1: Collecting the traveled distance of different types of vehicles using different fuel types.
Step 2: Determining emission factors for different types of vehicles using different fuel types. National default values from national GHG inventory will be used.
Step 3: Estimating the CO_2 and non-CO_2 GHG emissions using bottom-up approach described in GPG 2000 for energy sector[15].

$$LK_t = \sum\sum (EF_{ij}.FuelConsumption_{ij,t}).0.001$$

$$Fuelconsumption_{ij,t} = n_{ij,t}.ki_{j,t}.e_{ij,t})$$

Where
LK_t = total GHG emissions due to fossil fuel combustion from vehicles, tonnes CO2-e yr^{-1}
i = vehicle type
j = fuel type
EF_{ij} = emission factor for vehicle type i with fuel type j, kg CO2-e l^{-1}
$FuelConsumption_{ij}$ = consumption of fuel type j of vehicle type i, litre yr^{-1}
n_{ij} = number of vehicle type i used, yr-1
k_{ij} = kilometres travelled by each of vehicle type i with fuel type j, km
e_{ij} = average litres consumed per kilometre travelled for vehicle type i with fuel type j, litre km-1

C.5.3. Please specify the procedures for the periodic review of implementation of activities and measures to minimize leakage:

>> The leakage associated with the proposed A/R CDM project activity is in terms of the use of vehicles for the transportation of staff and products outside project area. Primary leakage and secondary leakage will be monitored and measures will be taken to minimize leakage. Primary leakage will be when the baseline activity is shifted to other areas due to project implementation. Primary leakage is not possible as currently the communities are not getting any benefit from the degraded lands. The anticipated leakages are demand of land for subsistence crops, commercial crops, which would deforest other lands. Periodic review of implementation of activity and measures for leakage prevention measures will be taken up. As there is no forested area nearby expected leakage is negligible. Through the Coolie Sangha, development of alternative sources of income such as animal husbandary, technical assistance to increase productivity of existing agricultural soils to reduce the need to clear new areas, and improvement in the quality of health and educational opportunities will be taken up by ADATS as part of holistic development of the area. Secondary leakage caused by market effects, would be minimal especially from such dry zones.

C.6. Description of formulae and/or models used to estimate ex-post net anthropogenic GHG removals by sinks for the proposed A/R CDM project activity (for each GHG, carbon pool, in units of CO_2 equivalent):

>> The formulae used to estimate net anthropogenic GHG removals by sinks will be according to the approved methodology AR-AM0001.

The net anthropogenic GHG removals by sinks is the actual net GHG removals by sinks minus the baseline net GHG removals by sinks minus leakage. The following formula will be used to calculate the net anthropogenic GHG removals by sinks of an A/R CDM project activity (C_{ARCDM}), in tonnes CO_2-e yr^{-1}:

$$C_{AR-CDM} = C_{ACTUAL} - C_{BSL} - LK$$

Where
C_{ACTUAL} = Actual net greenhouse gas removals by sinks, tonnes CO_2^{-e}
C_{BSL} = Baseline net greenhouse gas removals by sinks, tonnes CO_2^{-e}
LK = Leakage, tonnes CO_2^{-e}

C.7. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored:		
Data ***(Indicate table and ID number e.g. 3.-1.; 3.2.)***	**Uncertainty level of data (High/Medium/Low)**	**Explain QA/QC procedures planned for these data, or why such procedures are not necessary.**
4.1.1.06 Plot location	low	Random plot verification using GPS to ensure the consistent measuring and monitoring of carbon stock change over time
4.1.1.07 tree species	low	Random verification over the project area to ensure each tree species is correctly measured
4.1.1.08 age of plantation	low	Random verification over the project area to ensure the area in terms of plantation age is correctly measured
4.1.1.09 number of trees	low	Random plot verification
4.1.1.10 diameter at breast height (DBH)	low	Random plot verification
4.1.1.12 tree height	low	Random plot verification
4.1.1.14 Merchantable volume	low	All allometric equations used to calculate this data will be verified
4.1.1.15 wood density	low	Data that divert significantly from IPCC default value will be verified
4.1.1.16 Biomass expansion factor (BEF)	low	Data that divert significantly from IPCC default value will be verified
4.1.1.17 Carbon fraction	low	Data that divert significantly from IPCC default value will be verified
4.1.1.18 Root-shoot ratio	low	Data that divert significantly from IPCC default value will be verified

4.1.2.09 Direct N_2O emission of N input	low	Data that divert significantly from IPCC default value will be verified
5.1.01 Number of each vehicle type used	low	Project record shall be available and verified
5.1.02 Emission factors for road transportation	low	Data that divert significantly from IPCC default value will be verified
5.1.03 Kilometers travelled by vehicles	low	Project record will be available and verified

C.8. 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:

>> Operational and management arrangements would include the following elements:

A. Project Director of CER India Pvt. Ltd. will be responsible for coordinating the Programme;

B. The project implementation is based on the Coolie Sangha Units (CSU) in each village. These CSUs are non-governmental organizations consisting of members of the public owning small parcels of marginal degraded lands who have joined the CSUs and are implementing reforestation on their degraded lands. The main role of the CSUs is to manage the reforestation activity in their villages and clusters in close cooperation with ADATS. The CSUs have in the past implemented the DLDP and have management systems in place for coordinating the Bagepalli CDM Reforestation Programme work. The CSUs are organized formally at village levels, with CSU management through the federal Coolie Sangha structure in each talk. The CSUs are part of the federal structure of the Bagepalli Coolie Sangha which is officially registered, and is overseen by elected members.

C. The CSUs will be responsible for:

- planting, tending of the trees
- annual reporting of tree counts
- doing the first survival monitoring
- dissemination of information on project implementation and best practices to all CSUs
- coordination with all involved parties on project financing and supervision.

- managing day to day activities of the project implementation, coordination of the project monitoring plan, including verification and reporting.
- implementation of the Emission Monitoring Plan (EMP) and annual monitoring of the project progress and measure the impact of project activities against the baseline survey undertaken during project preparation.
- systematic analysis of the project activities and the results of the monitoring activities, which will be fed back into the implementation process.
- sustainability of the project reforestation activities through strengthening of the forestry management practices;
- project co-ordination and knowledge management of project activities.
- inventory and mapping of every sector with the use of GPS and GIS;
- supervision of project stipulations, plantation technique and technologies.
- establishment of polygons and methodologies concerning the necessary measurements within the project area.
- carrying out of project monitoring at initial phase, and after that in year V, X and XV;
- verification of inventories of plantations;
- preparation of annual reports;
- formulation of recommendations for re-addressing and improvements of works (reparation, maintenance, assurance of integrity etc.);
- preparation of recommendations concerning the management of new created forests;
- preparing and carrying out workshops and training within the project.

Any activity data and monitoring and measuring data will be reported to and archived in the ADATS offices in both electronic and paper copy.

E. District forestry offices will provide technical instruction and support on reforestation and forest management.

F. An expert team will be established if any technical issues will arise, conducting checking and verification of measured and monitored data.

C.9. Name of person/entity determining the monitoring methodology:

>> CER India Pvt. Ltd.
The entity is the project participant listed in Annex 1.

SECTION D. Estimation of net anthropogenic GHG removals by sinks:

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

>> The estimate of actual net GHG removals by sinks includes the carbon stock change in aboveground biomass and belowground biomass. The methodology adopted is based on the approved methodology and elaborated in section C and D.

'Approved afforestation and reforestation baseline methodology AR-AM0001 Version 2 – Reforestation of degraded land'.

The carbon stock changes in pools of soil organic matter, dead wood and litter are excluded.

The increment in aboveground biomass that would be achieved by the proposed A/R CDM project activity was estimated based on growth curves derived from literature and field studies (Fig D-1). Growth curves for syzygium was obtained from Rai, 1980 and for teak from studies conducted by Forest Research Institute, Dehra Dun[19]. Growth curves for Tamarind was not available. Field studies were collected from Indian Institute of Science for a similar study area to deduce the growth curves and the Biomass increments.[20] The following allometric equations was used for calculating the above ground biomass which is based on height measurements.

Y = -128.8+4.14H; where H=Height (Dugar *et al*., 1993)[21]

Using the biomass growth rates, the estimated biomass increment in aboveground biomass was calculated for each of the species separately, with default equations for certain species together. Thus the annual biomass yield shown in the fig.1 is calculated for 5000 trees per hectare of mixed dry land forest. Harvest is not considered as there will be intermittent harvest of small timber only, and an occasional Teak tree every decade.

Table 2: Annual biomass yield of mixed forest[22]

3.5 years			**5 years**		
Woody Biomass dry t/ha/year	Leafy Biomass dry t/ha/year	Total Tree Biomass dry t/ha/yr	Woody Biomass dry t/ha/year	Leafy Biomass dry t/ha/year	Total Tree Biomass dry t/ha/yr
5.77	3.11	8.88	5.83	2.6	8.43

[19] FRI. Growth and yield statistics of common Indian timber species, Forest Research Institute, Dehra Dun, India.
[20] Biomass generation in mixed tree plantations, R. Shailaja, Centre for Environmental Education, South Zone office,
Kamala Mansion, 143, Infantry Road, Bangalore-560 012, India; N.H. Ravindranath, H.I. Somashekar and K.S. Jagadish, Centre for Applications of Science and Technology to Rural Areas (ASTRA), Indian Institute of Science, Bangalore. Energy for Sustainable Development l Volume I No. 3 l September 1994
[21] Dagar, J.C., Gurbachan Singh. and Singh, N.T. Evaluation of crops in Agro forestry with Teak (*Tectona grandis),* Maharukh (*Ailanthus exelsa)* and Tamarind (*Tamarindus indica)* on reclaimed salt affected soils, 1993.
[22] R. Shailaja et al.

Below ground biomass was calculated using the formula given for tropical trees in the Annex 4.A.4 in IPCC LULUCF GPG, 2004 and described in section C. Planting will be done in a span of 3 years at the rate of 8181 ha during year 1, followed by 5000 ha in the subsequent 2 years, totaling 18,181 ha. The carbon sequestration potential for each year based on the area that will be planted and the average biomass yield was calculated separately and summed to estimate the cumulative carbon sequestration potential for the project area.

An estimate of the GHG emissions by sources was calculated from i.) decrease in living biomass of existing non-tree vegetation and ii.) Nitrous oxide emissions from nitrogen fertilization practices using organic manure. A sample survey as done to estimate the area under shrubs in each of the 5 taluks. The shrubs were harvested in 14 ha in 20 plots. The biomass of shrubs were estimated based on the methodology given in section C.

During the year of planting, farmyard manure will be applied to the trenches in the proportion of 5 kg of organic manure (dung+vegetable waste+crop residue) :15 kg of red loam: 15 kg of sand. The N content of organic manure is 0.5%[23]. The CO_2e of N_2O induced by N input was calculated according to the procedure given in the approved methodology and discussed in section C.

The actual net GHG removals by sinks is carbon stock change in aboveground biomass and below ground biomass minus the increase in CO_2e of N2O emissions due to organic fertilizer application and decrease in living biomass of existing non-tree vegetation.

Table D-1: Estimation of actual net GHG removals by sinks

Year	Annual carbon stock change (tCO_2yr^{-1})	Cumulative carbon stock change (tCO_2)	Annual GHG emission (tCO_2-e yr^{-1})	Cumulative GHG emission (tCO_2-e)	Annual actual net GHG removals (tCO_2-e yr^{-1})	Cumulative actual net GHG removals (tCO_2-e)
2006	0	0	-231	-231	0	0
2007	83,755	83,755	-376	-607	83,148	83,148
2008	218,699	302,454	-376	-983	217,716	300,864
2009	321,076	623,530	-376	-1359	319,717	620,581
2010	372,265	995,795	0	-1,359	370,906	991,487
2011	363,776	1,359,572	0	-1,359	362,417	1,353,905
2012	358,588	1,718,160	0	-1,359	357,229	1,711,134
2013	353,400	2,071,561	0	-1,359	352,041	2,063,176
2014	353,400	2,424,961	0	-1,359	352,041	2,415,217
2015	353,400	2,778,361	0	-1,359	352,041	2,767,258
2016	353,400	3,131,762	0	-1,359	352,041	3,119,300
2017	353,400	3,485,162	0	-1,359	352,041	3,471,341

[23] Mukherjee, H.N., Daji, J.A. and Raychaudhari, S.P. Manure and Fertilizer. Chapter 3 of Hand book of Agriculture. Indian Council Of Agricultural Research, New Delhi, 1961.

2018	353,400	3,838,562	0	-1,359	352,041	3,823,382
2019	353,400	4,191,963	0	-1,359	352,041	4,175,424
2020	353,400	4,545,363	0	-1,359	352,041	4,527,465
2021	353,400	4,898,763	0	-1,359	352,041	4,879,506
2022	353,400	5,252,164	0	-1,359	352,041	5,231,548
2023	353,400	5,605,564	0	-1,359	352,041	5,583,589
2024	353,400	5,958,964	0	-1,359	352,041	5,935,630
2025	353,400	6,312,365	0	-1,359	352,041	6,287,672
2026	353,400	6,665,765	0	-1,359	352,041	6,639,713
2027	353,400	7,019,166	0	-1,359	352,041	6,991,755

D.2. Estimated ex-ante baseline net GHG removals by sinks:

>> The baseline net GHG removals by sinks has been estimated as elaborated in section B. The carbon stock change in aboveground biomass and below ground biomass was estimated. The other carbon pools, dead wood, litter and soil organic matter was omitted. The CDM project area was stratified based on land capability classes (see section B for details). Aboveground biomass and below ground biomass for all the strata was calculated and determined at the taluk level. The taluk, Siddalaghatta was without trees and the baseline carbon pool was set to zero. The carbon stock of growing trees was estimated separately for each of the taluk. Based on stock change method, the mean annual increment of the existing trees were calculated at the taluk level. The MAI values estimated has been taken as the MAI for the next 20 years in the project area. approximately 4125 trees are there in the project area based on the sample study conducted. The average age of the trees is 10 years with a mean DBH of 22 cms and a mean height of 8 mts. The species recorded were Pongamia pinnata (71%), Tamarind (17%), Azadirachta India (4%) and Artocarpus indica, Eucalyptus and Tumbe (2% each). Biomass equation for dry deciduous species was used for to estimate the standing biomass and the IPCC equation was used to estimate the below ground biomass (refer to section B). The baseline net GHG removals by sinks are as follows:

Table D-2: Estimation of baseline net GHG removals by sinks

Year	Baseline net GHG removals by sinks (t CO_2 yr^{-1})	Cumulative Baseline net GHG removals by sinks (t CO_2)
2006	276.4	276
2007	276.4	553
2008	276.4	829
2009	276.4	1,106
2010	276.4	1,382
2011	276.4	1,659
2012	276.4	1,935
2013	276.4	2,211
2014	276.4	2,488
2015	276.4	2,764
2016	276.4	3,041
2017	276.4	3,317
2018	276.4	3,594
2019	276.4	3,870
2020	276.4	4,146

2021	276.4	4,423
2022	276.4	4,699
2023	276.4	4,976
2024	276.4	5,252
2025	276.4	5,529
2026	276.4	5,805
2027	0.5	5,806

D.3. Estimated ex-ante leakage:

>> Leakage has been estimated from the following sources.
- Transportation of seedlings from the local nursery to the project site
- Transportation of water from borewells to parcels of land in clusters of villages for initial 3 years after planting
- Transportation of harvested NTFPs to the nearest wholesale market from the 7th year.
- Lifting water using diesel run generator sets.

The seedlings will be transported within Kolar district to distribution points, from where the seedlings will be collected by the farmers for planting on their lands. The distance from the nurseries to the taluk headquarters ranges from 25-90 Kms. Based on approximately 5000 seedlings/trip, the number of trip required per year was calculated. Though the proposed project area is a semi-arid dry area prone to drought, the forests will be mainly rainfed, with protective irrigation arranged from local sources during summer months for the initial 3 years of planting. The GHG emissions from transportation of water from the nearest pond or borewell to a cluster of villages was calculated taking a watering plan based on tractor hire for the initial 3 years after planting. In this scenario watering will be done twice weekly for 4 months between March-June. This may however be over estimating emission from tractor hire for watering as the budget is limited. On the other hand some tractor hire may have to be done additionally for sapling distribution and gap filling in these years. So emissions from diesel consumption will occur, if not from watering activities then from sapling transportation. The emission factor for diesel for heavy vehicles in India is 71.4 tCO_2/TJ[24]. Based on the country specific net calorific value given by the IPCC for India, the emission factor is 3.05 kg CO_2 $litre^{-1}$. The GHG emissions from running generator sets for lifting water has also been calculated, though again this may be lesser, as the budget is not available for captive borewells or community borewell hire. The transportation of the harvested NTFPs from the project site to the nearest market ranges from 5-50 km from the project site. The nearest wholesale market is Hindupur for the taluks of Bagepalli, Gudibanda and Chickaballapur, while Chintamani provides the market for Chintamani and Siddlaghatta taluks. Thus the expected leakage from these activities is 51953 tCO_2-e by the end of 20 years. The annual and cumulative leakage estimate is as shown in Table D-3.

Table D-3: Estimates of leakage (**(tCO_2-e yr^{-1}) for 30 years (2006-2036)**

Year	Annual leakage (tCO_2-e yr^{-1})	Cumulative leakage (tCO_2-e)
2006	-8	-8
2007	-17	-25
2008	-22	-47
2009	-21	-67

[24] India's Initial National Communication to the UNFCCC, Ministry of Environment and Forests, Government of India, 2004.

2010	-10	-78
2011	-5	-83
2012	-1554	-1,637
2013	-1709	-3,346
2014	-1880	-5,226
2015	-2068	-7,294
2016	-2275	-9,569
2017	-2502	-12,071
2018	-2753	-14,823
2019	-3028	-17,851
2020	-3331	-21,182
2021	-3664	-24,845
2022	-4030	-28,875
2023	-4433	-33,308
2024	-4661	-37,969
2025	-4661	-42,631
2026	-4661	-47,292
2027	-4661	-51,953

D.4. The sum of D.1 minus D.2 minus D.3 representing the ex-ante net anthropogenic GHG removals by sinks of the proposed A/R CDM project activity:

>> The sum of actual net GHG removals by sinks **6,991,755 tCO_2**
The estimated baseline net GHG removals by sinks **5,796 tCO_2**
The estimated leakage - **- 51,946 tCO_2-e**
(6,991,755 tCO2) – (5,796 tCO2) – (51,946 tCO2-e) = 6,934,013 tCO2
Thus the anticipated net anthropogenic GHG removals by sinks by the proposed project activity is 6,934,013 tCO_2 for the first 20 year crediting period. The carbon sequestration potential per ha for 20 years is approximately 381.387 tCO_2, which is about 19.07 tCO_2/ha/yr. Ha

D.5. Table providing values obtained when applying formulae above:

>>

Table D-4: Estimates of net GHG removals by sinks

Year	Estimation of annual actual net GHG removals (tCO_2-e yr^{-1})	Baseline net GHG removals by sinks (t CO_2 yr^{-1})	Estimation of annual leakage (tCO_2-e yr^{-1})	Estimation of annual net anthropogenic GHG removals by sinks (tCO_2-e yr^{-1})	Estimation of cumulative net anthropogenic removals by sinks (tCO_2-e)
2006	0	0	0	0	0
2007	83,148	-276	-17	82,855	82,855
2008	217,716	-276	-22	217,418	300,273
2009	319,717	-276	-21	319,420	619,693
2010	370,906	-276	-10	370,620	990,313
2011	362,417	-276	-5	362,136	1,352,450
2012	357,229	-276	-1,554	355,399	1,707,849
2013	352,041	-276	-1,709	350,056	2,057,906
2014	352,041	-276	-1,880	349,885	2,407,791
2015	352,041	-276	-2,068	349,697	2,757,488
2016	352,041	-276	-2,275	349,490	3,106,979
2017	352,041	-276	-2,502	349,263	3,456,242
2018	352,041	-276	-2,753	349,012	3,805,254
2019	352,041	-276	-3,028	348,737	4,153,992
2020	352,041	-276	-3,331	348,434	4,502,426
2021	352,041	-276	-3,664	348,101	4,850,527
2022	352,041	-276	-4,030	347,735	5,198,263
2023	352,041	-276	-4,433	347,332	5,545,595
2024	352,041	-276	-4,661	347,104	5,892,699
2025	352,041	-276	-4,661	347,104	6,239,804
2026	352,041	-276	-4,661	347,104	6,586,908
2027	352,041	-276	-4,661	347,104	6,934,013

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

E.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:

>>

- Afforestation and reforestation activities can have negative impacts on biodiversity, if taken up in forest ecosystems with already existing biodiversity value. Conversely, if planting is being promoted on land that is degraded or with no trees, it will have a positive impact on biodiversity.
- Forestry on degraded lands without any trees on them has a positive impact on biodiversity, regeneration of vegetative cover through leading to soil and water conservation and protection of watersheds, and increased supply of biomass, which is essential as sustainable development issues of mitigation projects.
- Among the many environmental services they provide, the most critical places are soil conservation i.e. protection against erosion and maintenance of fertility, shelter against wind and shade.
- Decreases vulnerability to current climate change and climatic variability
- Forestry on these degraded lands will enrich the soil by fixing nitrogen, improve drainage, promote efficient nutrient cycling, opportunity to optimise land productivity and diversity in output to meet domestic needs and improving economy of farmers.
- The project area is devoid of trees in most on the parcels of lands. A few parcels of land have trees on the bunds which are mature and these trees will not be uprooted. The spacing of tamarind trees is 9 x 9 m. A total of 100 trees will be planted in a hectare. Thus the disturbance to soil will be limited.
- The species proposed Tamarind, Syzygium sp and Teak is native to the region.
- Since the planting will be done is discrete parcels of land, fire and pests are not a serious threat.

E.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:

>>

No significant negative impacts have been envisaged by the project activity. The project has received host country approval by the Indian National CDM Authority, hosted by the Ministry of Environment and Forests.

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

>>

Not required as no significant impacts are projected.

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

>>

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

>>

In a semi-arid, water scarce, poverty stricken region like this, the CDM A/R project activity which pays families to work on their land is extremely necessary, in fact life saving. It is a global environmental service activity which also generates substantial local benefits in terms of employment and income, and natural resource conservation.

- All forestry sector activities are labour-intensive and create rural employment in establishing, protecting and maintaining trees and also provide diverse biomass products. Thus, activities aimed at carbon sink creation or enhancement and in turn forest conservation and regeneration of degraded forests and non-forests will lead to improvement of the livelihoods.
- Further, the CDM A/R project activity increases the supply of biomass such as fuelwood to families to meet their biomass requirements.
- In the proposed project, which is multi-component including promotion of fruit orchards on a large-scale, biodiversity will be enhanced. Further, these fruit tree species with varied gestation periods and end-use would provide not only economic returns at different time periods but also in a sustained manner, as fruit orchards yield over many decades, albeit with variations in yield.
- The proposed CDM A/R activity will provide employment at the time of initiation of the project when various activities such as land preparation, pitting, nursery raising, transportation of seedlings and actual planting occurs, and is paid for through the CDM A/R project activity.

The proposed CDM activity will generate income and minimise risks in cropping enterprises. It provides long term investment opportunity, diversified land use, commercial tree cropping and best option for the marginal farmers. This can generate diversified on-farm employment, Non Timber Forest Produce (NTFP) and ensure raw-material supply to forest based industries. It is a potential technology for commercial farming, improving degraded and polluted sites, an opportunity for stabilizing fragile ecosystems and also a forestry system for arid and semi-arid zones.

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

>>

No negative impact is considered due to the implementation of the proposed A/R CDM project activity.

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

>>

No negative socio-economic impacts are envisaged. The project has received host country approval by the Indian National CDM Authority, hosted by the Ministry of Environment and Forests.

SECTION G. Stakeholders' comments:

>>

There has been 10 years of discussion, pilot project, participatory decision-making etc by ADATS in this region. The pilot activities for this project were the first reforestation project activity to receive approval from the Government of India as an AIJ project in 1996. Local stakeholders include the local village councils or Gram Panchayats and the farmers. Secondary data was obtained from Gram Panchayats regarding the land holding of different farmers within the villages chosen in all the 5 taluks of Kolar. Families were interviewed as to their interest in the scheme. A PRA exercise was also conducted in all the villages by ADATS to explore the interest of families and the extent of land they wanted to dedicate for the CDM A/R project activity. The farmers or the owners of these lands were interviewed using a questionnaire to elucidate their interest in planting, the species choice, the extent of land they were inclined to dedicate and species for bund and block planting, for implementation of the A/R CDM project. Thus, a list of species to be promoted, the proportion of the species to be promoted and the phasing of the activity was worked out based on the stakeholder's comments.

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

>>

A participatory approach was adopted to identify the area for afforestation and species choice through group meetings at cluster level comprising of 5-6 villages. Discussions were also held of the planting arrangement, tending to the seedlings, fertilizer application and maintenance of the plantations. ADATS has documented the process of evolving the present A/R CDM Programme based on how to take the DLDP Programme to its logical conclusion – these documents present an overall strategic view of how Kolar District land use needs to engage in dry land horticulture. The ADATS pilot project elicited enough and more comments over the last 10 years from participating families as to why and how the Bagepalli CDM Afforestation project can be taken forward for the benefit of all.

G.2. Summary of the comments received:

>>

During discussion families welcomed the idea of reforestation on degraded lands given that the region is dry, semi-arid and with low tree cover. Families are interested in promoting fruit orchards as it will be a source of additional income compared to leaving the land in a degraded condition. The concern that most of the farmers expressed was watering of plants during the establishment phase in the initial 3 years. Based on the experience of the AIJ project in this region, the communities requested for watering facilities during the initial years after planting. A strategic plan was developed with the participation of representatives of all the stakeholders.

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

>> This Bagepalli CDM Reforestation Programme has been designed in direct response to the interests and urgent needs of the participating families. Based on the species choice of the communities, fruit yielding species such as Tamarind, Mango and Syzygium are being promoted in combination with other multi-purpose tree crops for maximum biomass generation. Though Eucalyptus and Acacia Auriculiformis are fast growing species, the farmers did not prefer the species, as they would deplete the already scarce water table of the region. To ensure good survival rate of the seedlings, watering arrangements will be made as far as possible as part of the project activity for initial 3 years during summer months.

PROJECT DESIGN DOCUMENT FORM
FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD) - Version 02

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROPOSED A/R CDM PROJECT ACTIVITY

Organization:	CER India Pvt. Ltd.
Street/P.O.Box:	32/2 Kempapura Road
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No funding will be diverted from Official Development Assistance.

Annex 3

BASELINE INFORMATION

Data/Parameters	Descriptions	Vintage	Resolution	Sources
Historical land use/cover data	- Determining baseline approach - Demonstrating eligibility of land	- Statistics from Kolar Gazetteer - Village level cadastre maps for all the 471 villages showing the survey number of parcels of land prepared during 1890-1960s - 1989 digitized satellite imagery - 2005 digitized satellite imagery	District level statistics - Depending on village size. - 1:250,000 - 1:50,000	Land Records and Land Settlement Department, Govt. of Karnataka, - Karnataka State Remote Sensing Application Centre
Land use/cover map	Demonstrating eligibility of land, stratifying land area	- 2005 digitized satellite imagery	- 1:50,000	- Karnataka State Remote Sensing Application Centre
Satellite image area	Demonstrating eligibility of land, stratifying land	1989 and 2005	- 1:250,000 - 1:50,000	PAN+LISS III (final resolution of 5.8 m) merged data from IRS 1C/ ID satellite images of 2000-2001
Landform map area	Stratifying land	2005	1:50000	PAN+LISS III (final resolution of 5.8 m) merged data from IRS 1C/ ID satellite images of 2005
Land capability map	Stratifying land area	2005	2005	- Karnataka State Land Use Board, Bangalore, Karnataka - PAN+LISS III (final resolution of 5.8 m) merged data from IRS 1C/

				ID satellite images of 2005
National and sectoral policies	Additionality consideration	Before 1998	National, Karnataka and at district and taluk level	Planning Commission, Govt. of India, Karnataka Forest Department, National Forestry Action Plan
UNFCCC decisions UNFCCC website		1997 up to now	International	UNFCCC website
	Baseline net GHG removals by sinks			
ΔC_{ij}	average annual carbon stock change in living biomass of trees	2006	Stratum, species	Estimated based on field survey
$\Delta G_{Total,ij}$	Annual average increment rate in total biomass per hectare for stratum	2006	Local	Based on field studies conducted by ADATS
CF	Carbon fraction		Global default	GPG-LULUCF
C_{Actual}	Actual net greenhouse gas removals by sinks	Project specific		Calculated
	Carbon stock in aboveground biomass			Calculated
CABij	Carbon stock in belowground biomass			Calculated based on IPCC default value given for tropical forests
GHG_E	Increase in GHG emissions by the sources within the project boundary as a		Project specific	Calculated

	result of the implementation of an A/R CDM activity			
	Allometric equation		Species specific	Published data - FSI - Paper
$E_{biomassloss}$	Decrease in carbon stock in living biomass of existing non-tree vegetation			Estimated – Destructive harvesting
$CF_{non-tree}$	Carbon fraction of non-tree vegetation			GPG-LULUCF
N_2O_{direct}-$N_{fertilizer}$	Increase in N2O emission as a result of direct nitrogen application within the project boundary			Estimated
F_{on}	Annual amount of organic fertilizer nitrogen adjusted for volatilization as NH3 and NOx			Estimated
EF_1	Emission factor for emissions from N inputs		Global default	IPCC guidelines
$N_{ON-fert}$	Mass of organic fertilizer nitrogen applied			Estimated
$Frac_{GASM}$	Fraction that volatilizes as NH3 and NOx		Global default	IPCC guidelines
Nsn-fert	Amount of organic fertilizer nitrogen applied		Project	Monitored
EF_{ij}	Emission factor for vehicle type I with fuel type j		National	India's First National Inventory to the UNFCCC, 2004
$FuelConsumption_{ij}$	Consumption of fuel type j of vehicle type i		Project	Estimated

E_{ij}	Average litres consumed per km traveled for vehicle type I with fuel type j		Project	Interview with local communities
K_{ij}	Kilometres traveled by each of vehicle type I with fuel type j		project	Monitored
N_{ij}	Number of vehicles		Project	Monitored

Annex 4

MONITORING PLAN

Monitoring of the baseline net GHG removals

The baseline scenario of the proposed project activity is established using the approved methodology

'Approved afforestation and reforestation baseline methodology AR-AM0001 – Reforestation of degraded land'.

The carbon stocks changes in the baseline scenario is set to zero for Siddalaghatta taluk without trees in the baseline. For the other taluks, Bagepalli, Chickballapur, Chintamani and Gudibanda with trees, the projected carbon stock changes in above-ground biomass and below-ground biomass for existing trees for lands with growing trees was set based on calculations based on stock change method. Field studies were conducted in the 5 taluks of project area based on the land capability classification. The estimated mean annual increment (t/ha/yr) was determined which was projected as the carbon stock change in the project scenario in aboveground biomass and belowground biomass. A fixed crediting period of 30 years is chosen for the proposed A/R CDM project. The baseline net GHG removals by sinks does not need to be measured and monitored over time.

Monitoring the proposed project activity

1. Monitoring project boundary and project implementation

(a) Monitoring the boundary of the proposed A/R CDM project activity

AR-AM0001 requires that:

- Field survey concerning the actual boundary within which reforestation activity has occurred, site by site;
- Measuring geographical positions (latitude and longitude of each corner of polygon sites) using
- GPS;
- Checking whether the actual boundary is consistent with the description in the CDM-AR-PDD;
- If the actual boundary falls outside of the designed boundary in CDM-AR-PDD, additional information for lands beyond the designed boundary in CDM-AR-PDD shall be provided; the eligibility of these lands as a part of the A/R CDM project activity shall be justified; and the projected baseline scenario shall be demonstrated to be applicable to these lands. Otherwise, these lands shall not be accounted as a part of the A/R CDM project activity. Such changes in boundary shall be communicated to the DOE and subject to validation during the project, e.g. during the first verification event;
- Input the measured geographical positions into GIS system and calculate the eligible area of each stratum and sub-stratum;
- The project boundary shall be monitored periodically all through the crediting period, including through remote sensing as applicable. If the forest area changes during the crediting period, for instance, because deforestation occurs on the project area, the specific location and area of the

deforested land shall be identified. Similarly, if the planting on certain lands within the project boundary fails these lands shall be documented.

- The survey numbers of the land holdings of the farmers is the actual boundary within which reforestation activity will occur. These areas and boundaries have been measured and fixed by using the chain method by the revenue department. The project boundary shall be monitored periodically all through the crediting period by the CSU from ADATS. If the project area changes during the crediting period, for instance, because deforestation occurs on the project area, the specific location and area of the deforested land shall be identified. Similarly, if the planting on certain lands within the project boundary fails these lands shall be documented.
- The geographical positions (latitude and longitude of each corner of polygon sites) will be measured using GPS. These measured geographical positions will be input into GIS system and calculate the eligible area of each stratum and sub-stratum.
- The actual boundary for reforestation will be consistent with the description in the CDM-AR-PDD as the planting is on the farmer's lands who are part of the CSU. If the actual boundary falls outside of the designed boundary in CDM-AR-PDD, additional information for lands beyond the designed boundary in CDM-AR-PDD shall be provided; the eligibility of these lands as a part of the A/R CDM project activity will be justified and the projected baseline scenario will be demonstrated to be applicable to these lands. Such changes in boundary shall be communicated to the DOE and subject to validation during the project, e.g. during the first verification event.

(b) Monitoring of forest establishment

AR-AM0001 requires that:

To ensure that the planting quality confirm to the practice described in CDM-AR-PDD and is well implemented, the following monitoring activities shall be conducted in the first three years after planting:

• Confirm that site and soil preparations are implemented based on practice documented in CDM-AR-PDD. If pre-vegetation is removed, e.g., slash and burn of pre-existing vegetation, emissions associated shall be accounted;
• Confirm that site preparation does not cause significant longer term net emissions from soil carbon;
• Survival checking:
- The initial survival rate of planted trees shall be counted three months after the planting, and re-planting shall be conducted if the survival rate is lower than 90 percent;
- Final checking three years after the planting;
- The checking of the survival rate may be conducted using permanent sample plots;
• Weeding checking: check and confirm that the weeding practice is implemented as described in the CDM-AR-PDD;
• Survey and check that species and planting for each stratum and sub-stratum are in line with the CDM-AR-PDD.

The site and soil preparations implemented on the field before planting for each of the parcel of land will be monitored by the CSU and a database will be created for each of the farmer's land at the ADATS

office. Slash and burn of pre-existing vegetation is not practiced. The existing trees on the bunds will not be disturbed. No tillage will be done to cause significant longer term net emissions from soil carbon. For survival checking, the initial survival rate of planted trees shall be counted three months after the planting by the CSUs and reported to the ADATS office which will be maintained as a database. Replanting shall be conducted if the survival rate is lower than 90 percent. The final checking will be undertaken three years after the planting. The checking of the survival rate will be on 100% of lands and of all the trees. This will be done by the CSU and reported to ADATS, which will be documented and stored electronically. Also check will be done through permanent sample plots. Monitoring of weed checking procedure and species planted and for each stratum and sub-stratum will be done.

(c) Monitoring of forest management

AR-AM0001 requires that:

the practices to be followed to monitor forest management include:

- Thinning: specific location, area, tree species, thinning intensity, biomass removed;
- Harvesting: harvested location, area, tree species, biomass removed;
- Fertilization: tree species, location, amount and type of fertilizer applied, etc.;
- Checking and confirming that harvested lands are re-planted or re-sowed immediately after harvesting if direct planting or seeding is used;
- Checking and ensuring that good conditions exist for natural regeneration if harvested lands are allowed to regenerate naturally.

To monitor thinning and harvesting, the specific location, area, tree species, thinning intensity, biomass removed will be done by the CSU annually and entered in the database for each of the farmer. If harvesting takes place, it will be checked to see that re-planting or re-sowing is done immediately after harvesting. This will give the actual count of trees of each of the species annually for each parcel of land of the farmer. Farm yard manure will be applied during the first year of planting. This will be monitored at the time of planting.

2. Stratification and sampling for ex-post calculations

(a) Stratification

The pre-stratification of the proposed project area as detailed in Section B, which influences the carbon stocks in the above- and below-biomass pools was determined by using satellite imagery land use/cover maps and other factors i.e. micro-climate, soil depth, soil type, soil erosions and slope gradient. The further ex-post stratification will be based on tree species to be planted, year to be planted and human management.

The ex-post stratification will be further examined during the first monitoring and sub-stratification of the project area will be done into relatively homogeneous units to increase the measuring precision without increasing the cost unduly, or reduce the cost without reducing measuring precision because of the lower variance within each homogeneous unit. The sub-strata and strata will be grouped into one stratum or substratum if similar carbon stock and carbon stock change is seen.

(b) Sampling

(i) Determining sample size

Permanent sampling plots will be used for sampling over time to measure and monitor changes in carbon stocks of above- and below ground biomass. According to the AR-AM0001, the sample size for each stratum and sub-stratum will be determined by using the equation as given in section C.3.1. The sample size will be determined based on the mean standard deviation of carbon stock and carbon stock changes during the monitoring period for each of the sub-stratum.

(ii) Randomly locating sampling plots

To avoid subjective choice of plot locations, the permanent sample plots will be located systematically with a random start, which is considered good practice in GPG-LULUCF. This can be accomplished with the help of a GPS in the field. The geographical position (GPS coordinate), administrative location, stratum and sub-stratum series number of each plots shall be recorded and archived. The size of plots in general will be 50 x 50.(2500 m^2). Also, it will be ensured that the sampling plots are distributed as evenly spread as possible.

(iii) Monitoring frequency

Depending on the registration of the project, the planting will be conducted from 2006 to 2009. The frequency of monitoring will be every 5 years. The monitoring frequency will be accordingly during 2011, 2016, 2021, 2026, 2031 and 2036.

3. Measuring and estimating carbon stock changes over time.

The steps, parameters and formula in section C.3.1.3.1 will be followed.

4. Monitoring GHG emissions by sources as the results of the A/R CDM project activity

The steps, parameters and formula in section C.3.1.3.2 will be followed.

5. Quality assurance and quality control (QA/QC)

A quality assurance and quality control (QA/QC) procedure will be followed based on the Good Practice Guidance of IPCC of 2004 (section 4.3.4)

Procedures to ensure reliable field measurements

Personnel responsible for the measurement work will be fully trained in all aspects of the field data collection and data analyses. A Standard Operating Procedures (SOPs) for each step of the field measurements will be prepared and adhered to. These SOPs should detail all phases of the field measurements and contain provisions for documentation for verification purposes and so that future field personnel can check past results and repeat the measurements in a consistent fashion. To collect reliable field data the following will be ensured:

- Field-team members are fully cognisant of all procedures and the importance of collecting data as accurately as possible

- Field teams install test plots if needed in the field and measure all pertinent components using the SOPs
- All field measurements are checked by a qualified person in cooperation with the field team and correct any errors in techniques
- A document is filed with the project documents that show that these steps have been followed. The document will list all names of the field team and the project leader will certify that the team is trained
- New staff will be adequately trained.

Procedures to verify field data collection

To verify that plots have been installed and the measurements taken correctly, the following will be adhered to:

- Re-measure independently every 8-10 plots, and to compare the measurements to check for errors. Any errors will be resolved, corrected and recorded. The re-measurement of permanent plots is to verify that measurement procedures were conducted properly.
- At the end of the field work, independently 10-20% of the plots will be checked. Field data collected at this stage will be compared with the original data. Any errors will be corrected and recorded. Any errors discovered will be expressed as a percentage of all plots that have been rechecked to provide an estimate of the measurement error.

Procedures to verify data entry and analysis

Reliable carbon estimates require proper entry of data into the data analyses spreadsheets. Possible errors in this process will be minimized. The entry of both field data and laboratory data will be reviewed using expert judgement and, where necessary, comparison with independent data to ensure that the data are realistic. Communication between all personnel involved in measuring and analysing data will be used to resolve any apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot will not be used in the analysis.

Data maintenance and storage

Because of the relatively long-term nature of these projects, data archiving (maintenance and storage) will be an important component of the work. Data archiving should take several forms and copies of all data should be provided to each project participant. Copies (electronic and/or paper) of all field data, data analyses, and models; estimates of the changes in carbon stocks and non-CO_2 greenhouse gases and corresponding calculations and models used; any GIS products; and copies of the measuring and monitoring reports will be stored in a dedicated and safe place, preferably offsite.

Given the time frame over which the project will take place and the pace of production of updated versions of software and new hardware for storing data, the electronic copies of the data and report will be updated periodically or converted to a format that could be accessed by any future software application.

6. Uncertainty assessment

The uncertainty in each species in each stratum can be estimated from re-measurement of randomly selected plots and/or from the measurement of replicate plots. Uncertainties will be estimated and expressed as half the 95% confidence interval width divided by the estimated value, i.e.,

$$Us = \frac{1}{2} \frac{(95\% confidence.level.\text{int}erval.width}{\mu}.100$$

Where
μ = mean value
ó = standard deviation

$$Uc = \frac{\sqrt{(U_{s1}.C_{s1})^2 + (U_{s2}.C_{s12})^2 + ... + (U_{sn}.C_{sn})^2}}{\left|C_{s1} + C_{S2} + ...C_{sn}\right|}$$

Where
U_c = combined percentage uncertainty of sub-stratum, %
C_{si} = mean carbon stock of species i in the sub-stratum

The stratum and total percentage uncertainties are further combined in the same way as above.

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