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

CONTENTS

Annexes

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

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

Title: Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin
Version: GIFDCP01
Date of the document: 13 Dec 2005

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

The proposed A/R CDM project activity, Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin, China, will be implemented within the confines of the larger umbrella Guangxi Integrated Forestry Development and Conservation Project (GIFDCP) that addresses the closely inter-linked threats to the natural forests, watersheds and biodiversity in Guangxi Zhuang Autonomous Region through an integrated approach to managing all these natural resources at the landscape level. Its development and global environment outcomes will improve the supply, management, sustainability, and environmental conditions of the forest resources in Guangxi and conserve its globally significant biodiversity. The proposed A/R CDM project activity aims to reduce threats to local forests and generate the income to the poor farmers/communities by enabling the carbon sequestered by plantations to act like a "virtual cash crop" for the local project beneficiaries who will gain direct benefits from harvesting the plantation as well as from the sale of carbon credits, which will in turn reduce the threats to natural forests. In addition, forest restoration in this area plays a vital role in biodiversity conservation, soil and water conservation and poverty alleviation, while sequestering carbon dioxide from the atmosphere. The overall objective of the proposed A/R CDM project activity is to explore and demonstrate the technical and methodological approaches related to credible carbon sequestration and pilot the viability of enhancing the livelihoods of people and native biodiversity by facilitating reforestation activities in watershed areas along the Pearl River Basin. The specific objectives include:

(1) To sequester CO_2 through forest restoration in small watershed areas and test and pilot how reforestation activities generate high-quality emission reductions in greenhouse gases that can be measured, monitored and verified;

(2) To enhance biodiversity conservation by increasing the connectivity of forests adjacent to nature reserves;

(3) To improve soil and water erosion control;

(4) To generate income for local communities.

To achieve the objectives, the following A/R CDM project activity is proposed:

(1) Establishing 2,000 ha of multiple-use forests in Huanjiang County of Guangxi (including approximately 830 ha on sites neighboring Mulun National Nature Reserve and Shiwanshan National Nature Reserve, and around 1,170 ha on sites between them). Species and afforestation models include *Pinus massoniana* mixed with *Liquidambar formosana* (1,050 ha), *Cunninghamia lanceolata* mixed with *L. formosana* (450 ha), and *Eucalyptus* sp. (*E.grandis*×*E.urophylla*) (500 ha);

(2) Establishing 2,000 ha of multiple-use forests on sites with severe soil and water erosion in Cangwu County of Guangxi. Major species and afforestation models include *P. massoniana* mixed with *Quercus griffithii* (600 ha), *P. massoniana* mixed with *Schima. superba* (900 ha), and *Eucalyptus* sp. (500 ha);

(3) Promoting legal structures to aid the sale of Certified Emission Reductions (CERs), test carbon

purchase transactions and accumulate experience in practical and technical measures for A/R CDM project activities;

(4) Developing and testing local financing mechanisms for watershed management and degraded land restoration;

(5) Developing, testing and disseminating the best practice in watershed management and strengthening capacity building through support for training and technical assistance to the relevant agencies and communities.

Without the additional income from the carbon credits, reforestation in the project areas is not economically feasible. With the sales of carbon credits and additional income from managing the reforested lands as multiple-use plantations, the proposed A/R CDM project activity will provide benefits to local farmers and communities that range from direct income supplements to broader social and environmental benefits. Planting activities in both counties mentioned above will last two years, starting in 2006. Financial models and tree species to be used have been determined by interviewing local farmers, and taking into consideration carbon sequestration rates, biodiversity enhancement, soil erosion control and the value of associated forest products. Tree species will be planted in mixed species arrangements to minimize risks (fire, pest insect and disease) and maximize environmental and social benefits. For example, due to the fire resistance of broadleaf species and their environmental benefits (such as biodiversity conservation and soil erosion control), *L. formosana, S. superba* and *Quercus sp* are planted in accessible locations, while needle-leaf species, i.e., *P. massoniana* and *C. lanceolata* will be planted on the less accessible upper parts of the slopes. The most up-to-date technologies and silvicultural models will be adopted in the proposed A/R CDM project activity.

Based on the interviewing with individual farmers, communities and planting entities in the project areas, conducted by the local forestry agencies and an expert team, there are two production arrangements and management models that are proposed:

- Farmers group. Individual farmers voluntarily group-invest and undertake project activities, including site and soil preparation, planting and stand management. The lands are owned by the local villages (communities), but are contracted with farmers for plantation establishment and management for 50 years. The local forestry agencies will provide assistance for the planting design and other technical services including training, as well as supervising the project implementation and planting quality. Income from forest products and CER transactions would belong solely to the local farmers. About 440 ha of site will be managed under this model.
- Shareholding arrangements between local farmers/communities and forest farms/companies. Local farmers/communities will contribute lands and labors. Local forest farms/companies will invest in planting activities, provide technical inputs and manage the plantations during the crediting period, as well as take the natural and investment risks. The contractual arrangements will be made between the farmers/communities and the farms/companies on the plantation establishment and management responsibilities, inputs and benefit sharing. About 3,560 ha of sites will be managed under this model. The farmers/communities will share 40% of net income from forest products and 60% of revenues from CER transactions. In addition, the forest farms/companies will pay farmers' labor inputs in case to ensure their short-term income.

The project is designed on a demonstration basis to test carbon purchase transactions and accumulate experience in technical measures for A/R CDM project activities. In order to ensure unified management measures, homogeneous growth of the plantations, effective monitoring and analytic work, as well as maintain the carbon sequestered and reduce risks from natural disasters during the crediting period, the pilot program will be largely implemented through cooperation arrangements between farmers/communities and farms/companies. The project production arrangements are decided through a

participatory process carried out at the village level, reflecting the preference of the farmers and communities through consultation with them. Although interviews with farmers and communities by the local project agencies and the expert team confirmed the desirability of the above arrangement, some households would also like to invest and manage the reforestation activities through a farmers group. The local forestry agencies have committed to provide training and other technical services to the farmers/communities on the plantation establishment and management to ensure the plantation quality and to reduce management risks.

A.3. Project participants:

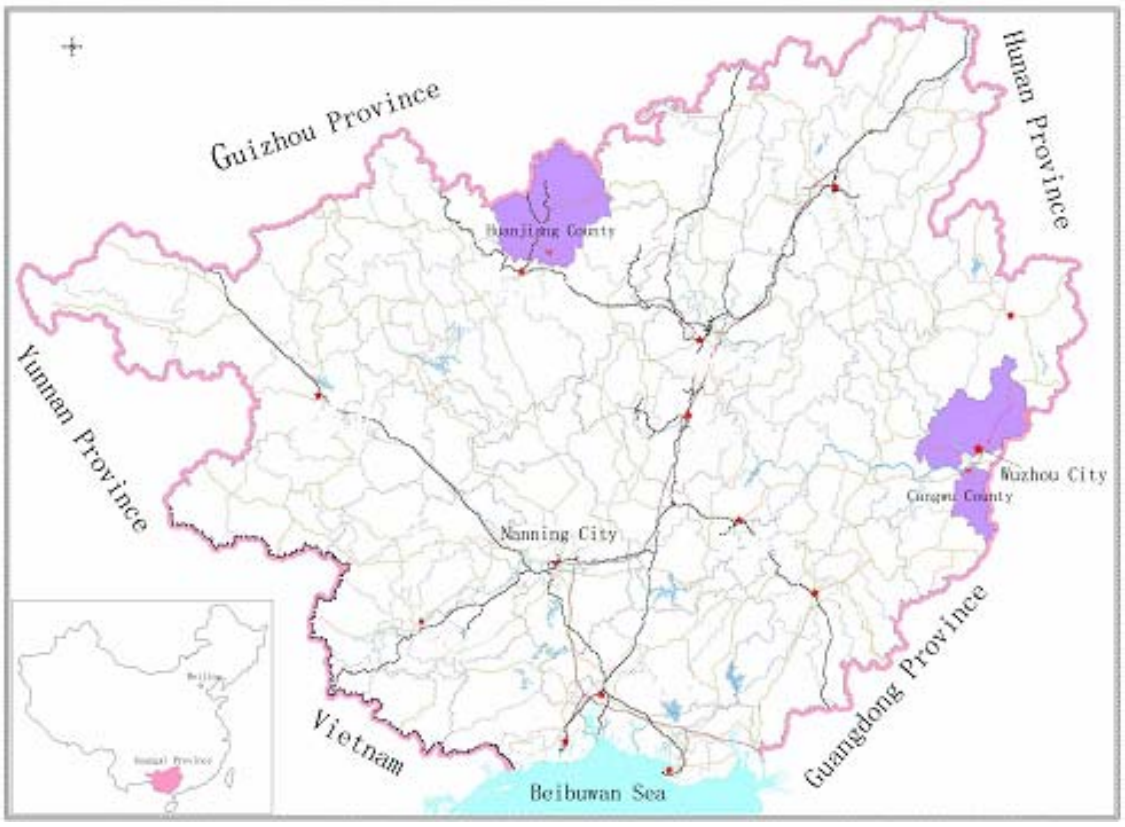
Name of Party involved (*) ((host) indicates a host Party)	**Private and/or public entity(ies) project participants (*)** (as applicable)	**Kindly indicate if the Party involved wishes to be considered as project participant** (Yes/No)
People's Republic of China	● Private entity A: Luhuan Forestry Development Company Ltd, Huanjiang County, P.R. China ● Private entity B: Xinghuan Forestry Development Company Ltd, Huanjiang, County, P.R. China ● Private entity C: Fuyuan Forestry Farm, Cangwu County, P.R. China ● Private entity D: Kangyuan Forestry Farm, Cangwu County, P.R. China ● Private entity E: Farmers/local communities	No
Italy	The International Bank for Reconstruction and Development (IBRD) as Trustee of the BioCarbon Fund	Yes
Spain		Yes

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 in Cangwu County (in the Eastern part of map) and Huanjiang County (in the Northern part of map), Guangxi Zhuang Autonomous Region, in southern China (Fig.A-1).

Fig.A-1 Locations of the proposed A/R CDM project activity



A.4.1.1.	**Host Party(ies):**

P.R. China

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

Guangxi Zhuang Autonomous Region

A.4.1.3.	**City/Town/Community etc:**

Lands to be reforested are located in 13 villages of 4 towns/townships in Cangwu County and 14 villages of 6 towns/townships in Huanjiang County.

Table A-1 List of Counties, towns/townships and villages involved

Cangwu County		Latitude (N, degree)	Longitude (E, degree)
Towns/Townships	Villages		
Dapo	Shengzhou	111.30214-111.38319	23.18890-23-24468
	Xinlong	111.26641-111.31870	23.18389-23.23788
	Dayan	111.32941-111.39390	23.14746-23.18596
Xindi	Diancun	111.14224-111.18855	23.26278-23.31513
	Dongxin	111.14349-111.18876	23.30142-23.32902
	Xunchun	111.13368-111.20041	23.15172-23.18319
	Dacun	11.189990-111.21657	23.33486-23.35340
	Daton	111.16250-111.20237	23.30050-23.35690
Longxu	Enyi	111.24467-111.27654	23.38740-23.44081
	Daen	111.18076-111.24528	23.34605-23.39321
Shatou	Cantian	111.48480-111.58910	24.04140-24.15430
	Shichuan	111.48530-111.53740	24.09310-24.17200
	Shentang	111.38871-111.47016	23.93381-24.04026
Huanjiang County			
Xunle	Taiping	108.30170-108.36460	25.24880-25.34270
	Shangang	108.28420-108.41080	25.44830-25.54000
Chuanshan	Hedun	108.07210-108.18020	25.11300-25.20940
Mulun	Leyi	107.96206-108.02698	25.07901-25.13427
Minglun	Minglun	108.32830-108.47680	25.15100-25.23620
	Baixiang	108.38310-108.44510	25.13800-25.19440
	Cuishan	108.34180-108.45050	25.26620-25.34140
Longyan	Huangzhong	108.36910-108.46960	25.37330-25.45990
	Jiuwei	108.35310-108.43720	25.31870-25.37580
	Dake	108.50030-108.61030	25.27220-25.33440
	chaoge	108.49880-108.59050	25.31400-25.41600
	Longyan	108.44375-108.51672	25.25342-25.30658
	Chenghuang	108.34800-108.42300	25.35410-25.42670
Shangchao	Beishan	108.12510-108.23410	25.18670-25.30860

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:

The project boundaries and geographical locations are indicated in figures below and the specific geographical positions (longitude, latitude) at each corner of each of 52 parcels of sites have been determined using GPS (see Annex 5).

Fig. A-2 Lands to be planted in Longxu, Xindi and Dapo Towns in Cangwu County
1:250,000

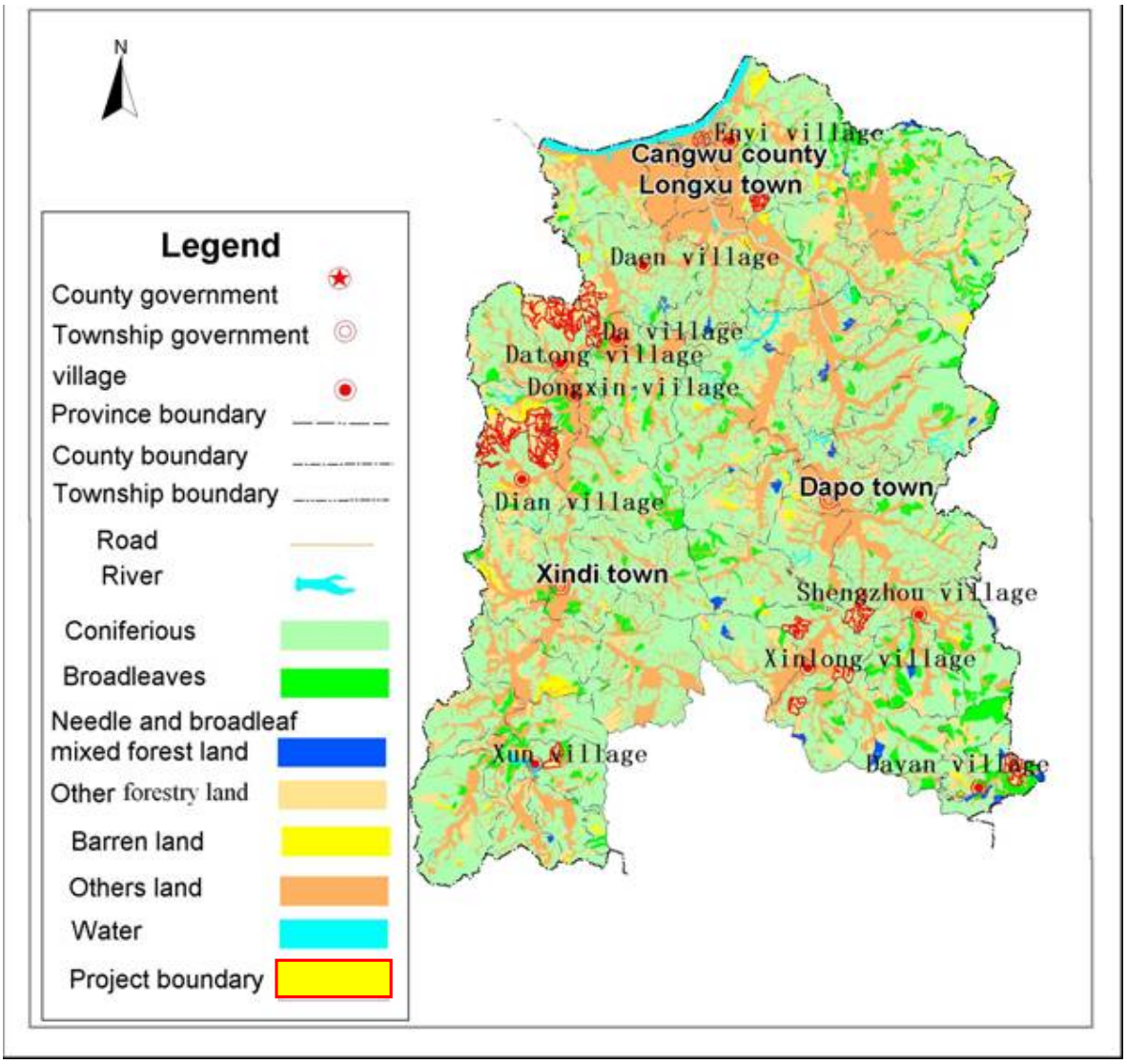


Fig. A-3 Lands to be planted in Satou Town in Cangwu County (1:250,000)

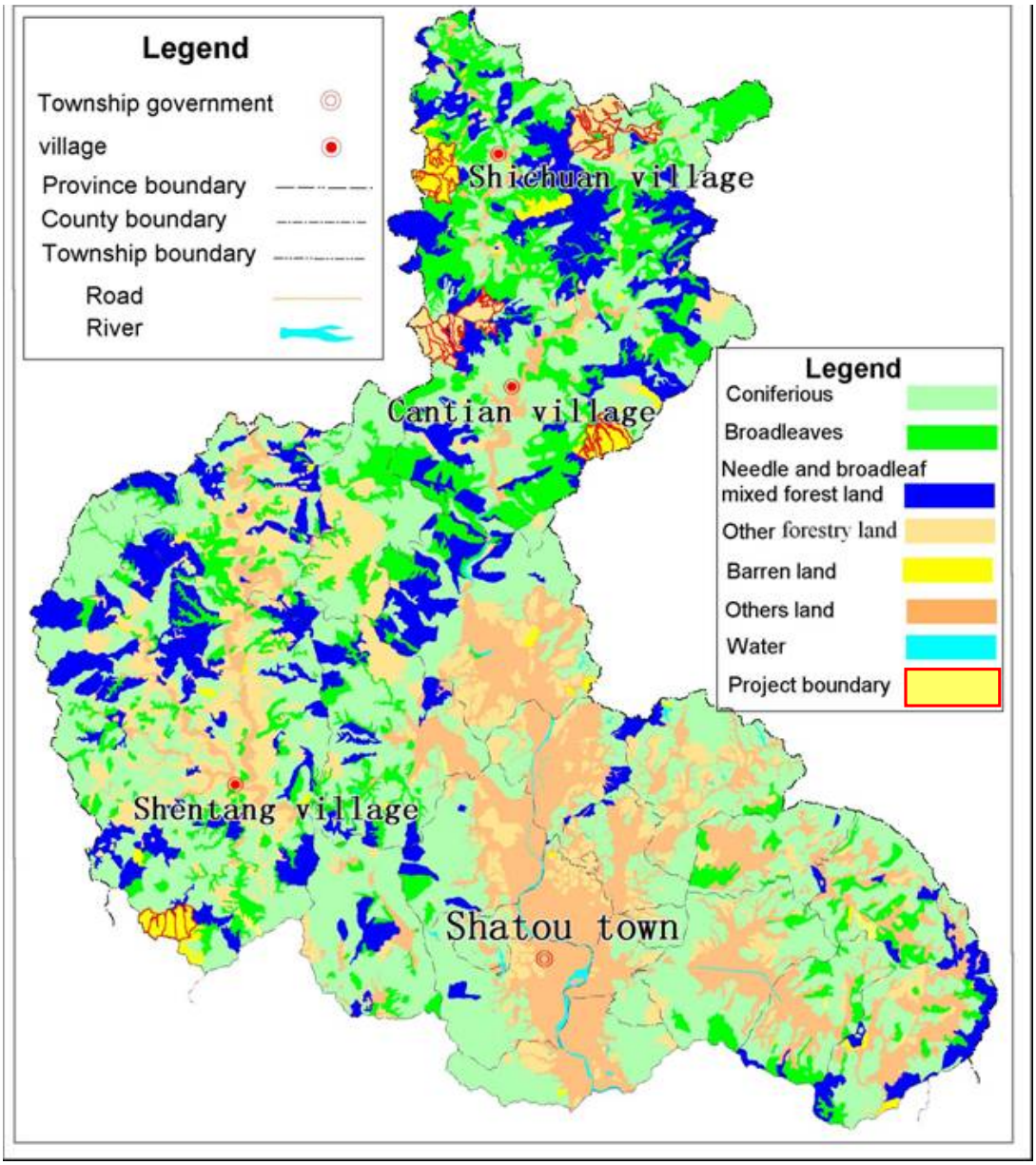


Fig. A-4 Lands to be planted in Longyan, Minglun and Xunle Town/Township of Huanjiang County (1:250,000)

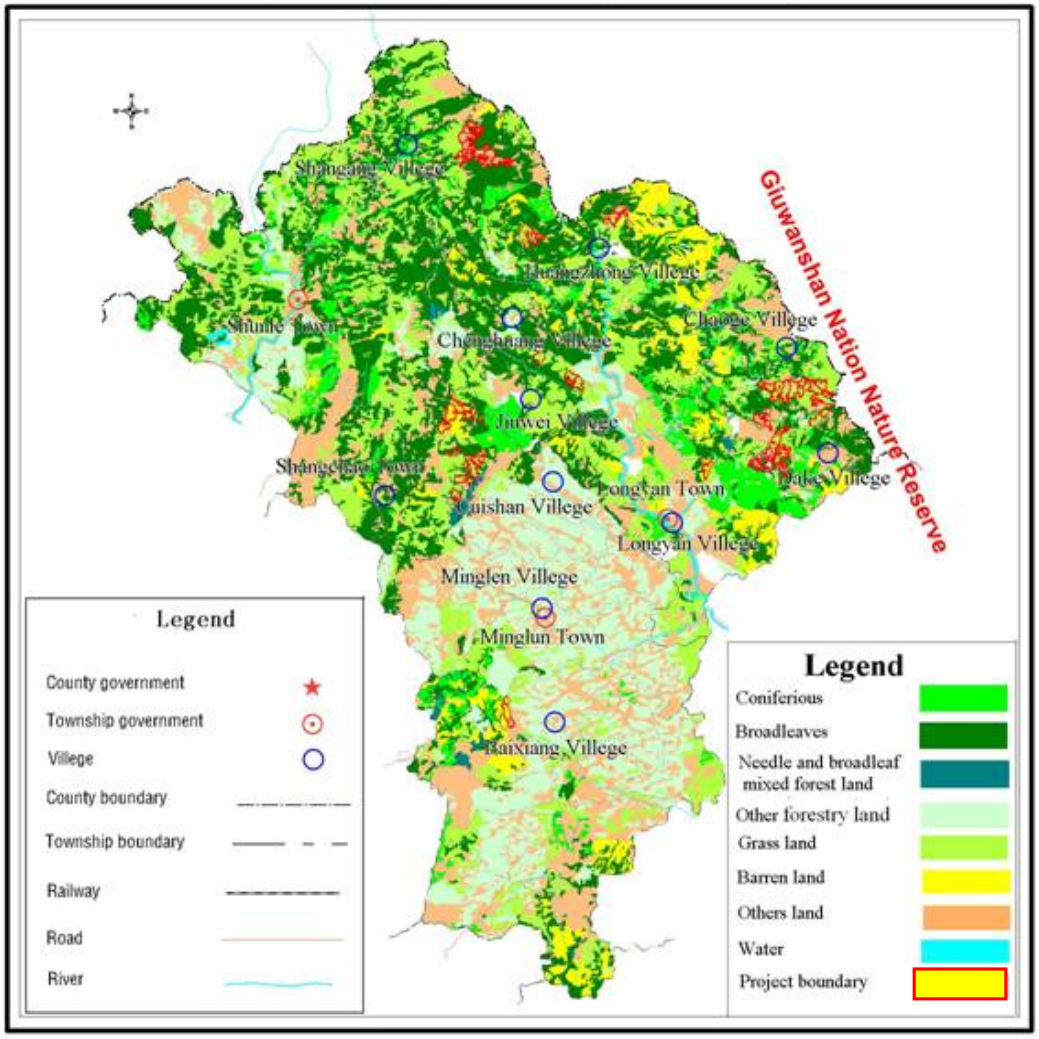
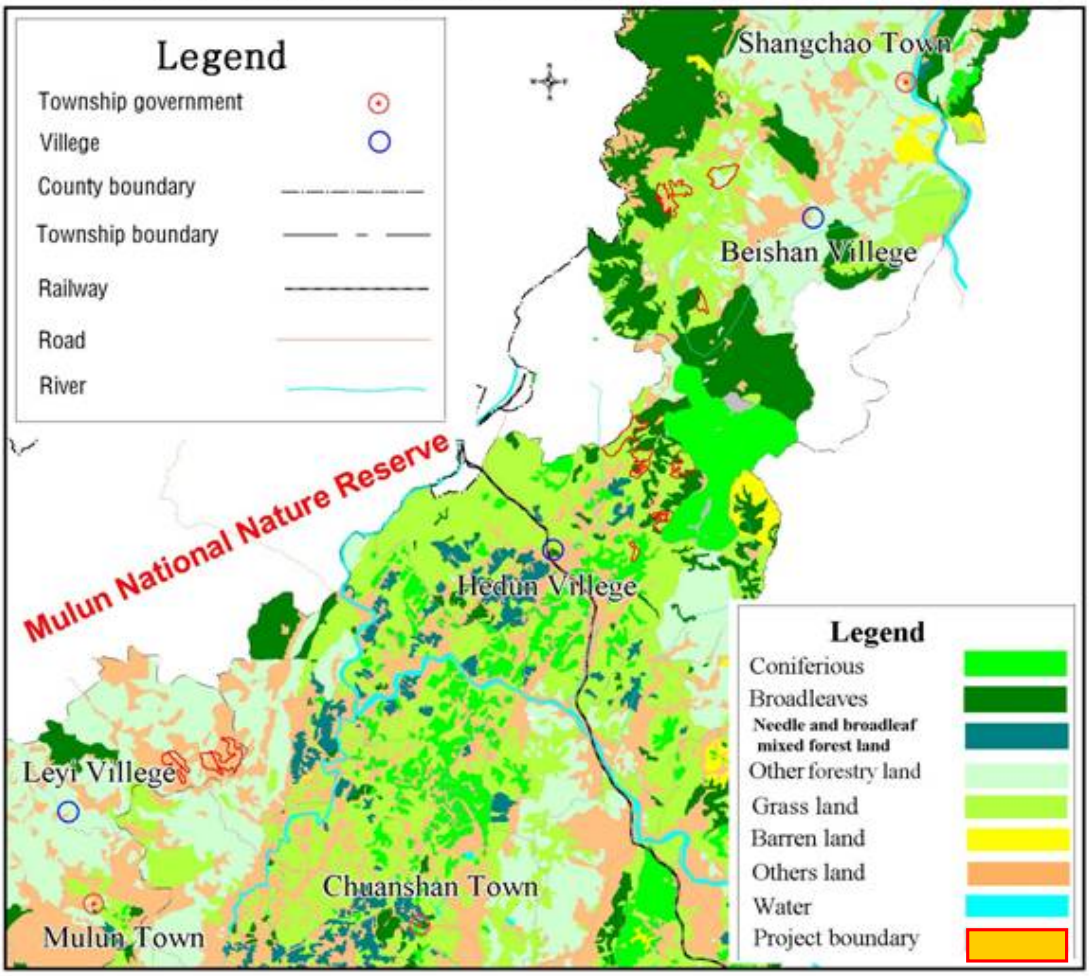


Fig. A-5 Lands to be planted in Mulun, Chuanshan and Shangchao Township of Huanjiang County (1:250,000)



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:

The sites to be planted are distributed in two counties with different environmental conditions, as described here:

Geology

Sites in Cangwu County lie in the Hunan-Guangxi folded zone, at the junction of the Dayao Mountain folded-fault belt and Tiantang Mountain folded-fault belt. Based on the geological development history,

the strata are divided into 6 systems, namely Cambrian system, Ordovician system, Devonian system, Tertiary system in Cretaceous system, Quaternary system and intrusive rocks. Main types of the rocks are sandy shale, argillaceous shale, meaty sandstone, fine sandstone, meaty-fine sandstone shale, meaty sandstone shale and granite. These rocks are 0.5-1 billion years old and are covered by deep red clay.

The geology in Huanjiang sites can be dated back to Sibao Period of the medium period of the Proterozoic era 1-1.8 billion years ago. The strata from bottom to top are Sibao Group, Danzhou Group, Sinian system, Cambrian system and Permian system, with a total thickness of the strata around 8,000-10,000m.

Landform

Cangwu County is composed mainly of hills and low-median mountains accounting for 77.9% of the total land area, with elevation mostly at 400-600m above sea level. The Yayan peak in the northwest part of Cangwu County is up to1,046 m.

Huanjiang County is the extension of the Yunnan-Guizhou plateau, with the elevation decreasing from north to south. Jiuwandashan Mountain in the east and northeast is the highest area in the County, with the elevation at highest peak of 1,693 m.

Climate

The climate of the project area in Cangwu County belongs to the subtropical monsoon climate. There is a high solar radiation, long and hot summer, and short and warm winter. The mean annual frost-free period is 331 days. Annual mean temperature is 21.2 ^{0}C, with the extreme temperature of 39.9 ^{0}C and -2.4 ^{0}C, and mean annual active accumulated temperature (above 10 ^{0}C) up to 6925.3 ^{0}C. The annual mean precipitation is 1,507 mm, mostly between April and August. The annual mean evaporation is 1,513 mm. The annual mean solar radiation is 112.64 Kcal per square centimetre and the annual mean sunshine is 1,779 hours. The annual mean relative humidity is 80%.

The climate of the project area in Huanjiang County belongs to the transitional monsoon climate between the south subtropical zone and the mid subtropical zone. The southern part is the north edge of south subtropics, while the middle part and the valleys belong to mid-subtropics, with mild climate, rich precipitation and sunshine, and long frost-free period. The north part belongs to mid-subtropical mountainous climate that is cool and moist. Annual mean temperature is 19.9°C, with extreme temperatures of 38.79°C and -5.2°C, and mean annual active accumulated temperature above 10°C of 7,043.3°C. The annual mean precipitation is 1,750 mm in the north and 1,389 mm in the south, 70% occurring between April and September. The annual mean evaporation is 1,571 mm. The annual mean solar radiation is 98.89 Kcal per square centimetre and the annual mean sunshine is 1,451 hours. The annual mean relative humidity is 79%.

Soils

Soils in the southern part of Cangwu County are red earth and yellow-red earth (over 500m above sea level) and crimson earth (below 500m asl), all developed from granite, while sites in the northern part have similar soil types but are developed mainly from sandy shale. Soils developed from granite are subject to soil erosion.

There are six types of soil in Huanjiang County, including red soil, yellow-red soil, yellow soil, brown limestone soil, black limestone soil, etc. They are developed mainly from sandy shale, limestone, sandstone and shale. Yellow soil spreads in the median and low mountains over 800m above sea level, yellow-red soil in the low mountains between 500m and 800m, red soil in the hills and low mountains below 500m.

Ecosystem

There are over 300 tree species from 66 families in the project area. The primary vegetation is mainly the subtropical evergreen broadleaf forest, dominated by Lauraceae and Fagaceae and with some features of seasonal rain forests. However, few primary forests remain. There are plantations of *Pinus massioniana, Cunninghamia laceolata, Pinus elliotii* and bamboo stands. However, lands to be reforested are barren lands covered with shrub and grass, dominated by *Rhodomyrtus tomentosa*, *Melastoma candidum*, *Baeckea frutescens*, *Dicranopteris linearis, Miscanthus floridulus*, *Saccharum fallax*, and ferns.

The Project areas suffered several large scale deforestation events since the 1950s, mainly caused by short-term policies that favoured rapid economic growth at the expense of sustainable forest management. Due to these unsustainable policies, as well as overuse for fuelwood, grazing and frequent fire, and the original forested lands have been severely degraded. In the early 1990s, the government tried to restore forests in the project area in Cangwu by air-seeding, but the action failed. Currently, most sites are seriously degraded and comprise low-productivity barren lands with some grass and shrubs. The only exceptions are a few sites at Shichuan Village and Chantian Village of Shatou Town in Cangwu County on which a few trees are growing. However, the crown cover of these sites is below 20% and will not reach 20% under continuation of current conditions. 20% crown cover is the threshold for defining a forest in China.

Hydrology

There are 6 main rivers in Cangwu County, with over 100 square kilometres of watershed area for each of them. They are Shangxiaohe River, Xiaxiaohe River, Dong'an River, Siliang River, Anping River and Longjiang River, with a total length of 745 km, and a total watershed area of 3,995 square kilometres and annual mean runoff of 30.55 billion cubic meters. All six rivers are the first-order branch of the Pearl River.

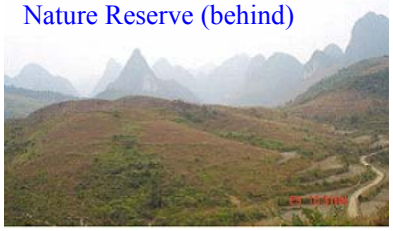
The main rivers in Huanjiang County are Dahuanjiang River, Xiaohuanjiang River and Dagouhe River, with a length of 147.2 km, 94.1 km and 26 km respectively and watershed areas of 2028.2, 1653.6 and 804 square kilometre, respectively. All of them originate from Guizhou Province and flow from the north to the south of the County. They form the second-order branch of the Pearl River.

Rare and Endangered Species

The Guangxi Zhang autonomous region is very rich in biodiversity. The flora is estimated to include over 6000 species, the third largest number of all Chinese provinces. Due to its mountainous topography and subtropical climate, the province has the second largest number of endangered and protected plant species with the total of 113 species. Of these, 3 are first class and 47 are second class protected species[1].

The lush forests of the province harbour a rich fauna. A total of 166 species of mammals are recorded in Guangxi. This is the sixth highest score of all provinces. Of these, 9 belong to the first class of protected species and 17 belong to the second class. The avifauna is fairly rich as well and 313 bird species have been recorded, two of which are in first class and 47 are in second class.

Landscape linked to Mulun Nature Reserve (behind)



Close to the project area, there are two national nature reserves, i.e., Mulun and Jiuwandashan Reserves in Huanjiang County. There are more than 3000 vascular plants in this area, and the region is one of the endemic and richest plant diversity centres of China. Many threatened species, such as *Macaca assamensis, Panthera pardus, Moschus berezovskii, Arborophila gingica* and *Python molurus* are recorded in the reserves.

[1] The protected animals and plants have been classified into 3 classes. The first class is highest priority, followed by the second and third class.

The project area in Cangwu County is surrounded by dense human settlements, and the wildlife habitat has been degraded /destroyed for a long time. The Daguishan National Forest Park is situated in the county and borders the project area in Shatou Township. Another protected area, the Feilinghu Forest Park, will be established in the county. Many state protected species are also found in the forest park with about 1000 plant species in the Daguishan forest park, including 3 species that are listed as first class state key protected species. In recent years, Varanus salvator have been found in the park, and now the local government is establishing a nature reserve to protect its habitat.

Table A-2 List of the endangered mammal and bird species in the project area which are threatened by past and ongoing habitat loss.

Latin name	English name	Chinese Red book	T	IUCN Red Book	CITES
Accipiter badius	Shikra	R	II		II
Accipiter trivirgatus	Crested Goshawk	R	II		II
Aegypius monachus	Cinereous vulture	V	II	V	II

Aix galericulata	Mandarin Duck	V	II		
Anthracoceros coronatus	Malabar Pied Hornbill	V	II		II
Aonyx cinerea	Oriental small-clawed otter	E	II	LR/nt	
Aquila chrysaetos	Golden Eagle	V	I		II
Arborophila gingica	White-browed Hill Partridge	I	II	R	
Assamese macaque	Assamese macaque	V	I	VU	II
Bonasa sewerzowi	Severtzov's Hazel Grouse	E			
Butastur indicus	Grey-faced Buzzard Eagle	R	II		II
Buteo rufinus	Long-legged Buzzard	R	II		II
Capricornis sumatraensis	Serow	V	II	VU	I
Cervus unicolor	Sambar		II		
Chrysolophus amherstiae	Chinese Copper Pheasant	V	II		
Chrysolophus spictus	Golden Pheasant	V	II		
Elanus caeruleus	Black-Winged Kite	V	II		II
Falco cherrug	Saker Falcon	V	II		II
Gallus gallus	Red Jungle Fowl	V	II		
Haliastur indus	Brahminy Kite	R	II		II
Hydropotes inermis	Chinese water deer	V	II	LR/nt	
Lutra lutra	Common otter	V	II		I
Lyrurus tetrix	Black Grouse	V	II		
Macropygia unchall	Bar-tailed Cuckoo Dove	R			
Mains pentadactyla	Chinese pangolin	V	II		II
Moschus berezovskii	Forest musk deer	E	II	LR/nt	II
Naemorhaedus baileyi	Red goral	R	I	VU	I
Naemorhaedus goral	Goral	V	II	VU	I
Neofelis nebulosa	Clouded leopard	E	II	VU	I
Otus spilocephalus	Spotted Scops Owl	I			II
Pandion haliaetus	Osprey	R	II		II
Panthera pardus	Leopard	E	I	EN	I
Phodilus badius	Bay Owl	R			II
Pigtailed macaque	Pig-tailed macaque	E	I	VU	II
Presbytis francoisi	Francois' langur	E	I	VU	II
Prionodon pardicolor	Spotted linsang	E	II		I
Psittacula roseata	Blossom-headed Parakeet	R	II		
Rhesus macaque	Rhesus macaque	V	II	LR/nt	II
Spilornis cheela	Crested Sperpent Eagle	V	II		II

Tetrao parvirostris	Black-billed Capercaillie	V	1		
Tibetan macaque	Tibetan macaque	V	II	LC/cd	II
Tragopan caboti	Yellow-bellied Tragopan	E	1	E	I
Tragopan temminckii	Red-bellied Tragopan	V	II		
Treron sieboldii	White-bellied Green Pigeon	R	II		
Ursus thibetanus	Asiatic black bear	V	II	VU	I
Viverra zibetha	Large Indian civet	V	II		
Viverricula indica	Small Indian civet		II		

A.4.2. Species and varieties selected:

Tree species to be used have been determined by interviewing local farmers/communities and farms/companies involved, and taking into consideration carbon sequestration rates, biodiversity enhancement, soil erosion control and the value of associated forest products. These species include:

- *Pinus massoniana;*
- *Liquidambar formosana;*
- *Cunninghamia lanceolata;*
- *Schima superba;*
- *Eucalyptus* sp.;
- *Quercus* sp.

All species are native to the area except eucalyptus. However eucalyptus was introduced into China about 100 years ago and has been widely planted in Southern China, including in the Guangxi region, for several decades and has shown no invasive characteristics. Eucalyptus was chosen for the project area at the request of local communities who prefer it due to the fact that it can generate a significant amount of CERs in the early stage of the crediting period, compared to other species that grow relatively slow in the first several years.

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

The greenhouse gases (GHG) that are expected to be emitted as a result of the implementation of the proposed A/R CDM project activity are CO_2, CH_4 and N_2O. They result from:

- Fertilization: Due to the low soil fertility and poor adaptation of eucalyptus to poor soils, it is necessary to apply fertilizer to eucalyptus plantations, resulting in nitrous oxide emission; and
- Vehicle use for the transportation of management staff, seedlings, timber and forest by-products, resulting in CO_2 and non-CO_2 emissions.
- The decrease in carbon stock of non-tree living biomass on the site due to competition from planted trees or site preparation.

Site burning and overall tilling will not be employed during site preparation. No machinery will be used in site preparation, planting, weeding, thinning, harvesting or other management

activities. Fertilizer will not be applied to other tree species because they are well adapted and suited for improving poor soils. Therefore no other emissions will occur as a result of the proposed A/R CDM project activity.

A.4.4. Carbon pools selected:

Decision 11/CP.7 requires parties to account for the carbon stock changes in five pools: aboveground biomass, belowground biomass, dead wood, litter and soil organic carbon[2]. This was reiterated in decision 19/CP.9[3]. The definitions for the five pools are given in the Good Practice Guidance for LULUCF[4]. Based on the decision 19/CP.9, project participants may choose not to account for one or more carbon pools if transparent and verifiable information are provided that the choice will not increase the expected net anthropogenic greenhouse gas removals by sinks.

Carbon stocks in the pools of soil organic carbon, dead wood and litter will not decrease more, nor increase less, as a result of the proposed A/R CDM project activity than in the baseline, since planting trees will be on degraded and/or degrading barren lands that have lower soil organic matter content, little if any dead wood and litter. Therefore, planting trees on degraded barren lands will improve the carbon balance in these other pools relative to the baseline scenario. As a consequence, to be conservative, we choose to account only for the aboveground biomass and belowground biomass in the proposed A/R CDM project activity. Other, non-tree vegetation will be treated in a conservative manner by deducting any such pre-existing vegetation as a carbon stock decrease at the beginning of the project.

A.4.5. Compliance with the definition for afforestation or reforestation:

The Chinese Government defines forests as land having growing trees with:

- A minimum area of 0.067 hectares;
- A minimum tree crown cover of 20%;
- A minimum height of 2 meters; and
- A minimum width of 10 meters.

Therefore, the threshold values of the forest definition of Chinese government complies with the UNFCCC definition and are to be used for the purposes of the Kyoto Protocol.

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:

Based on the Land Law of the People's Republic of China, the land to be planted in the proposed A/R CDM project activity is legally owned by local villages as a public property. However, the land use right of 1098.4 ha lands within the project boundary in Cangwu County is contracted to local farmers for 50 years and will be renewed upon expiration for another 50 years according to Chinese " Land Contract Law" if farmers apply for. Local farmers have the right to decide themselves how to use the land and own

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

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

[4] IPCC. 2003. Good practice guidance for land use, land use change and forestry. The Institute for Global Environmental Strategies (IGES) for the IPCC, Hayama, Kanagawa, Japan. ISBN 4-88788-003-0

the resources on the land. Other lands to be reforested are still managed by local villages. Currently all the land is abandoned barren land.

Under the contractual arrangement in the proposed A/R CDM project activity, local farmers/communities and forest farms/companies involved have the right to use the lands. They own the timber and other wood and non-wood forest products, and have the legal right to harvest and sell the products. However, they should have the license, which is issued by the local government, to harvest the timber.

To effectively promote and govern CDM project activities in China, the Chinese government issued the *Interim Measures for Operation and Management of CDM Projects* on Oct 12, 2005, effective immediately. Based on the *Interim Measures*, the Chinese Government allows any sponsor to apply, invest in, and implement a CDM project activity as long as it meets basic requirements stipulated in the *Interim Measures*. The rights of access to the sequestered carbon belongs fully to implementing after Chinese government taxes 2% of transfer value[5].

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

Restoration of natural forest and plantation with harvesting on tropical degraded and degrading land by tree planting. Aboveground and belowground biomass of trees are the carbon pools to be accounted.

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

One of the main technologies which will be employed under this project is reforestation through direct planting with environmental-friendly techniques on degraded lands. Good practice guidance and successful national and international technologies, as well as experiences gained from the World Bank financed forestry projects will also be adopted. The following technical standard will be strictly followed:

- State Technical Regulations for Afforesation/Reforestation: GB/T 15776-1995;
- State Technical Regulations for Establishing Eironmental Service Forests: GB/T 18337.1-2001, GB/T 18337.2-2001, GB/T 18337.3-2001;
- State Technical Regulations for Designing of Afforesation/Reforestation: LY/T 1607-2003;
- State Technical Regulations for Forest Management: GB/T 15781-1995;
- Standards for Seedling Qualification: GB 6000－1999;
- Technical Standard for Seedling Breading.

Geographical Information System (GIS) and Geographical Positioning System (GPS) will be employed in the verification and monitoring of the implementation of the proposed A/R CDM project activity. The local forestry agencies, i.e., Guangxi Provincial Forestry Department, Cangwu and Huanjiang County Forestry Bureaus, Guangxi Forestry Inventory and Design Institute, Guangxi Forestry Research Institute and the Chinese Academy of Forestry will provide technical consultation and guidance, including training courses, and conduct quality control to the preparation and implementation of the proposed A/R CDM project activity. Project participants will also seek advice from local, national, and international forestry and watershed management experts. The most up-to-date technologies and silvicultural models will be adopted, which will also demonstrate the viability of using carbon as a virtual cash crop in the region along Pearl River Basin.

Site and Soil Preparation

To prevent soil erosion, reduce GHG emission and protect existing carbon stocks, site burning and overall

[5] http://cdm.ccchina.gov.cn/

tillage will not be employed during the site preparation. Traditionally in southern China, sites to be planted and/or replanted are usually slashed and burned, followed by overall tillage. As a result, carbon will be released to the atmosphere immediately during burning, along with emissions of non-CO_2 GHGs. Furthermore, due to the steep slopes and overall tillage, severe soil erosion occurs during the rainy season if these practices are employed, and consequently a lot of organic matter and nutrients is removed. Substantial yield decline has been widely reported under this slash and burn system. In the proposed A/R CDM project activity, small holes (diameter 40-50cm and depth 40cm) will be dug along the landform contour in triangle form and most of the original vegetation will be kept. After harvesting, some tree species like *Quercus* sp.and *Eucalyptus* sp will be regenerated naturally by resprouting, thus avoiding site and soil disturbance. Even though, the limited removal of pre-existing vegetation will be accounted as carbon stock decrease.

Species and model arrangements

Tree species will be planted in mixed species arrangements to minimize risks (fire, pest, insects and disease) and maximize environmental and social benefits. For example, *P. massoniana* and *C. lanceolata* that are flammable will be planted on the less accessible upper parts of the slopes; in contrast, broadleaf species that are fire resistant will be planted in lower slopes and/or more accessible areas. Broadleaf species will also be used as firebreaks along hill ridges. Fig. A-6 presents a GIS example of species and planting model arrangement. Table A-3 lists the species and model arrangement.

Fig. A-6 Species and reforestation model arrangement in Hedun village
1:150,000

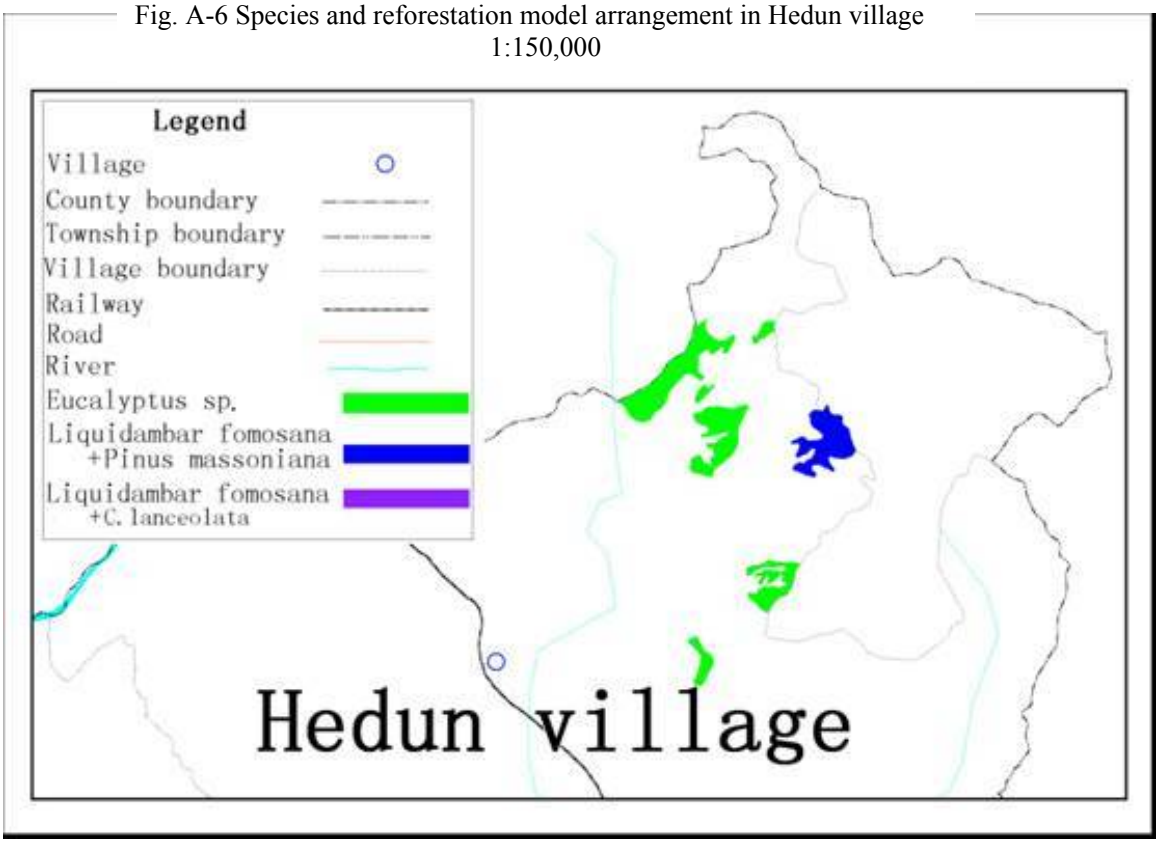


Table A-3 Species and model arrangement and planting plan

Species/Model	Species ratio	Area to be planted in 2006 (ha)	Area to be planted in 2007 (ha)	Total area (ha)
P. massoniana + *Quercus* sp.	6:4	100	800	900
P. massoniana + *S. superba*	6:4	220	380	600
L. formosana + *C. lanceolata*	6:4		450	450
L. formosana + *P. massoniana*	6:4	490	560	1,050
Eucalyptus sp.		850	150	1,000
Total		1,660	2,340	4,000

Genetic Sources and Nursery Practices

The tissue culture seedlings of the eucalyptus will be purchased from Guangxi Dongmen Forestry Farm which is close to the project area, and then cultured in the nurseries of Cangwu and Huangjiang Counties.

Seedlings of other species will be generated in temporary on-site nurseries besides streams and irrigated by stream water. Seeds of other species will be collected from local seed orchards or parent tree gardens. All seed and tissue cultured seedlings used will have a quality certificate, quarantine certificate and inspection certificate. Seedlings are produced in plastic tubes that hold soils formed by earth and

humus/fertilizers. This technique ensures the control of the growing conditions in the initial stage after planting, and thus increases the survival rate and early growth.

Forest Establishment

Planting activities will last two years, starting in 2006, with spacing as follows:

- Eucalyptus: 2 m × 4 m;
- *P. massoniana* and *S. superba*: 2 m × 2.5 m;
- *Quercus* sp and *C. lanceolata*: 2 m × 2 m;
- *L. formosana*: 2 m × 3 m.

To ensure high survival rates and good growth in the early stages, weed will be slashed manually two to three times a year in the first three years after planting. Survival rates will be checked and re-planting will be conducted 1 month after planting if needed.

Synthetic compound fertilizer with nitrogen content around 10% will be applied to eucalyptus due to its poor adaptation to poor soil conditions: 750g per tree at the time of planting, 300g per tree in the second year and 400g per tree in the third year.

Forest Management

The plantations will not be thinned. However, resin will be collected as a by-product of the *P. massoniana* plantation from 16 to 20 year-old to raise the income of the local communities.

P. massoniana and C. lanceolata will not be harvested during the crediting period. However, *L. formosana* and *S. superba* will be harvested around age 17, eucalyptus around age 10 and oak around age 7. Upon harvesting, Eucalyptus and Oak will be regenerated naturally through re-sprouting and other stands by direct re-planting. The re-sprouted stands grow faster and have many more stems per hectare than other stands.

This r font.

A.4.9. Approach for addressing non-permanence:

The issuance of tCER for the net anthropogenic GHG removals by sinks achieved by the proposed A/R CDM project activity is chosen.

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

30 years, fixed.

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

April 1, 2006 is the starting date of the proposed A/R CDM project activity and the first crediting period.

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

30 years

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

30 years, fixed

A.4.10.3.1. Renewable crediting period, if selected:

N/A

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

N/A

A.4.10.3.1.2. Length of the first crediting period:

N/A

A.4.10.3.2 Fixed crediting period, if selected:

30 years

A.4.10.3.2 .1. Starting date:

April 1, 2006

A.4.10.3.2.2. Length:

30 years

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:

Carbon dioxide will be sequestered from the atmosphere through the growth of planted trees and stored in the aboveground biomass and belowground biomass of living trees. Leakage (fossil combustion due to vehicle use), increase in GHG emissions from nitrogen fertilization and carbon stocks decrease from removal of pre-existing non-tree vegetation will occur only on a limited scale (see Table D-1 to D-4 in section D).

Due to the deforestation and subsequent cultivation, overuse for fuel wood, and frequent fires, the project areas have been steadily degrading over the last several decades (see Annex 3 for details). Currently the lands to be reforested within the project boundary are degraded barren lands occupied by grasses and shrubs. In addition there is severe soil and water erosion, and most lands are suffering from continuous human disturbance (fire, fuel collection, etc.). The carbon stocks will continue to decrease or remain at a lower steady state. We chose to set the baseline carbon stock changes for these degraded lands as constant, as far as aboveground and belowground biomass of living trees is concerned. For two sites with a few growing trees, our baseline scenario includes a slight increase in biomass carbon stocks due to the continued growth of these trees. As a result, the baseline net greenhouse gas removal by sinks is very small. Litter and dead wood and soil organic carbon pools are omitted, because their carbon balance is improved in the project scenario compared to the baseline.

Since the land is restricted to forestry purposes and is economically unattractive, the continuation of current situation is the most plausible alternative land use identified. The low land productivity, the investment and technical barriers and market risks prevent local farmers/communities from implementing the type of project activities in the absence of CER revenues.

Therefore, the net anthropogenic greenhouse gas removals by sinks will be achieved only by the proposed A/R CDM project activity, and would not occur without the A/R CDM project activity.

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

The net anthropogenic GHG removals by sinks as a result of the proposed A/R CDM project activity is anticipated to be over 600,000 tones of CO_2 equivalent during the crediting period (between April 1, 2006 and March 31, 2036) per the Table A-4 below.

Table A-4 Ex ante extimated net anthropogenic GHG removals by sinks

Years	Annual estimation of net anthropogenic GHG removals by sinks in tonnes of CO2 e
2006	-43,433
2007	45,893
2008	47,713
2009	47,184
2010	51,642
2011	62,505
2012	67,959
2013	61,497

2014	-39,499
2015	-16,721
2016	-13,431
2017	87,661
2018	76,020
2019	33,770
2020	17,982
2021	69,480
2022	-31,477
2023	-53,533
2024	-62,813
2025	32,226
2026	19,135
2027	72,063
2028	69,147
2029	62,974
2030	-32,086
2031	-85,741
2032	-89,970
2033	72,120
2034	71,040
2035	65,567
Total estimated net anthropogenic GHG removals by sinks (tonnes of CO2 e)	664,872
Total number of crediting years	30
Annual average over the crediting period of estimated net anthropogenic GHG removals by sinks (tonnes of CO2e)	22,162.4

Notes: minus sign indicates the source while plus indicates the sink

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

The establishment cost will be from local commercial bank loans, counterpart funds from local government, and the participants themselves. The operating and maintenance cost will be covered by short-term and long-term loans from local commercial banks, counterpart funding from local government and participants (see Annex 2). There is no available public funding that will result in a diversion of official development assistance and financial obligations of any Parties under UNFCCC.

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 methodology "Reforestation of degraded land" (AR-AM0001)[6] is applied.

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

[6] http://cdm.unfccc.int/EB/Meetings/022/eb22_repan17.pdf

The proposed A/R CDM project activity complies with the conditions under which the chosen methodology applies in the following ways:

- The project activity will 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 (see Section B.2.8 below);
- Lands to be reforested have been severely degrading over the last decades and are degrading. Most lands are currently covered by grasses and shrubs, except one piece of land of 44 ha with a few growing trees. But the tree crown cover on this land is below the thresholds for defining a forest set by Chinese DNA that are consistent with decision 11/CP.7 and 19/CP.9, and would not reach the threshold under continuation of current management.
- Unavailability of natural seed sources, and environmental conditions, do not permit the encroachment of natural forest vegetation, which has been demonstrated by failure of air-seeding activities in the early 1990s.
- Lands will be reforested by direct planting in the proposed A/R CDM project activity.
- As elaborated in Section A.4.8 and Section E.1, trees will be planted with low density (1250-2500 trees per hectare), small hole site preparation (40 cm X 50 cm in diameter or 0.2 m^2). As a result, the surface area disturbed by site preparation is estimated to be 2-5% of the total land surface. Therefore the site preparation will not cause significant long-term net emissions from soil carbon.
- Plantation will be harvested with a minimum rotation of seven years and will be regenerated by direct planting or natural sprouting (see Section A.4.8).
- In the context of degraded and degrading lands, carbon stocks in soil organic matter, litter and deadwood will decrease more or increase less in the absence of the project activity, relative to the project scenario.
- Although livestock were widely raised on some of the project areas until a few years ago, currently few farmers raise livestock outside houses and grazing will not occur in the project boundary.
- Due to the degraded feature of the lands, economical unattractiveness, identifiable barriers (unavailable funds, inaccessible commercial bank loans, lack of capacity for successful planting and management, inadequate institutional arrangements) and market risks, investors or local communities are prevented from using the land for economic revenue. Without the proposed A/R CDM project activity, the lands to be reforested will continue to degrade. Therefore the baseline approach 22(a) (existing or historical changes in carbon stocks in the carbon pools within the project boundary) is the most appropriate choice for determination of the baseline scenario.

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

The approved methodology (AR-AM0001) used by the proposed A/R CDM project activity described the baseline methodology that is followed below.

1. Eligibility of land

The eligibility of lands to be planted is presented under Section B.3 for the additionality below as per the approved methodology AR-AM0001.

2. Project boundary

Lands to be planted are composed of 52 parcels of sites. See Section A.4.1.4 for detail and Annex 5 for geographical positions (longitude, latitude) at each corner of the 52 parcels of sites. In addition, the emission sources and gases included the project boundary are:

- CO_2 emissions resulted from burning of fossil fuels due to the transportation of labors, seedlings, wood and non-wood forest products;
- Carbon stock decrease due to loss of pre-existing non-tree vegetation;
- N_2O emission due to fertilizer application.

No extra burning of biomass (i.e., manual site preparation rather than site burning) will occur in the proposed A/R CDM project activity (see Section A.4.8), hence there will be no non-CO_2 emission induced from burning of biomass.

3. Ex-ante stratification

The step 1-5 described in Section III.2 of the approved methodology has been followed for the ex-ante stratification through the following activities (see Annex 3 for details):

a) Identifying the factors that influence the carbon stocks in living biomass of trees: The lands to be reforested in the proposed A/R CDM project activity are distributed in two counties that have different climate and landform. Within each county, soil conditions, landform, vegetation, erosion intensity, tree species to be planted and planting time are the major factors that will influence the tree growth.

b) Collecting local information of key factors identified in above, including local site classification maps and/or tables, the most updated land use/cover maps, soil types/maps, parent rocks, landform maps, soil erosion information.

c) Pre-stratification based on the factors such as climate, landform and soil conditions as well as the vegetation (with growing trees versus without growing trees), using land use/cover maps, soil maps, vegetation maps.

d) Field tour studies on each piece of land to inspect the existing vegetation, soil condition and erosion status.

e) Interviews with local farmers/communities on land use/cover history, important events that have impacted or are impacting the land use/cover, and current human interventions (logging, grazing, fuel collecting, medicine collecting, etc).

f) Sampling surveys on representative land types (pre-strata) including the crown cover and mean height for herbaceous, shrubs and trees, soil type, soil depth, and soil sampling and analyzing.

g) Stratifying based on supplementary information gained from field tour study, interview and sampling surveys.

4. Determination of most plausible baseline scenario

The most plausible baseline scenario has been determined with steps presented in Section II.4 of the approved methodology AR-AM0001, "Procedure for selection of most plausible baseline scenario", as follows.

Step 1: Identify and list plausible alternative land uses: The field surveys, interviews with stakeholders (Annex 3 and Section G for details) and social economic analysis indicated that the plausible alternative land uses available to the project participants are either continuation of the current status of the land or forest plantation because the lands to be planted are legally restricted for forestry purposes by government. As a result other land uses, e.g., agriculture, are not allowed.

Step 2: The project areas would remain abandoned and degrading in absence of the project activity because

a) The lands are legally restricted to forestry purposes;

b) The lands have been degrading in last decades (see step 3 paragraph a) below and Annex 3);

c) Natural encroachment of trees is unlikely possible (see step 3 paragraph b) below);

d) In terms of the forestry land uses, the investment analysis indicates that the financial internal return rate (FIRR) without the carbon revenue for the type of proposed A/R project activity is only 8.33% which is much lower than the required rate of return (RRR) by Chinese government (see step 2 of the additionality test in section B.3 for details). In addition, there are apparent investment barriers and other barriers that prevent the implementation of the type of the project activity (see step 3 of the additionality test in section B.3 for detail).

Step 3: Demonstrate that the lands to be planted are really "degraded"

a) Assessment of the historical and existing land use/cover changes

The Project areas were forested lands in the 1950s. However, the areas suffered several large-scale events of deforestation since then, mainly caused by unreasonable policies (see Annex 3 for details). Currently, most sites are seriously degraded barren lands of low productivity with some grasses and shrubs. The only exceptions are a few pieces of lands at Shichuan Village and Chantian Village of Shatou Town in Cangwu County on which a few trees are growing. However, the crown cover of these sites is still below 20% that is the threshold of forest definition in China, and will not exceed 20% with continuation of current management (fuel wood collection, frequent fire, soil erosion).

b) Assessment of the possibility of natural encroachment of trees

The field survey (see Annex 3 for details) indicates that there is no possibility of natural encroachment of trees because there are few if any seed source that can disperse onto the project sites due to the large distance of project lands to adjacent forests. Also, the grass and shrub cover prevents seeds from landing on mineral soil and competes with young seedlings. This has been demonstrated by the failure of previous air seedling[7]. This is also supported by the fact that the lands to be reforested have been non-forested lands at least since 1989 and no natural growth of trees has been identified, even though the land was basically not used by humans for other purposes.

c) Assessment of the national and/or sectoral policies

Since 1980s, China has successively issued and revised a series of laws and administrative regulations related to forestry, such as the Regulations for Implementing the Forest Law, the Regulations for Grain for Green, the Regulations for the Protection of Wild Plants and Animals, the Regulation for Nature Reserve, the Regulation for Forest Fire Control, and the Regulation for Forest Diseases and Pests Control, etc.

In the 1990s, China initiated a policy of "the one who planted trees will be the one to benefit" to encourage afforestation/reforestation on barren lands. The villages owning barren lands were allowed to be contracted with farmers to reforest, with 50-year or even longer contract period. Within this period, the right of using lands will not be changed. The land use contract can be prolonged if the farmers apply for it.

To facilitate the restoration of forest resources, the Chinese government has launched several programs over the past years, such as the Grain for Green Program (started in 2001), the Intensively Managed Timber Plantation Base Program (started in 2000), the Natural Forest Conservation Program (launched in 1998), the Nature Reserve Development and Wild Conservation Program (started in 2000), etc.

[7] The air-seeding design used then will be provided to DOE during validation process.

Although these programs have set overall development goals for forestry development and were started before the adoption by the COP of the CDM M&P (/decision 17/CP.7, 11 November 2001), they are not legally- or policy-binding, and meeting the goals depends largely on the availability of funds. There is a large financial gap to realize these goals. As the domestic funds for the afforestation/reforestation in this region have been limited for many years, and mainly used for planting trees on the economically attractive lands or more accessible lands. The project lands are so remote that they are not attractive for timber markets and are usually not target lands for the reforestation/afforestation programmers. In addition, local farmers/communities are usually not able to fully finance forest establishment because it is hard for them to get loans from local banks for the purpose of reforestation activities (loans for agricultural activities are much easier to obtain).

Therefore, without the proposed A/R CDM project activity the project sites will not be reforested as a result of national or sectoral policies, and with the project activity the on-going reforestation programs will not be reduced.

The step 1-3 clearly demonstrated 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.

5. Estimation of baseline net GHG removals by sinks

Based on the approved methodology AR-AM0001, the baseline net GHG removals by sinks can be estimated by steps as follow:

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 of living trees is set as zero;
- For stratum II (the only stratum with growing trees), the sum of carbon stock changes in above-ground and below-ground biomass of living trees is determined based on the projection of their number and growth, based on growth models and national or IPCC default parameters using formula in Section II.5 of the approved methodology AR-AM0001 (see in Annex 3).

b) Sum the baseline net GHG removals by sinks across all strata: In the proposed A/R CDM project activity, it is equal to the sum of carbon stock changes in above-ground and below-ground biomass of living trees in stratum II.

6. Additionality

Please see Section B.3.

7. Ex ante actual net GHG removal by sinks

Please see section D.1 below for the estimation of the ex-ante actual net GHG removal by sinks.

8. Leakage

As elaboration in Section B.2 paragraph 4 above, lands to be planted in the proposed A/R CDM project activity are abandoned, economically unattractive lands and are legally restricted to forestry purposes. Therefore, as the result of the proposed A/R CDM project activity, agricultural activities will not be displaced from the project sites to other locations.

As elaborated in Section B.3, grazing is very few in the project area, hence as a result of the proposed A/R CDM project activity, grazing activities will not be displaced to land outside the project boundary.

Some villagers are using shrub, grass and/or deadwood and living branches for cooking and/or heating (refer to table F-1 for fuelwood consumption). Local farmers will be able to collect fuel within the project boundary without compromising the growth of trees established under the proposed A/R CDM project activity, including dead wood and branches and grasses/shrubs growing between the trees during the early stages of succession. Therefore, as the result of the proposed A/R CDM project activity, local farmers will not have to collect fuels on lands outside the project boundary.

As elaboration in paragraph 4 c) above, the proposed A/R CDM project activity will not result in any reduction of reforestation activities because of the vast amount of abandoned barren land, majestic governmental goal and financial gap in China. In addition, as the second largest timber import country in the world, China has a severe shortage of timber, therefore market leakage is unlikely to occur.

However, in the context of the proposed A/R CDM project activity, fossil fuel combustion from vehicles using for transporting seedling, labours, fertilizer, harvest products, etc., to and/or from project sites, will emit greenhouse gases. This is estimated based on method described in Section II.8 of the approved methodology applied (see section D.3 for detail estimation).

9. Ex ante net anthropogenic GHG removal by sinks

Please see Section D.4 below for the estimation of the ex-ante net anthropogenic GHG removal by sinks.

10. Uncertainties

The uncertainties for baseline net GHG removals by sinks are assessed based on equation (30) and (31) presented in Section III.10 of the approved methodology AR-AM0001 (see Annex 3 paragraph 5 for details).

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:

This is demonstrated by following two aspects:

- **Land eligibility**

The land eligibility is demonstrated using *the Procedures to Define the Eligibility of Lands for Afforestation and Reforestation Project Activities* approved by the Executive Board[8].

(a) the land at the moment the project starts is not a forest, which has been demonstrated by

(i) Field tour studies described in Section B.2.3 indicate that the lands to be planted in the proposed A/R CDM project activity are seriously degraded and comprise low-productivity barren lands covered mostly with grasses and a few shrubs, rather than forests or temporarily unstocked lands. Although a small piece of land has a few growing trees, the tree crown cover of the land is still below 20% of the threshold for defining a forest as communicated by the Chinese DNA, and would remain so under continuation of current management;

(ii) Most recent land use/cover maps showed in Fig B-1 and Fig B-2 also demonstrates that the lands to be planted are barren lands. The maps were derived from forestry inventory that is conducted once every five years.

(b) the activity is an eligible CDM reforestation project activity, which is demonstrated by

(i) Interviewing with local farmers/communities on land use/cover history and important events that have impacted the land use/cover (see Section B.2.3) indicates that the lands to be planted in the proposed A/R CDM project activity have been non-forested barren lands since at least 1989 (see Section G as well as Annex 3).

(ii) Land use/cover maps showed in Fig B-3 and Fig B-4 also demonstrate that the lands to be planted were barren lands in 1989.

Note: the actual GIS systems have a much higher resolution than the pictures inserted in here in the PDD; and will be accessible to the DOE to confirm eligibility of lands. The lands to be planted in the proposed A/R CDM project activity are marked with red lines in these figures.

[8] http://cdm.unfccc.int/EB/Meetings/022/eb22_repan16.pdf

Fig. B-1 Land use/cover map of Huanjiang County in 1999 (1:500,000)

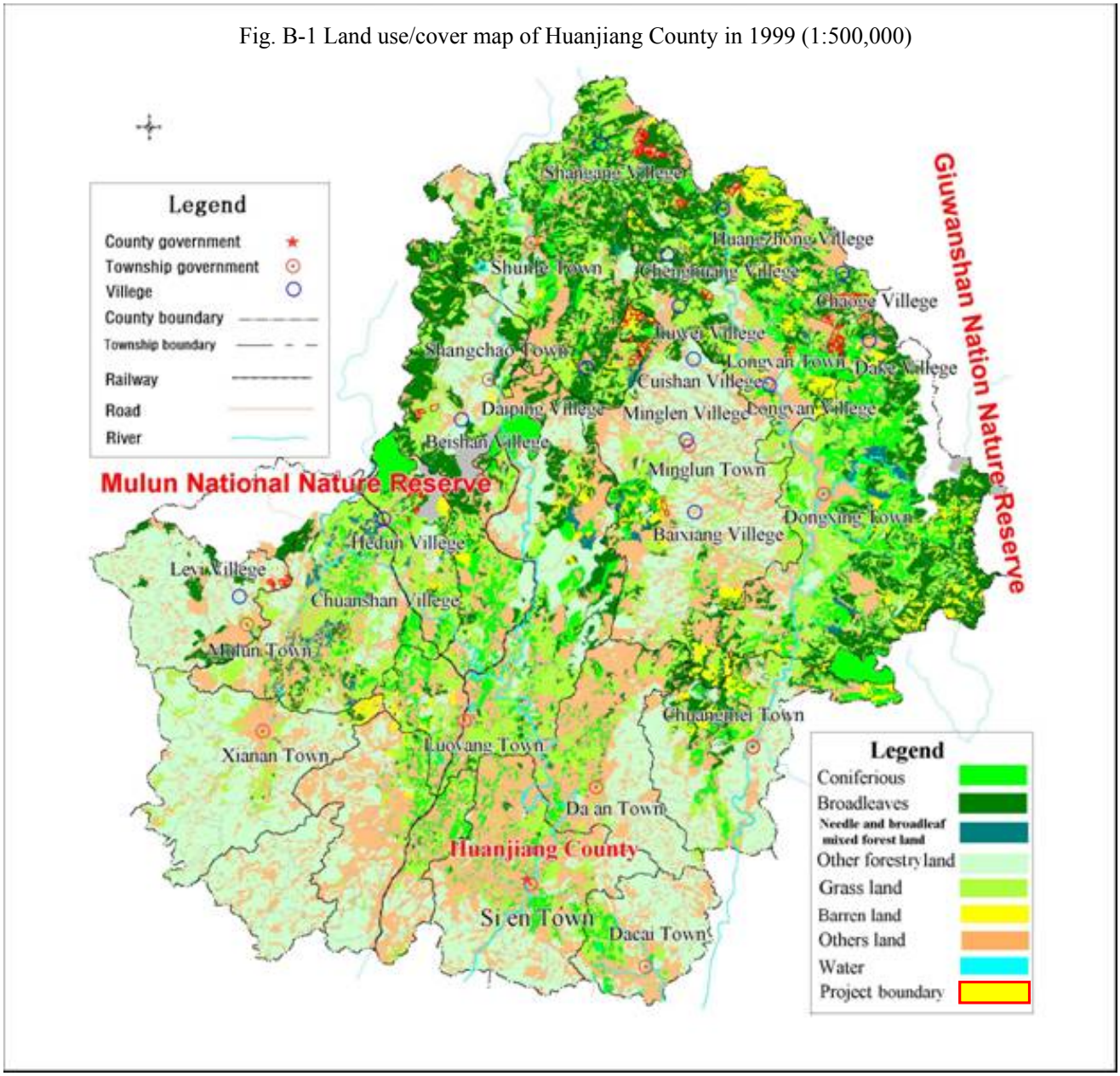


Fig.B-2 Land use/cover map of Cangwu County in 1999 (1:500,000)

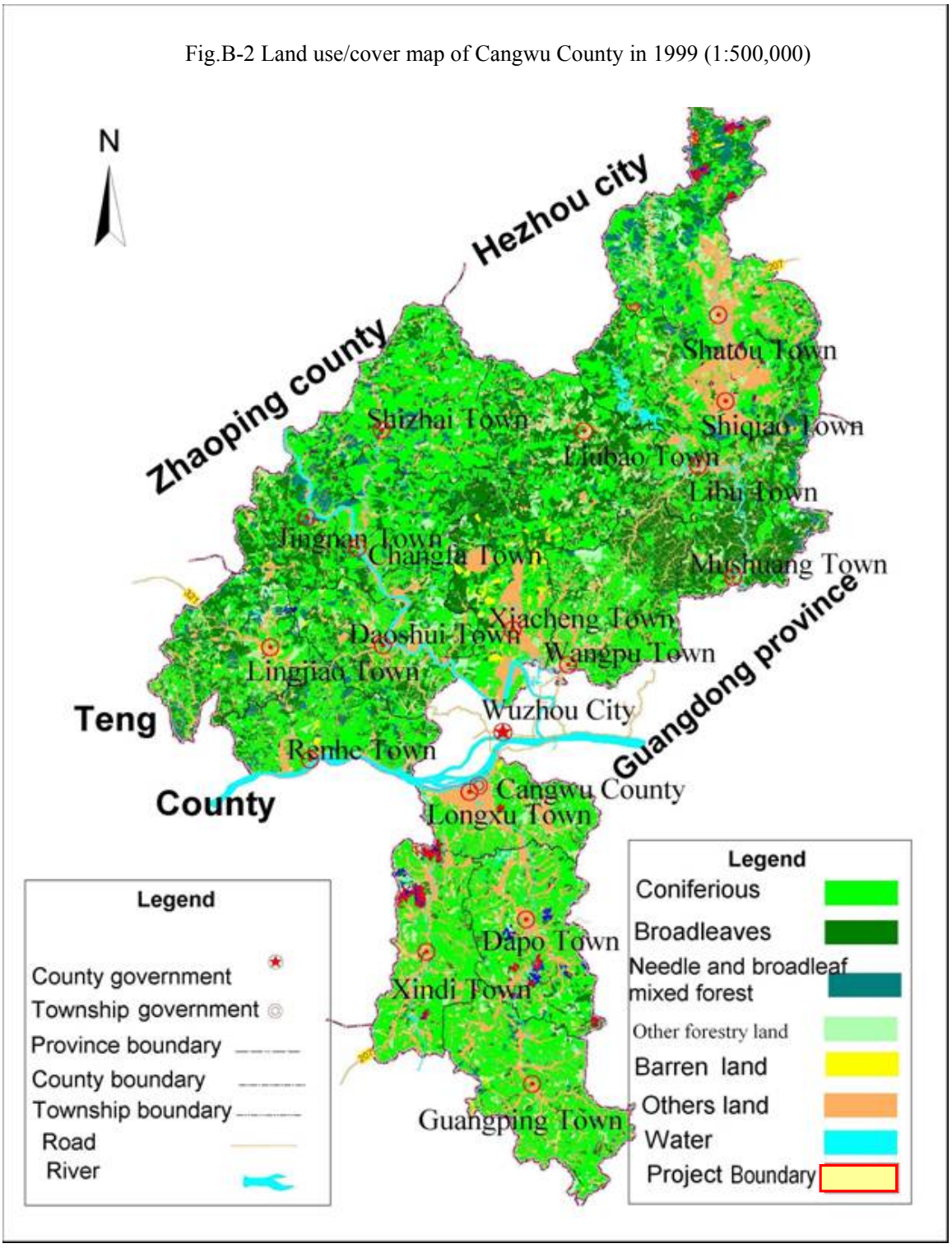


Fig.B-3 Land use/cover map of Huanjiang County in 1989 (1:500,000)

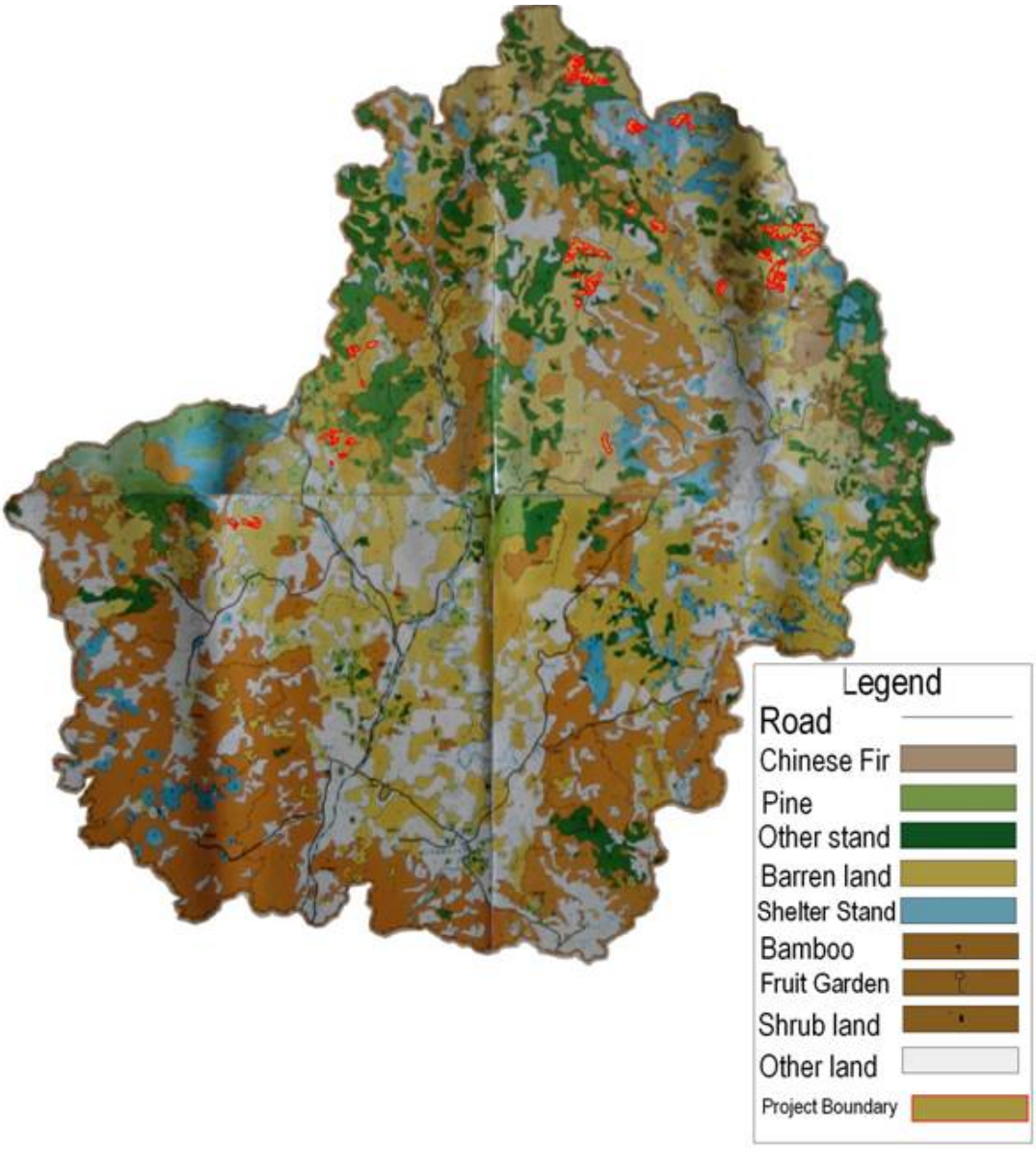
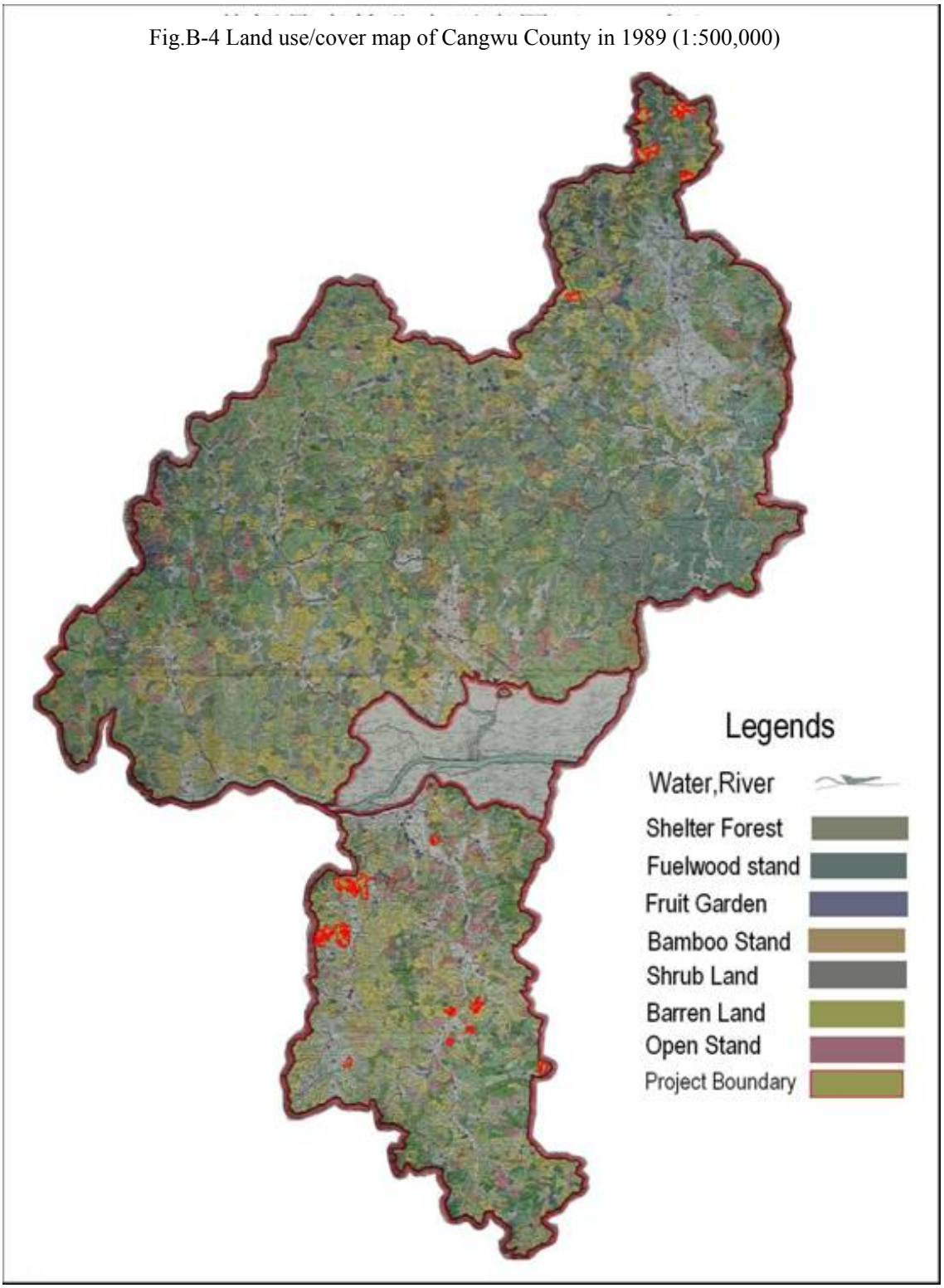


Fig.B-4 Land use/cover map of Cangwu County in 1989 (1:500,000)



- **Additionality test**

The steps as outlined in the additionality tool[9] are followed to demonstrate that the proposed A/R CDM project activity is additional and not the baseline scenario. Both investment analysis and barrier arguments (steps 2 and 3) are used.

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

The proposed A/R CDM project will start in the future on 1 April 2006, and the proof that the land is currently not forest can be found in land eligibility elaborated above.

The incentive of planned sale of GHG emission allowances is evidenced in the steps further below of the additionality test. Without the GHG allowance sales, the project would not be economically attractive, and would face significant barriers. The PIN and PDD were written before the project start, thus clearly demonstrating that the CDM was taken into account in the project planning process.

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

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

Due to deforestation and subsequent cultivation, fire, fuel wood collection and over grazing, the project areas have been steadily degrading over the last several decades. Currently the lands to be reforested in

[9] http://cdm.unfccc.int/EB/Meetings/021/eb21repan16.pdf

the project boundary are barren lands occupied by grasses and shrubs. In addition there are severe soil and water erosion, and most lands are suffering from continuous human disturbance (fire, fuel collection, etc.), please see Annex 3 for details.

As elaborated in section B.2, due to the economic unattractiveness as well as the policy restriction on land uses, barriers in finance, technique and institutional barriers and market risk, the only realistic and credible alternative available to the project participants is to continue the current degrading land use, so that it remains classified as barren land. In this scenario, natural regeneration will not occur, because dense grass cover (as in the pictures shown above) prevents seeds from landing on the mineral soil and compete with young seedling if any, which has been demonstrated by the failure of previous air-seeding. In addition there are few seed sources that can disperse onto the project sites due to the large pieces of lands without adjacent forests.

Thus, the continuation of the current situation (no project activity or other alternatives undertaken) represents the only alternative to the project activity.

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

Although the lands to be planted are restricted to forestry purposes by governments, they continue to be barren lands due to existing barriers as elaborated in Section B.2 above and Step 3 below. No laws and/or regulations stipulate that the continuation of the current situation is illegal. Therefore, the baseline scenario is entirely in compliance with applicable legal and regulatory requirements, currently and in the foreseeable future.

Sub-step 1c. Selection of the baseline scenario:

As elaborated in Section B.2 and sub-step 1a, the most plausible baseline scenario or the only alternative land use is the continuation of the degraded lands.

STEP 2: Investment analysis

Sub-step 2a. Determine appropriate analysis method

As the identified alternative (continuation of the current degraded land) does not need investments and no economic benefits will be generated, while the project scenario does produce economic benefits from timber harvest and resin production, the benchmark analysis method (Option III) is chosen. The PIN Financial Analysis spreadsheet developed by the World Bank BioCarbon Fund[10] is used to conduct the investment analysis in which FIRR with and without the carbon benefit are the relevant indicators.

Sub-step 2b – Option III: Apply benchmark analysis

The required rate of return (RRR) on equity is 12% for agricultural investment projects based on the standard issued by the State Development and Reform Commission of China[11]. This means projects can be approved by the government only when their FIRR is expected to be higher than this threshold value. This standard is usually taken as a reference for private investment and commercial forestry projects.

Sub-step 2c. Calculation and comparison of financial indicators.

The FIRR of the proposed A/R CDM project activity was calculated, both without and with carbon finance, and is 8.33% and 14.47% (at $4.00 per tonne of CO_2-e, roughly the price expected to be paid by the BIoCarbon Fund) for the 30 years of the crediting period chosen. When carbon finance was included, the FIRR exceeded the benchmark so that the proposed A/R CDM project activity is financially attractive. When carbon finance was excluded, the FIRR was significantly below the benchmark, so that the proposed A/R CDM project activity is not financially attractive in absence of the sale of carbon credits.

[10] www.biocarfund.org

[11] Related document will be provided to DOE during validation process.

Detailed calculation is summarized as following:

The planting is proposed to be conducted from 2006 to 2007. The planting area for each year and establishment and management costs (US$/ha) in the first 3 years after planting are listed in Table B-1 below. For those areas to be planted in 2007, costs for weeding and fire and disease control will occur through 2008-2009. The preparation cost (200,000 US$) is included in the establishment cost and verification and monitoring cost are included in the operating cost (20,000 US$ for each monitoring event and 20,000 US$ for each verification event).

Table B-1: Costs per step in US$/ha

	Eucalyptus sp.	*P.massoniana* + *Q.* sp.	*P.massoniana* + *S. superba*	*L. formosana* + *P.massoniana*	*L. formosana* + *C.lanceolata*
Planting in 2006 (ha)	850	100	220	490	
Planting in 2007 (ha)	150	800	380	560	450
1 Establishment	**815.89**	**447.71**	**403.71**	**429.30**	**449.70**
1.1 site preparation	160.69	139.06	132.88	122.37	139.06
1.2 seedlings	49.82	82.45	48.33	88.13	88.13
1.3 planting	27.81	40.79	37.08	33.38	37.08
1.4 fertilization (3 years)	346.10	0.00	0.00	0.00	0.00
1.5 fire and disease control (3 years)	16.68	18.54	18.54	18.54	18.54
1.6 weeding (3 years)	213.23	166.87	166.87	166.87	166.87
2 Equipment and infrastructure	**50.68**	**55.62**	**55.62**	**55.62**	**55.62**
2.1 road and protection	35.22	37.08	37.08	37.08	37.08
2.2 tools	14.84	18.54	18.54	18.54	18.54
3 Other costs (designing, training, technical demonstration and consultation, administration, supervision and monitoring, etc)	**70.64**	**58.90**	**58.90**	**58.90**	**58.97**
4 Unpredictable costs (10% of above cost)	**90.95**	**53.67**	**49.27**	**51.83**	**53.87**
5 Total	**1026.00**	**615.92**	**567.51**	**595.65**	**618.09**

The operation costs include harvesting, product (wood and resin) transportation, replanting after harvest, maintenance, administration, fire, pest and disease control, etc. from the 4th year after planting onward until the end of the crediting period. Revenues include income from selling wood, resin and carbon credits. *P. massoniana and C. lanceolata* will not be harvested during the crediting period, but *L. formosana* and *S. superba* will be harvested at age 17, eucalyptus around age 10 and oak at age 7. Upon harvesting, the oak and eucalyptus stands will regenerate naturally through re-sprouting. Resin collection on pine trees will be started at age 16 until age 20. Major parameters for operation cost are listed in Table B-2 below.

Table B-2 Parameters for estimating operating costs and revenues

Items	Eucalyptus	Q. griffithii	S. superba	L. formosana	C. lanceolata	P. massoniana	
	timber	timber	timber	Timber	timber	Timber	Resin
Standing volume at	156.37	27.22	93.25	93.25	120.93	112.38	

harvest (m^3/ha)							
Timber output ratio (%)	75	60	70	70	70	70	
Timber output at harvest (m^3/ha)	117.28	16.33	65.28	65.28	84.65	78.67	
Resin production (t/ha/yr, 16-20 year)							1.8
Labor cost for timber harvesting (US$/$m^3$)	7.42	8.03	8.65	9.27	9.89	9.27	
Labor cost for resin collection (US$/t)							197.78
Transportation (timber, US$/$m^3$)	3.71	4.33	6.18	6.80	7.42	6.80	
Transportation (resin, US$/t)							18.54
Selling price (timber, US$/$m^3$)	43.26	30.90	39.56	27.81	51.30	42.65	
Selling price (resin, US$/t)							432.63
Tax (% of gross income)	10	10	20	20	20	20	

Sup-step 2d: Sensitivity analysis

The most important factors influencing the FIRR for the proposed A/R CDM project activity are the product output, product price and operating costs. The establishment costs are only 12.4% of the total cost (2.82 versus 22.7 million US$) and will occur in the first 3 years. As a result, this cost has a smaller impact on the FIRR. Sensitivity analyses with ±10% variations of the most important factors show that the FIRR without carbon will be below RRR (12%) in the case of (Table B-3)

- 10% increase in product output or price, or
- 10% decrease in operating cost

And the FIRR with carbon revenue will still be above RRR in the case of

- 10% decrease in product output or price, or
- 10% increase in operating cost

This infers that the proposed A/R CDM project activity is still economically unattractive in absence of carbon benefit, and is still attractive with carbon revenues, if 10% changes in the key assumptions are assumed.

Table B-3 Sensitive analysis

Parameters	Variation	FIRR (%)	Sensitivity coefficient	Critical points that make IRR zero (%)
Without carbon benefit				
Product price	+10%	10.62	0.229	
	-10%	5.57	0.276	23.12
Product Output	+10%	9.67	0.134	

	-10%	6.82	0.151	41.6
Operating cost	+10%	6.50	0.183	36.3
	-10%	9.95	0.162	
		With carbon benefit		
Product price	+10%	16.74	0.227	
	-10%	11.64	0.283	31.77
Product Output	+10%	15.83	0.136	
	-10%	12.95	0.152	57.14
Operating cost	+10%	12.56	0.191	49.88
	-10%	16.16	0.169	

STEP 3: Barrier analysis

Sub-step 3a: Identify barriers that would prevent the implementation of the type of the proposed project activity:

a) Investment barriers

- Income from agricultural production is the main income source for local communities in the project area. However, due to severe soil erosion, agricultural production is subjected to flooding, drought and other disasters. Food productivity is very low and the mean annual income per capita in the project areas is only US$ 145, and even under US$ 100 in some very remote mountainous villages (see table F-1). Under this situation, many farmers still live below the national poverty level. It is hardly possible for local farmers/communities to afford the high plantation establishment investment in the early stage, because all incomes from wood and non-wood products will occur quite some time after the initial investment. On the other hand, carbon credits will provide income already after 4 years following the start of the proposed A/R project activity.
- The chances to get commercial loans from banks for the purpose of reforestation activities are very low (loans for agricultural activities are much easier to obtain) because of the long rotation, high market risk and economical unattractiveness in the context of degraded land. Only with the proposed A/R CDM project activity, the loan from local commercial banks is available, and the Chinese Government is willing to commit counterpart funding.

b) Technological barriers: Interviews with local communities indicate that local farmers/communities are usually short of access to quality seed sources and lack skills for producing high quality seedlings and for successful tree planting, as well as for preventing planted trees from being subject to fire, pest and disease attack.

c) Institutional barriers: Individual farmer households/communities are too weak to successfully manipulate the chain from investment, production to market especially for the wood and non-wood forest products which will take a much longer period than food production. In addition, the lack of organizational instruments also prevents them from overcoming technological barriers mentioned above.

d) Market risks: The availability of an income stream can be guaranteed by means of a fixed commodity price. However, there is a high market risks for wood and non-wood forest products, as these are 7 years or more after the initial investment. Currently the risks of timber market prices, especially in such remote degraded lands with low productivity and high transportation costs, are perceived to be high by the project participants, whereas the price per unit of tCER is guaranteed in the proposed A/R CDM project activity by means of a contract with the World Bank BioCarbon

Fund. This provides the certainty of future incomes (subject only to risk of failure of the reforestation per se). Although the market risks do exist for all other afforestation/reforestation projects, the higher productivity of other projects in other areas tends to reduce the risks. In addition, the project participants see the proposed A/R CDM project activity as a "testing ground" for carbon finance business, which further increases their interest to go ahead with the proposed A/R CDM project activity. Without the sale of CER, the basic financial considerations and the risk awareness cited above would drive the decision not to go ahead with the project.

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity).

The alternative land use (continued status as waste land) does not face the above-mentioned barriers.

STEP 4: Impact of CDM registration

The approval and registration of the proposed A/R CDM project activity will alleviate economic and financial hurdles, as well as the other identified barriers, and thus enable the proposed A/R CDM project activity to be undertaken and generate the following benefits:

- Removals of carbon from the atmosphere, and resulting sale of carbon credits. In absence of the project, carbon stocks in the project areas are expected to decrease or remain at lower steady status due to the continued land degradation.
- Attracting participants locally who see this as a testing ground for future carbon finance activities, and are highly motivated to participate in a "learning by doing" exercise regarding carbon monitoring, verification, certification, trading, and carbon project development in general.
- Reducing the perceived investment risks of the project activity, by providing a more steady, and guaranteed (fixed purchase price of CO_2) income stream that makes the project more independent from timber market risks and the risks associated with long transport distances from timber markets. The carbon sequestered by the growing trees creates a new 'virtual cash crop' for the participants at a guaranteed price (subject to negotiation with the funding entity upfront), which is secure and thus advantageous to add to the other products (such as wood products) which have an uncertain market price in the future. Income from CERs depends only on reaching the growth objectives, whereas income from timber and resin depends both on reaching growth objectives and on a viable market in the future, including established means of transportation. The cost of the latter is uncertain, and thus the CERs are the only income of the project that can be estimated and expected with a reasonably low market risk. Thus CERs can be seen as the means to ensure the proposed A/R CDM project activity, if timber and resin have a lower market price in the future, at least does not incur a loss. With that, the local farmers/communities are interested in it.
- As stated above, local farmers/communities usually cannot afford stand establishment and it is hard for them to get loans from banks for the purpose of reforestation activities. Only with the proposed A/R CDM project activity, farmers/communities and forestry farms will obtain loans from local commercial banks, which leads the Government to commit counterpart funding to support the plantation establishment in the degraded watersheds.
- The proposed A/R CDM project activity will entail close interaction between individuals, communities, forest farms and government to intensify the institutional capacity in linking networks for technical and productive services, and product markets; and
- The local forestry agencies as well as companies/farms will organize the training for local communities to extend the improved reforestation technologies such as seed and seedling selection, nursery management, site preparation, planting models and Integrated Pest Management both on-site and off-site.

With step 4 being satisfied, the proposed A/R CDM project activity is not the baseline scenario, and is thus additional.

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:

The detailed baseline information is attached in Annex 3.

Date of completion of Baseline study: 06/14/2005

Name of persons/entity determining the baseline

- Institute of Forest Ecology and Environment, the Chinese Academy of Forestry
  - Dr. Xiaoquan Zhang, xiaoquan@forestry.ac.cn
- Joanneum Research, Austria
  - Dr. Bernhard Schlamadinger, bernhard.schlamadinger@joanneum.at
- Guangxi Forestry Inventory and Design, P.R.China
  - Ms. Zhuping Mo, mzp1968@163.com
- World Bank reviewers
  - Ms Jin Liu, Jliu@worldbank.org

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:

The approved methodology "Reforestation of degraded land" (AR-AM0001) is applied.

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

Please see Section B.1.1.

C.3. Monitoring of the baseline net GHG removals by sinks and the actual net GHG removals by sinks:

1. Monitoring of the baseline net GHG removals by sinks

The baseline net GHG removals by sinks do not need to be monitored as per the approved methodology AR-AM0001.

2. Monitoring the boundary of the proposed A/R CDM project activity (refer to Section III.1(a) of the approved methodology AR-AM0001)

- Field survey of the boundary of areas with actual tree planting, site by site. The boundary is half the spacing distance from the last row of planted trees.
- Measuring geographical positions (latitude and longitude of each corner of polygon sites) using GPS.
- Check whether or not the actual boundary is consistent with the description in section A.
- If the actual boundary falls outside of the designed boundary in section A, additional information for the part of lands that are outside 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 communicated to the DOE and are subject to verification during the project.
- Enter the measured geographical positions into GIS system and calculate the eligible area of each stratum and sub-stratum.
- The project boundary, and the integrity of the planted area, will be monitored periodically through the crediting period. If the boundary is changed during the crediting period, for instance, because deforestation has occurred 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 then be excluded from the project monitoring. Similarly, if the planting on certain lands within the project boundary fails, and other land uses take the place, these lands will be documented and excluded from the project carbon monitoring.

3. Monitoring of the forest establishment (refer to Section III.1(b) of the approved methodology AR-AM0001)

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

- Confirm that site and soil preparation are implemented based on practice documented in section A, for instance no slash and burn and overall tillage will be used in the site and soil preparation.
- Confirm that site preparation does not cause significant longer term net emissions from soil carbon. This will be done by checking and confirming that site preparation technique described in Section A.4.8 are well implemented. In this case the surface area that has been disturbed through site preparation accounts for only 2-5% of the total surface area, which can infer that there will not be significant longer-term net emissions from soil carbon.
- Survival checking

- The initial survival rate of planted trees will be checked within one to three months after the planting, and re-planting will be conducted if the survival rate is lower than 90%.
- Final survival checking will be carried out three years after the planting.
- Survival checking will be conducted for each plantation site.

- Weeding checking: to check and confirm that the weeding practice is well-implemented.
- Surveying and checking the area of planted species and planting year for each stratum and sub-stratum.

4. Monitoring of the forest management (refer to Section III.1(c) of the approved methodology AR-AM0001)

- Harvesting: location, area, tree species of harvested sites;
- Fertilization: tree species, location, amount and type of fertilizer applied, etc., including fertilization during the first three years after planting;
- Checking and confirming that the harvested sites are re-planted immediately after harvesting if direct planting is used;
- Checking and ensuring that good conditions exist for natural regeneration if harvested lands are regenerated by natural re-sprouting.

C.3.1. Actual net GHG removals by sinks data:

1. Stratification and sampling for ex-post calculations

a) Stratification (refers to Section III.2(a) of the approved methodology)

Continuing with the step 6 in Section III.2(a) of the approved methodology, the strata built in section B.2.3 (ex-ante stratification) have been further divided into sub-strata in terms of the year to be planted. The stratification map will be created on a GIS platform. However, post stratification will be conducted after the first monitoring event to address the possible changes of project boundary and planting timing in comparison with the project design, and to respond any differences in growth conditions compared to what was expected. The following factors will be considered in the post-stratification:

- Data from monitoring of forest establishment: actual project boundary and planting year;
- Data from monitoring of forest management, e.g., fertilization;
- Variation in carbon stock change for each stratum and sub-stratum after the first monitoring event. Strata or sub-strata will be grouped into one stratum or substratum if they have similar carbon stock, carbon stock change and spatial variation.

b) Sampling (refers to Section III.2(b) of the approved methodology AR-AM0001)

Permanent sampling plots are used for sampling over time to measure and monitor changes in carbon stocks of the relevant carbon pools. The plots will be located with GPS and are invisible so as to be treated in the same way as other lands within the project boundary, e.g., during site and soil preparation,

weeding, fertilization, harvesting, etc., and will be prevented from being deforested over the crediting period.

- **Determining sample size**

As per the approved methodology, in the proposed A/R CDM project activity, the total sum of samples (n) are estimated as per a criterion of Neyman of fixed levels of accuracy, according to Wenger (1984)[12]:

$$n = \left(\frac{t}{E}\right)^2 \left[\sum_{h=1}^{L} W_h \cdot s_h \cdot \sqrt{C_h}\right] \cdot \left[\sum_{h=1}^{L} W_h \cdot s_h \Big/ \sqrt{C_h} \cdot\right] \quad (1)$$

$$n_h = n \cdot \frac{W_h \cdot s_h \Big/ \sqrt{C_h}}{\sum_{h=1}^{L} W_h \cdot s_h \Big/ \sqrt{C_h}} \quad (2)$$

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 $W_h \cdot s_h \Big/ \sqrt{C_h}$.
$W_h = N_h/N$
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 standard deviation of each stratum (s_h) is determined through soil sampling during stratification process (see Annex 3 and Section B.2) as soil conditions are major determinants of tree growth within each stratum. The t value for 95% confidence is approximately equal to 2 when the number of sample plot is over 30. The allowable error is a value on a per-plot basis and is estimated as ±5% of the expected mean biomass carbon stock per plot in living trees at the end of a rotation, which can be estimated as part of the ex-ante estimation of the actual net GHG removals by sinks described in the baseline methodology (see annex 4 for details).
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.

[12] Wenger, K.F. (ed). 1984. Forestry handbook (2nd edition). New York: John Wiley and Sons.

- **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. 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 plot will be recorded and archived. The size of plots is 400 m^2 (20m X 20m). It is to be ensured that the sampling plots evenly spread as possible.

c) Monitoring frequency

The planting activity will be conducted from 2006 to 2007. *P. massoniana and C. lanceolata* will not be harvested during the crediting period, but *L. formosana* and *S. superba* will be harvested around age 17, eucalyptus around age 10 and oak around age 7. To avoid the coincidence with peaks in carbon stocks, the first monitoring will be conducted in the year 2009 with subsequent monitoring in 2012, 2017, 2022, 2027,2032 and 2037 respectively (see Annex 4).

2. Measuring and estimating carbon stock changes over time

The growth of individual trees on plots shall be measured at each time interval of monitoring. The carbon stock changes in above- and below-ground biomass of non-tree vegetation will not be monitored in the proposed A/R CDM project activity. Should there by any such vegetation at the project start, this will be deducted as an emission. The carbon stock changes in above- and below-ground biomass of living trees on each plot are estimated through Biomass Expansion Factors (BEF) method (see section C.3.1.3.1 below).

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

The proposed A/R CDM project activity will result in increase in emissions of nitrous oxide due to nitrogen fertilizer application to eucalyptus plantation. Changes in GHG emissions caused by the nitrogen inputs can be estimated by monitoring activity data and selecting appropriate emission factors (see section C.3.1.3.2 below).

C.3.1.1. 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
3.1.1.01	*Stratum ID*	*Stratification map*	*Alpha numeric*		*Before the start of the project*	*100%*	*Electronic and paper*	*Each stratum has a particular combination of soil type, climate, existing vegetation and landform*

3.1.1.02	*Sub-stratum ID*	*Stratification map*	*Alpha numeric*		*Before the start of the project*	*100%*	*Electronic and paper*	*Each sub-stratum has a particular year to be planted under each stratum*
3.1.1.03	*Confidence level*		*%*		*Before the start of the project*	*100%*	*Electronic and paper*	*95% for the purpose of QA/QC and measuring and monitoring precision control*
3.1.1.04	*Precision level*		*%*		*Before the start of the project*	*100%*	*Electronic and paper*	*5% for the purpose of QA/QC and measuring and monitoring precision control*
3.1.1.05	*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*
3.1.1.06	*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*
3.1.1.07	*Tree species*	*Project design map*			*5 years*	*100%*	*Electronic and paper*	*Arranged in PDD*
3.1.1.08	*Age of plantation*	*Plot measurement*	*year*	*M*	*5 years*	*100% sampling plot*	*Electronic and paper*	*Counted since the planted year*
3.1.1.09	*Number of trees*	*Plot measurement*	*number*	*M*	*5 years*	*100% trees in plots*	*Electronic and paper*	*Counted in plot measurement*
3.1.1.10	*Diameter at breast height (DBH)*	*Plot measurement*	*cm*	*M*	*5 year*	*100% trees in plots*	*Electronic and paper*	*Measuring at each monitoring time per sampling method*
3.1.1.11	*Mean DBH*	*Calculated*	*cm*	*C*	*5 year*	*100% of sampling plots*	*Electronic and paper*	*Calculated via 3.1.1.09 and 3.1.1.10*
3.1.1.12	*Tree height*	*Plot measurement*	*m*	*M*	*5 year*	*100% trees in plots*	*Electronic and paper*	*Measuring at each monitoring time per sampling method*
3.1.1.13	*Mean tree height*	*Calculated*	*m*	*C*	*5 year*	*100% of sampling plots*	*Electronic and paper*	*Calculated via 3.1.1.9 and 3.1.1.12*
3.1.1.14	*standing*	*Calculated*	*$M^3 \cdot ha^{-1}$*	*c/m*	*5 year*	*100% of*	*Electronic*	*Calculated using equation (9)-(12) via*

	volume	*using equation (9)-(12)*				*sampling plots*	*and paper*	*3.1.1.11 and 3.1.1.13*
3.1.1.15	*Wood density*	*national inventory for LULUCF or direct measuring*	*t d.m. m^{-3}*	*E*	*Before the first monitoring event*	*100% of species*	*Electronic and paper*	*Species specific*
3.1.1.16	*Biomass expansion factor (BEF)*	*national inventory for LULUCF or direct measuring*	*dimensionless*	*E*	*Before the first monitoring event*	*100% of species*	*Electronic and paper*	*Species specific*
3.1.1.17	*Carbon fraction*	*IPCC or direct measuring*	*t C.(t d.m)$^{-1}$*	*E*	*Before the first monitoring event*	*100% of species*	*Electronic and paper*	*IPCC default value or direct measuring*
3.1.1.18	*Root-shoot ratio*	*national inventory for LULUCF or direct measuring*	*Dimensionless*	*E*	*Before the first monitoring event*	*100% of species*	*Electronic and paper*	*Species specific*
3.1.1.19	*Carbon stock in aboveground biomass of plots*	*Calculated from equation*	*t C ha^{-1}*	*C*	*5 year*	*100% of sampling plots*	*Electronic and paper*	*Calculated using equation (13) via 3.1.1.14-3.1.1.17*
3.1.1.20	*Carbon stock in belowground biomass of plots*	*Calculated from equation*	*t C ha^{-1}*	*C*	*5 year*	*100% of sampling plots*	*Electronic and paper*	*Calculated using equation (14) via 3.1.1.18-3.1.1.19*
3.1.1.21	*Mean Carbon stock in aboveground biomass per unit area per stratum per*	*Calculated from plot data*	*t C ha^{-1}*	*c*	*5 year*	*100% of strata and sub-strata*	*Electronic and paper*	*Calculated from 3.1.1.09-3.1.1.19*

	species							
3.1.1.22	*Mean Carbon stock in belowground biomass per unit area per stratum per species*	*Calculated from plot data*	*t C ha^{-1}*	*C*	*5 year*	*100% of strata and sub-strata*	*Electronic and paper*	*Calculated from 3.1.1.09 and 3.1.1.20*
3.1.1.23	*Area of stratum and sub-stratum*	*Stratification map and data*	*ha*	*M*	*5 year*	*100% of strata and sub-strata*	*Electronic and paper*	*Actual area of each stratum and sub-stratum*
3.1.1.24	*Carbon stock in aboveground biomass of stratum per species*	*Calculated using equation (7)*	*t C*	*C*	*5 year*	*100% of strata and sub-strata*	*Electronic and paper*	*Calculated using equation (7) via 3.1.1.21 and 3.1.1.23*
3.1.1.25	*Carbon stock in belowground biomass of r stratum per species*	*Calculated using equation (8)*	*t C*	*C*	*5 year*	*100% of strata and sub-strata*	*Electronic and paper*	*Calculated using equation (8) 3.1.1.22 and 3.1.1.23*
3.1.1.26	*Carbon stock change in aboveground biomass of stratum per species*	*Calculated using equation (5)*	*t C yr^{-1}*	*C*	*5 year*	*100% of strata and sub-strata*	*Electronic and paper*	*Calculated using equation (5) via 3.1.1.24*
3.1.1.27	*Carbon stock change in belowground biomass of stratum per species*	*Calculated using equation (6)*	*t C yr^{-1}*	*C*	*5 year*	*100% of strata and sub-strata*	*Electronic and paper*	*Calculated using equation (6) 3.1.1.25*
3.1.1.30	*Total carbon stock change*	*Calculated using equation (4)*	*t CO_2-e yr^{-1}*	*C*	*5 year*	*100% project area*	*Electronic and paper*	*Summing up carbon stock change in 3.1.1.26 and 3.1.1.27 for all strata, sub-strata and tree species*

C.3.1.2. 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
3.1.2.01	*Amount of synthetic fertilizer N applied per unit area*	*Monitoring activity*	*kg N ha-1 yr-1*	*m*	*annually*	*100%*	*Electronic and paper*	*For different tree species and/or management intensity*
3.1.2.02	*Amount of organic fertilizer N applied per unit area*	*Monitoring activity*	*kg N ha-1 yr-1*	*m*	*annually*	*100%*	*Electronic and paper*	*For different tree species and/or management intensity*
3.1.2.03	*area of land with N applied*	*Monitoring activity*	*Ha yr-1*	*m*	*annually*	*100%*	*Electronic and paper*	*For different tree species and/or management intensity*
3.1.2.04	*Amount of synthetic 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 3.1.2.03*
3.1.2.05	*Amount of organic*	*Calculated using equation*	*t N yr-1*	*c*	*annually*	*100%*	*Electronic and paper*	*Calculated using equation (18) via 3.1.2.02 and 3.1.2.03*

	fertilizer N applied	*(18)*						
3.1.2.06	*Fraction that volatilises as NH3 and NOx for synthetic fertilizers*	*GPG 2000, IPCC Guideline*	*dimensionless*	*e*	*Before start of monitoring*	*100%*	*Electronic and paper*	*IPCC default value (0.1) is used*
3.1.2.07	*Fraction that volatilises as NH3 and NOx for organic fertilizers*	*GPG 2000, IPCC Guidelines*	*dimensionless*	*e*	*Before start of monitoring*	*100%*	*Electronic and paper*	*IPCC default value (0.2) is used*
3.1.2.08	*Emission factor for emission from N input*	*GPG 2000, IPCC Guidelines*	*N2O-N (tonnes N input)-1*	*e*	*Before start of monitoring*	*100%*	*Electronic and paper*	*IPCC default value (1.25%) is used*
3.1.2.09	*Direct N2O emission of N input*	*Calculated using equation (19)*	*t CO2-e yr-1*	*c*	*annually*	*100%*	*Electronic and paper*	*Calculated using equation (19) via 3.1.2.04-3.1.2.08*

C.3.1.3. Description of formulae and/or models used to monitor the estimation of the actual net GHG removals by sinks:

The Actual net greenhouse gas removals by sinks represent the sum of the verifiable changes in carbon stocks in the carbon pools within the project boundary, minus the increase in GHG emissions measured in CO_2 equivalents by the sources that are increased as a result of the implementation of an A/R CDM project activity, while avoiding double accounting, within the project boundary, attributable to the A/R CDM project activity. Therefore,

$$C_{ACTUAL,t} = \sum_i \sum_j \sum_k \Delta C_{ijk,t} - GHG_{E,t} \quad (3)$$

Where:

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

C.3.1.3.1. 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):

Since carbon stock changes in pools of soil organic matter, litter and dead wood are ignored as per the approved methodology AR-AM0001, the verifiable changes in carbon stock equal to the carbon stock changes in above- and below-ground biomass within the project boundary, estimated using equation [13]

$$\Delta C_{ijk,t} = (\Delta C_{AB,ijk,t} + \Delta C_{BB,ijk,t}) \cdot 44/12 \quad (4)$$

$$\Delta C_{AB,ijk,t} = (C_{AB,m_2,ijk} - C_{AB,m_1,ijk})/T \quad (5)$$

$$\Delta C_{BB,ijk} = (C_{BB,m_2,ijk} - C_{BB,m_1,ijk})/T \quad (6)$$

Where

$\Delta C_{ijk,t}$ = verifiable changes in carbon stock in above- and below-ground biomass for stratum i sub-stratum j species k in year t, tonnes CO_2 yr^{-1}
$\Delta C_{AB,ijk,t}$ = changes in carbon stock in aboveground biomass for stratum i sub-stratum j species k in year t, tonnes C yr^{-1}
$\Delta C_{BB,ijk,t}$ = changes in carbon stock in belowground biomass for stratum i sub-stratum j species k in year t, tonnes C yr^{-1}
$C_{AB,m2,ijk}$ = carbon stock in aboveground biomass for stratum i sub-stratum j species k, calculated at time m_2, tonnes C
$C_{AB,\ m1,ijk}$ = carbon stock in aboveground biomass for stratum i sub-stratum j species k, calculated at time m_1, tonnes C
$C_{BB,m2,ijk}$ = carbon stock in belowground biomass for stratum i sub-stratum j species k, calculated at time m_2, tonnes C
$C_{BB,\ m1,ijk}$ = carbon stock in belowground biomass for stratum i sub-stratum j species k, calculated at time m_1, tonnes C
44/12 = ration of molecular weights of carbon and CO_2, dimensionless
T = number of years between monitoring time m_2 and m_1, $T = m_2 - m_1$, years. It is 3 or 5 years in the proposed A/R CDM project activity

[13] Refers to GPG-LULUCF Equation 3.2.3

The total carbon stock in above- and below-ground biomass for each stratum and sub-stratum in each monitoring time (m) is calculated from the area of each stratum and sub-stratum and mean carbon stock in above- and below-ground biomass per unit area, given by:

$$C_{AB,m,ijk} = A_{ijk} \cdot MC_{AB,m,ijk} \quad (7)$$

$$C_{BB,m,ijk} = A_{ijk} \cdot MC_{BB,m,ijk} \quad (8)$$

Where

A_{ijk} = area of stratum i sub-stratum j species k, hectare (ha)
$MC_{AB,m,ijk}$ = mean carbon stock in aboveground biomass per unit area for stratum i sub-stratum j species k at monitor time m, tonnes C ha^{-1}
$MC_{BB,m,ijk}$ = mean carbon stock in belowground biomass per unit area for stratum i sub-stratum j species k at monitor time m, tonnes C ha^{-1}

The mean carbon stock in above- and below-ground biomass per unit area is estimated based on field measurements on permanent plots using the Biomass Expansion Factors (BEF) method, with specific steps as follows:

Step 1: Measuring the diameter at breast height (DBH, at 1.3 m above ground) and preferably height of all the trees in the permanent sample plots above a minimum DBH (2 cm).

Step 2: Estimating the standing volume of trees based on following locally derived equations[14,15].

Pinus massoniana: $$V = 0.0000714265437 \cdot DBH^{1.867010} \cdot H^{0.9014932} \quad (9)$$

Cunninghamia lanceolata: $$V = 0.000065671 \cdot DBH^{1.769412} \cdot H^{1.069769} \quad (10)$$

Eucalyptus sp.: $$V = 0.000109154145 \cdot DBH^{(C_1 - C_2 \cdot (DBH+H))} \cdot H^{(C_3 + C_4 \cdot (DBH+H))} \quad (11)$$

Other tree species: $$V = 0.0000667054 \cdot DBH^{1.8479545} \cdot H^{0.96657509} \quad (12)$$

Where

DBH = diameter at breast height, centimetre (cm)
H = tree height, meter (m)
$c_1 = 1.87892370$
$c_2 = 5.69185503 \times 10^{-3}$
$c_3 = 0.65259805$

[14] Forestry Inventory Manule. 1986. Guangxi Institute of Forestry Inventory and Design

[15] Yield Table of Eucalyptus. 1995. Guangxi Institute of Forestry Inventory and Design

$c_4 = 7.84753507 \times 10^{-3}$

Step 3: Choosing BEF, wood density, root-shoot ratio and other parameters: Parameters from China's Initial National Communication for Land Use Change and Forestry Sector are used in the estimation (Table C-1). These parameters are estimated from published data. However, the average value of BEF may result in significant errors because BEF usually decreases with the increase of plantation age. Therefore database will be analyzed to derive age-dependent equations for BEF. IPCC default value (0.5) for the carbon fraction is used. All these parameters will be verified by direct measuring of existing plantation with similar site conditions. If the biomass estimated from the harvested trees is within about ±10% of that predicted by the equation, then it can be assumed that the selected parameters are suitable for the project. If this is not the case, it is recommended to develop local allometric equations or parameters for the project use. For this, a sample of trees, representing different size classes, is destructively harvested, and its total biomass is determined. The number of trees to be destructively harvested and measured depends on the range of size classes and number of species—the greater the heterogeneity the more trees are required.

Table C-1 Wood density, BEF and Root-shoot ratio for species used in the proposed A/R CDM project activity

Tree species	Wood Density (tonnes d.m.m^{-3} standing volume)	BEF	Root-shoot ratio
Pinus massoniana	0.380 (43, 0.019)	1.46 (103, 0.47)	0.283 (77, 0.043)
Cunninghamia lanceolata	0.307 (54, 0.009)	1.53 (237, 0.27)	0.255 (237, 0.040)
Eucalyptus sp.	0.578 (104, 0.019)	1.48 (82, 0.38)	0.201 (37, 0.065)
Quercus sp.	0.676 (82, 0.012)	1.54 (73, 0.46)	0.340 (65, 0.082)
Schima superba	0.598 (482, 0.012)	1.79 (120, 0.36)	0.217 (94, 0.075)
Liquidambar formosana	0.443 (189, 0.013)	1.54 (21, 0.36)	0.283 (14, 0.088)

Note: data in parentheses represent number of samples and standard deviation respectively

Step 4: Converting the standing volume of trees into carbon stock in above- and below-ground biomass via basic wood density, BEF root-shoot ratio and carbon fraction, given by equations 9 and 10 of the approved methodology AR-AM0001 [16]:

$$MC_{AB} = V \cdot D \cdot BEF \cdot CF \quad (13)$$

$$MC_{BB} = MC_{AB} \cdot R \quad (14)$$

[16] Refers to GPG LULUCF Equation 4.3.1

where:

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

C.3.1.3.2. 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):

The following emission sources will occur as a result of the proposed A/R CDM project activity:

- Decrease in carbon stock in living biomass of existing non-tree vegetation, caused either by competition of planted trees or site preparation including slash and burn;
- N_2O emissions caused by nitrogen fertilization application.

The GHG emission as a result of the implementation of the proposed A/R CDM project activity within the project boundary is estimated as follows (equation 13 in AR-AM0001):

$$GHG_{E,t} = E_{biomassloss,t} + N_2O_{direct-N_{fertilizer},t} \quad (15)$$

Where

$GHG_{E,t}$ = the GHG emissions as a result of the implementation of the A/R CDM project activity within the project boundary in year t, tonnes CO_2-e yr^{-1}
$E_{biomassloss,t}$ = the CO2 emissions as a result of a decrease in carbon stock in living biomass of existing non-tree vegetation in year t, tonnes CO_2-e. This is an initial loss, and therefore accounted once upfront as part of the first monitoring interval, not per year.

$N_2O_{direct-N_{fertilizer},t}$ = N_2O emissions as a result of direct nitrogen application within the project boundary in year t, tonnes CO_2-e yr^{-1}

A) Calculation of the decrease in carbon stock in living biomass of existing non-tree vegetation

It is assumed that all existing non-tree vegetation will disappear due to site preparation or competition from planted trees. This is a conservative assumption because there will be some non-tree vegetation in the project scenario.

Step 1: Measuring and estimating the above- and below-ground biomass of existing non-tree vegetation. This task shall be conducted before the start of project activity. The herbaceous plants can be measured by simple harvesting techniques. A small frame (either circular or square), usually encompassing about 0.5-1.0 m2 or less, is used to aid this task. The material inside the frame is cut to ground level and weighed, and the underground part is also dug and weighed. Well-mixed samples are then collected and oven dried to determine dry-to-wet matter ratios. These ratios are then used to convert the entire sample to oven-dry matter. For shrubs, destructive harvesting techniques can also be used to measure the living biomass. An alternative approach, if the shrubs are large, is to develop local shrub allometric equations based on variables such as crown area and height or diameter at base of plant or some other relevant variable (e.g., number of stems in multi-stemmed shrubs). The equations would then be based on regressions of biomass of the shrub versus some logical combination of the independent variables. The independent variable or variables would then be measured in the sampling plots (Refers to Chapter 4.3 in GPG LULUCF).

Step 2: Estimating decrease in carbon stock of existing non-tree vegetation (equation 15 in AR-AM0001)

$$E_{biomassloss,t} = \sum_i A_i \cdot B_{non-tree,i} \cdot CF_{non-tree} \cdot 44/12 \qquad \forall_t = 1 \qquad (16)$$

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

Where

A_i = area of stratum i, ha

$B_{non\text{-}tree,i}$ = 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}

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

44/12 = ration of molecular weights of CO2 and carbon, dimensionless

B) Nitrous oxide emissions from nitrogen fertilization practices

The proposed A/R CDM project activity will result in increase in emissions of nitrous oxide due to nitrogen fertilization practices to eucalyptus plantation. Only direct N_2O emissions from nitrogen fertilization are monitored and estimated as per the approved methodology AR-AM0001, because indirect N_2O emissions (e.g., leaching and runoff) are smaller in forest than in agricultural land and the emission factor used in the 1996 IPCC Guidelines appears to be high (GPG LULUCF). The method of 1996 IPCC Guideline, GPG-2000 and GPG LULUCF can be used to estimate the direct N_2O emissions.

Step 1: Monitoring and estimating the amount of synthetic and organic fertilizer nitrogen used within the project boundary during monitoring interval (equations 20 and 21 in AR-AM0001):

$$N_{SN-Fert,t} = \sum_k A_k \cdot N_{SN-Fert,k,t} \cdot 0.001 \qquad (17)$$

$$N_{ON-Fert,t} = \sum_k A_k \cdot N_{ON-Fert,k,t} \cdot 0.001 \quad (18)$$

Where

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

Step 2: Calculating direct N_2O emissions from nitrogen fertilization (equations 22, 23 and 24 in AR-AM0001):[17]

$$N_2O_{direct-N_{fertilizer},t} = \lfloor (F_{SN,t} + F_{ON,t}) \cdot EF_1 \rfloor \cdot 44/28 \cdot 310 \quad (19)$$

$$F_{SN,t} = N_{SN-Fert,t} \cdot (1 - Frac_{GASF}) \quad (20)$$

$$F_{ON,t} = N_{ON-Fert,t} \cdot (1 - Frac_{GASM}) \quad (21)$$

Where:

$N_2O_{direct-N_{fertilizer},t}$ = the direct N_2O emission as a result of nitrogen application within the project boundary during monitoring interval, tonnes CO_2-e yr^{-1} in year t
$F_{SN,t}$ = Amount of synthetic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NOx in year t, tonnes N yr^{-1}
$F_{ON,t}$ = Annual amount of organic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NOx in year t, tonnes N yr^{-1}
$N_{SN\text{-}Fert,t}$ = Amount of synthetic fertilizer nitrogen applied in year t, tonnes N yr^{-1}
$N_{SN\text{-}Fert,t}$ = Amount of organic fertilizer nitrogen applied in year t, tonnes N yr^{-1}
EF_1 = 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 = 0.1;
$Frac_{GASF}$ = the fraction that volatilises as NH3 and NOx for organic 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

The default values of GPG 2000 and 1996 IPCC Guideline are used for relevant parameters[18].

[17] Refers to Equation 3.2.18 in IPCC GPG-LULUCF, Equation 4.22 and Equation 4.23 in GPG-2000

C.3.2. As appropriate, relevant data necessary for determining the baseline net GHG removals by sinks and how such data will be collected and 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**

C.3.2.1. Description of formulae and/or models used to monitor the estimation of the baseline net GHG removals by sinks (for each carbon pool, in units of CO_2 equivalent):

Monitoring of the baseline net GHG removals by sinks is not needed, see section B and approved methodology applied.

C.4. Treatment of leakage in the monitoring plan:

As elaborated in Section B.2 paragraph 8, fossil fuel combustion from vehicles using for transporting seedling, labours, fertilizer, harvest products, etc., to and/or from project sites, as a result of the proposed A/R CDM project activity, will emit greenhouse gases. This can be monitored and estimated using IPCC bottom-up approach.

[18] Refers to table 4-17 and table 4-18 in 1996 IPCC Guideline

C.4.1. 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
4.1.01	*Number of each vehicle type used*	*Monitoring of project activity*	*number*		*annually*	*100%*	*Electronic and paper*	*Monitoring number of each vehicle type used*
4.1.02	*Emission factors for road transportation*	*GPG 2000, IPCC Guidelines, national inventory*	*kg CO2-e l-1*	*e*	*annually*	*100%*	*Electronic and paper*	*Value from National GHG inbentory*
4.1.03	*Kilometres travelled by vehicles*	*Monitoring of project activity*	*km*	*m*	*annually*	*100%*	*Electronic and paper*	*Monitoring kilometres for each vehicle type and fuel type used*
4.1.04	*Fuel consumption per km*	*Local data, national data, IPCC*	*Litre km-1*	*e*	*5 years*	*100%*	*Electronic and paper*	*Value from National GHG inbentory*
4.1.05	*Fuel consumption for road transportation*	*Calculated using equation (23)*	*litre*	*c*	*annually*	*100%*	*Electronic and paper*	*Calculated using equation (23) via 4.1.07, 4.1.03, 4.1.04*
4.1.06	*Leakage due to vehicle use for transportation*	*Calculated using equation (22)*	*t CO2-e yr-1*	*c*	*annually*	*100%*	*Electronic and paper*	*Calculated using equation (22) via 4.1.02, 4.1.07*

C.4.2. Description of formulae and/or models used to estimate leakage (for each GHG, source, carbon pool, in units of CO_2 equivalent:

As per the approved methodology AR-AM0001, leakage due to fossil fuel combustion from vehicles will be estimated using the following steps and formula

Step 1: Collecting the transportation distance of different types of vehicles using different fuel types. The commonly used vehicle in the project area is mid-size vehicle burning diesel.

Step 2: Determining emission factors for different types of vehicles using different fuel types. National default values from national GHG inventory will be used, e.g., 2.6353kg CO_2 per litre of diesel for mid size vehicles that commonly used by local farmers. The diesel consumption is 12 litre per 100 km.

Step 3: Estimating the GHG emissions using bottom-up approach described in GPG 2000 for energy sector (equations 25 and 26 in AR-AM0001)[19].

$$LK_t = \sum_i \sum_j (EF_{ij} \cdot FuelConsumption_{ij,t}) \cdot 0.001 \quad (22)$$

$$FuelConsumption_{ij,t} = n_{ij,t} \cdot k_{ij,t} \cdot e_{ij,t} \quad (23)$$

Where

LK_t = total GHG emissions due to fossil fuel combustion from vehicles, tonnes CO_2-e yr^{-1} in year t
i = vehicle type
j = fuel type
EF_{ij} = emission factor for vehicle type i with fuel type j, kg CO_2-e l^{-1}, 2.6353 kg CO2 l^{-1}
$FuelConsumption_{ij,t}$ = consumption of fuel type j of vehicle type i, litre yr^{-1} in year t
$n_{ij,t}$ = number of vehicle type i used in year t, yr^{-1}
$k_{ij,t}$ = kilometres travelled by each of vehicle type i with fuel type j, km in year t
$e_{ij,t}$ = average litres consumed per kilometre travelled for vehicle type i with fuel type j, litre km^{-1} in year t

C.4.3. Please specify the procedures for the periodic review of implementation of activities and measures to minimize leakage:

Leakage associated with the proposed A/R CDM project activity, in terms of the use of vehicles for the transportation of staff and products outside the project area, is not significant. This leakage will be monitored regularly and accounted using steps described in section C.4.2.

C.5. Description of formulae and/or models used to estimate 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):

[19] Refer to Equation 2.5 and Equation 2.6 in IPCC GPG 2000 for energy sector

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. Therefore, following general formula (equation 27 in AR-AM0001). can be used to calculate the net anthropogenic GHG removals by sinks of an A/R CDM project activity ($C_{AR\text{-}CDM}$), in tonnes CO_2-e yr^{-1}:

$$C_{AR-CDM,t} = C_{ACTUAL,t} - C_{BSL,t} - LK_t \quad (24)$$

Where

$C_{ACTUAL,t}$ = actual net GHG removals by sinks, tonnes CO_2-e yr^{-1} in year t
$C_{BSL,t}$ = baseline net GHG removals by sinks, tonnes CO_2-e yr^{-1} in year t
LK,t = leakage, tonnes CO_2-e yr^{-1} in year t

The tCERs will be calculated using equation (29) in the approved methodology AR-AM0001.

C.6. 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.**
3.1.1.06 Plot location	*low*	*Random plot verification using GPS to ensure the consistent measuring and monitoring of the carbon stock change over time*
3.1.1.07 Tree species	*low*	*Random Verification over the project area to ensure the area of each tree species is correctly measured*
3.1.1.08 Age of plantation	*low*	*Random Verification over the project area to ensure the area in terms of plantation age is correctly measured*
3.1.1.09 Number of trees	*low*	*Random plot verification*
3.1.1.10 Diameter at breast height (DBH)	*low*	*Random plot verification*
3.1.1.12 Tree height	*low*	*Random plot verification*
3.1.1.14 standing volume	*low*	*All equations used to calculate this data shall be verified*
3.1.1.15 Wood density	*low*	*Data that divert significantly from IPCC default value shall be verified*
3.1.1.16 Biomass expansion factor (BEF)	*low*	*Data that divert significantly from IPCC default value shall be verified*
3.1.1.17 Carbon fraction	*low*	*Data that divert significantly from IPCC default value shall be verified*
3.1.1.18 Root-shoot ratio	*low*	*Data that divert significantly from IPCC default value shall be verified*
3.1.2.09 Direct N2O emission of N input	*low*	*Data that divert significantly from IPCC default value shall be verified*
4.1.01 Number of each vehicle type used	*low*	*Project record shall be available and verified*
4.1.02 Emission factors for road transportation	*low*	*Data that divert significantly from IPCC default value shall be verified*
4.1.03 Kilometres travelled by vehicles	*low*	*Project record shall be available and verified*

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

The proposed A/R CDM project activity will be implemented within the confines of the larger umbrella of the Guangxi Integrated Forestry Development and Conservation Project (GIFDCP), a World Bank loan project. Under the authorization of the project participants, the provincial and county Project Management Offices (PMOs) that have been established for the GIFDCP will be responsible for coordinating the project participants, providing technical

services, including arranging training to the planting entities and farmers/communities involved, supervising the implementation of the proposed A/R CDM project activity, as well as organizing a technical support panel (TSP) to carry out the monitoring of the project implementation performance and impacts, as well as measuring and monitoring of the actual GHG removals by sinks and any leakage generated by the proposed A/R CDM project activity. The relevant information and data will be documented and archived in the PMOs and project entities in both electronic and paper copy.

Cangwu County and Huanjiang County PMOs, under the coordination of the provincial PMO, will provide technical instructions on reforestation and forest management including field work, and conduct the intensive supervision for the implementation of the proposed A/R CDM project activity, and collect specific activity data on a routine basis.

The Guangxi Forestry Inventory and Planning Institute, under the coordination of the provincial PMO, will be responsible for measuring and monitoring of the actual GHG removals by sinks and any leakage generated by the proposed A/R CDM project activity.

The Chinese Academy of Forestry will provide technical consultation and training in the measuring and monitoring of the actual GHG removals by sinks and leakage generated by the proposed A/R CDM project activity, and will be responsible for drafting the monitoring report.

An expert team will be established for addressing any technical issues that may arise, and for checking and verification of measured and monitored data.

C.8. Name of person/entity determining the monitoring methodology:

Same as those in Section B.4.

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

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

The estimates of the actual net GHG removals by sinks include the direct N_2O emissions caused by N input, decrease in carbon stock due to loss of pre-existing non-tree vegetation and the carbon stock change in aboveground and belowground biomass of living trees (see section C.3.1.3 and Section III.5 of the approved methodology applied).

Local growth curves are used to estimate the biomass stock change achieved by the proposed A/R CDM project activity. These curves were derived from Chinese forestry inventories data that have been carried out every five years since the 1970s. Growth data (standing volume per hectare) are converted into biomass via wood density and Biomass Expansion Factors (BEF) and root-shoot ratio (Table C-1) by using equations (6) and (9) described in Section II.5 of the approved methodology. These parameters are from LULUCF GHG inventory in China's initial national communications.

Since the planting will be carried out in two age cohorts from 2006 to 2007, carbon sequestration for each species planted in different years was calculated separately, and was added up at the end.

N_2O induced by N input is estimated by equation (23)-(25) in section II.7 of the approved methodology AR-AM0001 using the default values of GPG 2000 and 1996 IPCC Guideline. The synthetic nitrogen fertilizer is applied to eucalyptus plantation with 75 gN, 30gN and 40gN per tree respectively at the first, second and third year of the establishment or regeneration of the plantation.

The actual net GHG removals by sinks is that the carbon stock change in above- and below-ground biomass minus the increase in N_2O emission of nitrogen application. The carbon stock in biomass of existing non-tree vegetation is assumed to be 5 tC ha^{-1} based on default standing biomass of grassland in GPG LULUCF[20] and is deducted from the carbon stock in the first year of the crediting period. Detail data over 30-year-crediting period are listed in Table D-1 below.

Table D-1 Estimate of actual net GHG removals by sinks [21]

Year No	Year	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)
		Above-ground biomass	Below-ground biomass				
1	2006	-26,976	-15,872	-437	-437	-43,285	-43,285
2	2007	9,868	-6,535	-252	-688	45,929	2,644
3	2008	48,165	3,192	-264	-952	47,761	50,405
4	2009	85,792	12,807	-41	-993	47,200	97,606
5	2010	126,801	23,452	0	-993	51,653	149,259
6	2011	176,374	36,396	0	-993	62,517	211,776
7	2012	230,463	50,299	0	-993	67,993	279,769
8	2013	279,899	62,456	0	-993	61,593	341,362
9	2014	249,991	54,314	-57	-1,050	-38,108	303,255
10	2015	236,932	52,097	-126	-1,176	-15,402	287,853
11	2016	226,481	50,667	-217	-1,393	-12,098	275,755

[20] Refers to table 3.4.2 and 3.4.3 in GPG LULUCF

[21] Notes: minus sign indicates the source while plus indicates the sink.

12	2017	296,029	68,979	-160	-1,553	87,700	363,456
13	2018	356,780	84,462	-91	-1,644	76,143	439,598
14	2019	385,732	89,665	0	-1,644	34,155	473,754
15	2020	402,575	91,191	0	-1,644	18,368	492,122
16	2021	457,296	106,016	0	-1,644	69,546	561,668
17	2022	433,956	100,858	-57	-1,701	-28,554	533,113
18	2023	393,064	91,267	-126	-1,827	-50,609	482,505
19	2024	345,680	79,086	-217	-2,044	-59,782	422,722
20	2025	373,532	84,189	-160	-2,204	32,795	455,517
21	2026	391,337	86,124	-91	-2,295	19,649	475,166
22	2027	447,961	101,586	0	-2,295	72,086	547,252
23	2028	502,152	116,565	0	-2,295	69,171	616,423
24	2029	551,488	130,229	0	-2,295	62,998	679,422
25	2030	526,723	124,375	-57	-2,352	-30,675	648,746
26	2031	461,059	106,121	-126	-2,478	-84,045	564,702
27	2032	392,629	86,507	-217	-2,694	-88,260	476,442
28	2033	449,448	102,018	-160	-2,854	72,170	548,612
29	2034	505,244	117,394	-91	-2,946	71,080	619,692
30	2035	556,662	131,570	0	-2,946	65,594	685,287

D.2. Estimated baseline net GHG removals by sinks:

As elaborated in section B, under the baseline scenario, the carbon stock change in aboveground and belowground biomass on lands without growing trees is conservatively set to zero. Only the projected biomass growth of existing trees on lands with a few growing trees is included in the baseline.

There are 44 ha of lands with 50 growing trees per hectare in average, a mean DBH of 2.92 cm and mean height of 3.45m. The main species are *L. formosana, Elaeocarpus decipiens* and *Albizzia julibrissin* with the age around 6 years. The carbon stock changes in above- and below-ground biomass of the existing trees are estimated using the parameters in Table C-1 above, equations (6)-(9) in section II.5 of the approved methodology AR-AM0001 and local-derived growth curve of broadleaf trees (to be conservative, the curve for fertile sites is used), and, this represents the baseline net GHG removals by sinks (seed Annex 3 for details).

Table D-2 Estimates of baseline net GHG removals by sinks

Year No.	Year	Baseline net GHG removals by sinks (t CO_2 yr^{-1})			Cumulative Baseline net GHG removals by sinks (t CO_2)		
		Above-ground biomass	Below-ground biomass	total	Above-ground biomass	Below-ground biomass	total
1	2006	6.4	1.8	8.3	6.4	1.8	8.3
2	2007	7.1	2.0	9.2	13.6	3.8	17.4
3	2008	7.8	2.2	10.0	21.4	6.1	27.5
4	2009	8.5	2.4	10.9	29.9	8.5	38.3
5	2010	9.1	2.6	11.7	39.0	11.0	50.0
6	2011	9.7	2.7	12.4	48.7	13.8	62.4
7	2012	10.3	2.9	13.2	58.9	16.7	75.6
8	2013	10.9	3.1	14.0	69.8	19.8	89.6
9	2014	11.4	3.2	14.7	81.3	23.0	104.3
10	2015	12.0	3.4	15.4	93.3	26.4	119.7

11	2016	12.6	3.6	16.1	105.8	29.9	135.8
12	2017	13.1	3.7	16.8	118.9	33.7	152.6
13	2018	13.6	3.9	17.5	132.5	37.5	170.0
14	2019	14.1	4.0	18.1	146.7	41.5	188.2
15	2020	14.7	4.1	18.8	161.3	45.7	207.0
16	2021	15.2	4.3	19.5	176.5	49.9	226.4
17	2022	15.7	4.4	20.1	192.2	54.4	246.5
18	2023	16.2	4.6	20.7	208.3	59.0	267.3
19	2024	16.6	4.7	21.4	224.9	63.7	288.6
20	2025	17.1	4.8	22.0	242.1	68.5	310.6
21	2026	17.6	5.0	22.6	259.7	73.5	333.2
22	2027	18.1	5.1	23.2	277.7	78.6	356.3
23	2028	18.5	5.2	23.8	296.3	83.8	380.1
24	2029	19.0	5.4	24.4	315.3	89.2	404.5
25	2030	19.5	5.5	25.0	334.7	94.7	429.5
26	2031	19.9	5.6	25.5	354.6	100.4	455.0
27	2032	20.4	5.8	26.1	375.0	106.1	481.1
28	2033	20.8	5.9	26.7	395.8	112.0	507.8
29	2034	21.2	6.0	27.2	417.0	118.0	535.0
30	2035	21.7	6.1	27.8	438.7	124.1	562.8

D.3. Estimated leakage:

Labors used for the proposed A/R CDM project activity are from local villages, hence transportation for labors is not needed. Except for eucalyptus of which seedlings will be cultured off-sites, all seedlings will be bred on-site and will be transported to the project sites by manpower. There is also a need for transporting timber from the 7th year onward and resin from 16th to 20th year. A medium size vehicle that uses diesel is usually used in the project area. Based on the amount of eucalyptus seedlings needed for reforestation, the expected output of timber and resin as well as the needed amount of fertilizers, the leakage caused by vehicle uses is estimated using equation (27) and (28) in Section II.8 of the approved methodology applied. The emission factor is 2.6353 kg CO_2 $litre^{-1}$ for diesel for mid-size vehicle that is commonly used in the area (from China's national initial national communication). The expected leakage is 232 t CO_2-e by the year 2012, and 19,852 t CO_2-e by the end of the crediting period (Table D-3 below).

Table D-3 Estimates of leakage

Year No.	Year	Annual Leakage (t CO_2-e yr^{-1})	Cumulative Leakage (t CO_2-e)
1	2006	-140	-140
2	2007	-27	-168
3	2008	-38	-206
4	2009	-6	-212
5	2010	0	-212
6	2011	0	-212
7	2012	-21	-232
8	2013	-83	-315
9	2014	-1,376	-1,691
10	2015	-1,304	-2,995
11	2016	-1,317	-4,312
12	2017	-23	-4,335
13	2018	-105	-4,440
14	2019	-367	-4,808

15	2020	-367	-5,175
16	2021	-46	-5,221
17	2022	-2,903	-8,124
18	2023	-2,903	-11,027
19	2024	-3,009	-14,036
20	2025	-547	-14,583
21	2026	-491	-15,074
22	2027	0	-15,074
23	2028	0	-15,074
24	2029	0	-15,074
25	2030	-1,386	-16,460
26	2031	-1,671	-18,131
27	2032	-1,685	-19,816
28	2033	-23	-19,839
29	2034	-13	-19,852
30	2035	0	-19,852

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

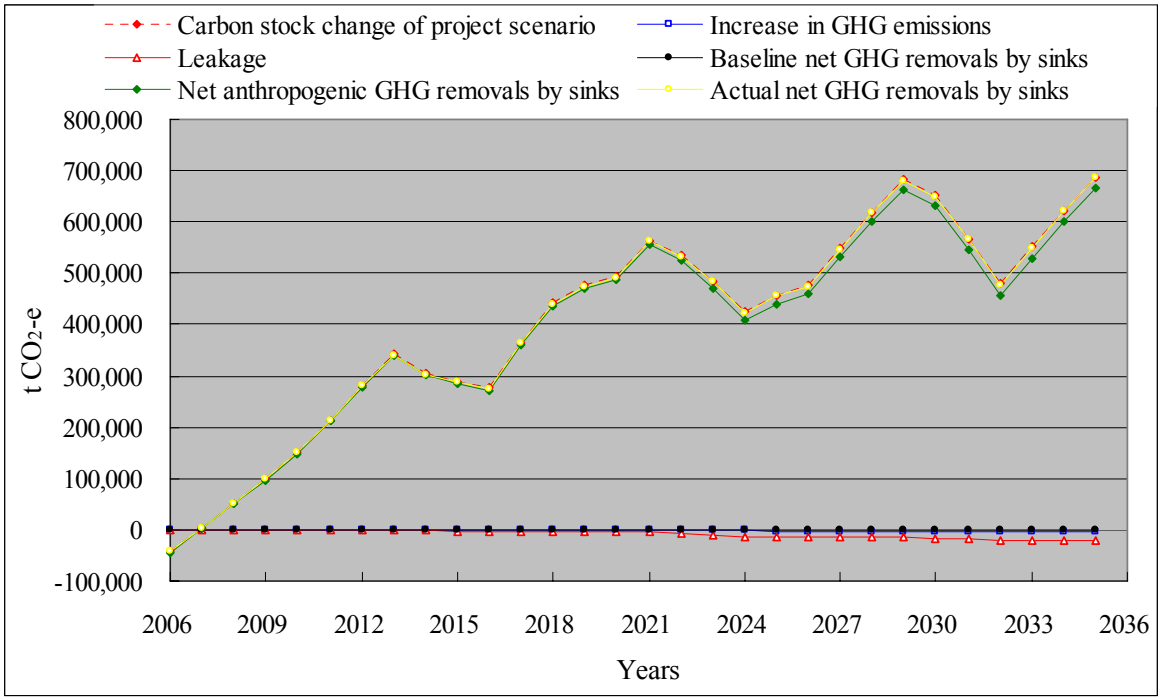
The sum of D.1 minus D.2 plus D3 indicates that the net anthropogenic GHG removals by sinks as a result of the proposed A/R CDM project activity is anticipated to be over 600,000 tones of CO_2 equivalent during the crediting period (between 1 April 2006 and 31 March 2036) per the Table D-4 and Fig. D-1 (by the year 2012: 279,461 t CO_2-e, by the year 2017: 358,968 t CO_2-e).

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

Year No	Year	Annual net anthropogenic GHG removals by sinks (t CO_2-e yr^{-1})	Cumulative net anthropogenic GHG removals by sinks (t CO_2-e)
1	2006	-43,433	-43,433
2	2007	45,893	2,459
3	2008	47,713	50,172
4	2009	47,184	97,356
5	2010	51,642	148,997
6	2011	62,505	211,502
7	2012	67,959	279,461
8	2013	61,497	340,958
9	2014	-39,499	301,459
10	2015	-16,721	284,738
11	2016	-13,431	271,307
12	2017	87,661	358,968
13	2018	76,020	434,988
14	2019	33,770	468,758
15	2020	17,982	486,740
16	2021	69,480	556,220
17	2022	-31,477	524,743
18	2023	-53,533	471,210
19	2024	-62,813	408,398
20	2025	32,226	440,624
21	2026	19,135	459,759
22	2027	72,063	531,822
23	2028	69,147	600,969

24	2029	62,974	663,943
25	2030	-32,086	631,857
26	2031	-85,741	546,116
27	2032	-89,970	456,145
28	2033	72,120	528,266
29	2034	71,040	599,305
30	2035	65,567	664,872

Fig.D-1 Ex ante estimated net anthropogenic GHG removals by sinks



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

See Table D-5.

Table D-5

Years	Estimation of baseline net GHG removals by sinks (tones of CO2 e)	Estimation of actual net GHG removals by sinks (tones of CO2 e)	Estimation of leakage (tonnes of CO2 e)	Estimation of net anthropogenic GHG removals by sinks (tones of CO2 e)
A	B	C	D	E=C+D-B
2006	8.3	-43,285	-140	-43,433
2007	9.2	45,929	-27	45,893
2008	10.0	47,761	-38	47,713
2009	10.9	47,200	-6	47,184
2010	11.7	51,653	0	51,642
2011	12.4	62,517	0	62,505
2012	13.2	67,993	-21	67,959
2013	14.0	61,593	-83	61,497
2014	14.7	-38,108	-1,376	-39,499
2015	15.4	-15,402	-1,304	-16,721
2016	16.1	-12,098	-1,317	-13,431
2017	16.8	87,700	-23	87,661
2018	17.5	76,143	-105	76,020
2019	18.1	34,155	-367	33,770
2020	18.8	18,368	-367	17,982
2021	19.5	69,546	-46	69,480
2022	20.1	-28,554	-2,903	-31,477
2023	20.7	-50,609	-2,903	-53,533
2024	21.4	-59,782	-3,009	-62,813
2025	22.0	32,795	-547	32,226
2026	22.6	19,649	-491	19,135
2027	23.2	72,086	0	72,063
2028	23.8	69,171	0	69,147
2029	24.4	62,998	0	62,974
2030	25.0	-30,675	-1,386	-32,086
2031	25.5	-84,045	-1,671	-85,741
2032	26.1	-88,260	-1,685	-89,970
2033	26.7	72,170	-23	72,120
2034	27.2	71,080	-13	71,040
2035	27.8	65,594	0	65,567
Total (tones of CO2 e)	562.8	685,287	-19,852	664,872

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:

Through establishing 4000 ha of multiple-use forests in the watershed along the Pear River Basin that suffers from severe soil erosion and on the lands close and between nature reserves, the proposed A/R CDM project activity will increase the forest coverage in project towns/townships by 1.34% in average, and provide the following additional environmental benefits.

- **Enhancing biodiversity and ecosystem integrity:**

As elaborated in Section A.4.1.5, the project areas are important habitats for rare and endangered wildlife, making the proposed A/R CDM project activity significant positive biodiversity benefits:

- Providing corridors to enhance the viability of wildlife populations through facilitation of gene flow.
- Restoring connectivity between forests will increase the protected forests scope to improve the status of currently unprotected species.
- *P. massoniana* and *Quercus* sp. will provide additional fruits/seeds and leaves as food for the primates and other wildlife.
- Providing firewood to the communities, thus reducing the pressure of firewood collection on the nature reserves and strengthening the biodiversity conservation.
- Providing habitats for the movement of some types of birds, mammals and snakes.
- Improving the habitats of migratory birds through habitat restoration. For instance, the project sites in Huanjiang County, through which birds migrate, will serve as roosting/staging sites once the trees have grown.
- Generating increased income to local communities from the proposed A/R CDM project activity. This will reduce their tendency to degrade biodiversity through practices such as poaching, forest fires and illegal logging and NTFP collection in the nature reserve. These activities are key threats to the nature reserve management.

- **Controlling soil erosion**

As elaborated in Annex 3, due to the consecutive deforestation, subsequent over-use of fuelwood and frequent fire, most lands are severely degraded and suffer from serious soil erosions that directly threaten the cropland nearby and the streams and rivers below. If the current situation remains as it has been, the lands will degrade further and the soil erosion will become more and more severely. The forest restoration will improve soil and water erosion control in this area.

- **Improving environmental services**
  - Regulating hydrological flows which in turn alleviates drought risk and reduces flooding risks;
  - Building and improving nutrient cycling within soil; and
  - Contributing to local climate stabilization.
- **Building incentives to people to invest in sustainable land use**
- **Improving watershed management and contributing to the ecosystem improvement along the Pearl River, through demonstration and extension of the project experience to other areas.**

Risk analysis and countermeasures:

- **Species:** To reduce or avoid the potential negative impacts by planting pure eucalyptus, mitigation measures will be taken, including limiting the land size of eucalyptus plantation, low planting density, appropriate fertilizer application, mixed planting sites with local species in mosaic layout and keeping the original vegetation in valleys.
- **Fire and pest risk:** The burning in neighboring cropland is subjected to bring fire threat to the forests. This can be alleviated through technical and awareness training to local farmers/communities, strengthening patrolling and monitoring, as well as building the fire-break belt. Furthermore, a mixed reforestation arrangements will be adopted to reduce fire and pest risks.
- **Site preparation:** The site preparation will disturb the vegetation and soil in the planting sites. The main technical measures to be employed in mitigating the impacts are to plant the trees with low density (1250-2500 trees per hectare), limited hole site preparation (40 cm X 50 cm in diameter or 0.2 m^2), retaining the existing vegetation as mush as possible (see section A.4.8). As a result, the surface area disturbed by site preparation is estimated to account for 2-5% of the total land surface. The hole will be dug along the landform contour in triangle form to reduce the soil loss. Therefore the site and soil preparation will have minor negative impacts on original soil and vegetation.
- **Fertilization:** In the proposed A/R CDM project activity, only eucalyptus will be applied with compound or organic fertilizer. As the eucalyptus will be planted in separate small patches, fertilizer will be applied within the small planting hole rather than overall dispersing, so that the potential risk of the fertilization application can be reduced to minimum.
- **Pesticide:** improper pesticide application would be harmful to natural environment, including polluting soil, water and air conditions, as well as the habitat of the wildlife. However under the proposed A/R CDM activity, the environmental friendly measures will be adapted such as mixed

species arrangement, seed and seedling quarantine, as well as an integrated pest management (IPM) approach, especially biological measures to control pests and diseases will be adopted. Therefore, the pesticide application will be limited. The pest management plan has been developed for the umbrella GIFDCP and it will be used to guide the pest prevention and control, as well as the pesticide application in case the pest and disease will be occurred during the project implementation.

None of these risks and/or negative impacts are considered to be significant.

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 identified due to the environmental-friendly techniques adopted in the proposed A/R CDM project activity, e.g., avoidance of slash and burn and overall tillage, proper choice of tree species and their spatial arrangement, etc. Even though, environmental impact assessment has been undertaken and the environment management plan has been developed under the umbrella GIFDCP to guide and monitor this project implementation. These documents are available to the DOE for inspection.

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

No significant negative impacts have been identified. However, environmental monitoring plan and remedial measures for any risks will be implemented and monitored under the integrated umbrella GIFDCP.

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

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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:

Agriculture is the main source of income for local communities in the project area. However, due to severe soil erosion, agricultural production has suffered very much from flood, drought and other disasters. Food productivity is very low and the mean annual income per capita in the project areas is only US$ 145, and even under US$ 100 in some remote villages. Income in Cangwu is relatively higher although there is less land per capita, but the income varies larger among different villages within the project boundary.

To maximize the socio-economic benefit, the reforestation design was prepared with a participatory approach. PRA methods were adopted in interviewing and consulting with farmer households in the project areas to understand the local farmers/communities' preferences, wishes and concerns, so that the proposed A/R CDM project activity would better respond to their desires for livelihood development (see section G below). Farmers decided the final contractual production arrangements as they liked, such as the individual farmer voluntary groups and shareholding arrangement between local farmers/communities and forest farms/companies (see section G2.1). The local farmers will participate in the reforestation activities such as site preparation, planting, weeding, thinning, harvesting, etc. and earning direct benefits during the crediting period. It is expected that 27 villages of 10 towns/townships will benefit from the proposed project. The main socio-economic benefits of the project include:

(1) Income generation: About 20,000 local farmers of 5,000 households will benefit from the project. The total income is estimated at US$ 21.1 million within the crediting period, including about US$ 15.6 million from employment, US$ 3.5 million from sales of wood and non-wood products and US$ 2.0 million from sales of CERs. The mean net annual income per capita will be increased by US$ 34 or by 23.8% compared to the year 2004 (table F-2 below). The income generation is especially significant and important for ethnic minorities in Huangjiang County where the proposed A/R CDM project activity will increase the mean net annual income per capita by about 200% compared to the year 2004 (table F-2 below). The added income per capita of local farmers/communities in Cangwu County is relatively less due to relatively higher population.

(2) Creating employment: The proposed A/R CDM project activity will create about 5 million person-days of temporary employment opportunities from planting, weeding, harvesting and resin collection. It will also create 40 long-term job positions during the crediting period (Table F-3). Most employment opportunities will be taken by the local farmers/communities involved in the proposed A/R CDM project activity and beyond (whose lands do not fall within the project boundary). Project areas in Huanjiang County are dominated by ethnic minorities, thus the employment opportunities will be available to local ethnic minority groups (Table F-4).

(3) Sustainable fuelwood supply: The local communities depend on fuelwood for living to a certain extent, especially in Cangwu County, where most of the fuelwood they collected currently are shrub and herbaceous plants. The proposed A/R CDM activity will provide more sustainable fuel sources for local farmers. In addition, local governments are demonstrating and extending bio-gas energy by providing subsidy for local farmers who builds bio-gas system, and this will alleviate the pressure of fuelwood collection on planted forests.

Table F-1 Socio-economic Profiles of Project Areas

County	Town/ township	Village	Planting area (ha)	Number of village group	Number of house-hold	Population	Number of labor force	People employed outside	Minority population	Cropland area (ha)	Food production per capita (kg)	Mean annual net income per capita (US$)	Annual fuelwood Consumption per capita (kg)
Cangwu	Dapo	Shengzhou	83	21	892	3,695	2,424	221		185	335	266	350
		Xinglong	123	16	910	3,170	2,040	420		182	307	309	300
		Dayan	87	6	185	767	443	90		41	287	241	400
		sub-total	293	43	1,987	7,632	4,907	731		408	319	281	334
	Xingdi	Dianchun	335	27	765	3,294	1,840	832		131	230	74	180
		Dongxin	102	30	900	4,368	2,100	1,304		162	200	76	180
		Xunchun	51	24	904	4,311	1,905	813		93	185	72	206
		Dachun	78	14	450	2,506	1,612	405		140	205	75	180
		Datong	294	17	854	3,814	706	308		107	210	63	160
		sub-total	861	112	3,873	18,293	8,163	3,662		634	205	72	182
	Longxu	Enyi	48	12	685	2,748	1,523	252		293	597	304	200
		Daen	90	21	783	3,225	2,079	484		299	479	292	172
		sub-total	138	33	1,468	5,973	3,602	736		592	533	298	185
	Shatou	Chantian	398	24	439	1,879	1,022	204		53	255	177	650
		Shichuan	210	17	214	1,062	484	98		27	260	190	850
		Shentang	100	34	795	4,010	1,712	413		102	250	204	730
		sub-total	708	75	1,448	6,951	3,218	715		183	253	194	727
	County Total		2000	**263**	**8,776**	**38,849**	**19,890**	**5,844**		**1,816**	**286**	**170**	310
Huanjiang	Mulun	Leyi	82	8	207	821	390	42	810	70	290	115	192
	Minglun	Baixiang	23	635	2,370	1,120	138	2,290	166	23	240	102	200
		Cuishan	20	324	1,692	805	77	1,630	120	20	235	100	190
		sub-total	43	959	4,062	1,925	215	3,920	287	43	238	101	196
	Shangchao	Beishan	84	28	699	2,742	1,326	165	2,693	180	280	117	160
	Xunle	Taiping	58	23	635	2,370	1,120	138	2,290	166	240	102	200

		Shangang	280	20	324	1,692	805	77	1,630	120	235	100	190
		sub-total	338	43	959	4,062	1,925	215	3,920	287	238	101	195
	Chuanshan	Hedun	123	30	613	2,960	1,382	210	2,730	239	290	133	180
	Longyan	Chaoge	455	27	570	2,300	1,120	178	1,867	153	210	89	210
		Dake	211	31	680	2,560	1,050	180	2,352	93	225	102	200
		Huangzhong	171	21	335	1,632	786	103	1,428	52	230	98	220
		Chenghuang	32	7	230	1,028	530	86	985	40	240	104	195
		Jiuwei	62	9	180	740	316	58	653	87	250	96	210
		Longyan	41	22	670	2,852	1,376	209	2,510	124	420	126	190
		sub-total	971	117	2,665	11,112	5,178	814	9,795	549	276	105	203
	County total		2000	**257**	**5,948**	**25,255**	**11,951**	**1,717**	**23,239**	**3,808**	**266**	**108**	193
Project total			4000	**520**	**14724**	**64104**	**31841**	**7561**	**23239**	**5623**	**278**	**145**	**264**

Table F-2 Income generated by project activities

County	Township	Number of villages that benefit	Number of Beneficiaries	Net income within lifetime of the project (US$ `000)				Added annual net income (10^3US$)	Added annual net income per capita (US$)	Net income per capita in 2004 (US$)	Income increase compared to 2004 (%)
				Labours	Wood & non-wood product	CERs	Total				
Cangwu	Dapo	3	3,600	1,037	281	121	1,439	48	13	281	4.7
	Xindi	5	8,563	2,881	1,249	341	4,470	149	17	72	24.2
	Longxu	2	1,530	428	106	59	592	20	13	298	4.3
	Shatou	3	4,520	1,703	540	234	2,477	83	18	194	9.4
	Sub-total	**13**	**18,213**	**6,049**	**2,175**	**754**	**8,978**	**299**	**16**	**170**	**9.7**
Huanjiang	Mulun	1	102	619	36	17	672	22	220	115	191.1
	Chuanshan	1	296	249	258	41	548	18	62	133	46.2
	Longyan	6	760	4,362	36	214	4,539	151	199	105	190.4
	Xunle	2	156	2,065	167	81	2,312	77	494	94	525.8
	Minglun	3	283	1,923	703	126	2,752	92	324	101	320.2
	Shangchao	1	196	314	159	31	504	17	86	117	73.0
	sub-total	**14**	**1,793**	**9,532**	**1,287**	**509**	**11,328**	**378**	**211**	**105**	**199.7**
	Total	**27**	**20,006**	**15,581**	**3,462**	**1,264**	**20,306**	**677**	**34**	**142**	**23.8**

Table F-3 Employment created by project activities

County	Town/ township	Number of villages that benefit	Number of Beneficiary	Temporary (days)					Long-term position
				Planting	Weeding & tending	Harves-ting	Resin collecting	Total	
Cangwu	Dapo	3	3,600	17,113	105,482	135,108	80,049	337,751	8
	Xindi	5	8,563	50,793	199,053	556,518	132,313	938,678	6
	Longxu	2	1,530	8,055	35,983	50,495	44,953	139,486	2
	Shatou	3	4,520	55,746	104,021	162,031	229,446	551,243	4
	Sub-total	13	18,213	131,707	442,656	897,054	486,000	1,957,416	20
Huanjiang	Mulun	1	102	7,273	19,071	156,319	17,712	200,375	2
	Chuanshan	1	296	8,162	14,594	51,944	5,886	80,587	2
	Longyan	6	760	90,944	129,265	1,078,880	112,482	1,411,571	5
	Xunle	2	156	28,362	45,400	533,859	60,480	668,101	3
	Minglun	3	283	28,071	118,364	445,555	30,240	622,231	9
	Shangchao	1	196	5,025	22,758	73,854	0	101,637	
	sub-total	14	1,793	167,836	349,453	2,340,412	226,800	3,084,501	20
Total		27	20,006	299,543	792,110	3,237,466	712,800	5,041,918	40

Table F-4 Number of beneficiaries for different town/townships and ethnic minorities created by project activities

Town/ township	Number of villages that benefit	Number of Beneficiaries	Number of beneficiaries for ethnic minorities						
			Zhuang	Maonan	Yao	Mao	Buyi	Shui	total
Mulun	1	102	76	26					102
Chuanshan	1	296	232	8					240
Longyan	6	760	620	15	7				642
Xunle	2	156	86			70			156
Minglun	3	283	270	6	7				283
Shangchao	1	196	196						196
Total	14	1,793	1,480	55	14	70			1,619

(4) Strengthening social cohesion: As indicated earlier, individual farmer households/communities are too weak to successfully manipulate the chain from investment, production to market especially for the timber and non-wood forest products which will take a much longer period than food production. In addition, the lack of organizational instruments also prevents them from overcoming technological barriers. Overall the proposed A/R CDM project activity will entail close interaction between individuals, communities, companies and government, with intensified communication among them and supporting networks for social and productive services, especially for the ethnic minorities.

(5) Technical training and demonstration: Interview with local communities indicated that local farmers/communities are usually short of access to quality seed sources and lack skills for producing high quality seedlings and for successful tree planting, as well as for preventing

planted trees from being subject to fire, pest and disease attack. This is one of the important barriers of local communities in planting trees on their lands. In the proposed A/R CDM project activity, the local forestry agencies as well as companies/farms will organize the training for local communities to assist them in understanding and evaluating the issues of hosting the proposed A/R CDM project activity, both on-site and off-site such as seed and seedling selection, nursery management, site preparation, planting models and Integrated Pest Management.

Potential socio-economic risks and countermeasures

(1) Cultural Resources


Burial ground on some sites

There are no cultural relics and/or cultural reserve that have been identified in the project area, and consequently, no damage to non-replicable cultural property will occur under the proposed A/R CDM project activity. Meanwhile, the project does not involve any sites for local social gatherings or other spiritual activities, thus the project activities will not impact the normal local gatherings and religious activities. It is found that the local farmers have the traditional custom of ground burial. According to some ethnic minority groups' beliefs (such as the Buyi), they view the mountains and trees around their lineage/family cemeteries or burial grounds as "geomantic/Fengshui mountain" and "sacred trees" that are untouchable. The project activities of reforestation are fully consistent with local people's beliefs to protect such mountains and forests from environmental degradation.

(2) Ethnic Minority Groups

There are 6 ethnic minority groups involved in the proposed A/R CDM project activities. According to the social assessment report done by the social assessment team, although there are few limiting factors that would restrict their access to development opportunities, most of the ethnic minority peoples overall remain vulnerable compared to the rest of the population due to a remaining gap with the mainstream society as well as due to their location in remote, disadvantaged areas. In view of the various situations of the ethnic groups, a Multi-Ethnic Minority Development Plan (EMDP) has been developed to address all the concerns and issues specific to these groups for the umbrella GIFDCP, which will apply to the project to indicate the ways for the proposed A/R CDM project activity to be designed compatibly with ethnic minorities' cultures.

(3) Economic risk

The potential economic risks will be poor management of the plantations established under the project such as lack of pest and fire control, which would contribute to project failure and farmers' loss. This risk will be mitigated by providing technical assistance and training to farmers and communities, by local forestry agencies, forestry research and design institutions, as well as by the extension network of the forestry sector. Forestry farms/companies are experienced in reforestation and watershed management, which will also provide the technical assistance to the farmers/communities.

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:

None of the potential risks is considered to be significant. Even though, socio-economic impact assessment has been undertaken under the umbrella GIFDCP.

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

Although there is no significant negative socio-economic impact, the monitoring plan including the mitigation measures to address any potential risks will be implemented under the umbrella GIFDCP.

SECTION G. Stakeholders' comments:

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

Comments by stakeholders have been invited using PRA methodology. One village from each of town/township has been randomly selected for the PRA. Ten villages were investigated, specifically the PRA include following processes:

(1) **Distribution of leaflet.** A project leaflet has been prepared with the brief introduction of the project objective, main activities, benefits and potential risk, as well as the modalities and procedures of the CDM A/R project. The leaflet was distributed to the proposed project communities before the PRA process, and was explained during the PRA process.

(2) **Seminar of farmers' representatives**. To get comprehensive information of the historic and current situation and existing problems in local communities, as well as to understand the need and desire of local farmers, a meeting of farmer representatives was held in each selected village. Participants include village headers, farmer representatives, chief town/township management staff responsible for agriculture and forestry, and staff of local forestry stations. Favorable tree species were also discussed and listed by scoring in the meeting.

(3) **Questionnaire**. Questionnaire forms were developed and distributed among different stakeholders, including households (10-15 households randomly selected from each selected villages), villages, town/township governments, forest farms, local forest stations and forestry bureau and nature reserves. The questionnaire forms were collected and analyzed to understand the local socio-economic profiles, land use, land tenure, income and sources, land management ways, awareness, technical know-how, favorable tree species, technical and financial barriers, need and desire of farmers in the ways to participating in the proposed A/R CDM project activity from relevant stakeholders.

(4) **Interview.** 35 persons in each town/township, village, private company and forest farm involved in the proposed A/R CDM project activity and nature reserves nearby were interviewed. 10-15 households were randomly selected from each selected village were also interviewed using semi-structured approach.

G.2. Summary of the comments received:

Comments from local farmers, villages and companies/farms, etc. are summarized as follow:

1. Primary stakeholders

(1) Farmers/communities

Local farmers/communities expresses their strong interests to participate in the proposed A/R CDM project activity because they thought that through participating in the proposed A/R CDM project activity they can obtain the following benefits:

- ✓ Employment chance. They do not have to find jobs far away from hometown, which make it possible to look after their cropland at the same time.
- ✓ Income increase from selling wood and non-wood products and CER trade in addition to direct products.
- ✓ Greening their barren lands that can improve local environment, shelter cropland and reduce drought, flood and other natural disasters.
- ✓ Learning good practice on tree planting and forest management from technical training.

PRA survey indicates that 117 out of 121 farmer households randomly chosen from 10 villages willing to participate the proposed A/R CDM project activity, accounting for 97%. Among all of households interviewed, more than 90% households prefer to cooperate with companies or forest farms by contractual arrangements. The survey showed the proposed production arrangements: the household offer lands as equity in return for a stake in net profits of about 20-30%, or like to lease their lands to companies or forest farm and then earn income through labor input and land lease; In addition, the households will receive the cash payment by planting entities. Local forest farms or companies invest in planting, provide technical inputs, manage the plantation stands and undertake related risks, taking 70-80% of stake shares in return for a profit; and less than 10% of households surveyed prefer to finance and manage the proposed A/R CDM project activity and obtain the full profits from the project.

During the PRA process, the scoring assessment on tree species also indicates that local farmers/communities prefer tree species that grow fast and have good market, such as Cangwu County: *Eucalyptus* sp, Oak, *Pinus massoniana*, bamboo, *Schima superba*, *Cunninghamia lanceolata*

C. lanceolata, *P.massoniana*, *Liquidambar formosana*, *Eucalyptus* sp., and bamboo.

(2) Companies/Farms

All of the four private forest companies/farms that mainly focus on afforestation/reforestation and forest management in Cangwu and Huangjiang County are very interested in participating in the proposed A/R CDM project activity. They would like to invest in the reforestation on the economically unattractive lands because:

- ➢ They can share part of income from sale of CERs that have no market risk, in addition to wood and non-wood forest products;
- ➢ The commercial loan and government counterpart funding can alleviate their financial pressure from pre-investment, as such loans and co-funding would be unavailable without the proposed A/R CDM project activity.
- ➢ Without the proposed A/R CDM project activity, they would be unwilling to invest in the afforestation or reforestation on the degraded barren lands due to the unacceptablly low economic revenues.

With regard to the financing arrangements, all of the four companies/farms prefer to rent lands from local farmers/communities and pay labor costs in addition to land lease costs. However, they would also accept the share holder arrangement as the project promoted.

2. Secondary stakeholders

(1) Local forestry departments: Forestry Bureaus and forestry stations of both project counties view that the proposed A/R CDM project activity will increase forest resources, improve the local environment and increase income of local farmers/communities, as well as demonstrate best practice of watershed management to other watershed areas in the Pearl River Basin. They would provide technical training and consultation to farmers/communities and planting entities, and supervise the implementation of the proposed A/R CDM project activity.

(2) Local Governments: County and township/town governments in Huangjiang and Cangwu Counties consider that the proposed A/R CDM project activity can improve local economy and alleviate local poverty especially for the ethnic minorities, and at the same time benefit to globally climate change mitigation and biodiversity conservation as well as improve watershed management. Therefore, the proposed A/R CDM project activity would have great impacts as if technical best practices developed by the proposed A/R CDM project activity are extended to neighbouring areas or local communities that do not involve in the project.

(3) Nature Reserves: The lands to be reforested in Huanjiang County are directly linked to or fall between two national reserves. Both nature reserves believe that the proposed A/R CDM project activity will benefit to the biodiversity conservation by enhancing forest connectivity and reducing pressure on the nature resources by providing sustainable fuelwood to the local communities. The reserves also propose to use native species as much as possible, establish mixed forests and avoid a large area of pure plantation.

(4) Downstream communities: Communities at the downstream areas believe that the proposed A/R CDM project activity will improve water quality downstream by reducing soil erosion and provide a good model for watershed management. However, they also advise to avoid slash and burn site preparation and overall ploughing soil preparation which result in severe soil erosion, and to carefully select and use fertilizers and pesticides.

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

The comments received from the PRA survey were fully taken into account as follows:

- Participation of local farmers/communities and companies/farms is on a voluntarily basis.
- Choice of financing arrangements was based on the preference of local farmers/communities. However, to maximize benefits of local farmers/communities, under the contractual arrangements, the project promotes joint partnerships where small farmers would not simply rent their land, but be full partners sharing in the profits of the venture, in which local farmers/communities can get 40% of revenue from forest products and 60% of revenue from CER. This benefit sharing of the farmers/communities is higher than the ratio that local farmers/communities expected.
- Preferences of local farmers/communities were taken into account in the selection of tree species;
- Most of tree species used are native to local, and a mixed species arrangements will be used. For eucalyptus, small patches will be planted rather than a large area of pure eucalyptus plantation;
- Compound and/or organic fertilizers will be applied to eucalyptus plantations through small holes rather than overall dispersion;
- Use of chemical pesticides will be limited. Rather, disease and pest will be controlled by mixed tree species arrangement and other biological measures;
- Slash and burn site preparation and overall ploughing for soil preparation will not be used.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The total cost for the proposed A/R CDM project activity is estimated at US$ 22.70 million. This will be financed as follows:

- US$ 1.13 million: long-term loan from the local commercial bank;
- US$ 1.13 million: counterpart funding from the government of Guangxi Zhuang Autonomous Region.
- US$ 4.70 million: equity from local farmers/communities and private forest farms/companies involved. This amount will mostly come from the future income raised by selling CERs, wood, resin and other forest products.
- US$ 15.74 million: short-term loan from local commercial bank as working capital used for harvest and timber transportation.

No funding will be used from Official Development Assistance.

Annex 3

BASELINE INFORMATION

1. Historical land use/cover changes

Collected information demonstrates that the lands to be reforested were forested lands in the 1950s. However these forests were destroyed gradually primarily due to three policy-induced events from the 1950s to the 1980s. The first event occurred due to the Great Leap Forward campaign and the Steel and Iron campaign in the late 1950s. A large area of forests was harvested for steel and iron production. The second event was during the Cultural Revolution campaign from 1966 to 1976. During that period many of the remaining secondary forests were cultivated as cropland. The third event occurred during the late 1970s and early 1980s due to an unsuccessful land tenure reform in which lands including remaining secondary forests were allocated to individual household or villager groups who immediately harvested all forests allocated to them without any measurement for regeneration because they did not have confidence in the land tenure reformation. Due to these deforestation events, most land had become non-forest lands by the mid 1980s. Nevertheless, human intervention did not halt on these lands, but continued as fuelwood over-exploitation and over-grazing. Frequent fires that are usually caused by prescribed burning of croplands have been another significant threat to the lands in the last decade. Due to the consecutive human interventions, the lands have severely degraded and serious soil erosion continues. Although grazing is uncommon now, fuel wood collection and fire events still occur widely within the project boundary. Some villages even harvest grasses and shrubs remaining on the lands for fuel because of the unavailability of other fuelwood sources. In the future, under baseline conditions, the lands will continue to degrade and soil erosion will accelerate, resulting in the continuous decrease of the carbon stocks both in living biomass and soils.

Interviews with local farmers also indicated that many barriers for them to plant trees on these lands exist, i.e., low land productivity, unaffordable front investment, failure to get loans for planting trees, lack and inaccessibility of reforestation techniques, and the inability of efficient marketing of forest products.

2. Site classification and quality assessment

The site quality information of lands to be planted has been collected and investigated (see elaboration in section B.2). Processes for land survey, information collection and site classification were as follows:

- Field study tours on each piece of land to inspect the existing vegetation, soil condition and erosion status.
- Interview with local farmers on land use/cover history, important events that have impacted the land use/cover, and current human interventions (grazing, collecting of fuel and medicinal plants, etc).
- Sampling surveys on representative lands including

- ✓ Crown cover and mean height for herbaceous vegetation, shrubs and trees;
- ✓ Soil type, soil depth, and soil sampling and analyzing.

Based on the collected information, in combination with landform, climate and soil types, the lands to be planted have been classified into 7 categories that are described below.

Category I (Locations: Lands in Satou Town of Cangwu County)

- ➢ Existing vegetation: Herbaceous cover 92%-94% with height 0.2-1.2m; shrub cover 4-5% with height 1.0-2.3m; **without growing trees**; fuel collection and frequent fire
- ➢ Landform: Elevation 300-700m, slope gradient 25-35 degrees
- ➢ Soils: red earth developed from sandstone, soil depth 70-110 cm, humus layer 2-5cm, soil erosion modulus 2500-5000 t km^{-2} yr^{-1}

Table annex 3-1 Soil conditions of site category I

No	Soil layer	Depth (cm)	Soil organic matter (g. $100g^{-1}$)	Total N (g. $100g^{-1}$)	Total P (g. $100g^{-1}$)	Total K (g. $100g^{-1}$)
1	A	0-16	7.254	0.273	0.055	2.005
	AB	16-25	2.682	0.135	0.060	2.289
	B	25-100	0.987	0.065	0.064	3.070
	Mean		2.142	0.105	0.062	2.829
2	A	0-11	6.648	0.248	0.081	1.322
	AB	11-28	3.176	0.140	0.071	1.567
	B	28-105	1.243	0.080	0.066	1.753
	Mean		2.166	0.109	0.069	1.674
3	A	0-14	6.623	0.253	0.060	2.423
	AB	14-26	3.549	0.169	0.058	2.886
	B	26-71	1.821	0.138	0.064	3.087
	Mean		2.701	0.158	0.063	2.970

Mean *	2.043(9.4%)	0.117(15.6%)	0.065(5.0%)	2.530(29.7%)

***** data in parentheses indicate the standard deviation in percentage of the mean.

Category II (Locations: Chantian Village and Shichuan village in Satou Town of Cangwu County)

- Existing vegetation: Herbaceous cover 95%-98% with height 0.2-1.5m; shrub cover 3-7% with height 1.0-1.5m; **with growing trees**; fuel collection and frequent fire
- Landform: Elevation 300-700m, slope gradient 25-35 degrees
- Soils: red earth developed from sandstone, soil depth 70-110 cm, humus layer 2-5cm, soil erosion modulus 2500-5000 t km^{-2} yr^{-1}

Table annex 3-2 Soil conditions of site category II

No	Soil layer	Depth (cm)	Soil organic matter (g. $100g^{-1}$)	Total N (g. $100g^{-1}$)	Total P (g. $100g^{-1}$)	Total K (g. $100g^{-1}$)
1	A	0-11	6.648	0.248	0.081	1.322
	AB	11-28	3.176	0.140	0.071	1.567
	B	28-105	1.243	0.080	0.066	1.753
	Mean		2.166	0.109	0.069	1.674
2	A	0-16	5.853	0.198	0.055	1.489
	AB	16-29	2.871	0.122	0.045	1.312
	B	29-110	1.122	0.102	0.047	1.357
	Mean		2.106	0.120	0.048	1.372
mean			2.136(2.0%)	0.114(7.0%)	0.058(24.9%)	1.523(14.0%)

The site conditions of category I and category II are similar. The only different is that there are growing trees in category II.

Category III (Locations: Lands in Xindi Town and Dapo Town in Cangwu County)

- Existing vegetation: Herbaceous cover 70-90% with height 0.2-1.2m; shrub cover 3-7% with height 0.5-2.0m; **without growing trees;** fuel collection and frequent fire
- Landform: Elevation below 300m, hilly land, slope gradient 15-25 degrees
- Soils: crimson soil developed from granite, humus layer 2-5 cm, soil erosion modulus 2500-5000 t km^{-2} yr^{-1}.

Table annex 3-3 Soil conditions of site category III

No	Soil layer	Depth (cm)	Soil organic matter (g. $100g^{-1}$)	Total N (g. $100g^{-1}$)	Total P (g. $100g^{-1}$)	Total K (g. $100g^{-1}$)
1	A	0-17	6.139	0.189	0.045	1.732
	AB	17-47	2.828	0.108	0.022	1.849
	B	47-102	0.969	0.055	0.015	2.061
	Mean		2.406	0.094	0.022	1.941
2	A	0-12	5.875	0.221	0.107	1.102
	AB	12-47	1.164	0.079	0.121	1.335

	B	47-100	1.053	0.066	0.132	1.416
	Mean		1.670	0.089	0.125	1.350
3	A	0-10	4.692	0.157	0.032	2.002
	AB	10-30	2.387	0.105	0.029	2.149
	B	30-110	1.698	0.086	0.01	2.452
	Mean		2.135	0.097	0.016	2.346
4	A	0-10	4.646	0.142	0.038	4.347
	AB	10-60	0.937	0.057	0.018	4.049
	B	60-110	0.855	0.046	0.015	3.724
	Mean		1.283	0.062	0.019	3.981
5	A	0-10	6.985	0.199	0.057	0.477
	AB	10-43	1.975	0.073	0.043	0.52
	B	43-93	1.228	0.055	0.05	0.758
	Mean		2.050	0.075	0.048	0.651
Mean			1.909(22.9%)	0.083(17.3%)	0.046(99.6%)	2.054(61.0%)

Category IV (Locations: Lands in Chuanshan, Shangchao, Minglun, Xunle Town/Township in Huanjiang County)

- Existing vegetation: Herbaceous cover 98% and height 0.5-0.8m; shrub cover 10% and height 0.7m; **without growing trees;** fuel collection and frequent fire
- Landform: Elevation below 300-700m, hilly land, slope gradient 20-30 degrees
- Soils: yellow red soil developed from sand stone, soil erosion modulus 2500-5000 t km^{-2} yr^{-1}

Table annex 3-4 Soil conditions of site category IV

No	Soil layer	Depth (cm)	Soil organic matter (g. $100g^{-1}$)	Total N (g. $100g^{-1}$)	Total P (g. $100g^{-1}$)	Total K (g. $100g^{-1}$)
1	A	0-19	6.08	0.227	0.062	2.127
	AB	19-29	1.96	0.125	0.057	2.237
	B	29-123	1.68	0.107	0.057	2.335
	Mean		2.544	0.132	0.058	2.286
2	A	0-15	5.78	0.231	0.067	2.123
	AB	15-31	2.05	0.130	0.053	1.973
	B	31-102	1.33	0.098	0.048	1.876
	Mean		2.113	0.123	0.052	1.929
mean			2.328(13.1%)	0.127(4.7%)	0.055(8.0%)	2.107(12.1%)

Category V (Locations: Lands in Longyan, Minglun Town/Township in Huanjiang County)

- Existing vegetation: Herbaceous cover 90% with height 1.2m; shrub cover <10% with height 0.3-0.7m; **without growing trees;** fuel collection and frequent fire

- Landform: Elevation below 700-1100m, hilly land, slope gradient 25-35 degrees
- Soils: yellow red soil developed from sand stone, lower fertility, soil erosion modulus 2500-5000 t km^{-2} yr^{-1}

Table annex 3-5 Soil conditions of site category V

No	Soil layer	Depth (cm)	Soil organic matter (g. $100g^{-1}$)	Total N (g. $100g^{-1}$)	Total P (g. $100g^{-1}$)	Total K (g. $100g^{-1}$)
1	A	0-15	4.16	0.239	0.037	2.565
	AB	15-30	1.58	0.112	0.029	2.250
	B	30-107	0.78	0.059	0.029	2.341
	Mean		1.407	0.094	0.030	2.361
2	A	0-15	5.70	0.254	0.069	2.536
	AB					
	B	15-107	1.87	0.108	0.055	2.673
	Mean		2.445	0.130	0.057	2.652
mean			1.926(38.1%)	0.112(22.7%)	0.044(43.6%)	2.507(8.2%)

Category VI (Locations: Lands in Xunle, Minglun and Longyan Town/Township in Huanjiang County)

- Existing vegetation: Herbaceous cover 90-95% with height 1.0m; shrub cover <5% with height 0.5-0.7m; **without growing trees;** fuel collection and frequent fire
- Landform: Elevation below 700-1100m, hilly land, slope gradient 25-35 degrees
- Soils: yellow red soil developed from sand stone, lower fertility, soil erosion modulus 5000-8000 t km^{-2} yr^{-1}

Table annex 3-6 Soil conditions of site category VI

No	Soil layer	Depth (cm)	Soil organic matter (g. $100g^{-1}$)	Total N (g. $100g^{-1}$)	Total P (g. $100g^{-1}$)	Total K (g. $100g^{-1}$)
1	A	0-12	3.20	0.237	0.019	0.807
	AB	12-28	0.82	0.102	0.013	1.238
	B	28-53	0.99	0.133	0.017	2.454
	Mean		1.439	0.147	0.016	1.714
2	A	0-12	1.13	0.093	0.021	0.364
	AB	12-39	0.55	0.068	0.029	1.432
	B	39-82	0.57	0.069	0.036	2.018
	Mean		0.866	0.106	0.022	1.812
3	A	0-6	4.43	0.218	0.033	1.065
	AB					
	B	6-67	1.97	0.108	0.033	2.128
	Mean		2.190	0.118	0.033	2.033
mean			1.498(44.3%)	0.124(17.2%)	0.024(36.3%)	1.853(8.8%)

Category VII (Locations: Lands in Chuanshan, Xunle and Minglun Town/Township in Huanjiang County)

- Existing vegetation: Herbaceous cover 98% with height 1.0 m; shrub cover 3-7% with height 0.3-0.7m; **without growing trees;** fuel collection and frequent fire
- Landform: Elevation below 700 m, hilly land, slope gradient 20-30 degrees
- Soils: brown limestone soil developed from limestone, lower fertility, soil erosion modulus 5000-8000 t km^{-2} yr^{-1}

Table annex 3-7 Soil conditions of site category VII

No	Soil layer	Depth (cm)	Soil organic matter (g. $100g^{-1}$)	Total N (g. $100g^{-1}$)	Total P (g. $100g^{-1}$)	Total K (g. $100g^{-1}$)
1	A	0-18	4.48	0.302	0.033	0.468
	AB	18-53	1.65	0.059	0.014	0.763
	B	53-105	0.83	0.074	0.015	1.538
	Mean		1.774	0.110	0.018	1.074
2	A	0-7	4.21	0.222	0.023	0.346
	AB	7-38	1.18	0.053	0.015	0.587
	B	38-103	0.84	0.060	0.019	1.219
	Mean		1.181	0.069	0.018	0.962
mean			1.478(28.4%)	0.089(32.1%)	0.018(0.6%)	1.018(7.8%)

3. Ex ante stratification

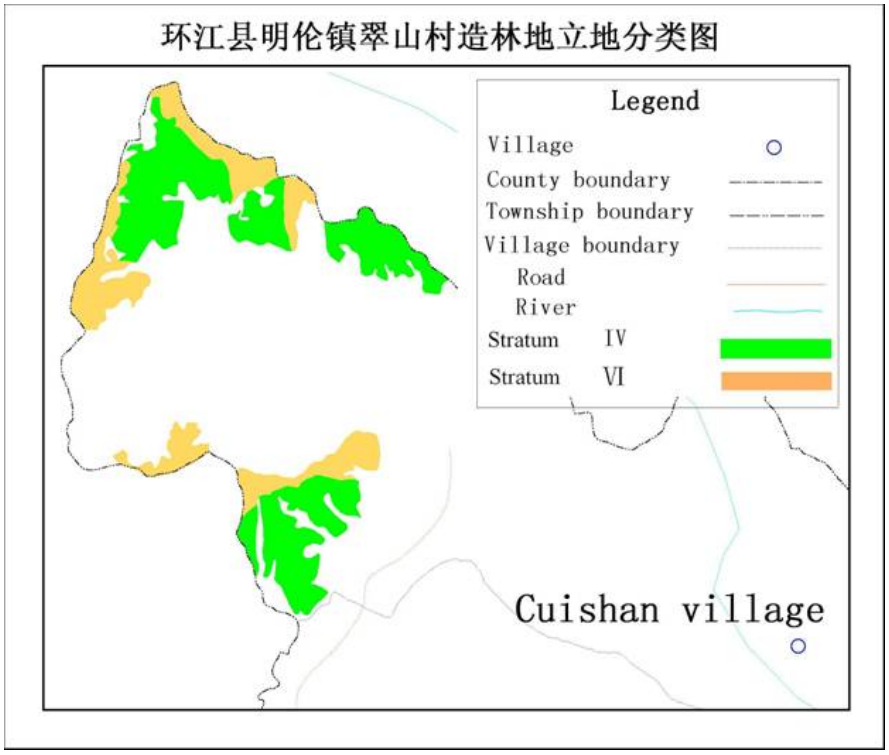
Based on the site investigation and assessment, the project area is categorized into 7 strata. Each category is a stratum (table annex 3-8). Strata I-III are located in Canwu County and strata IV-VII are located in Huangjiang County.

Table annex 3-8 Lists of strata

Stratum	Growing trees	Soil type	elevation	Soil erosion modules t km^{-2} yr^{-1}
I	No	Read earth from sandstone	higher	2500-5000
II	Yes	Red earth from sandstone	lower	2500-5000
III	No	Crimson from granite	lower	2500-5000
IV	No	Yellow-red from sandstone	lower	2500-5000
V	No	Yellow-red from sandstone	higher	2500-5000
VI	No	Yellow-red from sandstone	higher	5000-8000
VII	No	Brown limestone from limestone	lower	5000-8000

The stratification has been built into a GIS that has been used to produce stratification Maps. An example of a stratification map in Cuishan Village of Huanjiang County is shown in Fig Annex 3-1.

Fig Annex 3-1 Stratification map in Cuishan Village of Huanjiang County
(1:150,000)



4. Estimation of the baseline net GHG removals by sinks

For lands with growing trees, stratum II, with a total area of 44.05 ha, the carbon stock change is estimated by projecting the continuous growth rate of existing trees. The existing trees are dominated by *Liquidambar formosana* with age around 6 year, mean DBH of 2.92cm and mean height 3.45m. The mean number of trees per hectare is 50 trees.ha^{-1}. The crown area for 1 tree at maturity is estimated about 25 m^2, and 50 trees gives 1250 m^2, equivalent to 12.5% of crown cover, which is below the threshold of 20% for defining as a forest. Based on the growth curve of *Liquidambar formosana* derived from local data:

$$V = 126.27034 \cdot (1 - e^{0.0913281 \cdot A)})^{1.274443}$$

Where

A = age of trees

V = standing volume

Using following equations to estimate the carbon stock in the above- and below-ground biomass of the existing trees.

$$CStock_{AB} = 44.05 \cdot 50 \cdot V \cdot D \cdot BEF \cdot CF \cdot 44/12$$

$$CStock_{BB} = CStock_{AB} \cdot R$$

Where

V = Standing volume, m^3 tree^{-1}

A = age of trees, yr

$CStock_{AB}$ = the carbon stock in aboveground biomass of existing trees, t CO_2

$CStock_{BB}$ = the carbon stock in belowground biomass of existing trees, t CO_2

44.05 = area of lands with growing trees, ha

50 = number of trees per hectare, trees.ha^{-1}
D = 0.443, wood density, t d.m m^{-3}, see table C-1
BEF = 1.54, the biomass expansion factor, dimensionless, see table C-1
R = 0.283, the root-shoot ratio, dimensionless, see table C-1
CF = 0.5, the carbon fraction
44/12 = ration of molecular weights of carbon and CO_2, dimensionless

The estimated baseline GHG removals by sinks are the sum of the carbon stock change in above- and below-ground biomass. Detail information is listed in Table annex 3-9 below.

Table annex 3-9 Estimates of baseline carbon stock changes

Year No.	Year	Carbon stock change in aboveground biomass (t CO_2 yr^{-1})	Carbon stock change in belowground biomass (t CO_2 yr^{-1})	Baseline net GHG removals by sinks (t CO_2 yr^{-1})	Cumulative Baseline net GHG removals by sinks	
					t CO_2	t CO_2 ha^{-1}
1	2006	6.4	1.8	8.3	8.3	0.2
2	2007	7.1	2.0	9.2	17.4	0.4
3	2008	7.8	2.2	10.0	27.5	0.6
4	2009	8.5	2.4	10.9	38.3	0.9
5	2010	9.1	2.6	11.7	50.0	1.1
6	2011	9.7	2.7	12.4	62.4	1.4
7	2012	10.3	2.9	13.2	75.6	1.7
8	2013	10.9	3.1	14.0	89.6	2.0
9	2014	11.4	3.2	14.7	104.3	2.3
10	2015	12.0	3.4	15.4	119.7	2.7
11	2016	12.6	3.6	16.1	135.8	3.1
12	2017	13.1	3.7	16.8	152.6	3.4
13	2018	13.6	3.9	17.5	170.0	3.8
14	2019	14.1	4.0	18.1	188.2	4.2
15	2020	14.7	4.1	18.8	207.0	4.7
16	2021	15.2	4.3	19.5	226.4	5.1
17	2022	15.7	4.4	20.1	246.5	5.5
18	2023	16.2	4.6	20.7	267.3	6.0
19	2024	16.6	4.7	21.4	288.6	6.5
20	2025	17.1	4.8	22.0	310.6	7.0
21	2026	17.6	5.0	22.6	333.2	7.5
22	2027	18.1	5.1	23.2	356.3	8.0
23	2028	18.5	5.2	23.8	380.1	8.5
24	2029	19.0	5.4	24.4	404.5	9.1
25	2030	19.5	5.5	25.0	429.5	9.7
26	2031	19.9	5.6	25.5	455.0	10.2
27	2032	20.4	5.8	26.1	481.1	10.8
28	2033	20.8	5.9	26.7	507.8	11.4
29	2034	21.2	6.0	27.2	535.0	12.0
30	2035	21.7	6.1	27.8	562.8	12.6

5. Uncertainty Assessment

The uncertainties in the estimation of the baseline net GHG removals by sinks come from the growth curve, BEF, wood density and root-shoot ratio. The growth curve is derived from local forestry inventory data with the expert judgement percentage uncertainty of 10% at 95% confidence level. The mean values and standard deviations of BEF, wood density and root-shoot ratio are listed in Table C-1, from which the percentage uncertainties for *Liquidambar formosana* at 95% confidence level have been estimated at 47%, 6% and 62% for BEF, wood density and root-shoot ratio, using equations as follows[22],

$$U_s(\%) = \frac{1/2\,(95\%\,ConfidenceIntervalWith)}{\mu} \cdot 100$$
$$= \frac{1/2\,(4\sigma)}{\mu} \cdot 100$$

Where

U_s = percentage uncertainty of each parameter, %
μ = mean value of each parameter (BEF, wood density, root-shoot ratio)
σ = standard deviation of each parameter (BEF, wood density, root-shoot ratio)

The uncertainties of the baseline net GHG removals by sinks in the above- and below-ground biomass pools are then estimated at 78.7%, using equation[23]

$$U_S = \sqrt{U_{BEF}^2 + U_D^2 + U_{GC}^2 + U_R^2}$$

Where

U_S = percentage uncertainty of baseline net removal by sinks in above- and below-ground biomass carbon pools
U_{BEF} = percentage uncertainties associated with BEF
U_D = percentage uncertainties associated with wood density
U_R = percentage uncertainties associated with root-shoot ratio
U_{GC} = percentage uncertainties associated with growth curve

Although this uncertainty is high in relative terms, it is low in absolute numbers (563 tCO2) over the 30 year crediting period. This number is low because it is associated with the growth of pre-existing trees, which only exist on a small share of the project area.

[22] Box 5.2.1 in GPG LULUCF

[23] Equation 5.2.1 in GPG LULUCF

Annex 4

MONITORING PLAN

1. Monitoring of the baseline net GHG removals

The carbon stock changes in the baseline scenario do not need to be monitored.

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

a) monitoring actual project boundary;

b) Monitoring the areas and quality of forest establishment to ensure the technical design described in section A is well-implemented;

c) Monitoring of forest management.

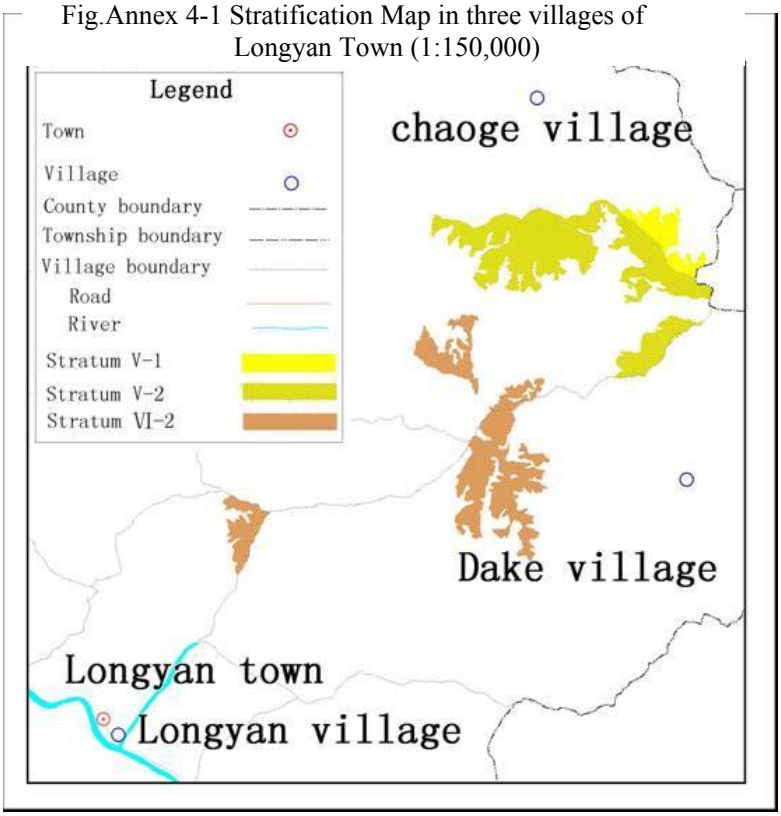
The specific indicators to be monitored listed in section C.3 will be applied.

3. Monitoring the actual net GHG removals by sinks data

a) Stratification

The strata built in the Annex 3 have been further divided into sub-strata in terms of the year to be planted. The planting activity will last two years starting in 2006. Therefore each stratum is divided into 2 substrata. As an example, a strata and sub-strata map in three villages of Longyan Town is shown in fig. Annex 4-1 below.

Fig.Annex 4-1 Stratification Map in three villages of Longyan Town (1:150,000)



However, post stratification will be conducted after the first monitoring event to address the possible changes of project boundary and planting year in comparison to the project design, and to address whether the change in carbon stocks is more or less variable than expected, taking into account data from the monitoring of the proposed A/R CDM project activity and the variation in carbon stock change for each stratum and substratum after the first monitoring event. Strata or substrata will be grouped into one stratum or substratum if they have similar carbon stock, carbon stock change and spatial variation.

b) Sampling Frame

- **Determining sample size**

Equations (1)-(2) in section C have been used to calculate the number of plots for each stratum and sub-stratum (table Annex 4-1). The standard deviation of each stratum/sub-stratum (s_h) has been calculated from the mean standard deviation of soil organic matter and nitrogen content in Annex 3. The allowable error is the 5% of the weighted mean carbon stock in living biomass per plot at harvest age of each stratum/sub-stratum. The t value is determined based on the 95% confidence level. The cost to establish a plot in each stratum/sub-stratum is assumed to be same. To ensure statistically independence for each stratum/substratum, minimum 3 plots are set for each species within each substratum.

However, it is possible to reasonably modify the sample size after the first monitoring event based on the variation of the carbon stock changes.

Table Annex 4-1 Number of monitoring plots for each stratum and sub-stratum

Stratum-Substratum ID	Area (ha)	Number of plots

I-1	211.0	6
I-2	454.3	9
II-1	9.0	6
II-2	33.0	6
III-1	540.0	17
III-2	752.7	10
IV-1	350.0	3
IV-2	150.0	3
V-2	450.0	15
VI-1	408.1	12
VI-2	560.0	17
VII-1	81.9	6
total	**4000.0**	**110**

- **Locating sampling plots**

The permanent sample plots will be located systematically with a random start, using GPS. The size of plots is 400 m^2 (20m X 20m).

c) Monitoring frequency

The planting activity will be conducted from 2006 to 2007. *P. massoniana and C. lanceolata* will not be harvested during the crediting period, but *L. formosana* and *S. superba* will be harvested at age 17, eucalyptus around age 10 and oak at age 7. To avoid the coincidence with peaks in carbon stocks, the first monitoring will be conducted in the year 2009 followed by a monitoring event in 2012, with a subsequent monitoring interval of 5 years, i.e., in 2017, 2022, 2027, 2032, and 2037 respectively (table Annex 4-2).

Table Annex 4-2 Monitoring times versus harvest time

Year No	Year	Monitoring	Harvesting			
			P. massoniana and C. lanceolata	*L. formosana* and *S. superba*	eucalyptus	Oak
1	2006					
2	2007					
3	2008					
4	2009	X				
5	2010					
6	2011					
7	2012	X				X
8	2013					X
9	2014				X	X
10	2015				X	
11	2016				X	
12	2017	X				
13	2018					X
14	2019					X
15	2020					X
16	2021					
17	2022	X		X	X	
18	2023			X	X	
19	2024			X	X	X
20	2025					X
21	2026					X
22	2027	X				

23	2028					
24	2029					
25	2030					X
26	2031				X	X
27	2032	X			X	X
28	2033				X	
29	2034					
30	2035					
31	2036					
32	2037	X				

d) Measuring and estimating carbon stock changes over time

Specific steps, parameters and formula in section C.3.1.3.1 will be adhered to.

e) Monitoring GHG emissions by sources as the results of the A/R CDM project activity

Specific steps, parameters and formula in section C.3.1.3.2 will be adhered to.

4. Monitoring the leakage

Specific steps, parameters and formula in section C.4.1 will be adhered to.

5. Monitoring the social economy of stakeholders

Although no significant negative social-economic impacts have been identified in section F, under the umbrella of GIFDCP, the output and selling price of wood and non-wood products including income from CER will be recorded instantaneously and the actual income of respective stakeholders (farmers/communities and forestry farms/companies) at different financing arrangements will be monitored and documented. Special attention will be paid to income of ethnic minorities. The income changes of the households and communities would also be monitored and assessed.

6. Monitoring environmental impacts

Although no significant negative environmental impacts have been identified as described in section E, The impacts on biodiversity and hydrological aspects will be monitored under the umbrella of the GIFDCP.

The biodiversity will be monitored by permanent sampling plots. Five subplots (2m×2m) within each plot will be randomly selected, and plant species and its richness within each subplot will be investigated. Any visible wildlife will be recorded.

To monitor the water and soil erosion of the planted sites, a paired catchments will be built respectively on planted land and control lands, and runoff from the catchments will be measured. This monitoring will be conducted under the larger umbrella Guangxi Integrated Forestry Development and Conservation Project (GIFDCP).

7. Quality Assurance and Quality Control (QA/QC)

To ensure the net anthropogenic GHG removals by sinks to be measured and monitored precisely, credibly, verifiably and transparently, a quality assurance and quality control (QA/QC) procedure will be implemented,

a) Reliable field measurements

To ensure the reliable field measurements,

- Standard Operating Procedures (SOPs) for each step of the field measurements, including all detail phases of the field measurements and provisions for documentation for verification purposes, will be developed and adhered to over time.
- Training courses on the field data collection and data analyses will be held for persons involving in the field measurement work. The training courses should ensure that each field-team member is fully aware of all procedures and the importance of collecting data as accurately as possible. To achieve this, both classroom examination and field examination will be conducted, and only those that have passed the examination can join the team. Test plots will be established and used for the field examination in which all measurements of pertinent components and procedures will be examined.
- A document that shows that these steps have been followed will be presented as a part of the project documents. The document will list all names of the field team and the project leader will certify that the team is trained;
- Any new staff will be adequately trained.

b) Verification of field data collection

To verify that the plots have been installed and the measurements taken correctly, the following work would be undertaken:

- 20% of randomly selected plots will be re-measured by another team
- 10% of randomly selected plots will be re-measured by an independent qualified team.
- Key re-measurement elements include the location of plots, DBH and tree height of all trees present.
- The re-measurement data will be compared with the original measurement data. Any errors found 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. If the difference between the re-measurement and original measurement is higher than 5%, the sample plot will be eliminated.

c) Verification of data entry and analysis

To minimize the possible errors in the process of data entry, the entry of both field data and laboratory data will be reviewed by an independent expert team and compared 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 should not be used in the analysis.

d) Data maintenance and archiving

Data archiving will take both electronic and paper forms, and copies of all data will be provided to each project participant. All electronic data and reports will also be copied on durable media such as CDs and copies of the CDs are stored in multiple locations. The archives include:

- Copies of all original field measurement data, laboratory data, data analysis spreadsheet;
- Estimates of the carbon stock changes in all pools and non-CO_2 GHG and corresponding calculation spreadsheets;
- GIS products;
- Copies of the measuring and monitoring reports.

8. Uncertainty assessment

The uncertainty for 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.[24],

$$U_s(\%) = \frac{1/2\,(95\%\,ConfidenceIntervalWith)}{\mu} \cdot 100$$

$$= \frac{1/2\,(4\sigma)}{\mu} \cdot 100$$

Where

U_s = percentage uncertainty of each species within sub-stratum, %
μ = mean value
σ = standard deviation

The uncertainty of each sub-stratum is then combined using the following error propagation equations[25]:

$$U_c = \frac{\sqrt{(U_{s1} \cdot C_{s1})^2 + (U_{s2} \cdot C_{s2})^2 + \cdots + (U_{sn} \cdot C_{sn})^2}}{\left|C_{s1} + C_{s2} + \cdots + C_{sn}\right|}$$

Where

U_c = combined percentage uncertainty of sub-stratum, %
U_{si} = percentage uncertainty of species i in the 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.

[24] Box 5.2.1 in GPG LULUCF

[25] Refers to equation 5.2.2 in GPG LULUCF

Annex 5

LIST OF GEOGRAPHICAL POSITION OF PROJECT SITES

The annex 5 is attached separately, as a part of the PDD package.